Social and Environmental Impact Assessment: Pannonia Ethanol Zrt.

Progressio

Prepared by Progressio Engineering Services Ltd.

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I. EXECUTIVE SUMMARY

This Social and Environmental Impact Assessment (this "Assessment") of Pannonia Ethanol Zrt.'s ("Pannonia") ethanol project in Dunaföldvár, Hungary (the "Project") has been prepared by Progressio Engineering Services Ltd. ("Progressio") on the basis of:

- a Phase I Environmental Site Assessment and Limited Phase II Soil and Groundwater Investigation (the "ESA") prepared by Tebodin EC Kft. ("Tebodin"), which is included as Appendix F;

- an Environmental Impact Assessment and an Integrated Pollution Prevention and Control permit application prepared by Progressio (the "EIA"), together with the government's approval of the same, which is included as Appendix G;

- a Greenhouse Gas Assessment prepared by Ecofys International BV (the "GHG Report"), which is included as Appendix H;

- a Feedstock and Market Report prepared by Agra CEAS Consulting Ltd., in conjunction with F.O. Licht (the "Market Report"), which is included as Appendix I; and

- Ethanol Europe Renewables Limited's ("Ethanol Europe") own efforts as owner and developer of the Project, which are described in this Assessment

(all of this list collectively, together with certain other Hungarian language geotechnical, hydrogeological, Seveso II permit applications and other reports summarized in the EIA, the "Investigations").

Please note that in preparing this Assessment, Progressio has not relied upon the English translation set forth in Appendix G, but only on the original Hungarian documents. This translation was commissioned by Ethanol Europe and has not been reviewed by Progressio for accuracy. Accordingly, in the event of a discrepancy between the description of relevant testing in the body of this Assessment and the text of Appendix G, it is likely that Appendix G may present translation errors. Please also note that Appendix G contains an incomplete set of appendices to the EIA, but the omitted attachments should not be of practical relevance to this Assessment.

The purpose of this Assessment is to identify areas where the Project's social and/or environmental impacts during planning, construction, operation and decommissioning may substantially contribute to adverse impacts on the natural or social environment in which the Project is located. This Assessment is founded in the Investigations as applied the relevant laws of Hungary and to the *Performance Standards on Social & Environmental Sustainability* promulgated by the International Finance Corporation (the "IFC Standards").

Thanks in large part to the nature of the dry mill ethanol production process and, as well, to the demographic situation in Hungary, **the Investigations have not identified any areas in which the Project threatens significant adverse social or environmental impacts**. The Investigations suggest that **the Project will have no or minimal potential adverse social and environmental impacts**. However, the Project is a large greenfield infrastructure project, and Ethanol Europe believes that it would be inconsistent with industry best practices to pursue Project development without a social and environmental management system. Accordingly, this Assessment includes such a system and an action plan for implementation.

The **Project is a Category B project pursuant to the IFC Standards**, which is consistent with the IFC's recent treatment of ethanol production projects in general. Progressio notes that the Project would be classified as a Category A project by certain potential lenders such as the Export-Import Bank of the United States and the Overseas Private Investment Corporation due to its size and/or current concerns about biofuels projects in general and/or the Project's large gross CO_2 emissions. In Progressio's opinion, Ethanol Europe's planned monitoring, reporting and continued environmental and social actions would be consistent with both Category A and Category B projects and so there is no reason to believe that the Project will have any greater or lower environmental or social benefits or mitigation whether the Project is formally classified as Category A or Category B.

Under the Action Plan, at present, the most important ongoing monitoring and assessment issues with respect to the Project are:

GHG Measurements While the Project will (subject to the reservations set forth in the next item in this list) result in a net reduction in GHG emissions against the baseline of fossil fuels, the Project will directly emit substantial amounts of CO_2 every year and indirectly be responsible for some third party GHG emissions. Pannonia will monitor and verify these emissions (as well as net GHG savings) every year.

GHG Impacts Evolving scientific research and methodologies mean that Project GHG impacts may change materially year on year due to changes in GHG accounting and measurement methodologies, especially with respect to indirect land use issues. As a result, senior management will need to make a concerted effort to stay current with this evolving regulatory climate and apply any changes to Pannonia's business in a responsible and proactive manner.

Cumulative Impacts Pannonia may, but is not under any obligation to: (i) double the size of the Project, (ii) acquire an ethanol loading jetty, (iii) pursue the opportunity to capture Project carbon dioxide for commercial use, and/or (iv) pursue the opportunity to act as steam host for a biomass power plant. Additionally, Ethanol Europe may pursue the development of projects similar to the Project within the general area of the Project. Each of the first four potential additions would involve the direct involvement of Pannonia and would, correspondingly, require a new or restated Social and Environmental Impact Assessment. While there is limited information at present about these additions, the quality of Pannonia's social and environmental management systems depends upon considering cumulative impacts as early as possible. The additions can reasonably be expected to involve extensive permitting processes and touch upon areas of environmental and social concern.

The preparation of this Assessment is not meant to foreclose later analysis of Project risks due to changed circumstances. Periodic and comprehensive reviews of environmental and social performance and risks are key components of responsible corporate governance.

II. POLICY, LEGAL & ADMIN. ENVIRONMENT

A. HUNGARIAN (EU) PERMITTING

For the decade prior to Hungary's accession to the European Union in 2004 (and as a precondition to Hungary's admission to the European Union), Hungary harmonized its domestic social and environmental legislation with EU standards. As a result, the legislative requirements in Hungary with respect to social and environmental issues (including permitting) is broadly similar to that in Sweden, France, Germany and other EU states, but observers note that enforcement may be lower in Hungary than in Western Europe at present, although the situation is improving (OECD 2008). Likewise, actual environmental performance (e.g. energy intensity, waste treatment) in Hungary lags behind Western Europe, in large part due to the need for additional investments in post-communist infrastructure, although dramatic improvements have been achieved in the past decade in air emissions and ambient air quality (OECD 2008). In 2004, Hungary became a member of the European Union, which means that all EU directives on environmental and social issues (e.g. the 2001 National Emissions Ceilings Directive and the 1996 Air Quality Framework Directive) now have binding effect in Hungary, and Hungary is required to adopt the contents of these standards into its national legislation.

The Hungarian laws, as amended, applicable to the Project's permitting (as explained in the EIA), include a 1995 Law on Environmental Protection, a 1996 Law on Nature Protection, a 1995 Water Act, a 2000 Law on Waste Management, a 2001 Law on Protection of Cultural Heritage, a 2005 Decree on Environmental Impact Assessment and Integrated Environmental Permitting, a 2004 Decree on Surface Water Quality, a 2004 Decree on Groundwater Protection, and 11 other laws.

Regional inspectorates are the main permitting authorities for most permitting matters (and, in the case of the Project, the Central Transdanubia Environment, Nature Protection and Water Management Inspectorate has lead authority), with the direct involvement of local governments (and, in the case of the Project, the municipality of Dunaföldvár and Tolna County). The Central Inspectorate would be the body to which a decision of the Central Transdanubia Environment, Nature Protection and Water Inspectorate would be referred on appeal.

Hungary embraces an integrated permitting procedure based on environmental impact assessments. In anticipation of EU accession, this procedure was modified in 2001 to be consistent with the EU integrated pollution prevention and control ("IPPC") scheme. In 2005, the EIA and IPPC schemes were merged into a unified procedure applicable to the Project whereby the IPPC permit is based upon the EIA's conclusions. In the case of the Project, the EIA covered and was organized

HUNGARIAN EIAS 1998-2006

	1998	1999	2000	2001	2002	2003	2004	2005	2006	1998-2006
EIA procedures started	497	502	527	587	532	589	574	578	489	4 875
Env. permits issued	250	277	303	341	321	294	329	298	269	2 682
Applications refused	12	12	15	13	11	15	19	18	20	135
Applications withdrawn	5	2	5	7	6	8	7	9	3	52
Procedures cancelled	0	3	0	0	0	0	0	0	0	3

Source: OECD 2008

according to several environmental disciplines: air, soil, water, noise, wildlife, and the Site itself.

The EIA conclusions are binding both upon the operator (i.e. Pannonia) and all other governmental authorities (e.g. entities issuing building permits). The EIA procedure begins with a preliminary EIA (including substantial public consultation and a public hearing), which may trigger the need (as in the case of the Project) for a detailed EIA.

The types of activities that require the need for an IPPC and/or EIA in Hungary are broader than required under relevant EU directives and in some cases requirements exceed the minimums required under EU law (for example, in maximum emissions levels allowed from thermal power plants). In many cases, as in the case of the Project, as required by EU law, permitting is conditional upon the use of best available technologies.

In general, the Hungarian permitting process for large projects like the Project is consistent with the generally high standards of the European Union. Approval of the EIA and the IPPC by the Hungarian authorities should be taken as a confirmation that the Project's environmental impacts are moderate and acceptable under any comparable governmental or multilateral standard.

An overview of the Project's permitting activities is set forth below:

Construction Permits		**Status**
1	Official resolution of Preliminary Environmental Impact Assessment	Done
2	EIA	Accepted
3	Integrated Pollution Prevention and Control	Done
4	SEVESO permit –construction phase	Done
5	Desk Top Archaeological Study from Heritage Authority	Done
6	Official Archaeological Survey	Expected late July 2010
7	Building Permit 1st Stage	Done
8	Modification of Zoning Plan	Done
9	Building Permit Final	Expected early July 2010
10	Permit for Cargill upgrade (in Cargill's name)	May not be needed If needed; expect issuance in summer 2010
C. Operating Permits		**Most cannot be applied for at present**

1	Building Permit Based Approvals - Hazardous liquid tanks, pressure vessels – establishment - Hazardous liquid tanks, pressure vessels – operation - Compressed air network- establishment - Compressed air network- operation - Other technology (e.g gas burners)- establishment - Other technology (e.g. gas burners)- operation - Water discharge- operation - CHP permit/electricity generation permit	
2	Water Sewage – establishment permit (by utility supplier)	
3	Water Sewage – operation permit (by utility supplier)	
4	Water use – establishment	
5	Water use – operation	
6	Preliminary well permit	Done
7	Well establishment permit	
8	Well operational permit	
9	SEVESO update- start up	
10	SEVESO update- operation	
11	Chimney sweeper permit – for gas connection	
12	Health and safety audit	
13	Permit for disposal of wastes	
14	Alcohol production license	
15	Occupancy permit	
16	Fire protection (alarm,sprinkler) network establishment permit	
17	20-120 kV electric power supply – establishment permit (E.ON)	
18	Gas supply establishment permit (E.ON)	
19	Electric supply establishment permit (E.ON)	

However, the Hungarian permitting process devotes only some, but not comprehensive, attention to social issues and GHG concerns, and this Assessment, accordingly, is intended to supplement the EIA in these areas.

B. HUNGARIAN (EU) INTERNATIONAL OBLIGATIONS

Hungary has ratified most major international and regional environmental treaties, such as the Framework Convention on Climate Change (and the Kyoto Protocol), the Convention on Biological Diversity, the Stockholm Convention on Persistent Organic Pollutants, the Long Range Transboundary Air Pollution Convention (and the protocols thereto), the Vienna Convention for the Protection of the Ozone Layer (and the Montreal Protocol), the Convention to Combat Desertification, the Ramsar Convention on Wetlands, the Commission of the Danube River, and the Convention on the Protection and Use of Transboundary Watercourses. Hungary has also ratified all, or almost all, international treaties on human rights. Codified Hungarian national law generally reflects the obligations that Hungary undertakes under international agreements.

C. EU BIOFUELS AND AGRICULTURE POLICIES AND DIRECTIVES

Corn ethanol in Hungary and in the European Union lies at the intersection of two important and influential interests: agricultural policy and environmental policy.

With respect to agricultural policy, there exist in Hungary and across the EU strong efforts to ensure continuing livelihoods for farmers. Traditionally, states used direct subsidies and import tariffs to support local agriculture, but the European Union has ended the ability of states to use tariffs with respect to other EU members, and the World Trade Organization is limiting the ability of states to use direct subsidies. The impacts of these changes have not been fully felt in the European Union as 2009 was the last year in which the EU's intervention scheme for corn (a last resort buyer program to provide a floor (usually around €100/ton) operated. In the fall of 2009, the price of corn fell to €85/ton in Hungary.

Currently, states continue to use indirect barriers to trade to support local agriculture, as well as relying on non-production related payments to farmers. These payments are termed the Single Farm Payment in most of the EU-15 member states or the Single Area Payment Scheme in most of the new member states that acceded after 2003. In Hungary the amount allocated was €947 million in 2009 and is expected to rise to €1.319 billion by 2013. Accordingly, for the agricultural community, a corn ethanol facility is a timely and important market substitute for previous state programs to provide floor prices for corn farmers. As a result, biofuels are considered by agricultural policymakers in the EU to be agricultural projects.

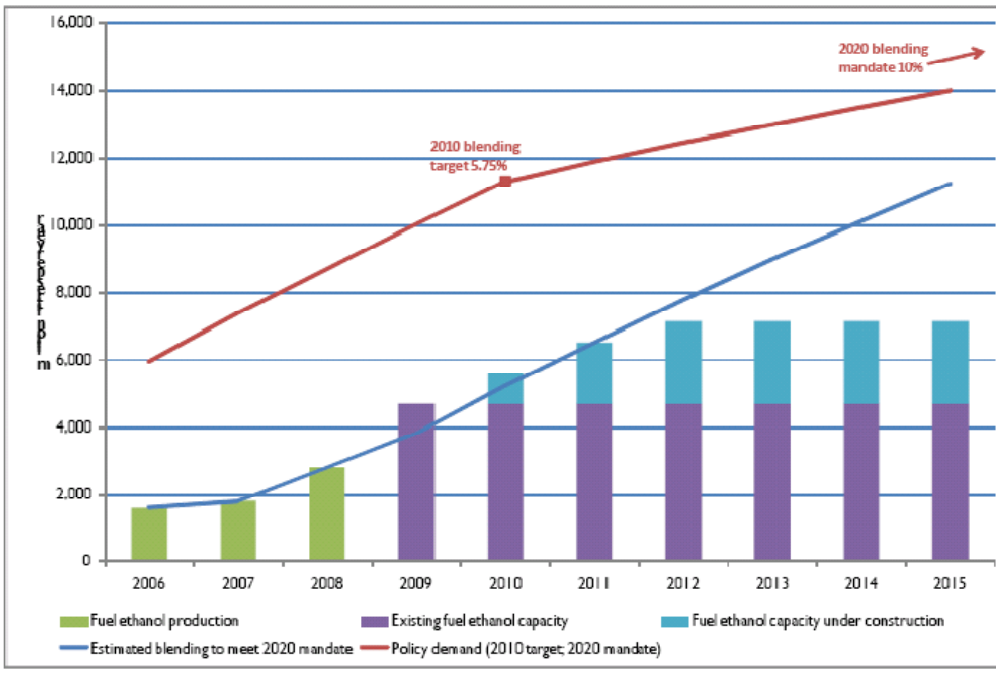
In contrast, environmental policymakers in the EU consider biofuels projects to be environmental projects due to their renewable character and to their ability to reduce GHG emissions in furtherance of the obligation of EU countries to meet their Kyoto Protocol obligations. In addition, domestic EU production is considered an energy security issue.

Hungary has adopted a small number of laws with specific application to biofuels (e.g. requiring at least 4.4% ethanol blending, exempting certain sales from excise taxes, etc.), none of which Ethanol Europe believes will have any material (positive or negative) impact on the Project. Within the European Union, biofuels policies are now being driven primarily by Brussels, and the main impact on Hungarian national legislation over the next decade will come from EU directives instead of from the Hungarian Parliament. The four most important directives are:

The '**Promotional' Directive** *(Directive 2003/30/EC)*, which entered into force in May 2003, sets indicative targets for the share of renewable fuels in the transport fuel market of at least 2% of EU transportation fuel from bio fuels by the end of 2005 and 5.75% by the end of 2010. These are indicative targets based on the energy content of all petrol and diesel for transport purposes placed on the market. Under this Directive the EU's goal for biofuels use was not mandatory, and there is no penalty for non-compliance.

A **Directive on the Taxation of Energy Products** *(Directive 2003/96/EC)*, in force since October 2003, allows member states to exempt from taxation, in full or in part, products that contain renewable substances (such as ethanol).

A Directive on the promotion of the use of energy from renewable sources (known as the **Renewable Energy Directive** *(Directive 2009/28/EC)*) entered into force in July 2009. Of particular importance for the biofuels sector is that this Directive sets a binding target for 10% of energy used in the transport sector to be from renewable sources. As part of the Renewable Energy Directive, a set of sustainability criteria were also established in order for biofuels to be eligible to be counted as meeting the EU's 10% mandate by 2020. In other words, companies blending and distributing transport fuel have to ensure that the biofuels they use meet these sustainability criteria if they are to meet their obligations.



Source: Market Study

Pursuant to the Renewable Energy Directive, the EU regulated demand for ethanol in 2015 is expected to be between 11.2 and 14 billion liters. Any shortfall in the ability of domestic producers to supply this amount of ethanol will need to be made up through imports. The EU has never anticipated that imports would be displaced in full by domestic production; its goal has been to keep imports in the range of 20% of total biofuels use.

The sustainability criteria (including biodiversity, land use, workers' rights, etc.) established by the Renewable Energy Directive specify that in order for renewable fuels to count towards the EU's 2020 target, they must achieve minimum rates of greenhouse gas saving compared to fossil fuels. This saving is set at 35% to start with, rising to 50% in 2017 for installations that enter into service prior to 2017 and 60% for all new installations after 2017. It is common knowledge in the EU that policymakers want to see 80% of biofuels sold in Europe coming from domestic production, and that these sustainability criteria can be used to exclude Brazilian ethanol on environmental and social grounds.

The European Commission decided on June 10, 2010 to encourage industry, governments and NGOs to set up certification schemes for all types of biofuels, including those imported into the EU. It laid down what the schemes must do to be recognised by the Commission. This will help implement the EU's requirements that biofuels must deliver substantial reductions in greenhouse gas emissions and should not come from forests, wetlands and nature protection areas. The rules for certification schemes are part of a set of guidelines explaining how the Renewable Energy Directive, coming into effect in December 2010, should be implemented. On the same day, the Commission made clear that biofuels should not be made from raw materials from tropical forests or recently deforested areas, drained peatland, wetland or highly biodiverse areas; in particular, it clarified that the conversion of a forest to a palm oil plantation would fall foul of the sustainability requirement. Finally, the Commission stated strongly that "We need biofuels to fight climate change and to help reduce greenhouse emissions by 20% as pledged by the European Council in 2007. Biofuels are the main alternative to petrol and diesel used in transport, which produces more than 20% of the greenhouse gas emissions in the European Union[1]."

Finally, amendments to the **Fuel Quality Directive "FQD"** *(Directive 2009/30/EC)*, which directive had previously set a ceiling on ethanol use at 5% in most markets, entered into force in July 2009. The amendments contain several aspects relevant to EU biofuels, including

- A binding target of a 6% reduction in the lifecycle greenhouse gases from transport fuel by 2020 was agreed, with possibility of increasing this to 10% after a 2012 review. There are also possible interim targets of 2% by 31 December 2014 and 4% by 31 December 2017; and

- The phasing in of E10 was agreed, with an agreement for E5 to be marketed until 2013 (and eventually beyond) to avoid damage to old vehicles.

As with the United States, the EU also has tariffs in place to protect domestic producers from foreign (mostly Brazilian) competition. Of little importance to the Project, the EU also has trade barriers to import of corn into the EU. Ethanol imported into the EU from Brazil is subject to a duty of €0.19/liter if undenatured and €0.10/liter if denatured (although little ethanol in Europe is sold on a denatured basis).

D. IFC STANDARDS / EQUATOR PRINCIPLES

The Project intends to comply with the IFC Standards and/or the Equator Principles, and the Project has been developed consistent with the spirit of these standards. Certain actions have been taken (especially in designing the Project for maximum GHG savings and in pursuing meaningful public consultations) with respect to Project development that would not have been taken in the absence of these standards.

E. OWNER REQUIREMENTS

In addition to other requirements and standards, Ethanol Europe is committed to two environmental goals that exceed what is required or expected under any other standards.

[1] *See europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/247&format=HTML&aged=0&language=en&guiLanguage=en*

First, Ethanol Europe is committed to owning and operating the most GHG friendly fleet of ethanol plants in Europe, within the bounds of cost practicality. Accordingly, Ethanol Europe will insist that all of its ethanol plants be in the top half of European plants with respect to GHG emissions.

Second, Ethanol Europe refuses on ethical grounds to consider burning or gasifying DDGS. While the European ethanol industry (in large part because most DDGS produced in Europe is of low and inconsistent quality) considers DDGS a waste product instead of a valuable food source, Ethanol Europe recognizes that by ensuring that Project DDGS is of high and consistent nutritive quality, it will, in effect, reduce its corn footprint by 1/3. Of every three tons of corn that the Project uses, it will produce one ton of DDGS. That DDGS will be consumed by livestock or poultry *in lieu* of their consumption of corn or soy meal. As a result, the Project will show that responsible biofuels projects have a lower nexus to "food v. fuel" issues than is popularly believed.

F. LENDER REQUIREMENTS

In addition to the requirements and standards discussed in this Assessment, Project lenders may have additional requirements and standards. The Project has not yet secured any lending commitments, and so no such additional requirements or standards are included in this Assessment.

G. INSURER REQUIREMENTS

In addition to the requirements and standards discussed in this Assessment, Project insurers may have additional requirements and standards. The Project, assisted by Marsh Kft., its insurance consultant, has selected Allianz Global Corporate & Specialty GmbH ("Allianz") as its insurer. It is expected that Allianz will have specific safety requirements with respect to industrial installations, and some of these requirements may exceed those required by Hungarian law and the IFC Standards with respect to design elements of secondary cost and importance (e.g. fire suppression equipment). However, since Allianz has not yet completed its due diligence, no insurer requirements are included in this Assessment. Based on a cursory examination, Ethanol Europe does not believe there will be any conflict between insurer requirements and applicable law and/or the IFC Standards.

III. PROJECT DESCRIPTION

A. SITE

The Project will be located on an approximately 12 hectare site (the "Site") in Dunaföldvár adjacent to a large grain storage facility owned by Cargill Hungary (the "Cargill Facility"), which is one of the most technologically advanced grain storage facilities in Hungary. A map of the Site is included in Section I (Project Expansions) below.

The town of Dunaföldvár is a rural community an hour's drive south of Budapest in Tolna County, which is the heart of the grain growing region of Hungary. The Site allows easy road delivery of corn to the Cargill Facility (or directly to the Project), easy road delivery of ethanol to the local train station, and river access to enable the loading of DDGS onto barges.

B. FACILITY

Pannonia will construct, own and operate a nameplate 200 million liter ethanol production facility at the Site. Pannonia expects the Project to produce approximately 240 million liters per year when fully operational. The Project has been fully designed and will be as pictured below.

The Project represents the first European iteration of the most successful ethanol plant model in the world, the Fagen, Inc. ("Fagen") 110 million gallon per year facility employing ICM, Inc. ("ICM") process technology. Fagen has constructed 91 ethanol plants in the United States over the past two decades and is currently finishing several additional facilities, with the design gradually evolving into that underlying the Project. By any measure, Fagen is the

MODEL OF THE FACILITY

Source: Ethanol Europe

world's leading, most experienced, and most respected corn ethanol construction company.

The Project will be constructed by Fagen pursuant to a turn-key fixed price construction agreement guaranteeing (i) costs, (ii) construction time and (iii) performance. This construction agreement is substantially similar to Fagen's agreements entered into for U.S. ethanol projects.

Most Fagen-constructed ethanol plants in the United States (and all completed in recent years) are substantially similar to the Project, meaning that robust data exists to make an accurate assessment of the Project's social and environmental impacts in Hungary as well as of its actual performance characteristics. Over the past two years, all of Ethanol Europe's staff, some of Pannonia's local permitting consultants, and a delegation of public representatives from Dunaföldvár and Tolna County have visited several Fagen ethanol plants in the United States (including the one in Lamberton, Minnesota that is, according to Fagen, most similar to the Project), often without the presence of any Fagen representatives. Accordingly, most of the Project's interested parties in Hungary have a robust conception of what the Project will look like, smell like, and sound like when it becomes operational.

The Project will consist of a dry mill plant operation and process approximately 575,000 tons of corn annually to produce up to 240 million liters of fuel grade ethanol to be blended into gasoline. Additionally, the Project will produce 175,000 tons (on a dry-matter basis) of dried distillers' grains ("DDGS") annually, as well as approximately 15,000,000 kWhs of electricity, which will be used in Project operations and is anticipated to provide more than 1/3 of the Project's electricity needs. Finally, the Project will use approximately 152,000 cubic meters of natural gas per day.

C. ASSOCIATED FACILITIES

Portions of third party infrastructure will be associated facilities for purposes of this Assessment as outlined below.

When operating at its full 240 million liter capacity, the Project will use 1700 tons of corn per day. Almost all corn is expected to be supplied by an over-the-fence conveyor to be operated by Cargill but paid for by Pannonia. The Project will be able to store up to 10,000 tons of corn at the Cargill Facility (which amount can be substantially increased if needed). This conveyor is a straightforward mechanical solution to moving corn several dozen meters and is included in Fagen's construction contract. There are no environmental or social concerns associated with this equipment that are not *de minimis* and/or addressed by Hungary's permitting procedures. Cargill will operate the

TRANSPETROL LOADING SYSTEM

Source: Transpetrol

equipment that comprises this associated facility.

When operating at full capacity, the Project will produce 672,300 liters of ethanol per day. Pannonia will be able to store 18.4 million liters at the Site. Pannonia will be able to ship all of this ethanol to customers via a truck to rail solution provided by Transpetrol GmbH ("Transpetrol"). Pannonia will own or lease four specialized Austrian-made container trucks, and Transpetrol will make available to Pannonia rail cars and specialized rail containers to ship Pannonia's ethanol production to destinations of Pannonia's choosing. For this purpose, Transpetrol will bring rail cars to the Dunaföldvár rail station (which is abandoned and, otherwise, was slated to close and is located on a line that is now only used by a nuclear power plant that is approximately 30 kilometers from the Site), where Pannonia's trucks will lift the specialized rail containers, take those containers to the Site, load the containers, and then transport the containers back to the rail station and load them back onto a rail car. Accordingly, the Dunaföldvár rail station is an associated facility. Transpetrol, the City of Dunaföldvár and multiple other authorities in Hungary have informed Pannonia that no special permits are needed for (i) the operation of these trucks between the Project and the Dunaföldvár rail station, (ii) Transpetrol's (minor) preparatory works at the Dunaföldvár rail station, (iii) or for Transpetrol's operation of several tracks at the Dunaföldvár rail station.

DUNAFÖLDVÁR RAIL STATION

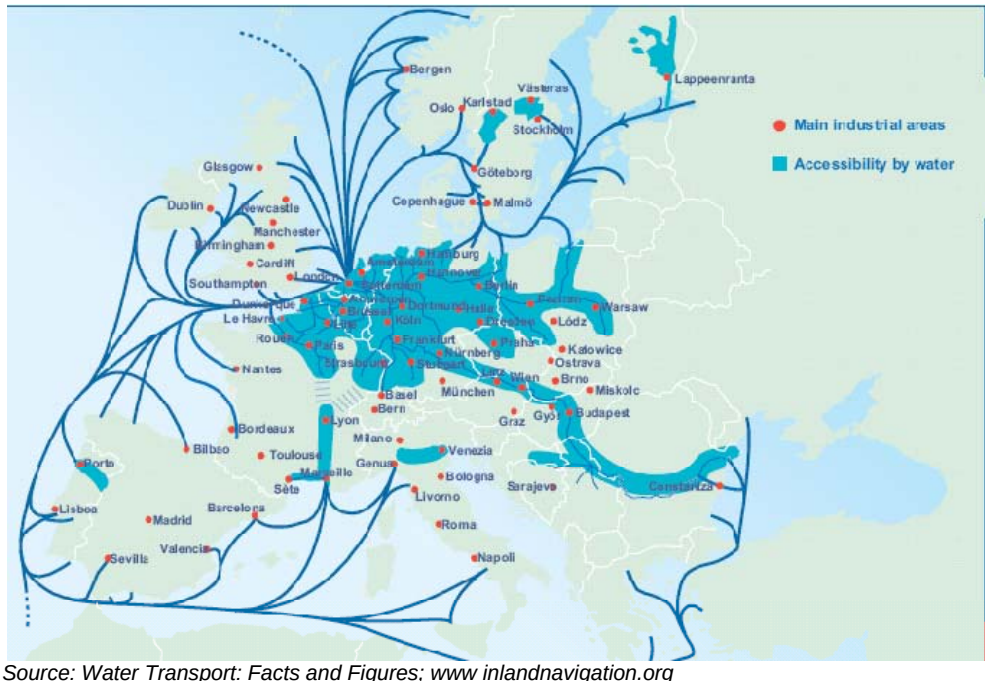
Source: Transpetrol

When operating at full capacity, the Project will produce 485 tons of DDGS per day. Whenever possible, the Project will produce WDGS (wet distillers' grains, which, because they are not dried, result in substantial energy savings) instead of DDGS, but since WDGS spoils quickly, WDGS production will depend upon certainty of purchases by nearby farms (for animal feed). The Project will be able to store 20 days of DDGS production at the Site and will load barges with DDGS via an over-the-fence conveyor operated by Cargill. This conveyor is a straightforward mechanical solution to moving DDGS a short distance and is included in Fagen's construction contract. There are no environmental or social concerns associated with this equipment that are not *de minimis* and/or addressed by Hungary's permitting procedures. Cargill will operate the equipment comprising this associated facility.

D. GEOGRAPHY & ECOLOGY

The Site (as well as the Cargill Facility) was once part of a Soviet military base and so is, in a certain sense, a brownfield site. For centuries before that, the Site was cultivated. As a result, the Site is in a generally degraded state with little biodiversity or cultural heritage value. The Site's location (see the map in Section 1 below on Project Expansions) sandwiched among existing industrial facilities on three sides makes it highly doubtful that the Site would

ever be used for any non-industrial use or, if unused, would provide any meaningful wildlife habitat.



Source: Water Transport: Facts and Figures; www.inlandnavigation.org

The Site is near, although not in the floodplain of, the Danube River. Because the Project anticipates that it will use the Danube River as its primary means of DDGS transport, and possibly in the future as a means of ethanol transport, for the Project, Europe's internal waterway geography is important. Accordingly, the picture above shows how the Project fits into this geography.

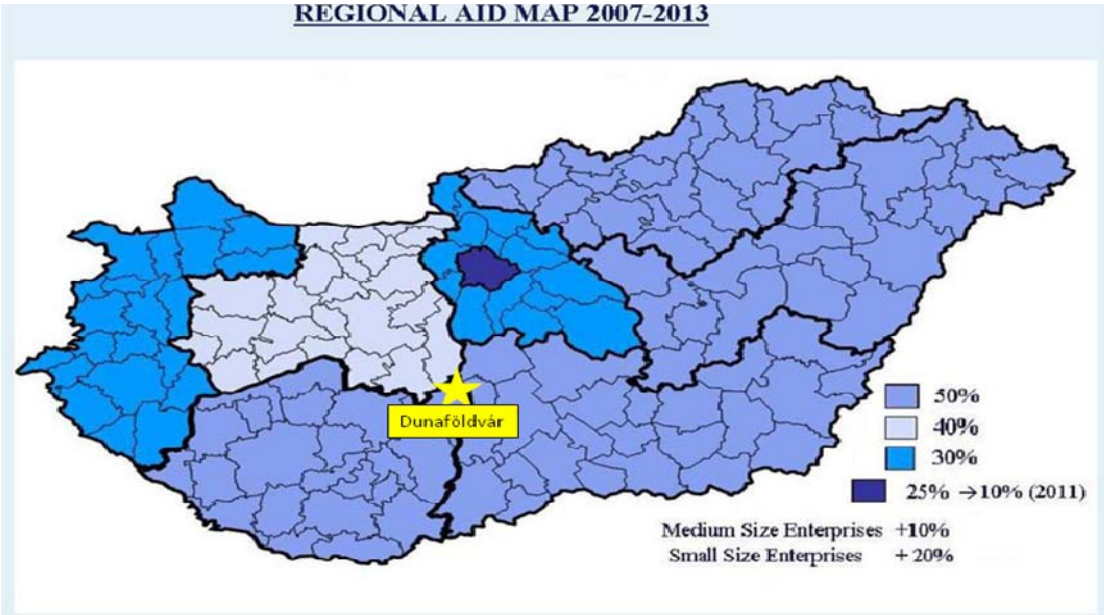
H. SOCIAL AND POLITICAL ISSUES

The Project enjoys support locally and nationally in Hungary. The Dunaföldvár government has consistently supported the Project, and in early 2010, the national government passed a decree awarding the Project with the status of "State Supported Large Project," which is only given to projects of vital significance to the Hungarian economy. The Project is only the second private sector project to be accorded such status. Hungary's national government changed in May 2010, but senior representatives from the new government have met with Ethanol Europe and provided assurances of continued support for the Project.

A significant part of Hungary's population and GDP is tied to agriculture, and corn is the most important crop in Hungary. The vast majority of corn is exported. The Project would be the single largest corn consumer in Hungary (and is viewed as providing price support for this commodity), would directly create no fewer than77 jobs and indirectly create hundreds more jobs, and would facilitate Hungary's attainment of the requirements set out in EU directives for biofuels use. As a result, the Project enjoys broad support across Hungary's political spectrum (with the exception of smaller fringe parties) and very strong local support. The only opposition to the Project to date has come from one, and only one, environmental NGO (Magyar Természetvédok Szövetsége, the Hungarian affiliate of Friends of the Earth) on (i) food vs. fuel and (ii) GHG grounds. Magyar Természetvédok Szövetsége protested the Project's State Supported Large Project status but has since never attended any public meetings organized for the Project, attended any Project permit proceedings or appealed against the issue of any Project permits.

Finally, the Project will take place in an area of Hungary that is characterized by low incomes. A goal of the European Union is to reduce income disparities across regions of the EU, and the European Union makes available structural funds for this purpose (although no such

funds would be used for the Project). To further this goal, each EU member prepares regional aid maps like the one below showing subnational average incomes based upon EU average incomes and corresponding levels of allowable state aid intensity. As the map below shows, Dunaföldvár is located in an area where average incomes are 45% or less than the EU average and where, correspondingly, the government can subsidize up to 50% of the cost of private sector investments.



The vast majority of new biofuels production capacity installed in the European Union in the past five years has been in Germany, Austria, France, England, Belgium and the Netherlands, even though the Renewable Energy Directive will require all EU states to increase their biofuels use. Accordingly, in the wider EU context, the Project has European-wide significance and support as being the type of investment needed to overcome the most serious income disparities within the EU, both based on past differences in standard of living and based on future economic trends.

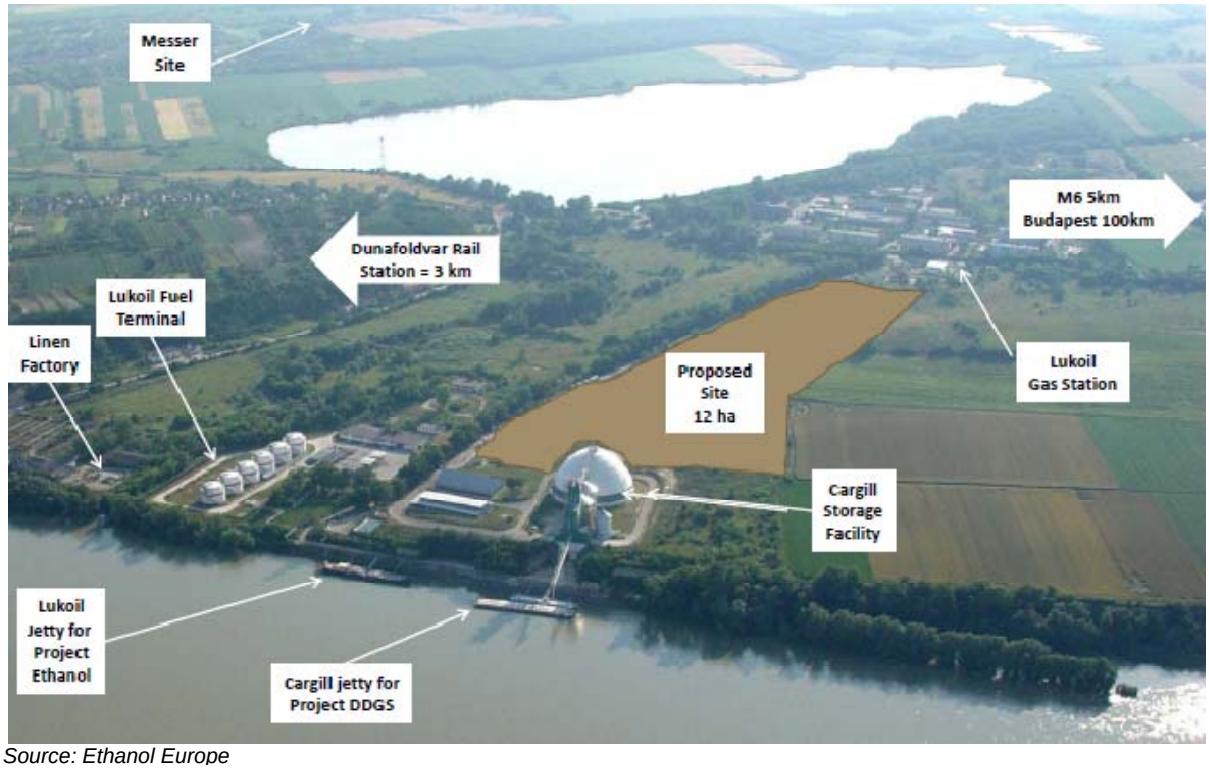
I. PROJECT EXPANSIONS

Pannonia believes that the Project's environmental attributes and commercial success will be enhanced if Pannonia can, in time: (i) double the size of the Project, (ii) acquire an ethanol loading jetty, (iii) pursue the opportunity to capture Project carbon dioxide for commercial use, and/or (iv) pursue the opportunity to act as steam host for a biomass power plant. While Pannonia cannot now accurately evaluate the likelihood of any of these expansion opportunities, it expects that some, but not all, of these expansions will be put in place within the next four years.

Each of these expansions is described below in the level of detail currently available to Pannonia. None of these expansions is included in the main discussion of this Assessment because there is a high degree of uncertainty in each case with respect to either necessary commercial contracts or with permitting, although the expansions are discussed with regard to cumulative impacts. When and if this uncertainty is removed with respect to any such expansion (or with respect to any other material capital improvement), then Pannonia has committed to, as appropriate: (i) revise or supplement this Assessment to account for such expansion (ii) cause a separate environment and social assessment to be conducted for such

expansion, and/or (iii) if such expansion will be owned and operated by an unaffiliated third party, ensure than such expansion complies with all applicable Hungarian laws and

PROJECT SITE



Source: Ethanol Europe

regulations.

1. Project Capacity Doubling

Pannonia anticipates doubling the capacity of the Project in 2013 (the "Expansion"), if the Project is economically successful. The Site was selected based on an assumption that the Expansion will occur, the Project was designed for the Expansion, the public is aware of the Expansion, and the permitting authorities have been made aware of the Expansion.

2. Ethanol Loading Jetty

As shown in the map of the Site above, the Site is adjacent to a fuels storage facility owned by Lukoil Hungary (the "Lukoil Facility") and in close proximity to an abandoned, derelict linen factory (the "Linen Factory") owned by Aduviep Kft. "Aduviep". The Lukoil Facility and the Linen Facility have, respectively, an underutilized jetty and fully-permitted but unconstructed jetty that could be used to load Project ethanol onto barges.

In the early development of the Project, Pannonia assumed that barge transportation of ethanol would be less expensive and less GHG intensive than rail transport and so prioritized jetty acquisition. However, Pannonia has evaluated the merits of rail and barge transportation of ethanol through the Market Study, Transpetrol and the GHG Assessment and determined that its initial assumptions about barge transportation are not supported by its consultants' conclusions. In general, rail and barge transportation have broadly similar cost and GHG impacts. As a result, Pannonia is no longer prioritizing barge transport.

Nevertheless, Pannonia expects that it is more likely than not that some of its ethanol production may be shipped by barge instead of by rail. For that purpose, Pannonia is negotiating with Lukoil and Aduviep. The Lukoil jetty is currently underutilized, and the Linen Facility jetty is currently unused.

If the Lukoil jetty is selected, Pannonia will (i) upgrade the Lukoil jetty to meet Hungarian legal requirements, (ii) lease half of the jetty from Lukoil, (iii) install a pipeline from the Project along an easement granted by Cargill to the Lukoil jetty, (iv) install loading equipment on the Lukoil jetty, and (v) facilitate Lukoil's modification of its existing loading permit to include ethanol.

If the Linen Facility jetty is selected, Pannonia will (i) purchase approximately half of the Linen Facility site, including the existing jetty site, (ii) construct the jetty, (iii) install a pipeline from the Project along an easement granted by a third party to the Linen Facility, and (iv) facilitate Aduviep's modification of its existing loading permit to include ethanol.

Whichever jetty is selected, permits will need to be issued before Pannonia can use the jetty for Project ethanol, and Pannonia anticipates that it will be the operator of the jetty. At present, both jetty options are uncertain, and planning for both jetty options is early and limited. The Project can operate without such a jetty and so final jetty decisions will in part depend upon the Project's ability to put in place a jetty option that is consistent with the Performance Standards.

3. CO_2 Capture

As mentioned above, the Project will produce substantial amounts of carbon dioxide, but unlike most industrial production of carbon dioxide, the Project will produce relative pure streams of gas that lend themselves well to capture for use by industrial gas companies. Pannonia does not intend to enter the industrial gas business and, accordingly, it is seeking a partner to develop the carbon dioxide opportunity presented by the Project.

No partner has yet been selected. As indicated in the map of the Site above, an industrial gas company (Messer) is in close proximity to the Project and could be fed by a pipeline from the Site. Likewise, Pannonia has had initial discussions with several European industrial gas companies.

Pannonia believes that the most likely scenario for a carbon dioxide capture project with a partner other than Messer would be for Pannonia to lease a partner a small portion of the Site and enter into a contract with such user for a nominal payment to Pannonia. In the case of Messer, a lease over a portion of the Site might not be required. The partner would then construct, own and operate a carbon dioxide facility in close proximity to the Project.

Accordingly, Pannonia would incur minimal capital costs and risk with respect to any such expansion. Pannonia, however, would benefit from such an arrangement since such an arrangement would increase Pannonia's GHG savings.

4. Biomass Power

The Project is also searching for a partner to whom it would lease a portion of the Site for the purpose of the construction and operation of a biomass (e.g. straw-fired) power plant, from which Pannonia would buy process steam at a price at or below its current cost to produce steam itself using its natural-gas fired boilers. Because the Project's process steam needs do

not require a steam provider to provide steam of very high pressure, and because the Project can fall back on its own boilers if the biomass power plant is not operating, the Project is an attractive offtaker for a small biomass power plant. Through such an arrangement, Pannonia could reduce its consumption of natural gas and, correspondingly, increase its GHG savings. To date, Borrower has held initial discussions with two biomass power plant developers in Hungary.

IV. BASELINE DATA

The Project's areas of influence have been defined based on both the Project itself and on the developed nature of Hungarian infrastructure. For localized study areas (e.g. non-GHG air pollution, soils, etc.), a broad conception of the Project's area of influence would include transmission corridors for gas pipelines and power lines. Due to the facts that (i) utility connections for the Project involve comparatively minor extensions of existing networks, and (ii) E.ON (Pannonia's service provider for the power and gas connections) is subject to Hungary's (and the EU's strict) environmental and permitting standards, for purposes of this Assessment, localized study areas include the Site (including very limited laydown areas adjacent to the Site) and its immediate environs only. Further information on E.ON's extensive environmental, health and safety standards can be found at www.eon.com, and a copy of the E.ON Global Climate Change and Environment Policy can be found at: www.eon.com/en/downloads/E.ON_Umwelt_und_Klimaschutz_Leitlinie_EN.pdf.

A. GENERALIZED ENVIRONMENT

1. GHGS

Study Area

Unlimited

Baseline

The baseline issues of concern with respect to GHG are (i) Hungary's GHG emissions, (ii) Hungary's GHG performance, (iii) the role of agriculture in Hungarian GHG emissions, and (iv) the GHG performance of EU biofuels facilities.

According to the UNFCCC (UNFCCC 2009), Hungary's aggregate GHG emissions were 116,453 Gg of CO_2e in the 1985-97 Kyoto baseline period applicable to Hungary, 78,016 Gg in 2000, and 75,944 Gg in 2007, representing an aggregate 34.8% reduction. Hungary's Kyoto Protocol obligation is to reduce GHG emissions by 6% from the 1985-87 baseline by 2012, meaning that Hungary appears certain to meet this commitment. Moreover, this compares very favorably to a 16.8% increase in the United States and an 11.3% increase in Austria over the same period. Hungary is one of the leading countries in the world in improving GHG emissions over the past two decades. While its initial severe reduction in GHG emissions is similar to that of other post-communist countries, Hungary's GDP tripled from $47.9 billion in 2000 to $139 billion in 2007, while GHG emissions actually slightly declined over the same period.

Hungary's GHG performance is commendable, and the agricultural sector has contributed disproportionately to Hungary's success. While GHG emissions have been reduced by

34.8% generally, in the agricultural sector, they have decreased by 51.6% (OECD 2008), even though agricultural production increased by 9% over the same 1985-2007 period. 64% of the total GHG emissions from agriculture in Hungary comes from emissions of nitrous oxide from soils.

In order for biofuels to be eligible to satisfy the requirements of the Renewable Energy Directive, they must satisfy the requirement that they be certified as effecting at least a 35% net reduction in GHG emissions.

2. Land Acquisition

Study Area

Site

Baseline

Hungary is a civil law country in which all land sales and ownership are recorded through land registries. The land registration system is a key part of the legal infrastructure for the private real estate market. When Hungary embarked upon its transition to a private market economy in 1989, the land registration system, which was administered for decades by the Ministry of Agriculture, was ill-prepared for the demands of a private property market. The system was paper-based and inefficient. The land registry offices were understaffed, underfunded and operated under procedures devised in the early 1970s.

In 1992 and 1993, various technical and legal reform proposals were introduced with the aim of making the land registration system more efficient and reliable. On the technical side, computerization was introduced with assistance from the European Community's Phare Program.

A title page is the record of the legal status of a parcel of land maintained by the land registry office. The records of the land registry office publicly and officially attest to the existence of rights and status of real property. Under Hungarian law, a person acquiring any right for value in a property based on information concerning such property on file at the land registry office and without knowledge of rights or interests not reflected in the title page is a good faith acquirer. A good faith acquirer obtains title subject only to those matters which appear on the title page (or otherwise by law, such as utility easements and zoning restrictions).

B. SOCIAL ENVIRONMENT

1. Disadvantaged Groups

Study Area

Dunaföldvár

Baseline

Minority	Minority identity	Native language	Spoken language other than nat. lang.	Estimated population
Roma	142 683	48 072	22 933	400 000 – 600 000
German	30 824	37 511	416 182	200 000 – 220 000
Slovak	10 459	12 745	56 107	100 000 – 110 000
Croatian	13 570	17 577	18 297	80 000 – 90 000
Romanian	10 740	8 730	40 625	25 000
Serb	2 905	2 953	13 646	5 000
Slovene, Wend	1 930	2 627	1 566	5 000
Armenian		37	48	3 500 – 10 000
Greek		1 640	1 260	4 000 – 4 500
Bulgarian		1 370	1 665	5 000
Polish		3 788	5 948	10 000
Ukrainian, Ruthenian*		674	1 192	
Ruthenian				6 000
Ukrainian				2 000
Other**	19 640			
Total	232 751	137 724	579 469	

* The two languages were worded as a common question in the census.
** Number of persons in the census declaring a minority affiliation not listed in the questionnaire.

Source: Hungarian Ministry of Foreign Affairs

Disadvantaged groups in Hungary include ethnic minorities and rural populations in general (due only to income disparities). Of the ethnic minorities, only the Roma are generally accepted as a disadvantaged population subject to widespread discrimination and harassment.

2. Labor

Study Area

Dunaföldvár and surrounding towns

Baseline

Because Hungarian labor law is consistent with ILO standards, the Project should comply with IFC Standard 2 through compliance with national law.

Hungarian labor law is codified in both the Hungarian Labor Code and in the Hungarian Civil Code. To illustrate some of the mandatory standards of Hungarian labor law, Hungarian workers can expect:

- starting with the third year of employment, a severance payment equal to 1-4 months' salary depending upon length of service (Labor Code, chapter 4);
- a workday limited to 8 hours a day, or 40 hours a week, unless the employee agrees otherwise, but in any case not to exceed 12 hours a day, or 60 hours a week (Labor Code, chapter 6);
- a work schedule assigned in view of the nature of the work and in accordance with occupational safety and health requirements (Labor Code, chapter 6);
- for any work day exceeding six hours, and after each additional three hour period, a minimum twenty minute and maximum one hour uninterrupted break from work. Where an employee is entitled to more than one break in a working day, the combined duration of these breaks may not exceed one hour (Labor Code, chapter 6);
- Paid vacation of at least 20 days, which is increased to:
    - 21 days for employees over 25
    - 22 days for employees over 28
    - 23 days for employees over 31
    - 24 days for employees over 33
    - 25 days for employees over 35

- 26 days for employees over 37
- 27 days for employees over 39
- 28 days for employees over 41
- 29 days for employees over 43
- 30 days for employees over 45

Vacation time is scheduled by the employer following advance discussion with the employee. Vacation time is allocated in the year in which it is due. Upon termination of employment, the employee shall be paid financial compensation for any unused vacation time as appropriate for the duration of employment. Vacation time shall not be financially compensated under any other circumstances; no deviation from this provision shall be considered valid (Labor Code, chapter 6);

- sick leave of at least 15 days per calendar year for the duration of time during which the employee is unable to work due to illness, not including accidents at work and occupational diseases as specified by social insurance provisions. An employee's incapacity to work shall be certified by a physician. Employees shall be paid 70% of the absentee pay for the duration of the sick leave (Labor Code, chapter 6);

- maternity leave of at least 24 weeks, starting 4 weeks prior to scheduled delivery (Labor Code, chapter 6);

- paternity leave of 5 days (Labor Code, chapter 6);

- equal pay for equal work (Labor Code, chapter 7); and

- a 15% supplement for working night shifts (Labor Code, chapter 7).

3. Social/Human Safety

Study Area

The relevant study areas for social and safety issues are Dunaföldvár, Tolna County and Hungary. For the most part, social impacts resulting from the Project should be stronger in Dunaföldvár, more muted when considered in the wider context of Tolna County and much lower for Hungary as a whole.

Baseline

Hungary is a member of the European Union, NATO and the OECD, evidencing the fact that it is a relatively developed country. Moreover, like many other post-communist countries, it has high social indicators and comparatively low (although increasing) social stratification. Hungary ranked 43 in UNDP's 2009 Human Development Report, at the top of the "High Human Development" group of countries, and Hungary's human development index has increased every year this past decade (UNDP 2009). Hungary's literacy rate is 98.9%, none of the population lacks an improved water source, less than 2% of the population survives on less than $2/day, and Hungary ranks 37 in terms of gender related development (UNDP 2009). Anecdotally, the mayor of Dunaföldvár is a woman and has served in this office without affiliation to any major political party for over a decade.

Community health and safety falls under the regulatory authority in Hungary of the National Public Health and Medical Officer Service and the Directorate of Disaster Management.

There are two large operating ethanol plants in Hungary: (i) Hungrana Kft., which uses corn to produce approximately 170 million liters of fuel ethanol and other corn by-products, and (ii) Gyôri Szeszipari Rt., which uses molasses to produce approximately 50 million liters of various kinds of ethanol. Both of these facilities are very different technologically from the Project.

Hungrana is a multi-product wet mill ethanol facility (the Project is dry mill) that produces corn starch and isoglucose (holding 27% of the EU market share in that commodity) as well as ethanol. Hungrana often emits a strong odor, quite in contrast to Fagen ethanol facilities. Likewise, the Gyori distillery dates back to 1884 and claims on its website to focus primarily on pharmaceutical and industrial ethanol, but also have the capacity to produce 26 million liters of ethanol from molasses and grains. Again, this facility has very little in common with the Project.

However, Hungarian society may naturally assume that these two existing facilities are representative of ethanol facilities in general and assume that their visual, noise and odor attributes will be the same as those of the Project.

4. Health

Study Area

The relevant study areas for health issues are Dunaföldvár, Tolna County and Hungary. For the most part, health impacts resulting from the Project should be stronger in Dunaföldvár, more muted when considered in the wider context of Tolna County and much lower for Hungary as a whole.

Baseline

According to the World Health Organization (Country Cooperation Strategy):

- Since the 1990s, the introduction and spread of family practice has achieved significant results; now almost the entire population is enrolled in family practice groups.
- People have freedom to choose/change their family doctor once a year.
- Hungary has achieved almost universal coverage of its population with mandatory social health insurance. Social health insurance is the main source of public funding for the health sector. Participation in the social health insurance scheme is mandatory for everyone who works in Hungary, including the self-employed. A large section of the population does not contribute but is nevertheless covered.
- Noncommunicable diseases are the leading causes of morbidity and mortality. The high mortality rate among men aged 30-65 is of particular concern.
- Ischemic heart disease and cerebrovascular disease accounted for 37.8% of total deaths in 2005. High blood pressure affects more than 50% of those aged 25-64 years and type 2 diabetes affects approximately 10% of the population.
- Hungarians have the highest death rates for lip, colorectal, larynx, trachea, bronchus and lung cancers in Europe; cancer causes every fourth death in Hungary. Cancers

of the respiratory tract, attributable to smoking, have increased in women since the 1980's.

- Suicide rates are among the highest in Europe.
- Lifestyle-related risk factors are prevalent, particularly smoking, unhealthy diet and lack of physical activity. Hungarian males have the world's highest lung cancer mortality rate.
- Excessive alcohol consumption is the main cause of high male mortality from cirrhosis of the liver.
- Unhealthy diet, high intake of animal fat, cholesterol, salt, too few vegetables, minerals and dietary fibre, compounded with low physical activity (only about 21% of men and 14% of women aged 15-64 exercise regularly) lead to obesity, high blood pressure and nutritional deficiencies. Two thirds of Hungarian men and half of women are overweight or obese.
- About 11.5% of the country (inhabited by 48% of the population) can be regarded as polluted. Air pollution, mainly from vehicle emissions, is a major causal factor for respiratory disease. Pollution of surface waters from geologically-based arsenic is a health hazard.
- Estimated HIV/AIDS incidence is low compared with other EU countries and it remains stable.

Currently, Hungary ranks among the regions with medium air pollution within Europe. The substantial part of air pollution in Hungary comes from pollution that spreads from over the borders. Apart from a few settlements with significant and moderate air pollution, air quality is acceptable in most of the country, and the air quality of large forests and nature reserves is impeccable.

International treaties, Hungarian air quality protection rules and measures in the protection of the environment have caused the concentration of air pollutants and the size of polluted areas to reduce on the continent also in Hungary in the recent decade. With the decline of heavily polluting industries, the impact of traffic with the perimeter of densely populated settlements and in the immediate vicinity of high traffic roads has become a defining factor.

Mortality and reduced life expectancy due to air pollution have shown improving results in the last decades. International and Hungarian data prove that aerial dust due to traffic is one of the most important risk factors in terms of health. An environmental health impact assessment has shown that a health gain can clearly be demonstrated from the long term reduction of aerial dust pollution – which also implies compliance with the mandatory EU limits to be introduced in 2005 and 2010. Namely, many more human lives can be saved on long term through improving the quality of air than by reducing pollution peak values on short term.

Per capita GDP is much lower in Tolna County than the national average. GDP in Dunaföldvár was 1,204 thousand HUF per capita in 2002, while the national average was 1,458 thousand HUF per capita.

The per capita value of investments in Dunaföldvár is 222,983 HUF, which is also lower than the national average. These data show very substantial regional variations, where the particularly outstanding situation of the Central Hungary Region is quite defining (982,540 HUF/capita).

The demographic profile of the inhabitants is rather negative. The age tree of Dunaföldvár is

irregular: it shows the characteristics of an aging society, not unlike the demographic profiles of the population of Hungary and other European countries.

The near pear-shaped chart is a graphical illustration of low fertility rates of the last few years. Some variations in demographic policies have caused major differences in the size of different generations.

The age tree is getting evenly slimmer under 20 years of age, the generations between 25 and 30 and 45 and 50 years of age are the most populous. The slightly higher rate of male births evens out at around 35-40 years of age, and the rate of females is higher in the older age brackets. Differences in the rates of males and females become more and more predominant with the progress of age, which indicates the high mortality rates of males.

This increase in the number of people older than 65 years of age, and the high rate of reduction, also on national scale, of the rate of population under 15 years of age and of males in the working age are factors that project a serious deterioration in the proportions of earning and supported populations. Aging processes of the population in Dunaföldvár can be described as critical.

Cardiovascular diseases are the leading causes of death for both sexes, followed by tumors and then external reasons for morbidity and mortality. The fourth most important cause of death for males is diseases of the digestive tract, followed by diseases of the respiratory system.

The number of people passing away from infectious diseases is low for both sexes. Accidental deaths are gradually decreasing for both sexes.

Mortality values for the leading causes of death for males are higher than the national average for cardo-vascular diseases, malignant tumors in the windpipe, bronchia and lungs and chronic diseases of the lower respiratory tract. Mortality due to ischaemic heart diseases is slightly lower in Dunaföldvár.

Tolna County has the second worst levels of cardio-vascular diseases in Hungary, with mortality rates exceeding the national average by 10. There is also a 46% higher mortality rate due to chronic diseases of the lower respiratory tract.

Excess consumption of fats increases the risk of cardiovascular diseases and tumors (breast, colon and rectal cancer). The consumption of unsaturated fats and vegetable oils has a positive effect on health.

52% of men live in households where oil is used for cooking, and the same rate is 60% for women. 10% of the adult population of the region lives in households where lard or fat bacon is used for cooking. The mixed use of lard and oil is typical for almost one third of the region's adult population (men: 36%, women: 29%). The use of butter or margarine or the elimination of fat from cooking is not typical in the region's households.

Less people (56%) in the region use oil for cooking than in the whole country (60%). There is no significant difference in the use of fat/lard between the average of the region (10%) and the national average (9%). The mixed use of oil and lard is more common in the region (32%) than it is in the whole country (29%). There is no difference between the regional and the country average as regards that no butter or margarine is used in the households, and there are almost no households where none of these are used.

Physical exercise plays an outstanding role in maintaining and safeguarding health. It has beneficial effects on the immune system, bones, joints and muscles. It helps to prevent obesity, relieves stress, and it is one of the vehicles of recreation. Almost 90% of males and females report a proper level of physical activity.

Obesity is the third most important preventable cause of disease and death after smoking and alcoholism. High blood pressure, disturbed fat metabolism and diabetes are much more prevalent with obese people than with people in the normal weight range. 40% of men and 47% of women have normal body weight. About two-thirds of males and half of females are overweight or obese. Pathologically low weight is prevalent in 5% of women, and much more rare (1%) in men.

Alcohol consumption – depending on the amount consumed – can be beneficial, or quite the opposite, can be harmful to health. Drinking with moderation reduces the risk of cardiovascular diseases, while heavy drinking will greatly increase the prevalence of certain diseases (liver cirrhosis, stroke, cancer in the oral cavity, the gullet and breasts, and birth defects) and the number of premature deaths.

Based on self-reported data, 22% of men and 57% of women never consume any alcohol. Based on their drinking habits, one quarter of men and a similar proportion of women are occasional drinkers. Moderate drinking is reported by one third of men and ten percent of women. There are six times as many heavy drinking men as women (men: 23%, women:4%). The proportion of those who never drink any alcohol (41%) is smaller in the South Transdanubia region than in the country in general (46%).

Smoking is one of the most important lifestyle risk factors. It plays a defining role in the development of many diseases, and leads to death. Smoking can be blamed not only for other tumors (e.g. cancer in the oral cavity, gullet or bladder), but also for cardiovascular diseases and some chronic illnesses of the respiratory tract. Passive smoking will increase the risk of lung cancer and respiratory illnesses also in non-smokers. Smoking in pregnancy is a risk to the health of the unborn baby. One third of men and 60% of women have never smoked. One quarter of men and 11% of women quit smoking. The prevalence of smoking is similar in the region to the national average, where heavy smokers are an exception with a higher regional proportion than the national average.

C. NATURAL ENVIRONMENT

1. Air

Study Area:

Dunaföldvár

Baseline

The annual number of sunny hours amounts to 2000 in the north and to 2050 in the south. The southern parts have more sun also in the summer trimester, while 800 hours are probable in the northern parts. Sunshine may slightly exceed 200 hours in the winter trimester.

The annual mean temperature is 10.2-10.3°C in the south and 9.8-9.9°C in the north; the mean temperatures in the vegetation period are 16.1 and 17.0°C respectively. The number of days with mean temperature values exceeding 10°C is 188-189, somewhat more in the southern part. The length of frost-free period is of 186-190 days on NW, 203 days in the central parts and over 207 days along the Danube. The average of the annual maximum temperatures is 34.0-34.2°C in the southern parts, and 33.6-33.8°C elsewhere. That winter absolute minimum is -16.0°C.

The annual precipitation value remains below 550mm. The highest amount of daily precipitation was 113mm in the neighboring town of Dunaújváros. The average number of days with snow-cover is 30-32; the mean maximum snow thickness is of 20-22cm.

Aridity index: 1.17-1.21.

The prevailing wind direction is northwesterly, the mean wind speed slightly exceeds 2.5m/s. In spring, during soil cultivation works and when the plant cover is still not tight, the NW winds stir up the fine Aeolian soil into high airspaces in dry weather conditions.

Decree 4/2002. (X. 7.) of the Ministry of Environment and Water specifies air quality categorization of the country's different territories. According to this Decree, the district of Dunaföldvár does not belong to any of the distinguished agglomeration zones; the general air quality requirements relating to the remaining territories of the country are applicable (Zone 10).

According to Zone 10 classification, the settlement's air is not qualified as polluted.

According to Decree 4/2002. (X. 7.) of the Ministry of Environment and Water establishing agglomerations and zones on the basis of air pollution data, the community of Dunaföldvár belongs to the following categories.

Air quality classification of the project area

SO_2	NO_2	CO	Solids (PM 10)
F	F	F	E

The classification codes as to the above table are defined here below in compliance with *Annex 4* of the joint Decree 14/2001. (V. 9.) of the Ministry of Environment, Ministry of Health and Ministry of Agriculture and Rural Development:

Group E: areas where the air pollution is between the lower and upper threshold values for one or more air pollutants.

Group F: areas where the air pollution does not exceed the lower threshold value.

The Site was cultivated in the past. The basic air pollution within the area is determined by emissions deriving from the territory of the neighboring settlement, from the neighboring agricultural crop storage and fuel storage plants and from the traffic.

In February 2006, Progressio Mérnöki Iroda Kft. employed Fővárosi Levegőtisztaságvédelmi Kft. to perform air quality measurements in compliance with the measurement plan approved by the National Inspectorate for Environment, Nature and Water. The assignment covered determination of the concentration values of air pollutants, including CO, NO_x, SO_2 and airborne dust (TSPM: total suspended particulate matter).

The assessment was performed at three sampling sites, during 3 days, for eight hours periods each day (from 08:00 a.m. to 04:00 p.m. on 20.02 and 22.02 and from 09.00 a.m. to 05:00 p.m. on 23.02).

During evaluation, the concentration values of the air pollutants were determined through establishing hourly and eight hourly averages.

Measuring point 1 was set to the south-east from the envisaged project, at the north border of Kisapostag community, in an agricultural area.

Measuring point 2 was set at 200m distance from an industrial railway crossing near an industrial plant. The track of highway M6, under construction, is at about 300m distance from the measurement point.

Measuring point 3 was set at about 400m to the north of the bridge to be constructed within Dunavecse community. Setting of the measuring point had been previously agreed upon with the representative of the local municipality.

The following table summarizes the measurement data.

Baseline emission data

SITE	EOV X	EOV Y	CO	NO_x	TSPM	NO_2	SD	SO_2	Type
			[µg/m^3]						
Kisapostag	173363.00	641068.00	333.00	17.20	16.40	-	-	<3.99	FLÁ
Dunaújváros	175936.00	641636.00	530.70	33.10	44.10	-	-	<3.99	FLÁ
Dunavecse	173693.00	643570.00	496.50	29.10	22.40	-	-	<3.99	FLÁ
Hourly limit value			***10,000***	***200***	***200***	***100***	***-***	***250***	
Annual limit value			***3,000***	***70***	***50***	***40***	***-***	***50***	

In the table the maximum values from among the hourly measurements of FLÁ Kft. and the mean values of the measurement results of the OLM automatic station and of the RIV measuring points are included.

2. Soil

Study Area

Site

Baseline

Dunaföldvár is a small city located in the Southern Transdanubian Region, in the north-east corner of Tolna County, within the Paks subregion. The city lies in the centre of the country, on the right bank of the Danube River, at about 90 km distance to the south from Budapest. It is located at the meeting point of main roads Nos. 6, 61 and 52.

The area under survey is part of the Great Plain large region, the Mezőföld mid-region, the Duna-Sárvíz-köze sub-region, and, within this, of the Közép-Mezőföld small region. The Mezőföld is located in the territory bordered by the Sió and Danube rivers. In geographical sense it constitutes part of the Great Plain, though it is not an integrated part thereof

according to popular comprehension. In topographical sense, however, it can be defined as eastern part of the Transdanubia, constituting the western half of the country.

Administratively it lies within the territory of Tolna County. It is prevalently covered by sandy, loess soil; the rivers of the Transdanubian Central Range have formed the landscape with their alluvial deposits. A bigger level difference (terrace) separates it from the remaining parts of the Great Plain. Originally grassland, it is now good quality agricultural area.

According to the Péczely macro-synoptic classification, the climate of the concerned area is moderate warm – moderate dry, while in silvicultural classification, it belongs to the forest-steppe type.

As regards landscape typology, the project area and its environment belongs to the landscape type "moderately continental plain with dominantly agricultural utilization", and within it, to "culture steppe of grade III grassland soil".

The small region is a loess-covered colluvium with altitude above Baltic Sea level of 97 to 204m. The portion lying to the south of the Seregélyes valley is the Sárbogárd loess platform, which bluffs with a 50-60m high embankment wall to the Danube. The surface of 150-180mBf altitude is diversified by erosion/derision valleys and other erosion configurations characterizing loess areas.

The envisaged plant will be implemented on a hill-side from 97 to 112mBF levels, sloping down to the south. The internal level difference approaches 15m, therefore, the plant's site will be partly dug and partly backfilled.

Due to the topographical and soil stratification conditions, typically argillaceous, sandy silt and fine grain sand layers will be excavated from the diggings. This material should be used for backfilling the deep-lying parts.

The Mezőföld surface is covered by glacial loess (in 50m width at Dunaújváros), and more rarely by sand. Its north-western and southern parts were marshlands, which have been mainly drained by the modern era. The loess ridges were conserved on the higher surfaces through accumulation of airborne rock dust. Excellent quality soil has formed on the loess. The original grassland vegetation and forest have almost disappeared. . Nowadays it is almost all arable land. As regards soil quality, good quality soil types are most typical. Due to their crumbliness and high humus content, these soils constitute the most important and largest agricultural resource in Hungary.

On the surface of the project area, fine-grained soil structures: argillaceous, sandy silt, and, in the deeper layers, fluvial sediments with scattered flinty grounds are to be found. The upper soil layers of 0.4-1.2m width are rich in humus; typical width of the top-soil is of 0.5m.

In the geological construction of the area under survey, blow sand ($_eQp_3^h$) deriving from wind-borne dust often descended on wet surface and fluvial sediments from the Upper Pleistocene epoch have participated. The role of the fluvial sediments ($_fQh_2$) of the Holocene period is unimportant; they merely appear in the southern part of the project area, in the valley of the nearby stream, known as Nagykarácsony. The geological formations of the natural surface are presented on Hungary's geological map segment.

Also the stratifications of the previously bored water extraction wells provide a picture of the Neozoic formations. During boring of the 311m deep well established in 1973 on the area of the former Soviet barrack square, the following dating was provided:

- 0.0 – 0.5 Holocene
- 0.5 – 75 Pleistocene
- 75 – 121 Levantine
- 121 – 311 Upper Pannon

Also the stratifications of the previously bored water extraction wells provide a picture of the Neozoic formations. During boring of the 311m deep well established in 1973 on the area of the former Soviet barrack square, the following dating was provided:

The Site was formerly cultivated, there were no buildings, it was not mined, there were no perceptible contaminations neither on the surface, nor in soil explorations.

There are no plants to be protected other than agricultural cultures.

The surface is generally covered by a 0.3 - 0.5 m thick arable layer. There can be found a 0.1 m thick slag spreading on boring point TDF-01 and on its surroundings.

It is geotechnically important, that the envisaged plant will be built in a hill-side sloping to the south, between 97 – 112 mBf levels, the inside lift is near 15 meters, therefore the plant will be built partly on aggradation, partly in cutting.

In the geological construction of the area under survey, blow sand (${}_{e}Qp_{3}^{h}$) deriving from wind-borne dust often descended on wet surface and fluvial sediments from the Upper Pleistocene epoch have participated. The role of the fluvial sediments (${}_{f}Qh_{2}$) of the Holocene period is unimportant; they merely appear in the southern part of the project area, in the valley of the Nagykarácsony stream.

The soil environment was explored by high diameter borings. Bore depths were defined by the topography; we performed deeper borings on higher sites and shallow borings on lower sites, with regard to the need of grading works.

Bores were deepened by a 130 mm, high diameter machine boring, exploring the soil environment to the required depth. The medium grained dispersedly small graveled fluvial soil layers with slightly greater bearing capacity were reached by 6 bores, in 3.2 – 8.4m depth, at 94 - 96 mBf level.

Due to the topographical and soil stratification conditions, typically argillaceous, sandy sludge and fine grain sand layers will be excavated from the diggings. This material should be used for backfilling the deep-lying parts.

Nine borings were deepened for exploring the near-surface layers. On the surface of the area, fine-grained soil structures: argillaceous, sandy silt, and, in the deeper layers, fluvial sediments with scattered flinty grounds are to be found. The upper soil layers of 0.4-1.2m width are rich in humus; typical width of the top-soil is of 0.5m.

Ground-water samples were taken from borings marked TDF-01, TDF-02, TDF-03, TDF-07 and TDF-08. During laboratory testing of the ground-water samples, the following components were checked (assessing laboratory: Bálint Analitika Kft.):

- TPH
- BTEX
- Halogenated aliphatic hydrocarbons
- Halogenated aromatic hydrocarbons
- Toxic metals
- Total water chemistry (for subsoil water samples)

The measurement findings were compared to "B" limit values included in Annex 3 of joint Decree 6/2009 (IV.14.) of the Ministries of Environment Protection, Health and Agriculture. According to the comparison performed, none of the measured parameters exceeded the relevant "B" limit value.

3. Groundwater

Study Area

Dunaföldvár

Baseline

The Dunaföldvár area is rich in groundwater. The city's water supply comes from wells in the Pannonian Strata but there are many shallower wells in operation from 70mm to 300mm bore diameter. The town's steam baths is replenished by waters 37-38°C that are rich in mineral salts and carbonic acids and that are drawn from a well that is more than 600 meters deep.

Groundwater is to be found within the area everywhere above the top impermeable layer. The ground-water conditions are influenced in the region beyond the actual precipitation quantity also by the water-conditions in the Danube River and the Nagykarácsony River. During floods, the groundwater flowing towards the river is backed up and its water-level elevated. The water-level increase depends on the duration of the flood. The trend of the ground-water level follows the ground level, but with a lower gradient.

During the course of the Project environmental due diligence, a groundwater flow map was elaborated and groundwater samples for laboratory analysis were taken at five separate points. The summary of the baseline groundwater analysis is as follows:

The pH was found to be in the range 7.28 – 7.86 and the conductivity to be in the range of 571 – 949 µS/cm. Toxic metals were all present in small fractions of the permitted limit values as were total petroleum hydrocarbons. Both BTEX and halogenated aliphatic hydrocarbons were undetectable.

In compliance with Decree 27/2004. (XII. 25.) of the Ministry of Environment and Water on classification of the settlements located in sensitive areas to subsurface waters, the settlement is located in a sensitive area.

However, Dunaföldvár does not lie within a Nitrate Sensitive Zone designated for protection of waters against Nitrates from agricultural sources in accordance with Decree 27/2006. (II. 7.) on protection of waters against agricultural nitrate pollution.

Test borings that encountered groundwater and two existing wells found within the project area are shown in the table below. The groundwater was at 92.4-98.4mBf depth, 3.4-9.8m below the ground between 31.03 and 01.04.2009. The groundwater level slopes towards the Danube, receiving the groundwaters. The Danube's stage in the design period can be estimated at 91.5mBf level. The uncertainty of this estimation is increased by the fact that the Danube's water level increased quickly, growing by more than 2.5m between 28.03 and 06.04.2009.

Typical ground-water levels of the project area

Investigation mark	Ground level	Groundwater table	
	mBf	m	mBf
TDF-1	103.99	5.85	98.14
TDF-2	98.56	4.15	94.41
TDF-3	102.95	7.85	95.10
TDF-7	99.32	6.20	93.12
TDF-8	102.2	9.80	92.40

Beyond the actual precipitation quantity, the groundwater level is also determined by the level of the Danube Reiver and of the Nagykarácsony River. The Danube level also influences the lower course's level of the Nagykarácsony River, as the Danube flood backs up the water flow.

Consequently the maximum groundwater level may be estimated at 95.5mBf at the deepest point and at 99.5mBf at the top, that is, at 2-4m below the ground level.

The design ground-water level is estimate by 0.5m higher, between levels 96.5 and 100.5mBf, increasing at the same direction together with the ground level's acclivity.

Groundwater samples were taken from borings marked TDF-01, TDF-02, TDF-03, TDF-07 and TDF-08. During laboratory testing of the groundwater samples, the following components were checked (assessing laboratory: Bálint Analitika Kft.):

- TPH
- BTEX
- Halogenated aliphatic hydrocarbons
- Halogenated aromatic hydrocarbons
- Toxic metals
- Total water chemistry (for subsoil water samples)

The measurement findings were compared to "B" limit values included in Annex 2 of joint Decree 6/2009 (IV. 14.) of the Ministries of Environment Protection, Health and Agriculture. According to the comparison performed, none of the measured parameters exceeded the relevant "B" limit value. Furthermore, the boring results allowed establishing the flow direction of the ground-water, being S-SE, towards the Nagykarácsony River and the Danube River.

4. Surface Waters

Study Area

Nagykarácsony and Danube River impacts

Baseline

The Danube River is the determining surface water course of the region. All other watercourses of the region belong to the Danube's catchment area. In front of the project area (on its southern side), in the valley the lower course of the Nagykarácsony River is to be found. After the river barrage, the slightly meandering creek flows into the Danube with a minimal stream flow. (The managing authority does not perform flow and water level measurements; therefore no relevant data are available.)

The area selected for the project is located in line with the 1563 river km section of the Danube. Characteristics of the Danube's hydrological conditions can be specified by using data of the nearest watermark post located in Dunaföldvár (source: Közép-Duna-völgyi Környezetvédelmi és Vízügyi Igazgatóság).

Location of the watermark post: right Danube bank, 1560.600 river km

"0" point altitude: 88.86mBf
Highest water level: 924cm
Lowest water level: -150cm

Design flood typical of the 1563 river km area: 98.23mBf.

The "0" levels of the buildings were set at 103.9mBf altitude and at 104.2mBf for the office building.

Council resolution 191/2006. (XI. 28.) of Dunaföldvár Municipality establishes the high-water bed, the river bank zones and the areas endangered by welling-up groundwaters.

The assigned site of the project falls partially within the line of the high-water bed. Partly due to this fact, and partly for reasonableness of locating the plant buildings and designing the public roads, the first phase of the construction implies ground-grading. During this process the relatively high level differences will be equaled, thus forming a nearly flat terrain which will be in its entirety above the maximum flood level.

It can be stated with certainty that Danube floodwaters do not endanger the plant either directly or indirectly.

5. Noise

Study Area

Vicinity of the Site

Baseline

The project site is located on the north part of Dunaföldvár city, in a business zone. Businesses and vacant lots are found in its direct vicinity. The nearest residential and social use buildings to the Project are not closer than 350 meters as shown below.

Nearest buildings to be protected

Establishment to be protected	Direction	Zoning	Distance from the ground-plot border, m
Residential houses at Hunyadi tér 2. and 3., Napsugár Home for the Elderly at Hunyadi tér 5.	W	Vt	400
Residential houses at Felsőfok utca 2-4-6.	S	Gksz	360
Residential house at Felsőfok utca 1.	SW		560

The area is slightly declining, covered by plants. In the sound propagation calculations, we have taken into account sound-absorbing soil and for a worst case analysis unobstructed sound propagation.

Based on available documentation, the background load values established by instrument measurement are as follows:

Background load values

Background load on the project site $L_{AH,üzem}$							
Southern border		Western border		Northern border		Eastern border	
Day	Night	Day	Night	Day	Night	Day	Night
40.3dB	34.7dB	37.5dB	30.2dB	39.8dB	34.6dB	44.8dB	38.5dB

Background load in the vicinity of the residential houses $L_{AH,üzem}$							
Hunyadi tér 3.		Felsőfok u. 2-4-6.		Felsőfok utca 7/a-b.		Felsőfok utca 1.	
Day	Night	Day	Night	Day	Night	Day	Night
38.2dB	33.5dB	38.8dB	32.5dB	38.4dB	33.4dB	38.1dB	33.2dB

The measurement results clearly show that the operational background load of the buildings to be protected is low.

In principle, the indirect impact area may include the primary main road No. 6 and the connected secondary main road No. 61. Noise load calculation of the public roads was performed in compliance with Annex 2 of Decree 25/2004. (XII. 20.) of the Ministry of Environment and Water.

*Traffic data of section 86+500km of main road 6**

Trucks, small trucks	Solo buses	Light trucks	Motorcycles, powered cycles	Articulated buses	Solo heavy trucks	Train trucks	Low velocity vehicles
6220	101	505	61	3	464	999	11

* The relevant traffic data were drawn from the publication of Magyar Közút "Section traffic of the national main roads in 2007 – I".

Calculations have been performed on the basis of the following parameters:
Acoustic roughness: B
Design running speeds: v_1 = 90km/h; v_2 = 70km/h; v_3= 70km/h, constant speed.
Day and night traffic rate: mean night traffic road.

Calculation of 7.5m reference value:

Vehicle category	Component calculation – right side (slope)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	80.2	80.3	80.4	-12.3	-14.8	-21.1

II.	81.8	82.0	82.1	-20.9	-23.5	-29.5
III.	85.2	85.4	85.5	-17.6	-20.2	-25.7

Vehicle category	Component calculation – left side (ascent)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	80.7	80.8	80.8	-12.3	-14.8	-21.1
II.	81.8	82.0	82.1	-20.9	-23.5	-29.5
III.	85.2	85.4	85.5	-17.6	-20.2	-25.7

Period	$L_{Aeq}(7,5)_{a.s.t.i.i}$ dB - right
During day	71.2
Evening	68.8
Night	63.0
Day	70.7
Whole day, (L_{DEN})	72.3

Period	$L_{Aeq}(7,5)_{a.s.t.i.i}$ dB - left
During day	71.4
Evening	69.0
Night	63.1
Day	70.9
Whole day, (L_{DEN})	72.6

Traffic data of section 3+744km of main road 61

Trucks, small trucks	Solo buses	Light trucks	Motorcycles, powered cycles	Articulated buses	Solo heavy trucks	Train trucks	Low velocity vehicles
3469	59	128	56	7	215	523	17

Calculations have been performed on the basis of the following parameters:
Acoustic roughness: B
Design running speeds: in residential area, in the vicinity of Előszállási út - v_1 = 50km/h; v_2 = 50km/h; v_3= 50km/h, constant speed.
Day and night traffic rate: mean night traffic road, α = 2.0 ° slope (ascent).

Calculation of 7.5m reference value:

Vehicle category	Component calculation – right side (ascent)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	74.7	74.8	74.8	-12.4	-14.8	-21.2
II.	78.5	78.6	78.7	-24.1	-26.6	-32.6
III.	82.4	82.5	82.5	-19.1	-21.6	-27.1

Vehicle category	Component calculation – left side (slope)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	73.4	73.5	73.6	-12.4	-14.8	-21.2
II.	78.5	78.6	78.7	-24.1	-26.6	-32.6
III.	82.4	82.5	82.5	-19.1	-21.6	-27.1

Period	$L_{Aeq}(7,5)_{a.s.t.i.i}$ dB - right
During day	66.1
Evening	63.7
Night	57.9
Day	65.6

Period	$L_{Aeq}(7,5)_{a.s.t.i.i}$ dB - left
During day	65.7
Evening	63.3
Night	57.5
Day	65.2

Whole day, (L_{DEN})	67.3		Whole day, (L_{DEN})	66.8

Traffic data of section 3+554km of by-road 6228

Trucks, small trucks	Solo buses	Light trucks	Motorcycles, powered cycles	Articulated buses	Solo heavy trucks	Train trucks	Low velocity vehicles
1330	14	96	9	6	106	131	7

Calculations have been performed on the basis of the following parameters:
Acoustic roughness: C
Design running speeds: in residential area, in the vicinity of Hunyadi tér, Daruszentmiklós - v_1 = 50km/h; v_2 = 50km/h; v_3= 50km/h, constant speed.
Day and night traffic rate: low night traffic road.

Calculation of 7.5m reference value:

Vehicle category	Component calculation – right side (ascent)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	75.5	75.5	75.6	-13.5	-16.4	-23.1
II.	79.4	79.5	79.5	-24.1	-27.0	-33.4
III.	83.0	83.1	83.1	-20.9	-23.8	-29.8

Period	$L_{Aeq}(7,5)_{a,s,t,i,j}$ dB
During day	65.5
Evening	62.6
Night	56.3
Day	64.9
Whole day, (L_{DEN})	66.2

6. Solid Wastes

Study Area

Site

Baseline

Act XLIII of 2000 on waste management regulates waste management in Hungary and is consistent with relevant EU directives on waste management. The Act specifies the priority ranking for waste management, contains waste management principles and definitions, and responsibilities of the producer and owner of waste. The Act lays down the general conditions of performing various waste management procedures and activities (collection, transportation, export-import, pre-treatment, storage, recycling, neutralization), special rules for the management of municipal and hazardous wastes, and waste management planning tasks. The Act specifies the organizations of waste management administration and their powers, and the general, legal and financial responsibility conditions of players in waste management. The Act deals with the availability of waste management information to the

public domain, registration and reporting obligations concerning data, sanctions for defaults, and finally it lays down governmental and ministry tasks relating to its enforcement, and completion deadlines for various concrete measures.

Detailed regulations are provided for the assessment and management of risk from chemicals and for operation of the prior informed consent (PIC) procedure, based on the Rotterdam Convention, which was ratified by Hungary.

With respect to non-residential waste, around 100-110 million tons of solid waste are generated annually, with industry and agriculture producing 40% and 60% of that amount, respectively. The quantity of waste generated dropped by about 20% due to a reduction in output and consumption between 1985 and 1994.

Only about half the production waste is reused, which represents 3% of total material use. 85% of municipal solid waste is collected and treated in an organized way.

Hazardous wastes and their management is a substantial problem in Hungary. A program to build a network of regional hazardous waste landfills and incinerator plants was elaborated in the mid-1980s, but has not been completed due to limited financial resources. One modern incinerator plant, one chemically secure landfill and four interim storage sites have been constructed and put into operation. This is less than half of what was planned. The establishment of new regional incinerators is planned in the near future. In addition, many large and small factories have their own storage facilities.

The planned activities of the Site anticipate only minimal and ordinary generation of solid wastes. Please see the discussion of surface wastes impacts for a discussion of some hazardous waste issues with respect to the Project.

7. Biodiversity

Study Area

Dunaföldvár/Site

Baseline

Hungary as a country exhibits a comparatively low level of biodiversity of both flora and fauna. The area has been subject to human habitation for millennia and to intensive cultivation for centuries. This applies equally to

Source: United Nations Environment Program

the area around Dunaföldvár.

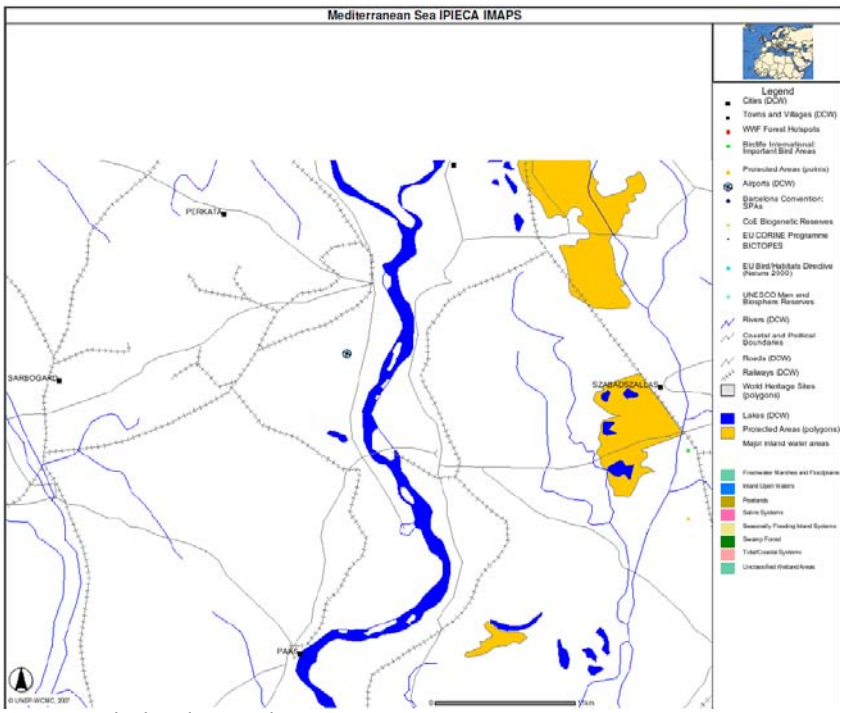
Hungary's biodiversity classification is the second lowest on the UNEP Biodiversity scale in the range -1.228999 to -0.2900000. As such it has lower general biodiversity than all of its neighbours except Romania and the Ukraine. Along with the Balkans and its immediate neighbours in Austria, Slovakia and the Czech Republic, Hungary is in the lowest category for endangered mammals in the range of 0–12. Hungary exhibits a slightly higher density of threatened bird species than its immediate neighbours. Nevertheless, on a scale from 0–24 nowhere in Hungary scores higher than 6 and the area around Dunaföldvár scores a 3.

The Project is adjacent to the Danube River, and it is therefore appropriate to examine the baseline biodiversity of fish and freshwater shellfish. As can be seen in the graphic below, Hungary is not at all impacted by areas of concern for freshwater shellfish, while the area of fish diversity is centred around the Tisza River, far to the east of the Site.

As far as the biodiversity of the immediate locality is concerned, the area belongs in terms of flora to the „Mezőföld és Solti-síkság" sub-area (*Colocense*) of the „Alföld" flora area (*Eupannonicum*) which is again a sub-area of the Pannonia flora area (Pannonicum). From the point of view of fauna the whole area belongs to the „Nagy-Alföld" area (*Eupannonicum*).

Only agricultural and military activities have taken place on the planned site. The latter activity has resulted in large-scale biologically inactive and degraded areas, embankments overgrown with weeds and non-native tree species.

The Project area is not under nature conservation protection according to Act LIII of 1996 on Nature Protection (referred to hereinafter as TVT), Article 22, paragraphs a) and c), and is not qualified as a nature conservation area according to TVT Article 4, paragraph b) and Article 15, Section (1). Article 6, Section (3) of the TVT has introduced the definition of individual landscape value; at present, the area concerned does not belong to this category. The area under survey does not make part either of the National Ecological Network as defined in Article 12, Section (1) of Act XXVI on the National Country Planning or of the Natura2000 Network defined in Govt. Decree 275/2004. (X. 8.). Elements of the National Ecological Network located in the vicinity of the project area include the Danube river and the water surfaces and the swamps of the Upper Lake and Lake Matild. To the west form the area, the special nature conservation area of particular importance



Source: United Nations Environment Program

“Tolnai-Duna”, recorded under site code HUDD 20023, is located. The water stream discharging the waters of the lakes – even though edged by near-natural habitats – does not make part either of the ecological network or of a nature conservation area.

The Project area lacks a diverse fauna, and the wider area is a mosaic of habitats that have no significant natural values. The assessment shows that the environment of the studied area is already highly degraded and could be described by the dominance of cultivar species.

Potential ecological associations of the region included the loess steppe oak-woods with tatar maples (*Aceri tatarico-Quercetum pubescenti-roboris*) and the oak forests (*Quercetum petraeae-cerris*), with riparian forests (*Fraxino-pannonicae-Ulmetum*), willow and poplar forests (*Salicetum albae-fragilis*), loess grasses (*Salvio-Festucetum rupicolae*) and grazing lands (*Cynodonti-Poëtum angustifoliae*) in the river valley. On the place of the original ecosystems, today typically agricultural lands and “cultural forests” are to be found. Within the area under study and in its surroundings agricultural lands, cultivated and fallow fields are prevailing; the dominant species – especially in the fallows – include agricultural, roadside, ruderal and adventive weeds.

Regular disturbance due to economic utilization and species-poorness due to monocultures accompanied by low population except for the pestiferous species connected with field cultures characterize also the fauna of the small region belonging in animal geographical aspect to the Great Plain fauna district (*Eupannonicum*) of the Plain fauna region (*Pannonicum*). From among the vertebrata some amphibians accepting the dry conditions, for example common toads (*Bufo bufo*) and agile frogs (*Rana dalmatina*) live in the area under survey, while some lizard species represent the reptiles. From the bird species mainly those well tolerating human vicinity are found here. The yellowhammer (*Emberiza citronella*) and the crested lark (*Galerida cristata*) are nesters of the weedy lands. Frequent species nesting in the nearby forests and bushes include: song thrush (*Turdus philomelos*), greenfinch (*Chloris chloris*) and goldfinch (*Carduelis carduelis*) etc. The turtle dove (*Streptopelia turtur*) and the wood pigeon (*Columba palumbus*) are already rarer, the latter is otherwise nesting in forest belts and patches located at greater distance from the road. Due to the intensive cultivation, the number of species and the population of the small mammals, and, as a consequence, also that of the birds of prey, for example of the common buzzard (*Buteo buteo*) and of the mammals, for example of the European polecat and of the fox (Vulpes vulpes), feeding upon them, are low. The stock of game is primarily presented by the deer (*Capreolus capreolus*) and by the wild boar (*Sus scrofa*); from among game birds, pheasants (*Phasianus colchicus*) are encountered. The animal life of the nearby water habitats is considerably richer, but the envisaged operation has no impact on such habitats.

No directly or actually endangered species are found in the fauna of the area, and only the most frequent of the protected species that tolerate best the human presence and disturbance are present.

The map on the previous page shows the area around Dunaföldvár in more detail. The Site is immediately east of the small lake in the centre of the map. As can be seen, the area is characterized by a general lack of areas of special interest or concern from the biodiversity point of view or. It can be specifically stated that:

- The nearest protected area is more than 18km to the east.
- The nearest area listed by Birdlife International as an important area for birds is more than 25km distant.

- The area is not possessed of any designated WWF Forest hotspots.
- The area exhibits no Council of Europe designated Biogenetic Reserves.
- The area does not contain any area designated as an EU CORINE Program Biotope.
- The Site contains no area protected under the EU Birds/Habitats Directive (Natura 2000), although much of the Danube riverbank is so protected (*see below*).
- The area does not include any UNESCO designated Man and Biosphere Reserves.

Govt. Decree 275/2004. (X. 8.) on nature protection areas of European Community importance provides for the protection of the areas listed as Natura 2000 sites. Decree 45/2006. (XII. 8.) KvVM issued by the Minister of Environment and Water by way of execution of the Government Decree, in its Annexes lists the land portions concerned by nature protection areas of European Community importance.

To the east of the area under survey, in the direction of the Danube River, the approved nature conservation area of enhanced importance, named Tolnai-Duna and registered under site-code HUDD 20023 is located. Properties of the Dunaföldvár municipality area with the below listed topographical lot numbers belong to this Natura 2000 area:

015, 016/3, 016/5, 017/3, 017/11, 017/24a, 017/24b, 017/38, 018/a, 018/b, 018/c, 018/d, 018/f, 018/g, 018/h,018/j, 018/k, 018/l, 018/m, 018/n, 018/p, 018/r, 019, 021/a, 021/b, 021/c, 021/f, 021/g, 037/63, 040/a, 040/b, 040/c, 040/d, 040/f, 041, 042/a, 042/b, 042/c, 042/d, 042/f, 042/g, 042/h, 043, 044/1, 044/2a, 044/2b, 044/2c, 044/2d, 044/2f, 045, **0105/2a, 0105/2b, 0125/a, 0125/b, 0126/a, 0126/b, 0126/c, 0127/1**, 0128/1a, 0128/1b, 0128/2, 0129, 0130/1, 0130/2, 0130/3, 0136/4, 0137/1, 0137/2, 0137/3, 0138/a, 0138/b, 0139, 0140, 0141, 0142, 0143/a, 0143/b, 0146/2, 0153/1, 0155, 0156, 0159/2, 0160, 0161, 0164/12a, 0164/12b, 0608, 0609, 0610, 0616, 6424/5.

The lots with the highlighted numbers are in the vicinity of the project area. The lots with number 0105 and 0127 designate the Danube River itself, according to the meaning with the mid-water river edge as limit. Areas marked 0125 and 0126 are located in the Danube's riparian zone to the south of the right bank of the Nagykarácsony River's mouth. Therefore the riparian zone between the Nagykarácsony and the crop loading berth of Cargill Kft. is not part of a Natura 2000 protected area.

Consequently there are no habitat types or species of enhanced Community importance either on this riverside section or on the reinforced, stone-covered embankment or on the connection road that would justify classification of the site to the Natura 2000 area.

8. Cultural Heritage

Study Area

Site

Baseline

Hungary acceded to the UNESCO World Heritage Convention in 1985, and eight World Heritage sites are located in Hungary, none of which are listed as currently in danger, and 11 other sites have been nominated for recognition. Within Hungary, the Ministry of Education and Culture, in concert with the Hungarian National Commission for UNESCO and the National Office of Cultural Heritage, is responsible for identifying and preserving cultural heritage. Hungary is also party to three other international conventions with cultural heritage as the subject matter.

The National Office of Cultural Heritage is the administrative authority of first instance for historic monuments, archaeological sites and movable cultural heritage. The National Office is responsible for nearly 12,000 listed historic sites, buildings, conservation areas and historic gardens all over Hungary as well as for more than 100 thousand archaeological sites and 35,000 movable cultural heritage items and 240 collections in private ownership.

The envisaged project qualifies as major investment project. Pannonia previously prepared a desktop archaeological survey, which is not attached again, due to reasons of volume. This study identified a single site, where removal of the surface layer should be performed under archeological monitoring

Heritage protection officials evaluating the site discovered some ceramic fragments of undistinguished historic ages and 10-12 small Paleolithic fragments (Neolithic or bronze age) and some perhaps identifiable as deriving from the Roman age. An archaeological survey on parts of the site is continuing, but the cultural heritage authorities have approved issuance of the IPPC permit for the Project.

V. IMPACTS

During most of the construction period, Fagen will control the Site and almost all activities on and adjacent to the Site, and Pannonia will only control the Site and equipment after the Project is operational. As a result, one of the largest Project risks is with Fagen and its ability to work in a safe and environmentally responsible manner. Fagen has been actively involved in all aspects of Project design and permitting to date. The construction agreement between Pannonia and Fagen requires Fagen to observe all Hungarian environmental and labor laws and standards. Fagen's excellent reputation as a contractor and the developed state of Hungarian regulations mean that Progressio and Ethanol Europe consider Fagen's standard of care to be consistent with the IFC Standards and Fagen professionally capable of working at such standards.

A. GENERALIZED ENVIRONMENT

1. GHGS

The Project, when operating at full capacity, will be a large gross emitter of carbon dioxide, but will result in a substantial net reduction in GHG emissions. To examine the Project's GHG impact, this section examines (i) direct Project GHG emissions, (ii) indirect Project GHG emissions, (iii) net Project impacts on GHG emissions, and (iv) indirect land use concerns.

Direct Project GHG Emissions

At no time is the Project expected to emit, directly, more than *de minimis* amounts of any GHG other than carbon dioxide.

GHG emissions from the Project will result from Project construction, Project operation and Project decommissioning. The EIA and the GHG Report provide information about aggregate GHG emissions from construction and operation. Neither the EIA nor the GHG Report estimates aggregate GHG emissions from Project decommissioning, but it is reasonable to assume that these will be equivalent to the construction-period emissions. The Project is a large civil structure that is composed primarily of steel and concrete; as such no special technical or environmental problems should be associated with its decommissioning.

During Project operation, when the Project is operating at full capacity, the Project will each year directly emit approximately 305,782 tons of carbon dioxide, attributable approximately 181,147 tons to fermentation and 124,636 tons to combustion of natural gas and power generation. Accordingly the Project may directly account for approximately 0.4% of Hungary's aggregate GHG emissions.

This estimate of aggregate direct emissions of GHG during Project operation carries a high degree of certainty due to the fact that the Project is so similar to dozens of other ethanol production facilities.

Because the direct GHG emissions of the Project will exceed 100,000 tons per year, pursuant to IFC Standard 3, Pannonia should quantify and monitor GHG emissions annually in accordance with internationally recognized methodologies. The methodology directly applicable to the Project is the methodology promulgated by the European Commission pursuant to the Renewable Energy Directive and is the methodology that Ecofys has used to date in advising Pannonia on the Project's GHG emissions.

Indirect Project GHG Emissions

Indirect Project emissions could include (i) emissions related to electricity used by the Project (except for the 1/3 of estimated electricity used that will be generated by the Project itself), (ii) emissions from crop establishment, cultivation, harvesting and drying, (iii) emissions related to transportation vessels used to deliver corn to the Site and ethanol and DDGS to end customers, (iv) emissions related to direct land use change (e.g. if a new farm is specifically established for the Project), and (v) indirect land use.

With respect to indirect emissions from electricity generation, the Ecofys model predicts (assuming that the Project works with the same efficiencies actually achieved by other recent Fagen ethanol production facilities), 11,521 tons of CO_2 emitted per year.

With respect to emissions from crop establishment, cultivation, harvesting and drying, the Ecofys model predicts 158,766 tons of CO_2 emitted per year.

With respect to emissions from transportation, the Ecofys model predicts 6,073 tons of CO_2 emitted per year if all product is shipped by barge and 4,448 tons of CO_2 emitted per year if all product is shipped by rail. Depot and filling operations would add another 2,797 tons of CO_2 emissions.

Because the Project will not itself convert any land to cropland, nor is Pannonia or Progressio aware that anyone will be reasonably likely to convert any land to cropland specifically for the Project, emissions from direct land use changes are limited to the construction period.

Finally, as the GHG Report makes clear, there is no way to calculate emissions from indirect land use, and this issue is discussed below.

Because the Project's direct emissions already exceed 100,000 tons of CO_2e per year, indirect Project emissions are important to monitor on an ongoing bases, but they do not trigger any additional requirements under IFC Standard 3.

Net Project GHG Emissions

The Project's net GHG emissions are derived by adding direct Project GHG emissions with indirect Project GHG emissions and then subtracting the GHG savings calculated in the GHG Report.

The Project's sum of direct GHG emissions and indirect GHG emissions, assuming that Project is operating at full expected capacity and shipping all ethanol by rail, is 494,139 tons, which represents approximately 0.65% of Hungary's aggregate annual GHG emissions.

However, including crop establishment, cultivation, harvesting and drying in the Project's GHG emissions assumes that none of this corn would be grown or transported but for the Project, which is not likely.

The GHG Report calculates an approximately 57% GHG savings due to the Project. At this 57% level of GHG savings, the Project will result in net GHG emissions annually of (230,209) tons of CO_2e, which equates to 0.3% of Hungary's aggregate GHG emissions or 3.3% of Hungary's reduction requirement under the Kyoto Protocol.

Ecofys will likely be retained to perform an ongoing GHG audit of actual Project performance after the Project enters commercial operation.

Indirect Land Use

In February 2008, two articles in *Science* (*see* Fargione et al. 2008 and Searchinger et al. 2008) introduced the concept of indirect land use ("ILU") into the biofuels debate. The argument proposed in these articles is that if mandates for increased biofuels use result in the clearing of non-farmland for farmland, then biofuels may worsen rather than mitigate climate change due to resulting carbon dioxide, methane and nitrous oxide emissions. Over the past year, the situation with ILU has not become much clearer. An additional *Science* article (Melilo et al. 2009) broadly supports the conclusions of the 2008 articles, but in 2010, the USEPA reduced the impact of ILU when it issued its RFS 2 guidance. Accordingly, the situation around ILU remains controversial.

Some opponents of biofuels argue that any increase in biofuels will result in adverse climate change since any incremental demand in biofuels will result in incremental clearing of sensitive ecosystems for farmland. However, this argument runs against the thesis of the 2008 *Science* articles. Both articles assume regional increases of biofuels use on the order of tens of billions of gallons, and implicit in this approach is the understanding that incremental increases in biofuels use could be accommodated without indirect land use impacts. Moreover, both articles focus on the United States, Brazil and southeast Asia (either as biofuels producers or areas where new crops will be grown due to indirect land use impacts of biofuels policies in the United States).

These three regions are much different when it comes to an analysis of indirect land use issues than is Hungary. In each of these three regions, there is not much of an argument that agriculture can be materially expanded without new acreage. In Hungary, by contrast, new acreage is, at least currently, a remote consideration. Indeed, on June 10, 2010, the European Commission announced that because so much existing EU farmland is now unutilized or underutilized, the entire 10% requirement under the Renewable Energy Directive could be met with EU-produced biofuels without converting any non-farmland to farmland.[2]

Accordingly, it is possible that indirect land use concerns will become relevant in Hungary (and by extension the EU) only after a certain amount of new biofuels capacity is added and so will not be an issue for several more years, if ever.

In Hungary, only 4% of corn production is currently being used for ethanol. This figure compares to 11%, 14% and 17% in the Netherlands, France and Germany respectively. The

[2] *See* *europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/247&format=HTML&aged=0&language=en&guiLanguage=en*

vast majority of the Hungarian corn crop (90%) is currently used as animal feed. Effectively no Hungarian corn (commercial corn production) is used for human consumption since the entire commercial crop is silage and feed corn with almost no sweet corn.

	Food	Feed	Industrial		
			Ethanol	Starch	Other
France	4.0%	82.0%	14.0%		
Romania	5-10.0%	90-95%	0%		
Germany	23.0%	60.0%	17.0%		
Italy	7.4%	89.7%	0.0%	0.0%	2.9%%
Hungary	0.0%	90.0%	4.0%	6.0%	0.0%
Netherlands	7.0%	82.0%	11.0%		

Source: Market Study

On balance, it does appear that ILU issues are currently not relevant to Hungary. Within Hungary, as the Market Report makes clear, (i) existing cropland is underutilized, (ii) average corn yields are very low by EU standards, (iii) yields can be increased through more effort and care, (iv) yields can be increased through fertilizers (which will have a GHG impact), (v) yields can be increased through better irrigation, and (vi) since the 2008 Health Check reforms the mechanism requiring a proportion of arable land to be set-aside or taken out of production is formally no longer in force, putting additional acreage back into use. If corn prices are above €100/ton when the Project reaches commercial operation, the Market Study suggests that corn production can expand dramatically.

The Market Study makes clear that (i) the Project appears to meet EU sustainability requirements because corn produced in Hungary is reasonably certain to be produced from lands that have historically been used for farming, and (ii) all of the Project's corn will likely come from within Hungary;

Taking into consideration all of these factors, Hungary should be able to produce approximately five million additional tons of corn each year before ILU concerns become pressing. The Project would demand 0.575 million tons per year. There are two additional ethanol projects in Hungary that may be constructed (but Ethanol Europe believes that they will not) that would consume, together, less than 0.5 million tons per year. If Pannonia expands the Project in 2013 to double its size and even if Ethanol Europe builds a second expanded Project in Hungary, that 2.3 million tons of corn per year would still be lower than half of the ILU threshold calculated above.

For the EU as a whole, according to the Food and Agricultural Policy Research Institute of the University of Iowa, which also provides long-term production forecasts to 2018/19, even in the absence of biofuels mandates, EU corn yields are expected to increase from 6.83t/ha to 7.11t/ha in the EU as a whole and from 4.38t/ha to 5.21t/ha in the new member states. Yield improvements mean that corn output is expected to rise by 6.65% over this period. Despite a substantial projected increase in biofuels output consistent with the Renewable Energy Directive, current EC estimates suggest that biofuel use will represent only 7% of total cereals consumption in 2015 (12.5% of EU corn use) and overall the EU cereals market is forecast to remain relatively balanced throughout the period.

Further Reductions and Offsets

Ethanol Europe has, consistent with IFC Standard 3, evaluated options to reduce Project GHG emissions. Some of these options are not yet feasible or cost-effective, and some have already been adopted.

In contrast to almost all U.S. Fagen ethanol facilities, the Project includes a steam let down turbine, which is an additional capital expense, but which will result in decreasing indirect GHG emissions from off-site electricity generation by approximately 6,000 tons per year.

After construction, Pannonia will continue to pursue efforts to reduce Project GHG emissions. Without foreclosing other options, Ethanol Europe has already identified the two most likely avenues that Pannonia will pursue to do this: biomass power and eventual cellulosic conversion.

With regard to biomass power, Ethanol Europe has entered into negotiations with BHD Hõerõmû Kft, a leading Hungarian independent power producer ("BHD"), with respect to the construction adjacent to the Site of a small straw-fired power plant that will (i) sell renewable power into the Hungarian power grid and (ii) sell renewable process steam to the Project. Under the proposed agreement, BHD would assume all of the capital costs and financing obligations for this biomass power plant, and Pannonia would pay less for this renewable steam than its production cost for its own steam. Accordingly, the biomass power plant would (i) reduce Project opex, (ii) increase Project flexibility and (iii) further increase the environmental attributes of Project ethanol.

With regard to cellulosic ethanol, in selecting Fagen as its construction partner and ICM as its process technology partner, Ethanol Europe has also selected the company that is most likely to be at the forefront of next generation corn ethanol developments. Although Fagen has earned its position as the world's leading constructor of corn ethanol facilities through its work in traditional corn-based facilities, it is actively involved in work towards transitions to second and third generation biofuels. These transitions include not just cellulosic ethanol, but also algae based biofuels, dry fractionization, and combined heat and power solutions using biomass fuel or natural gas. In addition, ICM has brought more than 100 dry mill grain ethanol plants into commercial operation, and on June 8, 2010 announced that it had signed an agreement with the U.S. Department of Energy to retrofit one of those plants to use cellulosic (corn fiber and other feedstocks) feedstocks.

Fagen's and ICM's current work is informed by the belief that conversions to cellulosic processes will become economically viable in an intermediate time frame. Because there are so many Fagen/ICM ethanol facilities, Ethanol Europe expects Fagen to be able to provide a cost-effective and turnkey cellulosic conversion solution when such technology is commercialized. In any conversion from corn starch ethanol to corn stover, switchgrass or related feedstocks, the vast majority of the Project's equipment, utilities and systems will not need to be retrofitted.

2. Land Acquisition

The Site was purchased from Cargill in June 2010. There is no direct or indirect evidence that the Site is used by any person or group for any purpose at present or in the recent past.

B. SOCIAL ENVIRONMENT

1. Disadvantaged Groups

Dunaföldvár is an apparently socially and ethnically homogenous community, and Ethanol Europe has been unable to identify any minority rights issues within Dunaföldvár. By definition, the community of Dunaföldvár is itself a disadvantaged group under European Union law since average incomes are so far below the European Union average.

Accordingly, by providing jobs in Dunaföldvár, from an EU perspective, the Project will have a strong beneficial impact on a disadvantaged group.

There is a risk, however, that minorities in Dunaföldvár will be excluded from these jobs. Pannonia intends to rely on the local government as an important source of referral for jobs, so if the local government excludes job applicants from disadvantaged groups, then this risk could exacerbate minority rights problems in the local area.

Source: Hungarian Ministry of Foreign Affairs

Theoretically, based upon the accompanying map and the fact that the population of Dunaföldvár is 9,320, hundreds of Roma live in Dunaföldvár, However, local respondents tell Ethanol Europe that the actual number is barely in the dozens. Accordingly, due to the fact that Ethanol Europe has been unable to identify any disadvantaged ethnic group in Dunaföldvár, this issue is not included in the Action Plan.

There is no subnational indigenous group in Hungary of any relevance to the Project.

2. Labor

Pannonia will employ, initially, 77 people, as illustrated in the organizational chart in Appendix D. Each of the employees will have an employment contract that complies with Hungarian labor laws, which are broadly consistent with ILO standards. Moreover, Pannonia on December 10, 2009 adopted the equal employment opportunity policy set forth in translation in Appendix E, which will be provided by the Human Resources Manager to each employee upon assuming employment.

Ethanol Europe and Progressio have jointly tried to assess the broader labor and economic impact of the Project by reference to measured impacts on local communities in the United States from similar ethanol facilities. Although Hungary and the United States are very different under many metrics, Ethanol Europe, Progressio, Fagen and the government of

Annual Economic Impact of
50 and 100 MGY Dry Mill Ethanol Plant

Impact from annual operations	50 MGY	100 MGY
Total Spending (Mil $)	$83.9	$164.7
Local Spending (Mil $)	$56.1	$108.9
Local GDP Impact (Mil $)	$152.3	$300.1
Household Income (Mil $)	$40.4	$76.7
Total Employment (Jobs)	618	1,137
Direct jobs	40	50
Indirect jobs	578	1,087

Source: Urbanchuk 2008

Dunaföldvár believe that rural Midwest towns and Dunaföldvár are similar enough structurally to make U.S. precedents meaningful and instructive.

In a February 2010 trip, a public delegation from Dunaföldvár and Tolna county met with elected officials from two communities in Minnesota that host ethanol facilities similar to the Project, and as a result the delegation voiced the belief that the Project would likely have very similar impacts to those described in academic research such as Urbanchuk 2008 (see the chart above with the column for 50 MGY, which is the size of the Project). Please note that the Project would have a higher proportion of local spending and provides a greater number of direct jobs than shown in the chart above of typical U.S. ethanol plants.

3. Human Safety

The Project will be subject to strict European standards for occupational safety, supplemented by the Project's operating manuals, which represent U.S. best practice in operating similar ethanol facilities. Accordingly, occupational safety risks should be minimized from the very beginning of Project operation. There should be no, or almost no, lost time accidents if the operating manuals are followed, and data from the United States suggests that ethanol facilities do not pose substantial occupation health risks.

The Project will be fenced, monitored by video cameras, and staffed by 24 hour security guards. As a result, the risk of unauthorized entry (e.g. by children) and resulting accidents is deemed minimized.

Pannonia's security guards will, at least initially, not carry firearms. Accordingly, risks from firearms are deemed minimized.

The Project will result in incremental increases in vehicle traffic due to (i) increased deliveries of corn to the Cargill facility, (ii) some potential deliveries of corn directly to the Project (in the case of off-spec corn), (iii) the carriage of ethanol tank containers from the Dunaföldvár rail station to the Project and back, and (iv) during construction, construction vehicles and equipment and deliveries of construction materials. Additional traffic due to employee commuting in passenger cars is not addressed here since it is a minor potential impact.

Each of these four uses will utilize Dunaföldvár's main traffic artery. The first use would also involve the use of the existing Cargill/Lukoil access road, while the remaining uses would utilize a new road being constructed by Pannonia just after the turn-off from Dunaföldvár's main road.

Pannonia has discussed road issues with the Dunaföldvár municipal government and commissioned GMZ Tervező és kivitelező Kft. to prepare a report on the existing Cargill/Lukoil access road, which report was issued in June 2010. GMZ determined that the road is currently suitable for the intended purposes of the Project, but made clear that traffic congestion issues need to be managed to avoid trucks or other vehicles parking on the access road.

Perhaps the largest human safety issue with respect to the Project concerns truck traffic, both from corn deliveries and loading operations at the rail station. Trucks delivering corn will be driven by third parties who will have no physical contact with Project staff as they will deliver corn to the Cargill facility and will need to comply with all health and safety procedures of the Cargill facility. Accordingly, the Project intends confirming Cargill's standards and procedures.

With respect to rail loading operations, it is intended that Pannonia will own 3-4 trucks for this purpose and employ their drivers directly. Accordingly, Pannonia is developing training, operational and procedural plans to ensure that such truck operations are conducted consistent with best safety and environmental practices.

The public of Dunaföldvár, Tolna County and Hungary have had multiple opportunities to learn about the Project and become involved in the permitting process for the Project. The Project has received national news coverage, and several community informational meetings have been organized (as required by applicable law). Except for the very first public meeting organized in Dunaföldvár in late winter 2010, which was attended by dozens of local residents, these meetings have had no attendees other than people required to be in attendance, and no citizen or public organization has protested (other than to ask critical questions) at any public meeting. To the best knowledge of Progressio, which has been in attendance at most of these meetings, there is no opposition to the Project at the Dunaföldvár or Tolna County levels, and there is in-principle opposition by one environmental NGO in Budapest that has written a critical letter but has never taken the effort to attend a Project meeting.

4. Health

Airborne dust is the mixture of solid and/or liquid particles suspended in air. Airborne dust can be divided into two groups depending on the size of the particles: particles of 10 µm circumference are called coarse particles which cannot find their way to the lower respiratory tract.

“Fine” dust particles that are smaller than 2,5 µm constitute the respirable fraction that can access the lower respiratory tract, the very small ones can even get into the alveoli. The $PM_{2,5}$ dust fraction is constituted of secondary aerosols, combustive byproducts, condensed organic or metallic particles, and it is responsible for the mutagenic effect and acidity of airborne dust.

The PM_{10} fraction contains particles from soil erosion, road erosion and industrial activities. Sources of emission connected to harmful effects to health are related to exhaust gases and coal heating. Inert dust carried by the wind is less harmful to health due to the larger size of the particles.

Health impacts from dust include reduced life expectancy due to the increased frequency of cardiovascular and respiratory diseases and lung cancer. Beyond increased mortality rates there is an increasing body of evidence that higher airborne dust concentrations increase the number of admissions to hospitals with cardiovascular and respiratory problems. Increased airborne dust concentrations also increase the rate of general mortality, and death due to asthma, chronic, non-specific respiratory disease, cardiovascular diseases and non-malignant lung illnesses. Scientific literature shows that air pollution from traffic (including airborne dust pollution) will increase the mortality of the population living in the vicinity of roads with intensive traffic due to illnesses of the cardiovascular and respiratory systems.

Nitrogen-oxides originate primarily from the combustion of fuel in vehicles, and also from energy production and heating. In the exterior, NO will quickly transform into NO_2 due to oxidative substances in the atmosphere. The level of NO_2 concentration is a marker of traffic induced air pollution. NO_2 and other air pollutants (airborne dust and ozone) are related in a very complex way, so that it is quite difficult to look at the separate effect of NO_2 in epidemiological research. The health effects of NO_2 are based primarily on the findings of animal tests.

Short-term, NO_2 has a corrosive effect on the skin and the respiratory system. Nitrogen-dioxide and its reactive derivatives will reduce respiratory functionality, and increase the risk of various respiratory symptoms. Inhalation of gas or steam may cause edema in the lungs. Exposure well over the limit can also cause death. Symptoms may appear with a certain delay.

Long-term, NO_2 may have an effect on the immune system and the lungs, and it may cause reduced resistance to infections. Animal tests suggest that it may also have a toxic effect on human reproduction.

The symptoms of short-term exposure start to show above a concentration of 5 ppm (= 9,5 mg/m^3) in healthy adults. According to WHO guidelines, an acute effect will appear in healthy adults at a very high concentration only (1 990µg/m^3); however persons with asthma and chronic lung illness may have a higher limit value, so that WHO, on the basis of clinical trials, suggests a one-hour limit of 200 µg/m^3.

The environmental and health effects of sulfur-dioxide have been known for long. Its primary source is the energy industry, coal heating and traffic on public roads. However, there has been a substantial reduction in its emission in recent years. SO_2 increases the risk of daily total mortality, also the risk of death due to cardiovascular and respiratory diseases, it also irritates the respiratory system, causes a contraction in the bronchia and reduced pulmonary functionality.

SO_2 is seriously irritating/disturbing for the eyes and the respiratory system. Inhalation of the gas may cause edema in the lungs. It may have an effect on the respiratory system causing an asthma-like reaction, reflex cramps in the larynx and respiratory paralysis. Exposure may lead to death. Symptoms may appear with a certain delay. Longer term or repeated exposure through inhalation may cause asthma.

The symptoms of short-term exposure first appear at a concentration of 5 ppm (= 13 mg/m^3) in healthy adults.

CO enters the atmosphere from the imperfect combustion of fossil fuels, from power plants, traffic and general heating by the people. Metallurgy, the oil industry, chemical industries and silicate industries are also main sources of this pollutant. Tobacco smoke and interior gas combustion are also important sources.

CO is extremely toxic for humans and animals alike. If inhaled, it attacks on two main paths. One is the hemoglobin in the blood, to which it attaches and thus repels oxygen. Hemoglobin transforms into CO-hemoglobin, which causes shortage of oxygen in the nervous system and heart muscles. The other point of attack is the subcortical centers of the brain. No acute poisoning can happen in the open. Carbon-monoxide will not stay in the body in clean air.

Short-term, CO may have an impact the blood, the cardiovascular system and the central nervous system. Larger exposure may cause reduced mental functions and death. Long-term, CO may have effects on the cardiovascular system, the nervous system, and may cause problems with nervous system and cardiac functioning. It is assumed to also have an adverse effect on reproduction: it may cause disturbances in the nervous system, low birth weight, irregular heart development and higher frequency of stillbirths.

The symptoms of short-term exposure first appear above a concentration of 113 ppm (= 132 mg/m^3) in healthy adults.

On the basis of the WHO guideline document on the quality of air we know that the limit for carbon-monoxide is defined with the Coburn-Foster-Kane exponential equation, which calculates with all physiological effects that can be caused by CO. WHO has defined this exposure value such that the relevant concentration does not cause any pathological changes in healthy individuals.

- 100 mg/m^3 15 minutes
- 60 mg/m^3 30 minutes
- 30 mg/m^3 1 hour
- 10 mg/m^3 8 hours

The following table is a summary of all air pollution expected to caused by Project operations. When assessing the figures, we consistently used the worst case scenario with the highest pollution levels within hourly spreading (actual values will be lower than this during live operation).

Emmission air pollution totals (µg/m^3)

	CO	NO_X	SO_2	EtOH	TSPM
Baseline	496.5	29.1	4*	500**	22.4
Emission from transport, machinery	145.6	12.6	3.52	0	15.12
Spreading model	6.66	6.66	2.33	16.8	22.44
Total	***648.76***	***48.36***	***5.85***	***516.8***	***59.96***
LIMIT VALUES (HOURLY)	***10 000***	***200***	***250***	***5000***	***200***

*Determined with exaggerated estimates according to relevant legal requirements

It was demonstrated above what is the presence of air pollutants and what effects can these air pollutants have on the health of humans if they are exposed to them for shorter or longer terms or repeatedly. In order to protect the health of citizens, limit values were set for certain pollutants in the Decree 14/2001. (V. 9.) KöM-EüM-FVM.

Article 2. In the context of the Decree

a) for air pollution

aa) health limit: means the level of air pollution defined according to the current state of scientific knowledge that does not cause any long term health damage, and which shall be complied with as and within the term defined in this Decree in order to protect the health of humans.

Priority air pollutants

Air pollutant [CAS number]	Limit [µg/m^3]				
	hourly		24 hours	annual	
	limit	tolerance		limit	tolerance
Sulfur-dioxide [7446-09-5]	250 not be exceeded more than 24 times during any calendar year	50% which is to be reduced by equal parts from 1.1.2001 to reach 0% by 1.1.2005	125 not be exceeded more than 3 times during any calendar year	50	
Nitrogen-dioxide* [10102-44-0]	100 not be exceeded more than 18 times during any calendar year	50% which is to be reduced by equal parts from 1.1.2001 to reach 0% by 1.1.2010	85	40	50% which is to be reduced by equal parts from 1.1.2001 to reach 0% by 1.1.2010
Nitrogen-oxides (incl. NO_2)	200		150	70	
Carbon-monoxide [630-08-0]	10 000		5 000**	3 000	
Airborne dust (PM_{10})		50 not be exceeded more than 35 times during any calendar year	50% which is to be reduced by equal parts from 1.1.2001 to reach 0% by 1.1.2005	40*	20% which is to be reduced by equal parts from 1.1.2001 to reach 0% by 1.1.2005
Ethyl alcohol 64-17-5	5 000	-	5 000	-	-
Hydrogen-chloride 7647-01-01	20	-	5	-	-
Hydrogen-fluoride 7664-39-3	20	-	10	-	-

The limits included in the Decree were determined on the basis of the WHO guidelines. WHO set their limits on the basis of the findings of clinical trials. The trials included humans and other species as well. The effects of short and long term exposure was researched not only for healthy humans but also for more at risk groups of society (children, asthma sufferers). The limit was set relative to the time point when disease symptoms appeared.

WHO makes the following recommendations:

PM_{10}: 20µg/m^3 annual limit
50 µg/m^3 24 hour limit

NO_2: 40 µg/m^3 annual limit

200 µg/m^3 1 hour limit

SO_2: 20 µg/m^3 24 hour limit
500 µg/m^3 10 minute limit

CO: 30 mg/m^3 1 hour limit
10 mg/ m^3 8 hour limit

Limit values are different for SO_2 only, which is attributable to the fact that the 2005 WHO guidelines already contain values based on the most recent research. The former 24 hour value, which is the same as the current Hungarian value (125 µg/m^3) was set on the basis of the lowest noticeable adverse effect level. The current value of 20 µg/m^3 was set according to the research results of the American Cancer Research Society and 12 towns in Canada. WHO does not set an hourly limit for SO_2.

International Chemical Safety Cards (ICSC) contain health risk effects for individual hazardous materials, and the peak concentration that is permissible in the air of a work environment. Hungarian legislation also includes a decree on the chemical safety of workplaces (Decree 25/2000. (IX. 30.) EüM-SZCSM), the purpose of which is to avoid the health and safety risks arising from exposure to hazardous materials.

For this purpose a short-term exposure level (STEL), a time weighted average level (TWA), and the maximum workplace concentration (MAK). These levels once again served the purpose of reducing the risk of health perils to the minimum, so that the risk of concentrations below these to cause any harm to health is slim. On the basis of calculated values it can be determined what the impact of the given air quality indicator will be on the inhabitants of the given area, i.e. whether the given level of air pollution is harmful to health or not.

Air pollution against the limit levels

Air pollutants		14/2001. KöM-EüM-FVM	WHO 2000	WHO 2005	Background pollution and emissions from the ethanol plant
SO_2	24 hours	125µg/m^3	125 µg/m^3	20 µg/m^3	
	hourly	250 µg/m^3	-	-	9.85 µg/m^3
	annual	50 µg/m^3	50 µg/m^3	-	
	10 min.	-	-	500 µg/m^3	
NO	24 hours	150 µg/m^3	270 µg/m^3	this pollutant is not included in the document	
	hourly	200 µg/m^3	-		48.36*0.7 µg/m^3
	annual	70 µg/m^3	30 µg/m^3		
NO_2	24 hours	85 µg/m^3	-	-	
	hourly	100 µg/m^3	200 µg/m^3	200 µg/m^3	48.36*0.3 µg/m^3
	annual	40 µg/m^3	40 µg/m^3	40 µg/m^3	
	8 hourly	-	120 µg/m^3	-	
CO	15 min.	-	100 000 µg/m^3	this pollutant is not included in the document	
	30 min.	-	60 000 µg/m^3		
	hourly	10 000 µg/m^3	30 000 µg/m^3		648.76 µg/m^3
	8 hourly	5000 µg/m^3	10 000 µg/m^3		
	annual	3000 µg/m^3	-		
PM_{10}	24 hours	50 µg/m^3	No limit is set as there is no dose that		

	annual	40 µg/m^3	would not cause any changes in the human body. Certain doses are associated with risk values.	

It can be stated in summary that the emissions resulting from the Project will contribute just fractions of the relevant limit levels. The limits set in the relevant law were determined according to the recommendations of WHO, so that the environmental and health risks of emission values that are much lower than those are reassuringly under the acceptable levels.

Because the Project will have almost no dangerous air emissions or water emissions, during operations, the Project is not anticipated to play any role, positive or adverse, on the local health situation. Moreover, it is expected that almost all employees will be hired locally or are living in towns within commuting distance of the Project.

However, during construction, there may be temporary immigration to Dunaföldvár. Most prospective Fagen subcontractors are headquartered within commuting distance of the Project, and so it is anticipated that their employees will also commute to the Project on a daily basis. However, approximately one dozen U.S. citizens, Fagen employees, are expected to be resident in Dunaföldvár or Budapest for one year to oversee construction. All of these individuals are expected to be male. If they are resident in Dunaföldvár, they could impact local health consistent with impacts at other construction sites around the world (the "men, money, movement and mixing" phenomenon).

However, given the facts that Hungary ranks high in international surveys of gender equality, Dunaföldvár is an hour away from one of Europe's largest cities, contraceptives are widely available and used, the socioeconomic situation in Dunaföldvár appears stable, and residents of Dunaföldvár travel widely within and outside the European Union, these risks are noted but Ethanol Europe does not at this time consider it warranted to include this concern in the Action Plan.

C. NATURAL ENVIRONMENT

1. Air

The EIA examined potential Project air pollution impacts from Project construction and from Project operation.

During construction, about 23,000m^3 of earth will be moved. Given the number and size of trucks and other equipment projected to be at the Site and typical wind conditions, the EIA concludes that construction emissions into the air from soils will be within tolerable levels and will have no adverse impact on Dunaföldvár's ambient air quality. Emissions from vehicles during construction are anticipated to be as set forth below.

Vehicle	Carbon monoxide CO	Nitrogen oxide NO_x	Sulphur dioxide SO_2	VOC (Ethanol)	Particle (Dust)
me.	mg / m ^{3}	mg / m ^{3}	mg / m ^{3}	mg / m ^{3}	mg / m ^{3}
Background	496.5 *	29.1 *	4 *	500 **	22.4 *
Machinery, transport vehicle	145.6	12.6	3.52	0	15.12
Modeling of spread	6.66	6.66	2.33	16.8	22.44
All	648.76	48.36	9.85	516.8	37.56

Limit	*10 000*	*200*	*250*	*5 000*	*200*

The following Table represents the typical point sources of the different envisaged technological phases.

Typical point sources of the envisaged technology (at worst case scenario)

	No.	EOV X EOV Y	Chimney height [m]	Exit gas temp. [K]	Wet volume flow rate [Nm^3/h]	Comp.	Relative output conc.* [mg/Nm^3]	Limit value (mg/Nm3)
Corn reception	P1	640088 165413	41.5	299	60522	solid matter	45	50
Mill	P2	640067 165392	41.5	303	28949	solid matter	45	50
DDGS cooling	P3	640173 165364	41.5	327	49028	solid matter	45	50
DDGS loading	P4	640109 165428	12	310	4613	solid matter	45	150
Gas washer	P5	639839 165452	25	283	9689	VOC	135	150
Power center	P6	639894 165375	30.5	420	163955	CO	90	100
						NO_x	90	100
						SO_x	31.5	35
						VOC	135	150
						solid matter	4.5	5

**Referred to dry gas volume flow rate and 3% O_2 content only for P6 point source, in compliance with the provisions of Decree 10/2003. (VII. 11.) KvVM.*

That table above shows that the Project has actual emissions exclusively during entry of the raw materials and drying of the DDGS.

The Project has no steady diffuse emission pollution sources.

Examining the transport activities in one hour duration during peak period, the following calculation parameters have been taken into account:

- 15 transport vehicles, proceeding with a speed of 20km/h, 0.5 hours of effective work;
- 5 work/power engines, proceeding with 10km/h speed, 0.5 hours of effective work.

On the above basis, the emissions of the Project due to transport activities are included in the following table.

Emissions of the transport vehicles serving the ethanol production technology

Vehicles	Pc	CO (g/h)	NO_x (as NO_2) (g/h)	SO_2 (g/h)	Particles (g/h)
Transport vehicles	15	3000	106.4	60	302
Work/power engines	5	735	216	30.5	86
Total	**20**	**3735**	**322.4**	**90.5**	**388**

Diffusion calculations have been performed for each main component emitted within the plant. Also one hour calculations under the most frequent meteorological conditions and annual

average calculations for the main components have been prepared. Comparing the resulting diffusion maps, we have evaluated the plant's impact on the air quality.

The transmission calculations have been performed in compliance with norms MSZ 21459 and MSZ 21457, for 3.0m/s wind speed and neutral air stability conditions. Consequently the exponent of the p wind profile equation has been established in 0.27. The point sources have been assumed as continuously operating during the annual diffusion calculations. The terrain has been considered as homogeneous in compliance with the surface roughness parameter, estimated to be of 1.0m.

Parameters of the point sources – height, diameter exit gas rate, temperature, emission – are detailed in the table below. The locations of the point sources were taken into account with their own EOV coordinates, and also the diffusion concentration contour maps were plotted in the Uniform National Projection System.

Provisions of Govt. Decree 21/2001. (II. 14.) have been observed while defining the limits of the air quality impact area.

The legal rule applies three definitions for the determination of the direct impact area of an air polluting source. From among them, in each case the largest area will be considered as the concerned impact area.

During calculations, all of the three conditions have been examined for determining the impact area:

a) The area defined by concentration values exceeding 80% of the one hour maximum value;
b) The area defined by concentration values exceeding 10% of the one hour air pollution limit value;
c) The area defined by concentration values exceeding 20% of the loadability limit (loadability: difference of the air pollution limit value and of the basic air pollution value).

During annual diffusion calculations, items a) and b) are not interpretable, therefore, in such cases we have proceeded according to item c). Based on the thus performed calculations, no interpretable and delineable impact areas resulted for any of the components.

STUDY AREA

In the case of the calculations concerning short duration (one hour average under the most frequent meteorological conditions), for the components only the definition as to item a.) leads to an interpretable impact area.

Of course, the definition as to a.) provides in all cases interpretable impact area concentration values, therefore this has been performed and also figured for each component.

When representing the impact areas, due to the different spatial emissions by

components, we have also displayed the impact areas by components. From among these areas, the largest resulting area has been taken into account as impact area.

In our case this means a circle of 1125 m radius according to definition a.) for nitrogen oxides, carbon monoxide and sulphur dioxide as set forth in the map above.

Also the long term transmission calculations in compliance with the annual average meteorological conditions have been performed.

The following boundary conditions have been established for the model:

- calculation of annual average concentration,
- application of dispersion parameters relating to countryside areas,
- calculation of additional chimney height,
- plain ground.

The following meteorological parameters have been taken into account:

- annual mean temperature: 10°C,
- thickness of the average mixing layer: 600m
- annual wind direction frequencies as specified in Figure 1,
- atmospheric stability values according to Pasquill categorization, represented in Figure 2.

Annual distribution of the Pasquill stability categories was taken into account during our model calculations.

The diffusion patterns have been presented on a map by help of a geographic information system.

The following tables explain the system of conditions for the impact area determination.

Represented impact area	**NOx**		
	Annual limit value	70	µg/m^3
	One hour limit value	200	µg/m^3
	Impact area		
X	a.)	6.66 *0.8=5.33	µg/m^3
-	b.)	200*0.1=20	µg/m^3
- -	c.)	(70-21)*0.2=9.8 :annual (200-60)*0.2= 28:hourly	µg/m^3

Represented impact area	**CO**		
	Annual limit value	3000	µg/m^3
	One hour limit value	10000	µg/m^3
	Impact area		
X	a.)	6.66 *0.8=5.33	µg/m^3
-	b.)	200*0.1=20	µg/m^3
- -	c.)	(70-21)*0.2=9.8 :annual (200-60)*0.2= 28:hourly	µg/m^3

Represented impact area	**SO_2**		
	Annual limit value	50	µg/m^3

	One hour limit value	250	µg/m^3
	Impact area		
X	a.)	2.33*0.8=1.87	µg/m^3
-	b.)	250*0.1=25	µg/m^3
- -	c.)	(50-5)*0.2=9 (250-25)*0.2=45	µg/m^3

Represented impact area	Airborne dust		
	Annual limit value	50	µg/m^3
	One hour limit value	200	µg/m^3
	Impact area		
X	a.)	12.24*0.8=9.79	µg/m^3
-	b.)	200*0.1=20	µg/m^3
- -	c.)	(50-20)*0.2=6 (200-80)*0.2=24	µg/m^3

Represented impact area	Ethanol		
	24 hour design guidance value	5000	µg/m^3
	One hour guidance value	5000	µg/m^3
	Impact area		
X	a.)	16.8*0.8=13.44	µg/m^3
-	b.)	5000*0.1=500	µg/m^3
-	c.)	(5000-500)*0.2=900	µg/m^3

The following Table represents the maximum hourly emission concentrations due to the operations within the project site, based on overestimates (as the peak emission concentrations of the traffic and of the point emission sources are not coinciding in the space).

Excess loads due to imissions from the activities during operation

Vehicle	Carbon monoxide CO	Nitrogen oxides NO_x	Sulphur dioxide SO_2	VOC (ethanol)	Particles (airborne dust)
Unit	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
Background load	496.5*	29.1*	4*	500**	22.4*
Work machines/ transport vehicles	145.6	12.6	3.52	0	15.12
Diffusion modeling	6.66	6.66	2.33	16.8	22.44
Total	**648.76**	**48.36**	**9.85**	**516.8**	**37.56**
Limit value	***10 000***	***200***	***250***	***5 000***	***200***

*Measurement results: 2006, Dunavecse
**Background load index

By this calculation method the expectable concentration had been overestimated. Therefore, it may be stated with high confidence that the above overestimated expectable loads are within the limit values specified in Annex 1.1 of joint Decree 14/2001. (V. 9.) of the Ministry of Environment, Ministry of Health and Ministry of Agriculture and Rural Development; the impact thus exercised is qualified as tolerable.

Based on the impact area determination, it may be established that the largest area results for nitrogen oxides, carbon monoxide and sulphur dioxide in short period, according to definition

as to item a). The impact area thus resulting represents the same 1125m radius circular area**.**

Performing emission measurements once in a year for point sources P1 – P5 and twice in a year for P6 point source is justified. Diffusion modeling demonstrates only a small load to the environment. Performing emission basic condition survey is justified. Performance of measurements twice a year (in winter and in summer) is justified in the first 3 years of operation. If the results of the diffusion modeling are validated, no more emmission measurements will be needed.

The Project will also contain a Continuous Emissions Monitoring System (CEMS), which the Project will use to constantly check air emissions in addition to the periodic checks which will be performed by the environmental authority.

With respect to potential impacts during decommissioning, demolition of any type of building in Hungary requires a permit which means that actual impacts would be assessed at the relevant time. However, based on currently available information, emissions resulting from decommissioning would likely be close to levels from construction.

Finally, air impacts connected to the Project's rail operations will be conducted in accordance with all applicable laws, and the Project has received a letter from the Hungarian state railway company confirming that the proposed operations will not give rise to any issues at the rail station. The rail impacts are minimal enough that neither the Project nor Transpetrol require any permit in order to use the rail station as anticipated.

2. Soil

The Project should have no impact to the surrounding soil areas. Contamination of the soil layers below the humus-containing top layer is not expected in the operation period, due to the high technical level of the activity and public utility supply of the area.

However, due to the space occupation of the establishments implemented during the construction period, the land remains unable to provide its natural functions, therefore – applying overestimation – the impacts on soil are qualified as constituting load.

The rail station loading areas are not anticipated to be equipped with containment areas in the event of an ethanol spill, but after review this has been deemed to be acceptable due both to the fact that an ethanol spill would not pose a risk to groundwater (since Project ethanol will not be denatured) and because the minimal nature of the loading and unloading operations and the nature of the sealed ethanol storage tanks effectively mitigates the risk of a spill.

3. Groundwater

Prior to any actual testing, consultants recommended having four water wells, only two of them installed on identical depth ranges, with 100m and 150m or 150m and 200m bottom depth.

If an aquifer of sufficient thickness is present, the required water quality could be obtained with the help of two well pairs (1+1 of 100m and 1+1 of 150m depth). It would be reasonable to locate the well pairs apart, at the borders of the ground-plot.

For assessing the water extraction's impacts, a simplified model was prepared. The model predicted a water table decline due to the envisaged water withdrawal of 3,000m^3/day of 14m in the vicinity of the wells and of 0.5m at a distance of 1,150m.

The water-bearing sand layers are separated by rock dust containing, muddy and argilleous layers from each other. The efficiency of separation, that is the water seal is not complete: these separating muddy and argillaceous layers operate as water barrier only for a short time period and up to a certain difference in pressure; what more, they are not homogeneous. Therefore, leakage to the sites of production sand layers (depressed through pumping) starts (to the well) not only laterally, within the layer concerned, but – subject to the pressure difference – also from upstairs, through the muddy and argillaceous layers (from the shallow aquifers and from the groundwater).

It is easy to understand that vertical leakage is much less and slower than the lateral one, consequently the **indirect impact** area, where effects of the water extraction could be sensed above the production layers in the shallow aquifers and groundwater-bearing layers (water level degradation) remains within the direct impact area. Its dimension will be biggest near the wells and will depend on the actual depression required for the production of the required water yield. This will be quantifiable on the basis of the exploratory well's factual data.

Estimation of the **direct impact area** has been made by a simplified hydraulic model generated through consideration of the data contained in Sections 2.1 and 2.2, by the help of a PMWIN (Processing Modflow for Windows) application.

As horizontal filtration coefficient for the groundwater-bearing layer the average value of 0.7m/day applicable to coarse silt (loess), while for the aquifers exploited by wells an average value of 1.8m/day has been taken as basis.

In the expectation of long term operation, the area concerned by water level degradation of at least 0.5m in the exploited layers may be approximated by an ellipse having a major axis of 2250m and a minor axis of 2150m.

Within the space concerned, there is a single approved subsurface water usage, namely the well of the asphalt mixing plant of Vegyépszer Építő és Szerelő Zrt. (depth: 105m, filtering between 80 and 86m) with allowed water withdrawal of 1m^3/day. Here the estimated water level degradation is between 1 and 2m. No data are available on the well's actual standing and operational water level, but the actual data have to be measured on the site – as initial data and basic condition assessment – for the detailed modeling to be attached to the water withdrawal's water right implementation permit application.

The direct impact area does not concern any other allowed water usages.

The wells of settlement's water works have no designated protective zone; the border line of the bioethanol plant's estimated direct impact area is at about 1000-1200m distance from the location of the waterworks' wells.

The **indirect impact area** concerning the groundwater bearing layer and the shallow aquifer remains within the direct impact area.

In knowledge of the above explained facts, the possible consequences of the effects from deep groundwater withdrawal can be summed up as follows:

- In the case of the existing water withdrawals, operating water level deeper of the actual one may be required for the production of the previous water yield. This requires relocation of the submersible pump at a deeper level and implies additional energy consumption (in an extreme case, when the pump is hardly able to perform the actual pressure need, even replacement of the pump may be necessary).

- As already mentioned above, there is a single licensed water withdrawal site within the pre-estimated impact area; its present parameters (actual stationary water level, working water level, operating water yield, well structure, type, characteristics and depth of installation of the submersible pump) have to be measured and used for the detailed modeling and survey. In order to avoid future discussions, it would be reasonable to involve the well into the monitoring, perform or make perform regular observations also during the future operation of the bioethanol plant. It seems to be reasonable to come to an agreement with the owner in this respect.

- In the indirect impact area located within the direct impact area, degradation of the groundwater level is to be expected, at an extent decreasing with the increase of distance from the axis of water withdrawal. Of course, the biggest degradation will occur within the bioethanol plant requiring attention in soil mechanical respect: during foundation planning of the building parts implying serious load, the permanent dewatering has to be taken into account; the load bearing layer and the method of foundation have to be selected in compliance therewith, taking into account the groundwater conditions developing in the future. (The exact quantitative data from the detailed survey of the water withdrawal effects will be available already at that time.)

- Any degradation of the groundwater level beyond the plant area to the N or NW of the property does not impair the condition of the existing foundations: due to the higher relief, the groundwater level has been already deep, at 10-15m even until now.

- From among agricultural land uses, forest, wine culture and fruit farming could be concerned by the effects of the groundwater degradation, because, due to the groundwater table being already located too deep, water resources stored in the soil could be taken into account – beyond watering – for other cultures even until now. The envisaged usage of the areas concerned is anyhow industrial park.

- Through implementation and operation of the monitoring system to be implemented in compliance with the preliminary water rights permit, and through evaluation of the data obtained, the actual water level degradations will be traceable and predictable. This grants sufficient safety also for the neighboring water usages (even those located farther off), as the extent of water withdrawal could be limited in extreme necessity and the pressure levels may recover through decreasing any production that proves to be excessive.

An exploratory well was drilled at the Site in May 2010, and the well has been continually pumped since then. There has been ongoing monitoring of the flow rate, water chemistry and temperature as well as the standing and operating water levels. The test well was drilled to a depth of 200m and in rough accordance with the desk study identified two strata from which adequate volumes of water could be extracted, one at a depth of 85-100m and another at

roughly 180m. From the initial results it was decided to develop the strata at 85m depth. The temperature of the water in this layer is stable at roughly 16°C whereas the temperature of the deeper layer is 24°C. Since the overwhelming discharge volume of the plant is simply recycled cooling water and since the maximum permitted outflow temperature under the IPPC is 30°C there is clearly less impact from extracting a smaller volume of lower temperature water. This has provided factual data, beyond the exact stratification, also on the sand layers' coefficient of permeability, the volume of recharge and on the hydraulic relationship between the superimposed layers. These factual data, through detailed modeling, will allow unequivocal quantification of the scenario presumed in the actual forecast; thus, also the direct impact area will be exactly determined and the data obtained from the exploratory well will determine the location of the monitoring wells required for monitoring the environmental impacts. It is anticipated that the final test well analysis results will be available by the end of June 2010 and a decision will be taken at that time on the number and location of the final production wells in compliance with the Project's preliminary water use permit.

4. Surface Waters

Almost no process waste water is generated by the Project, as "contaminated" water from the processes is re-circulated and reused.

It is envisaged to send the high saline content blow-down water produced in large volume due to the technology, into the Danube, through the Cargill/Agrograin plant. The quantity of the water outlet will be of 780m^3/day on average, with a peak discharge volume of 1000m^3/day.

The quality of the waste water remains within the limit values specified in Decree 28/2004. (XII. 25.) of the Ministry of Environment and Water on the national regional emission limit values of the waste waters directly discharged into surface reception waters. No process-specific limit value is to be established for bioethanol technology, because no waste water discharge occurs from the water-saving production technology.

Recommended limit values for the Danube outlet point (for typical parameters)

Component	Limit value
pH	6-9.5
Salt content	7 000mg/l
Temperature	30ºC

The environmental impact of the water discharged is de minimis taking into account the Danube's stream flow of 2,000,000 to 28,000,000m^3/h. The dilution ratio is 2,400-times (calculated with half of the Danube's minimal water stream).

With regard to the high dilution rate, implementation of a special monitoring system is not necessary. The quality of the water to be drawn is still not known; therefore the salinity of the blow-down waters has been taken into account, constituting overestimation.

In the factory building, energy center and dryer drain holes and collecting shafts will be implemented. All escaped waters (including cleaning water) will be entirely re-circulated to the beginning of the technological process at the mash tank.

Containment shafts and surfaces of the outdoor tanks: all escaped waters and rain waters will be re-circulated into the technological process.

Any local process leakages (at the ethanol tanker loader) from the ethanol loading station will be collected from the inclined surface through the discharge hole (passing through an oil and sediment trap) to the containment facility of the tank farm.

As far as the Ethanol tank farmis concerned, it is of a properly dimensioned capacity, recessed containment platform with continuous HDPE plastic plate insulation covering the entire surface. As required by best practice it is sized to accommodate spillages of up to 25% of the entire storage volume or 110% of the volume of the largest tank plus a safety margin for firewater etc. Any leakages and precipitation waters from here will be recirculated into the process or, in case of smaller quantities, evaporated. (Otherwise, if precipitation waters accumulate in excessive quantity, upon sampling and registration, the excess will be pumped into the storm-downpipe through an oil-trap. It may also be used for watering.) The ethanol storage tanks are leak proof metal tanks specially manufactured for this purpose and will have a floating roof.

Certain tanks designated for storing raw materials (e.g. sulphuric acid) will be equipped with independent water-proof concrete containment basins. Leakages, escaped materials or rain waters accumulated here will be –if necessary – gathered and removed for disposal by freighters authorized to transport dangerous materials or recirculated into the process (including generated or residual rain waters).

Also sealed containment shaft will be constructed for gathering oil-containing leakages originated in the maintenance building. Leakages from here will be removed by freighters authorized to transport dangerous materials.

Precipitation waters from the general parking surfaces will be discharged through a appropriate sand trap and oil separator. They will be discharged into the Danube by a properly dimensioned rain pipe through the adjacent Cargill plant. (Modification of the water right permit will be necessary.) Precipitation waters of the normal road surfaces (not used for parking) will be directly discharged into the rain-pipe system.

At present, no sewage network is still implemented in the vicinity of the development area, therefore collection and disposal of any generated waste waters has to be resolved by the plant operator.

For collecting communal waste waters, the sewage network will be built out to connect to the existing trunk pipeline alongside Main Road 6. The volume of the generated communal waste water amounts to $9m^3$/day.

Rainwater from the buildings' roofs, roads and green surfaces is to be discharged, where no oil contamination occurs, to green surfaces. It is partly desiccated there. Any residual rainwater will be discharged through gullies located at the deepest points of the green surfaces into a closed channel system.

Rainwater from surfaces, where contamination with oil products is probable – parking lots, loading stations – will be discharged into the channel system through an oil trap. The channel discharges the waters thus collected into the storm-sewer previously implemented on the adjacent ground-plot of Cargill, discharging the collected waters into the Danube. The sewer system of Cargill is provided with permits of KDT KTVF (The Middle Transdanubian Inspectorate for Environmental Protection, Natural Protection and Water Management)

(implementation: Application No.: 18379/2006, File No.: 82289/2006; operation: Application No.: 6419/2007, File No.: 52322/2009, water registry No.: 72/8004-17065).

In summary, it may be established that, if proper technological discipline is maintained, neither surface nor sub-surface waters are endangered within the Project area during the operation period.

During the operation, no loading of the surface or sub-surface waters occurs, the impacts will be considered as tolerable.

The size of the impact area will be the surface segment of the area delineated by the contour line of the water table depression of 0.5m caused by water extraction.

Due to the technical design of the different establishments, the operation of the technology implies minimal environmental risk; the 3 monitoring wells to be implemented provide sufficient information of any environmental pollution.

Regular measurement (every three months) of the following components is justified in the monitoring wells:

- pH,
- Conductivity,
- Salinity,
- Ammonia-ammonium-nitrogen,
- Nitrate,
- Sulphate
- TPH

Sampling and measurements at the monitoring sites will be performed by an accredited, duly authorized professional company.

Testing of the discharged used waters is envisaged at two self-checking sites:

1. At the point of cooling water discharge into the sewer system,
2. At the point of delivery to Cargill.

On the above basis it may be established that the operation will not imply any load impacts either to the surface waters or to the subsurface waters, therefore the impact is classified as tolerable.

5. Noise

The EIA determined that the increase in ambient noise for the nearest Dunaföldvár residents will be in the range of 0.1 db to 0.4 db, which it labels as insignificant. Progressio has identified no problem with the methodology of the testing nor any reason to be concerned about the accuracy of the results.

In compliance with the preliminary plans, the following main groups of noise sources are expectable. The typical noise output levels are based on evaluation of Pannonia's data and on examination of the conditions implying the highest noise load.

Main noise source groups

Noise source group	
Description	**Estimated noise output level, $L_{WAi(eq)}$(dB)**
Storage entry, conveyor system	95
Mill	105
Fermentor	100
Saccharification, dehydration, distillation	95
Drying, air handling system	105
Ethanol extraction system	101
Finished product storage	90
DDGS cooling, storage	100
Cooling tower	92
Water treatment	100
Boiler house	90
Turbine	100
Transport traffic within plant	95
Passenger car parking lot	65
Office building (central cooler)	85
Maintenance building ventilation	80

Calculations have been performed in compliance with norm MSZ 15036:2002. From among the correction factors, we have taken into account the air absorption, the soil/meteorological effects, the acoustical reflection from vertical surfaces and the partial noise shielding effect of the buildings within the plant. We have calculated with -5dB in case of fully shielded and with -3dB in case of partially shielded noise sources.

Point of calculation: before the E front of the residential houses at Hunyadi tér 2-3.

Noise source description	Noise output level, dB(A)	Equivalent height, m	Distance from the theoretical border of the residential area, m	Corrections, dB					10.log(D)	L_{Aeqi},dB
				K_d	K_h	Kt-m	Ká	K_l		
Storage entry, conveyor system	95	20	700	-67.9	2	-4.3	-3.0	-1.3	0	20.5
Mill	105	10	700	-67.9	2	-4.5	-3.0	-1.3	0	30.3
Fermenter	100	10	410	-63.3	2	-4.3	0.0	-0.8	0	33.7
Saccharification, dehydration, distillation	95	10	480	-64.6	2	-4.4	0.0	-0.9	0	27.1
Drying, air handling system	105	10	500	-65.0	2	-4.4	0.0	-1.0	0	36.7
Ethanol extraction system	101	5	700	-67.9	2	-4.6	-3.0	-1.3	0	26.1
Finished product storage	90	10	700	-67.9	2	-4.5	-3.0	-1.3	0	15.3
DDGS cooling, storage	100	10	730	-68.3	2	-4.5	-3.0	-1.4	0	24.8
Cooling tower	92	5	600	-66.6	2	-4.6	-5.0	-1.1	0	16.7
Water treatment	100	4	600	-66.6	2	-4.6	-5.0	-1.1	0	24.7
Boiler house	90	5	500	-65.0	2	-4.6	-3.0	-1.0	0	18.5
Turbine	100	4	490	-64.8	2	-4.6	0.0	-0.9	0	31.7
Transport traffic within plant	90	1	400	-63.0	2	-4.7	0.0	-0.8	3	26.5
Passenger car parking lot	65	0.5	320	-61.1	2	-4.7	0.0	-0.6	3	3.6
Office building (central cooler)	85	1	330	-61.4	2	-4.7	0.0	-0.6	0	20.3
Maintenance building ventilation	80	5	410	-63.3	2	-4.5	0.0	-0.8	0	13.4

Aggregate value: L_{Aeq} = 40.7dB

Point of calculation: before the NE front of the residential houses at Felsőfok utca 2-6.

Noise source description	Noise output level, dB(A)	Equivalent height, m	Distance from the theoretical border of the residential area, m	Corrections, dB					10.log(D)	L_{Aeqi},dB
				K_d	K_h	Kt-m	Ká	K_l		
Storage entry, conveyor system	95	20	650	-67.3	2	-4.2	-3.0	-1.2	0	21.3
Mill	105	10	650	-67.3	2	-4.5	-3.0	-1.2	0	31.0
Fermenter	100	10	500	-65.0	2	-4.4	0.0	-1.0	0	31.7
Saccharification, dehydration, distillation	95	10	510	-65.2	2	-4.4	0.0	-1.0	0	26.5
Drying, air handling system	105	10	520	-65.3	2	-4.4	0.0	-1.0	0	36.3
Ethanol extraction system	101	5	500	-65.0	2	-4.6	0.0	-1.0	0	32.5
Finished product storage	90	10	500	-65.0	2	-4.4	-3.0	-1.0	0	18.7
DDGS cooling, storage	100	10	650	-67.3	2	-4.5	-3.0	-1.2	0	26.0
Cooling tower	92	5	550	-65.8	2	-4.6	-3.0	-1.0	0	19.6
Water treatment	100	4	500	-65.0	2	-4.6	-3.0	-1.0	0	28.5
Boiler house	90	5	450	-64.1	2	-4.5	0.0	-0.9	0	22.5
Turbine	100	4	450	-64.1	2	-4.6	0.0	-0.9	0	32.5
Transport traffic within plant	90	1	420	-63.5	2	-4.7	0.0	-0.8	3	26.0
Passenger car parking lot	65	0.5	560	-66.0	2	-4.7	0.0	-1.1	3	0.0
Office building (central cooler)	85	1	560	-66.0	2	-4.7	0.0	-1.1	0	15.3
Maintenance building ventilation	80	5	450	-64.1	2	-4.5	0.0	-0.9	0	12.5

Aggregate value: L_{Aeq} = 41.1dB

Noise load limit values in compliance with Annex 1 of Decree 27/2008. (XII. 3.) KvVM-EüM:

No.	Area to be protected from noise	Limit value (L_{TH}) for L_{AM} evaluation level* (dB)	
		Daytime 06-22	Nighttime 22-06
1.	Recreation area; from among the special areas: health sites	45	35
2.	Residential areas (of small town-garden-city-, village- or estate-like design); from among the special areas: sites of the educational institutions, cemeteries, green areas	50	40
3.	Residential areas (of metropolitan-like design), mixed purpose areas	**55**	**45**
4.	Economic areas	**60**	**50**

According to the calculations, compliance with the noise load limit values is expected.

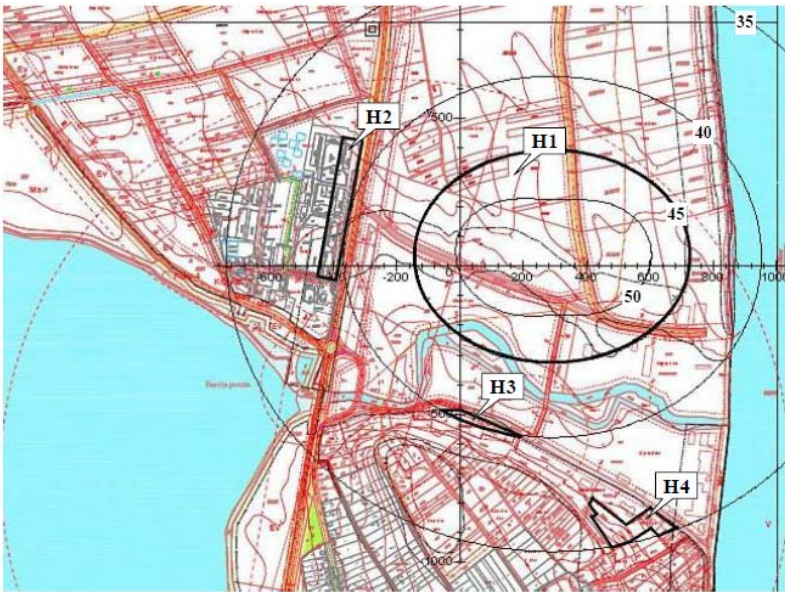
During preparation of the construction plans, the necessity of the following technical measures is to be deliberated through involvement of an acoustic expert:

- Provision of noise screening covers (shields) for the climatic and air conditioning systems to be installed on the buildings' roofs;
- Installation of sound dampers into the inlet and outlet apertures of air ducts of high volumetric flow rate;
- Avoiding, if possible, any apertures without acoustic treatment (free apertures) in buildings with high internal noise level (e.g. mill), opening towards the residential buildings;
- In the case of transport lines with high internal flow rate and friction, installation of a double shell may also be necessary.

The chart below represents the equal-loudness curves L_{Aeq} (dB), with informative character.

H1 impact area – business zone without building to be protected (L_{Aeq} = 45 dB)

NOISE ZONES



H2 impact area – mixed character area (L_{Aeq} = 35 dB)

H3 impact area – business area with buildings to be protected (L_{Aeq} = 40 dB)

H4 impact area – mixed character area (L_{Aeq} = 35 dB)

Upon examining the basic conditions it could be established that the maximum expansion of the impact area as defined by Article 6 of Govt. Decree 284/2007. (X. 29.) is determined by the following values:

- to the West: L_{Aeq} = 35dB
- to the North: L_{Aeq} = 45dB
- to the East: L_{Aeq} = 45dB
- to the South: L_{Aeq} = 40dB

The calculation diagram allows establishing that:

- the impact area reaches the residential area to the W and to the S
- it may slightly extend to (non economic purpose) areas beyond the project area.

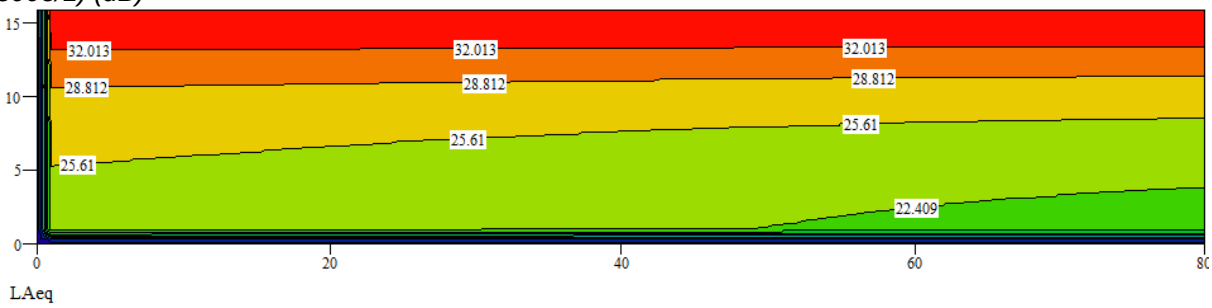
We have examined in detail the noise load charging the partially screened buildings of Hunyadi tér (hrsz: 5003/1, 5003/2) to determine whether such buildings are located within the impact area.

We have taken into account two typical sound propagation paths:

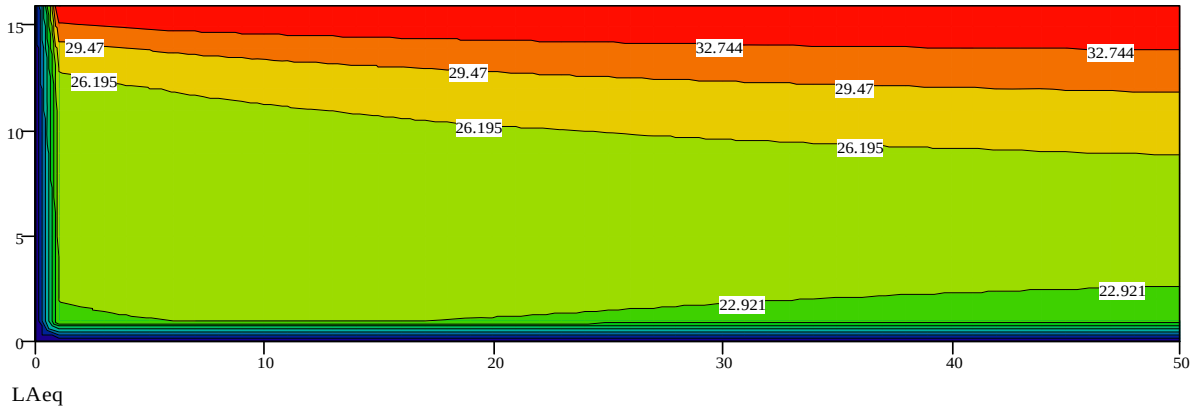
- The first one is the acoustic field partially screened by the buildings along road No. 6 (hrsz. 5003/3, 5003/);
- The second one is the acoustic field generated by the aperture between buildings hrsz. 5003/3, 5003/ 51, as hypothetic radiation surface.

Graphical display of the acoustic field produced is shown in the following Figures.

Noise load of the E front of the residential building of GF+4 floors under Hunyadi tér 4. (hrsz.: 5003/1) (dB)



Noise load of the S front of the residential building of GF+4 floors under Hunyadi tér 3. (hrsz.: 5003/2) (dB)



The most important result deriving from the calculations is that the noise load calculable in the height of the buildings' critical point (h ≈14.5m) does not attain the L_{Aeq} = 35 dB value defining the maximum extension of the impact area. The building of hrsz: 5003/1 (at Hunyadi tér 4.) is located already beyond the impact area. However the non-protectable (E) front of building 5003/2 (Hunyadi tér 3. wall number) is reached by the impact area.

The following estimates may be given in respect of the destination traffic connected with the envisaged operation on the basis of the actually available data:

- corn supply: 35 trucks/day
- raw material supply: 2 trucks/day
- bioethanol delivery on public road: 8-10 trucks/day
- DDGS delivery on public road: 8-10 trucks/day

Total increase of the destination transport traffic: 50-60 trucks/day – in daytime.

The additional daily load concerning main road 6 of 60 trucks/day amounts, under the same parameters specified at the description of the actual conditions:

$L_{Aeq}(7.5)$ = 56.4-59.4 dB– subject to the angle of vision

The order of increase of 0.3-0.6dB – negligible.

Partial transport activities may also occur on roads Nos. 61 and 6228. Assuming a daily traffic of 15 trucks on each of them:

The order of increase of 0.1-0.3dB – negligible.

Some ethanol and DDGS will be shipped on the Danube. Ttransport on the Danube occurs on 1100-1300MT capacity barges, implying a 50-times specific transport capacity compared to trucks (1 to 2 barges daily). The traction power is about 1000HP, with an estimable noise output level of $L_{WA} \approx$ 105-110dB.

Calculation of the noise load is made by the following approximation formula:

$$L_{Aeq} = L_{WA} + 10 \cdot \log(N) + 10 \cdot \log(\int_{l} \frac{1/l}{x^2 + d^2} dx) - 8 + 0.5$$

Where 'N' is the number of transports relating to the estimation period, 'l' is the length of travel during 'T' estimation time (l = v*T, where 'v' is the rate of travel), 'd' is the distance between the axis of the road and the point of calculation (areas to be protected). The water surface is considered as sound-reflecting; other corrections are neglected.

Numerically:

In case of: L_{WA} = 110dB, d = 200m, v = 10km/h

L_{Aeq} = 38.8dB.

Noise load of the water transport is negligible, thanks to the low traffic and the high protection distance.

Upon analyzing the noise impacts of the envisaged project, we have established that:

- *Maintenance of the noise load (noise emission) limit values is expectable;*
- *The change of the noise load from the operation will be sensible in the residential area, but no remarkable disturbing effects are to be expected;*

- *The destination traffic of the site causes only an unimportant noise load increase in relation to that of the actual traffic.*

The noise load of the operation remains within the relevant limit values, its impact is tolerable.

The Project has not yet completed its evaluation of noise issues with respect to loading and unloading operations at the Dunaföldvár rail station. From equipment suppliers, Pannonia understands the both loading and loading are relatively quiet operations, and the primary noise issue would be in respect of use of a locomotive to bring, shunt or take away rail cars, in each case operations that would last a short period of time. Because the rail station was formerly actively used during better economic times, the situation with respect to noise is somewhat skewed in that the local community views use of the rail station as a positive development signaling community revitalization. Consultations to date with stakeholders (railway operator, rail station staff, and the Dunaföldvár authorities) have resulted in assurances that, given the information currently known, noise from rail station operations should not pose a problem.

The Project does not need to use the rail station often and has substantial flexibility in scheduling operations to target only certain parts of the day. In the event that operations at the rail station give rise to noise issues, Pannonia is confident that it will be able to restructure operations to mitigate the problem.

6. Solid Wastes

The Project will produce inert wastes, hazardous wastes and municipal wastes. During construction, it is estimated that the Project will produce five tons of concrete waste, 1-2 tons of asphalt waste, 2-3 tons of wood waste, 3-5 tons of scrap waste, 6 tons of plastic waste, and 30 tons of mixed construction waste, all inert wastes.

No process-related waste will be produced during operation of the bioethanol plant. The corn dust generated during dust separation following milling will be recycled into the production process. No husking residues are generated during the process, because the corn kernels will be supplied in cleaned quality, containing no wastes.

The DDGS (by-product) generated during the production process will be sold as animal feed.

Typical maintenance waste includes: spent oil, oily rags, oily condensates, storage batteries, residual paints and packaging materials, used air filter cartridges, oil filters, broken light tubes, dry batteries, metal scraps and communal waste.

Estimated process waste quantities

Waste type	Estimated annual quantity	Qualification	Treatment
TECHNOLOGICAL PROCESS WASTE			
-			
MAINTENANCE WASTE			
13 02 06* Spent oil	100kg/year	Dangerous	Incineration in waste burner
16 01 07* Oil filters	20kg/year	Dangerous	Depositing in dangerous waste disposal site
15 02 02* Oily rags	100kg/year	Dangerous	Incineration in waste burner

Waste type	Estimated annual quantity	Qualification	Treatment
TECHNOLOGICAL PROCESS WASTE			
13 05 02* Oily sludge from oil traps	30kg/year	Dangerous	Incineration in waste burner
15 02 02* Absorbing material for oils	400kg/year	Dangerous	Incineration in waste burner
15 01 11* Other mixed dangerous wastes (paint residues, packages)	Depends on maintenance work performed	Dangerous	Depositing in dangerous waste disposal site or incineration
05 01 01 Other mixed non-dangerous wastes (packaging materials)	Depends on maintenance work performed	Non-dangerous	Deposition in communal waste deposit

An on-site dangerous waste collection facility will be erected for gathering dangerous waste. The on-site waste collection facility's design will be in compliance with the technical requirements specified in Govt. Decree 98/2001. (VI. 15.).

Mowing waste generated on the green surfaces will be cut as necessary and mixed back into the soil for composting.

The principle of waste generation prevention or at least minimization has been kept in eye during planning of the ethanol production technology; therefore waste is only produced during the operation.

The measures envisaged during technology design for decreasing the quantity and dangerousness of the generated wastes include:

- Continuous maintenance, organization of trainings;
- Empties will be returned to manufacturers for refilling;
- As regards the materials to be used, materials have to be preferred that are suitable for the technological purposes but wastes generated from their utilization are not qualified as dangerous wastes.
- Through continuous monitoring of the purchases, registering the quantities of the wastes generated in compliance with the relevant provisions, the process may be well regulated and any necessary correction measures taken in due time.

The first step for preventing waste generation includes continuous control and analysis of the processes serving the technology. Continuous registration of the quality and quantity of the wastes generated allows definition of the system's points, where prevention of waste generation is justified.

Recording of the (dangerous and non-dangerous) wastes is made in compliance with the provisions of Govt. Decree 164/2003. (X. 18.). According to the legal provisions, Pannonia must prepares annual declarations regarding the wastes produced.

The impact of waste as an independent environmental factor is neutral in the operation stage

7. Biodiversity

The EIA found that the Site does not carry value in terms of nature protection or biodiversity and is best described as fallow agricultural land that had been cultivated for several centuries before the Site became part of a Soviet military base. The nearest national park is 18 kilometers from the Site

If the Project proceeds with its plan to landscape the Site after construction with native species, then the EIA concludes that the Project may even have a net benefit to biodiversity.

8. Cultural Heritage

As noted above, the relevant cultural heritage authorities in Hungary have provided their consent to issuance of the IPPC based upon both a desktop archaeological survey and ongoing excavations at the Site.

The Site excavations are scheduled to end in July and are now limited to only a portion of the Site and do not prohibit the start of construction on the Project.

During construction of the Project, a government archaeologist will need to be present for all excavation works. In the event that artifacts are found, these would need to be removed before plant construction could continue.

D. CONTINGENCY PLANNING

Through its Seveso II permitting process, Pannonia has evaluated various accident scenarios and their risk impacts on human health and safety, and measures to mitigate those risks. These are summarized below.

1. Air

In case of a fire at the plant, large quantities of air polluting substances may get into the atmosphere. Protection against such a contingency implies granting of sufficient fire water and fire water network; preparation of a fire protection plan is a legal requirement.

There is little probability of any large fire, if the above facilities and proper technological discipline are granted. The air polluting substances discharged to the atmosphere in case of a contingent fire will be diluted due to the almost steady wind direction, however pollutant concentrations over the hygienic limit values may be expected even in this case in the vicinity of the surrounding properties.

2. Soil

Due to improper operation, breakdown or accident of the motor vehicles and work machines, fuel may only spill onto paved surfaces. Soil contamination may therefore be excluded even if similar events occur.

Accidents may be prevented through observing the traffic rules applicable within the plant area and maintaining the factory regulations.

3. Water

Through the rainwater run-off system implemented at the site, contaminations getting onto the pavement may be washed away together with the rainwater into the system. However the sand-box and oil trap implemented on the border of the industrial plant should prevent release of the contaminating substances into the surface waters.

4. Waste

In case of contingency – that is, in the events described in the previous sections – generation of dangerous waste (principally of absorbing material) is to be expected.

Provisions of Govt. Decree 98/2001. (VI. 15.), as amended several times, on the conditions of performing activities connected with dangerous wastes are to be complied for collecting and storing these materials. Through observation of these provisions, also collecting and temporary storage of the dangerous wastes can be performed in a manner so as to prevent any environmental pollution.

During the remediation period following the intervention, disposal of the dangerous materials generated has to be granted through involvement of contractors duly authorized for the necessary removal and treatment activities.

5. Noise

Noise effects of any contingencies occurring in the different operational stages constitute a transitory, short duration event.

6. Biodiversity

The possible contingency events are of short duration, therefore their impact to the wildlife is negligible. Excessive overcrowding of rodents qualifies as a contingency from the wildlife aspect. Merchantable rodenticides with marketing authorization are used for control and, if intervention is necessary, a duly licensed professional company may perform rodent extermination.

E. CUMULATIVE IMPACTS

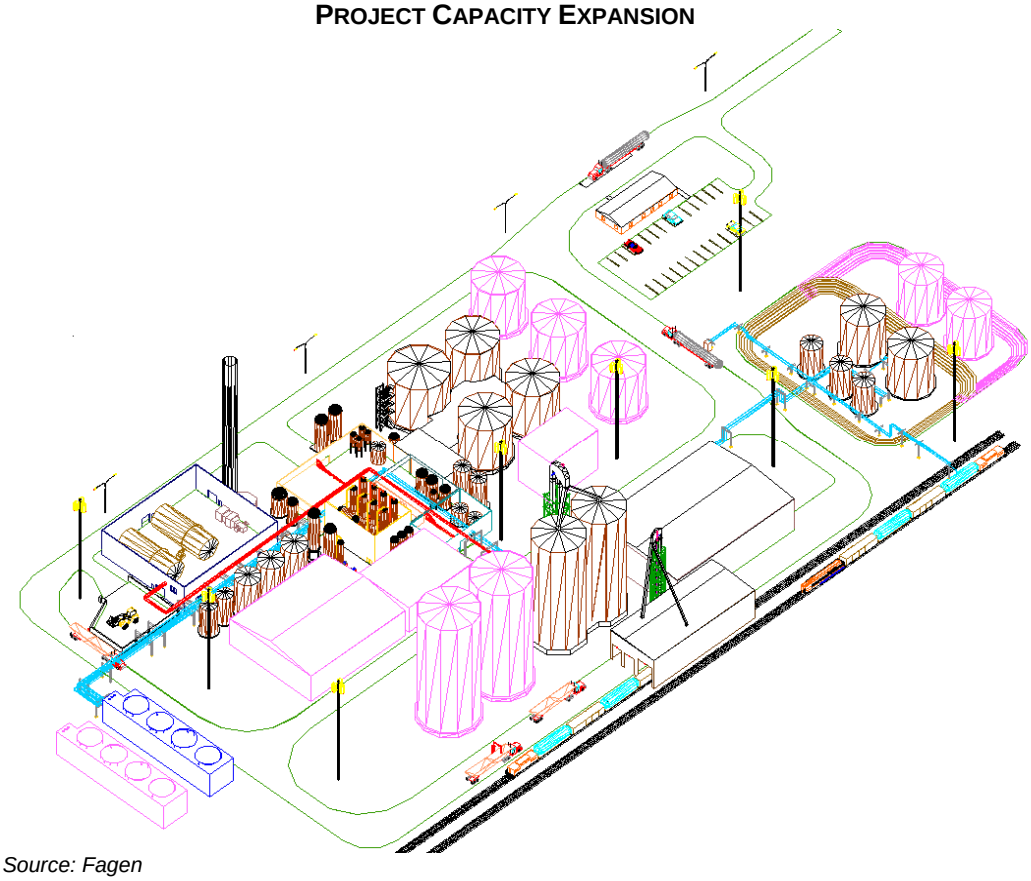
As far as Ethanol Europe is aware, neither Cargill nor Lukoil are planning expansions of their facilities. However, the Project represents part of a larger organizational and regional growth in biofuels capacity, resulting in three types of cumulative impacts: Pannonia's planned expansion, Ethanol Europe's additional project, and additional ethanol projects spurred by regulatory incentives on an EU-wide scale.

Pannonia Cumulative Impacts

Although the Expansion would be the subject of a separate social and environmental impact assessment, as well as a separate permitting procedure, some of its impacts are, for the most part, already capable of being assessed.

Expansions to double capacity are common with Fagen facilities. Fagen estimates that approximately 10 Fagen ethanol facilities have been expanded to date (dozens more were constructed to full capacity at the outset), and six of these expansions have been undertaken by Fagen itself. The facilities themselves are designed to accommodate the slotting in of

PROJECT CAPACITY EXPANSION



Source: Fagen

extra tanks and equipment in pre-defined areas, as illustrated in the Project diagram below, in which the expansion is in purple. Pannonia does not hold permits necessary for the Expansion, and only intends to apply for such permits, in consultation with its lenders, in 2011-2012, if at all.The Expansion would not be likely trigger any new concerns relevant to IFC Standards 2 (Labor; there would be no new employees as a result of the Expansion), 4 (Community Health, Safety and Security), 5 (Land Acquisition and Involuntary Resettlement), 6 (Biodiversity Conservation and Sustainable Natural Resource Management), 7 (Indigenous Peoples), or 8 (Cultural Heritage). In each case, the Expansion is likely to be neutral or modestly incremental in its impacts, although, of course a final determination would be left to the Expansion's formal assessment procedure. Accordingly, the primary additional areas of concern for the Expansion would likely be:

- air emissions, although the Project is sufficiently below thresholds that Pannonia does not envision this being an issue in permitting or under the Expansion's EIA;

- water, since either an additional well will likely need to be drilled, or water will likely need to be drawn from the Danube River. In either case, the Hungarian permitting and EIA process will devote attention to this consistent with the IFC Standards;

- roads, since Pannonia has agreed with the municipality to upgrade the Cargill/Lukoil access road. Strictly speaking, this road is not Pannonia's responsibility, but Pannonia has agreed to undertake the expected modest cost since most of the incremental road traffic on this road is anticipated to be from trucks delivering Project corn to Cargill;

- utility upgrades, since it is possible that E.ON would need to effect upgrades to gas or electricity supply infrastructure. In either case, the Hungarian permitting and EIA process, as well as E.ON's corporate environmental policy, will devote attention to this consistent with the IFC Standards; and

- a potential proprietary ethanol loading jetty in the Danube River (if not constructed earlier as described above). The Hungarian permitting and EIA process will devote attention to this consistent with the IFC Standards.

Ethanol Europe Cumulative Impacts

Ethanol Europe is considering a second Hungarian ethanol project, and, in general, Ethanol Europe intends to build other ethanol projects if the Project is successful. If Ethanol Europe builds a second facility, there is a likelihood that it will be within 100 km south of Dunaföldvár:

No site for a second project has been selected, although a shortlist exists with three sites in Hungary and Croatia. However, assuming that this second project is substantially similar to the Project, then Ethanol Europe is not aware of any additional adverse impacts from a second project, but is aware of an additional positive impact. Increased corn demand would, theoretically, increase corn prices in all of Hungary, which would benefit all Hungarian (and/or Croatian) corn farmers and farm communities.

Biofuels Incentives Cumulative Impacts

According to the Market Study, the fuel ethanol sector in Europe has developed slowly compared to the United States but quickly in absolute terms. Production increased from 60 million liters in 1993 to 525 million liters in 2004. It then increased to approximately 3.6 billion liters in 2009 as shown in the chart below. Approximately two billion liters of production below in each year is not fuel ethanol, but beverage ethanol.

EU TOTAL ETHANOL (FUEL AND OTHER) PRODUCTION 2000-2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Austria	8	9	9	8	7	7	12	25	89	180
Denmark	19	20	19	18	18	21	20	13	13	8
France	812	812	844	817	830	910	850	1,150	1,550	1,850
Germany	285	295	275	280	230	335	742	689	815	1,050
Hungary	43	43	43	47	54	58	86	99	93	192
Italy	206	207	200	149	150	161	180	118	100	115
Poland	173	181	210	220	195	241	279	208	190	400
Spain	145	225	258	292	334	379	478	438	417	590
Sweden	17	92	97	100	105	110	115	116	124	220
U.K	435	430	330	310	285	290	280	327	350	580
Other EU	317	313	274	266	283	299	360	404	574	847
EU	**2,460**	**2,627**	**2,559**	**2,507**	**2,491**	**2,811**	**3,402**	**3,587**	**4,315**	**6,032**
Of which fuel ethanol	7%	10%	12%	19%	24%	32%	46%	50%	65%	63%

Source: Market Study

Imports into the EU have also been increasing. Total imports of ethanol (fuel and non-fuel) are estimated to have reached 1.9 billion liters in 2008, primarily from Brazil. The Market Study assumes that imports will increase.

If the EU target for 10% of transportation fuels to be reached incrementally by 2020 were attained and began with the 5.75% target for 2010 contained in the Promotional Directive, the

EU fuel ethanol supply would need to rise to 11.3 billion liters by 2010 and (assuming a linear increase to meet the 2020 mandate) 14.0 billion liters by 2015. However, given that the EU is not expected to meet the 2010 target, assuming a linear blending trajectory from current blending levels to the 2020 10% mandate, EU fuel ethanol supply would need to rise to 11.2 billion liters by 2015 (an amount equivalent to the annual output of approximately 50 ethanol production facilities the size of the Project).

Theoretically, the EU mandate can be satisfied regardless of where ethanol production facilities are sited, but politically there will be pressure for facilities to be located pursuant to some conception of proportionality. On the one hand, these considerations could give rise to expectations that several more ethanol production facilities will be constructed in Hungary over the next decade. On the other hand, Hungary is, empirically, perhaps the least attractive site for ethanol projects in Europe. While many new and large ethanol production facilities have been built in recent years in England, France, the Netherlands, Germany, Spain, and Austria, and while smaller facilities have recently been built in the Czech Republic, Slovakia, and Romania, none has been constructed in Hungary. Hungary's inability to attract investment is especially striking considering that 41 projects have been loudly announced by investors in recent years.

Accordingly, while it is reasonable to assume that EU regulatory incentives will result in substantial new biofuels capacity in the European Union over the coming decade, there is no meaningful way at present to estimate how much of this capacity will be constructed in Hungary or how it will be distributed across Europe.

In the United States, cumulative adverse impacts from ethanol relate primarily to purported increased fertilizer runoff into waterways, leading to wildlife and fisheries impacts. However, Hungarian corn farmers use only a fraction as much fertilizer as U.S. corn farmers.

Accordingly, it is too early at this point to make a meaningful evaluation of cumulative impacts from the European biofuels sector doubling or tripling in size.

VI. ANALYSIS OF ALTERNATIVES

A. TECHNOLOGY SELECTION

Ethanol Europe began its existence in 2007 after the decision of its founders to pursue corn ethanol projects in Eastern Europe. Ethanol Europe's first project was anticipated to be in northern Croatia using ICM process technology and a to-be-identified construction contractor, but that project failed to an inability of all the project partners to reach agreement. However, in part thanks to that project, difficulties in receiving worthwhile bids from qualified construction contractors, and Ethanol Europe's growing appreciation in 2008 of the factors that were shaping the U.S. ethanol industry, in 2008 Ethanol Europe decided that it would only proceed if could secure the services of Fagen.

In the United States, Fagen has never been responsible for a serious construction problem on any of its projects, and very few of its projects have suffered from outside construction problems. This track record stands in remarkable contrast to the frequency and severity of construction problems that impact non-Fagen projects, including projects using ICM technology. A large number of non-Fagen ethanol projects in the United States have never reached commercial operation due to construction problems. Outside the U.S., no corn ethanol process technology is proven; the track record of other process technology providers is not encouraging (for either price or performance), and there are only a handful of dry mill corn ethanol projects in Europe. Indeed, in Europe, a similar general trend in ethanol construction in now apparent (including wheat ethanol since so few corn ethanol plants are in operation) with a large proportion of recent project delayed or ruined because of construction problems.

While a number of potential construction providers and process technology providers in Europe suggest that they have relevant experience and cutting edge process technologies, and in some cases suggest that their work could be superior to Fagen's, none has any meaningful track record to back up such assertions and none is willing to provide a full and binding creditworthy guarantee to back up its claims. As a result, Ethanol Europe felt that no European players in corn ethanol could ensure that a project would be built on time, on budget and perform as promised.

Likewise, after review, there is no commercially proven and/or cost-effective cellulosic ethanol process currently in the market for commercial scale ethanol facilities.

Therefore, purely based on quality and reliability concerns, Ethanol Europe believes that there is no real alternative to Fagen.

Accordingly, Ethanol Europe decided in 2008 to select Fagen as its exclusive construction partner, with ICM as Fagen's process technology provider.

B. SITE SELECTION

Before selecting the Site, Ethanol Europe evaluated dozens of other potential sites in Hungary, Romania, Croatia, and Serbia. All that Fagen requires for an ethanol project is a flat site of sufficient size with appropriate utility connections. Accordingly, there are, theoretically, thousands of potentially good sites for Fagen ethanol facilities in Hungary, Romania, Croatia and Serbia.

Ethanol Europe received an invitation from Cargill to review sites adjacent to existing Cargill installations in the region and assurances from Cargill that Cargill would enter into corn supply or procurement agreements if Ethanol Europe wanted the same. As a result, Ethanol Europe limited its search to co-locations with Cargill installations.

Of the sites reviewed, the Site was selected because of its proximity to Budapest and its proximity to the Danube. Most other sites considered would have presented environmental and social issues no, or little, different from those at the Site.

C. DESIGN SELECTION

Fagen offers its customers little latitude in design issues. Fagen builds 52.5 million gallon per year (undenatured) and 105 million gallon per year ethanol plants. The smaller plants are designed to be expanded. As a result, on most design issues, Ethanol Europe faced no choices, and Fagen's existing design is both reliable and environmentally friendly. However, Ethanol Europe did add additional storage capacity at the Site and a steam let down turbine, as well as the conveyor equipment to be located at the Cargill Facility, but these are relatively minor changes.

D. UTILITY SELECTION

While Fagen is responsible for construction of most of the Project, Pannonia is responsible for water, gas, electricity and sewage connections and supply. For these, Pannonia contracted with leading names in Europe (e.g. E.ON), and Pannonia had relatively little latitude in making design or other decisions with regard to these utilities since the Hungarian market is so well-developed in this regard.

E. TRANSPORTATION

While with respect to most issues after Site selection, Ethanol Europe faced relatively few decisions about design and operation, that is not the case with transportation. Most plants like the Project in the United States rely on railroads for both corn delivery and for shipments of ethanol and DDGS and, consequently, own substantial on-site rail infrastructure. As a back-up option, almost all such plants have the capacity to use trucks for transportation. Only a handful of U.S. ethanol plants use water transportation. The Site cannot feasibly have its own on-site rail infrastructure (and, accordingly, the Project's planned method for rail transportation is workable but is not inexpensive competitive advantage), an excellent site for water transportation and a good site for truck transportation. Because of the environmental benefits of water transportation and the developed nature of European inland waterways, Ethanol Europe elected to proceed with the Site despite its comparatively weak situation with respect to rail transportation. Pannonia hopes to use water transportation to ship a material amount of its product.

F. STAFFING

The largest departure of the Project from its U.S. counterparts is in staffing. An ethanol facility in the United States of the type and size of the Project usually has around 40 employees. Pannonia will have almost twice this number. The decision to add so many jobs was a product of a desire to ensure operational success, a desire to enhance the social impact and community relevance of the Project, and a reflection of a different staffing environment in Hungary than in the United States.

With respect to this last consideration, (i) a number of employment positions in Hungary (e.g. the cleaners) are usually outsourced in U.S. plants, and (ii) some positions in Hungary have no analogy in the United States (e.g. staff to handle tax warehouse regulatory requirements).

VII. SOCIAL AND ENVIRONMENTAL MANAGEMENT PROGRAM

A. OVERVIEW

Pannonia's Social and Environmental Management Program (the "SEMP") aims to prevent, mitigate and manage the impacts identified by this Assessment. The SEMP evidences Pannonia's commitment to address and manage potential negative and positive impacts associated with the Project, outlines management structures to be implemented for all stages of the Project, and identifies any additional studies or assessments that may need to be performed. The purpose of the SEMP is to structure and guide all activities during all phases of the Project to ensure orderly, safe, compliant and environmentally and socially responsible Project operations. The SEMP aims to manage significant environmental, safety and social impacts with the objective of reducing or mitigating the adverse impacts of the Project on the environment, society and workers. The SEMP applies to all Project operations.

The SEMP focuses on three core activities: mitigation (feasible and cost-effective measures that may reduce potentially significant adverse environmental impacts), monitoring (both social and environmental), and training.

In most cases, an SEMP is a more process oriented document than an Environmental Action Plan ("EAP"). Usually, the EAP is meant to be an interface document between the Project and internal and third party engineers and operators and so is meant to contain specific standards and guidelines phrased and presented in a more simple and more prescriptive manner. Moreover, the IFC Standards require development of an EAP to address any adverse impacts identified by an environmental and social impact assessment, but it is not the case that any item contained in an EAP addresses an adverse impact.

In the case of the Project, (i) this Assessment has identified no issues that, *per se* under the IFC Standards require an EAP and (ii) all of Pannonia's construction contractors and operational staff are, or when hired will be, highly literate. Accordingly, the Action Plan set forth as Appendix K blends into one document the functions of an SEMP and an EAP. Because this Assessment has not identified any serious adverse social or environmental impacts of the Project, the Action Plan aims to ensure that the Project operates at consistently high levels of environmental and social performance.

The Action Plan will be continuously updated and revised to reflect both changing Project circumstances and any changing legal or normative standards applicable to the Project. In its current form, the Action Plan is preliminary; as permits are issued, then specific permit conditions, limits and reporting requirements will need to be inserted into the Action Plan. It is possible that the Project will (through identification of an issue overlooked or mis-assessed by this Assessment or through changed circumstances) encounter an adverse social or environmental impact of the Project. In that case, the Action Plan will address this impact as recommended under the IFC Standards.

B. ROLES AND RESPONSIBILITIES

Pannonia's staffing is set forth on Appendix D to this Assessment. Pursuant to an Asset Management Agreement with an Ethanol Europe-affiliated management company, Ethanol Europe's management will play an active and, sometimes, direct role in ensuring Pannonia's commercial success and compliance with the SEMP. Under the Asset Management Agreement, Ethanol Europe will be responsible for selling the Project's ethanol and DDGS, and each of the senior managers of Pannonia will report directly to one or more senior managers of Ethanol Europe.

Within Pannonia, the CEO will be responsible for managing the SEMP, including approving all environmental and social policies and plans, all auditing protocols, action planning and verification procedures. The CEO will be accountable directly to the CTO and the COO of Ethanol Europe. In addition, the Health, Safety and Environment Manager (the "HSE Manager") will be accountable to both Pannonia's CEO and Ethanol Europe's COO on all matters related to the SEMP and will be the only Pannonia employee who is not senior management with direct reporting to Ethanol Europe. The HSE Manager, assisted by the Human Resources Manager, will also be responsible for ensuring that all Pannonia employees are aware of and act in accordance with the SEMP. The Legal Director, depending upon the skills of the person hired, may also assume key SEMP functions.

During construction and prior to the time that Pannonia's employees are hired, Ethanol Europe's CTO (who will be Pannonia's CEO until completion of construction) and COO will ensure compliance with the SEMP by all contractors and subcontractors. Cargill has in place health and safety protocols that are consistent with, and often more stringent than, Hungarian legal requirements. Given the limited scope of work at its site during the construction period, in the absence of Pannonia becoming aware of any deficiency in these health and safety plans, contractors and subcontractors will be expected to comply with the health and safety plans of Cargill for work conducted on its site.

The HSE Manager will be hired as soon as an ideal candidate is identified, and may be hired prior to any of Pannonia's senior management. At a minimum, the HSE Manager will be fluent in English and Hungarian and will have a Master's level education in an environmental field (e.g. from the Department of Environmental Sciences and Policy of Central European University).

The HSE Manager will be responsible for translating the Action Plan into Hungarian and maintaining up-to-date English and Hungarian versions of the Action Plan.

C. DEROGATIONS FROM IFC STANDARDS

The Action Plan does not prioritize any actions over any other actions, which is a potential derogation from the IFC Standards. Because the Action Plan contains no mitigation or avoidance actions for substantial adverse impacts, this lack of prioritization appears appropriate. In the event that such an adverse impact is identified at a later date, prioritization of Action Plan items may be implemented. For similar reasons, the Action Plan currently contains no cost estimates.

Pursuant to paragraph 18 of IFC Standard 1, Pannonia should train Fagen in applicable standards. Given Fagen's experience and skills, such training has been deemed

unnecessary. In lieu of such training, Fagen has been provided with a copy of this Assessment.

Pannonia will not translate this Assessment into Hungarian, which may not be entirely consistent with the letter of paragraph 20 of IFC Standard 1. However, since (i) the Action Plan will be provided in Hungarian, (ii) since the EIA is in Hungarian and a matter of public record in Hungary, and (iii) since this Assessment identifies no substantial adverse impacts, this decision is consistent with the spirit of IFC Standard 1, pursuant to which this Assessment is more detailed and extensive than required.

APPENDIX A
REPORT PREPARERS

The bulk of this Assessment comes from various reports and applications by Project consultants completed over the course of the past year. These are described below.

Agra CEAS Consulting Ltd., in conjunction with F. Licht, was hired by Nordkap Bank AG (in its capacity as a potential lender to the Project) on June 25, 2009 to prepare a market report for Project lenders. Agra is the leading provider of such reports in Europe. In November 2009, Agra delivered the Market Study.

AGRA CEAS CONSULTING LTD
DR. EDWARD OLIVER
IMPERIAL COLLEGE LONDON
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UNITED KINGDOM
+44 (0)1233 812 181
EDWARD.OLIVER@CEASC.COM

Ecofys International BV was hired by Ethanol Europe on August 31, 2009 to prepare a greenhouse gas assessment for Project lenders. Ecofys is the leading expert in Europe on this issue. In June 2010, Ecofys delivered its final amended *Greenhouse Gas Assessment*.

ECOFYS INTERNATIONAL BV
CARLO HAMELINCK
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NL-3503 RK UTRECHT
THE NETHERLANDS
+31 30 66234 43
C.HAMELINCK@ECOFYS.NL

Ethanol Europe hired ERI Solutions, Inc. on August 17, 2009 to advise on insurance and plant operation and safety. ERI has advised a large number of U.S. ethanol projects on these topics. ERI was never appointed as broker for the Project and merely provided advice.

ERI SOLUTIONS, INC.
BRUCE PEARSON
125 N. FIRST ST.
COLWICH, KS 67030
UNITED STATES OF AMERICA
+1 316 927 4292
BRUCE.PEARSON@ERISOLUTIONS.COM

In January 2010, Pannonia entered into a Letter of Authorization with Marsh Kft. appointing Marsh as the Project's insurance broker.

MARSH KFT.
ZSOLT GASPAR
SENIOR CLIENT EXECUTIVE
CORVIN OFFICES I
FUTO UTCA 47-53
H-1082 BUDAPEST
HUNGARY
+36 1 881 7242
ZSOLT.GASPAR@MARSH.COM

The Project is working with GMZ Kft. on road design and traffic assessment issues and received a road assessment report (in Hungarian) in May 2010.

GMZ Tervező és kivitelező Kft,
Zoltán Gema
Szőlőskertek utca 9
7200 Dunaföldvár
Hungary
+36-30-916-1613
gmzterv@t-email.hu

Tebodin Hungary Limited and Ethanol Europe entered into a Services Agreement In June 2009 to handle the Project's permitting work. Tebodin in turn subcontracted the EIAs (and IPPC) to Progressio Engineering Services Ltd. and the Seveso II (disaster and emergency management permit) to CK-Tricolor.

Tebodin Hungary Ltd.
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+ 36-1-2059601
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PROGRESSIO Mérnöki Iroda Kft.
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roland.toth@progressio.hu

CK Trikolor Kft.
Czakó Sándor
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H-1023 Budapest
Hungary
+ 36-1-315 1101
czako.dnv@t-online.hu

Recently, Progressio replaced Tebodin as the Project's primary permitting and environmental consultant.

The Progressio team is led by Roland Toth, an employee of Enviprog LP under special contract with Progressio. Mr Toth holds a degree in environmental engineering from University of Veszprém and has nine years of experience in the evaluation, design, permitting and operation of industrial projects in Hungary. He also holds a degree in chemistry from the Pálfy János Chemical Technical College and has received six months of training at the Umweltforschungszentrum in Leipzig, Germany. He began his environmental career with Balluff Elektronika Ltd. and was in charge of the environmental management system of this 450 person company. He then held a position with GreenLab Ltd. before joining Enviprog LP in 2004 as an environmental consultant. Mr. Toth speaks German and English, as well as Hungarian.

APPENDIX B
References

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Stakeholder identification and analysis

A stakeholder is a person, group or institution who may potentially have an interest in, be affected by, or have an influence on the Project. A stakeholder analysis is a dynamic document and will need to be updated regularly, in particular whenever the Project enters a new phase, as this often coincides with changing stakeholder relations.

PROJECT STAKEHOLDERS		
KEY?	**GROUP**	**INTEREST**
YES	Residents of Dunaföldvár	Direct jobs, Indirect Jobs, Environmental Impact, Noise, Smell, Impact on Local Taxes, Potential charity benefits
YES	Residents of towns adjacent to Dunaföldvár	Direct Jobs, Indirect Jobs, Environmental Impact
NO	Residents of Tolna County	Direct Jobs, Indirect Jobs
YES	Hungarian Environmental NGOs	Various (some support on GHG and clean energy grounds; some oppose based on general opposition to biofuels, such as Magyar Természetvédok Szövetsége)
YES	Media (for so long as Project is a high profile project)	Professional
YES	Two existing ethanol facilities in Hungary; two most advanced proposed projects	Project success will damage these projects both directly (since Project will be more competitive) and indirectly (since Project is less of an environmental nuisance)
NO	Construction Companies in 60km radius	Professional
NO	National governmental agencies	Different agencies have different views of Project, but overall Project supported as consistent with national development goals
NO	US Embassy	Project is "showcase" U.S. investment

Stakeholder consultations to date

The following does not include meetings with Ethanol Europe or Pannonia consultants, nor with ITD, the Hungarian agency tasked with encouraging foreign direct investment.

Date	*Person or Agency Consulted*	*Subject of Consultation*
Mar-09	Minister of Finance	Confirmation of availability of State Aid and in particular Development Tax Allowance. Methods of maximizing State Aid
	Minister of Agriculture and Rural Development	Ministry of Agriculture support for the project and State Aid, MFB bank guarantee and offer of "State Supported Large project"
	State Secretary, Ministry of Economics, Hungarian Trade Development Agency, National Development Agency	Availability of direct post financing non refundable grants under EU/Hungarian co-financing grant schemes
Apr-09	Director MKEH, Technical Safety Authority	Permitting of US technology and standards in Hungary
May-09	State Secretary, Ministry of Agriculture	Initiation of the process to obtain "State Supported Large Project" status
	Mayor of Dunaföldvár	Land rezoning of part of the site and agreement to swap land with the municipality to have a single contiguous parcel of land
Jun-09	Minister of Finance	Commitment from MoF to do everything permitted in law to help the project. Discussion of the need to modify Government Decree 206/2006 on Development Tax Allowance to enable notification of state aid to EC of agricultural projects over €25 million
	State Secretary, Ministry of Economy	Formal agreement to initiate the process to modify Government Decree 206/2006 on Development Tax Allowance
Jul-09	Director, Regional Environmental Authority	Introduction of the project prior to submission of the preliminary EIA. Commitment by the Authority to give a high priority to processing our application
Aug-09	State Secretary, Ministry of Economy, Hungarian Trade Development Agency	Text of eligibility and evaluation criteria for the KEOP 4.6.0 grant scheme to maximize benefit to PE. Progress in application for State Supported Large Project
Sep-09	State Secretary, Ministry of Agriculture, National Development Authority	Text of eligibility and evaluation criteria for the KEOP 4.6.0 grant scheme to maximize benefit to PE
	State Secretary, Ministry of Economy	Text of eligibility and evaluation criteria for the KEOP 4.6.0 grant scheme to

	Mayor of Dunaföldvár	maximize benefit to PE. Progress in application for State Supported Large Project Follow up consultation on Zoning and Land swap issues and relocation of a municipally owned dirt track "road"
Oct-09	State Secretary, Office of the Prime Minister	Text of eligibility and evaluation criteria for the KEOP 4.6.0 grant scheme to maximize benefit to PE
	National Development Authority	Text of eligibility and evaluation criteria for the KEOP 4.6.0 grant scheme to maximize benefit to PE
	Trade Development Agency	Submission of supporting documentation for State Supported Large Project
	Head of Excise Section, Ministry of Finance	Excise procedures for the transportation of ethanol in an undenatured state. Excise categories of Denatured and Undenatured Ethanol. Requirements for the operation of a Tax Warehouse
Nov-09	Colonel in Charge, Excise Section, Hungarian Customs, Trade Development Agency	Procedures and requirements to set up and operate a Tax Warehouse. Excise requirements for various modes of ethanol transport.
	State Secretary, Office of the Prime Minister	Delays in Environmental Permitting and processing of State Supported Large Project
	Mayor of Dunaföldvár	Signing of the land swap contract
Dec-09	State Secretary, Office of the Prime Minister	Ministry of Economy approval for State Supported Large Project and forwarding of recommendation to the cabinet
Jan-10	State Secretary, Office of the Prime Minister	Publication of Ministry of Economy proposal to grant State Supported Large Project status
	State Secretary, Office of the Prime Minister	Cabinet approval of State Supported Large Project
	State Secretary, Office of the Prime Minister, Head of Section, Ministry of Finance, Development Tax Allowance, Case Officer, Ministry of Agriculture, State Aid	Development Tax Allowance strategy, EC Notification issues, Examination of previous EU precedents on State Aid to Ethanol Projects
	Head of Section, Ministry of Finance, Development Tax Allowance, Case Officer, Ministry of Agriculture, State Aid	Development Tax Allowance strategy, EC Notification issues, Examination of previous EU precedents on State Aid to Ethanol Projects
Feb-10	Case Officer, DG-AGRI, Section M2 Agricultural State Aid	Development Tax Allowance strategy, EC Notification issues, Examination of previous EU precedents on State Aid to Ethanol Projects

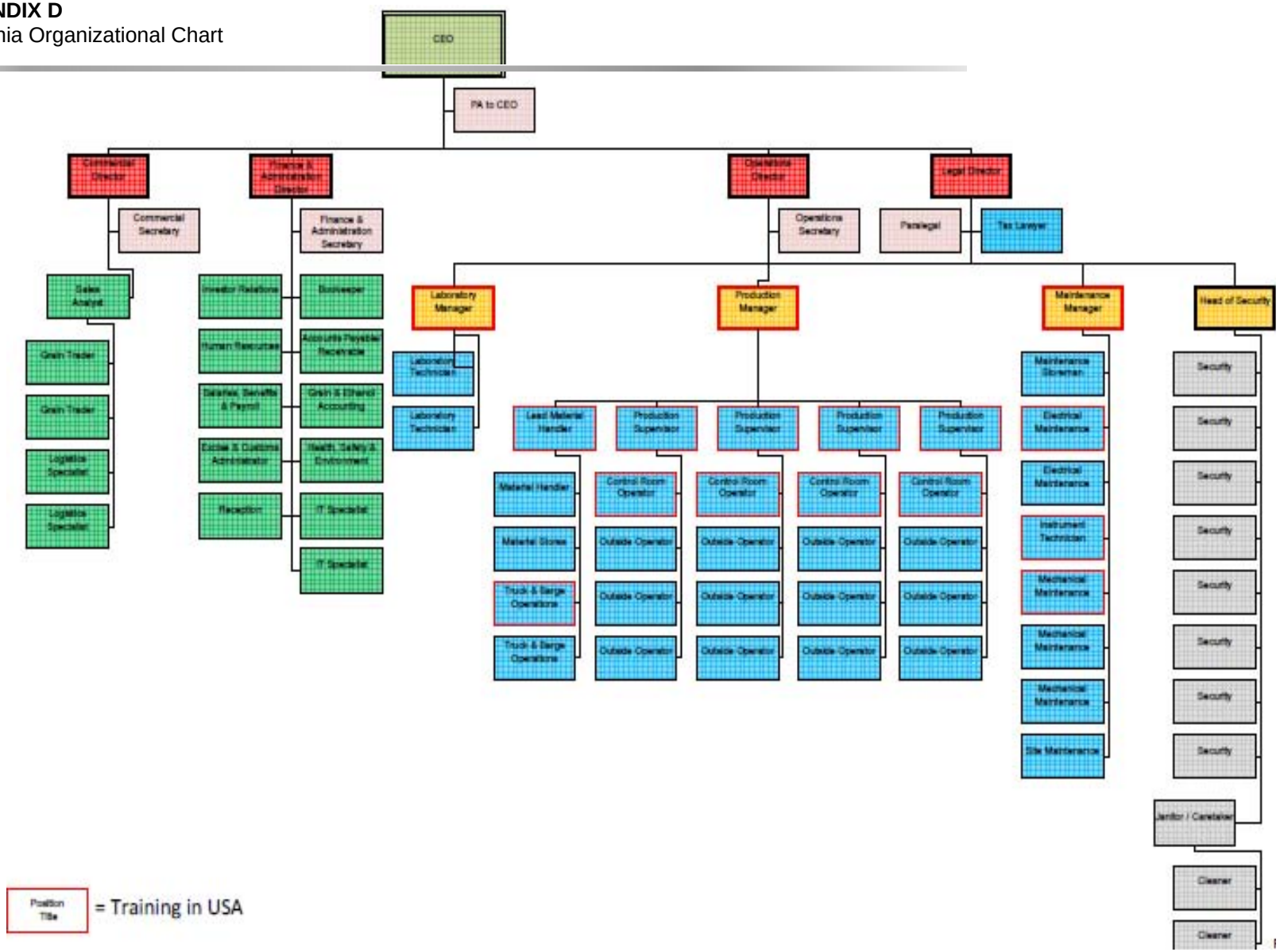
	State Secretary, Office of the Prime Minister, Head of Section, Ministry of Finance, Development Tax Allowance, Case Officer, Ministry of Agriculture, State Aid	Development Tax Allowance strategy, EC Notification issues, Examination of previous EU precedents on State Aid to Ethanol Projects
	Head of Agriculture Section, Hungarian Permanent Representation to the EC	Development Tax Allowance strategy, EC Notification issues, Examination of previous EU precedents on State Aid to Ethanol Projects
	Local Community Delegation to USA	Fact finding visit to the US for three days to visit almost identical ethanol plants in similar rural locations and assess any and all positive and negative impacts. The delegation was comprised of the Mayor of Dunaföldvár, the head of the municipal permitting authority, the leaders of the two main political parties, a leading local businessman and a leading local farmer.
	City Council and citizens of Dunaföldvár	Public, locally televised meeting which announced the project and alllowed live and telephone interaction with the local citizens
Mar-10	State Secretary, Office of the Prime Minister, Head of Section, Ministry of Finance, Development Tax Allowance, Case Officer, Ministry of Agriculture, State Aid	Finalization of DTA strategy and EC notification
	Case Officer, Ministry of Agriculture, State Aid	Final coordination of DTA and Notification submission documents
	Mayor of Dunaföldvár, Tolna County Disaster Prevention Agency, Tolna County Fire Department	Public hearing on Disaster Prevention
Apr-10	Mayor of Dunaföldvár	Site Formation Process & Lease Back Agreement after land swap VAT classification of site to be purchased
May-10	Technical Safety Authority Tolna County Fire Authority Mayor of Dunaföldvár	Sub-Authority Meeting on the Main Building Permit
	Regional Environmental and Water Authority Mayor of Dunaföldvár	IPPC Public Meeting
	Regional Environmental and Water Authority	Consultation on compliance with Best Available Techniques

Public Information

Pannonia has established an information center in the Dunaföldvár public library and has invited other interested parties (including, directly, Magyar Természetvédok Szövetsége, the Project's only known opponent) to place any information there it would like to be available to the public.

In February 2010, the Project's web site was launched (www.pannoniaethanol.hu).

APPENDIX D
Pannonia Organizational Chart



Equal Opportunity Policy

Pannonia Ethanol Zrt. (having its registered seat at H-1051, Budapest, Zrínyi u. 16. III./10.; company registration number: 01-10-046437) (hereinafter the "Company" or "Employer") adopts the following equal opportunity policy in adherence to the provisions of Act XX of 1949 on the Constitution of the Republic of Hungary, Act CXXV of 2003 on equal treatment and the promotion of equal opportunity, Act XXII of 1992 on the Labour Code and Act IV of 1959 on the Civil Code and international legal documents adopted by the United Nations Organisation, the Council of Europe, and the European Union.

I. GENERAL

1. Persons within the scope of this Policy:
   The scope of this Policy includes all employees employed by the Company.
2. Term of the Policy:
   This Policy is effective from 1 December 2009 until 1 December 2011.

II. GENERAL GOALS AND ETHICAL PRINCIPLES

1. **No Discrimination, Equal Treatment**

   In order to respect the principles of equal treatment and promote equal opportunity the Employer may take supportive measures and dedicates itself to the principles of equal opportunity at work and to this end the Employer will take measures if these principles are violated.

   The Employer undertakes to prevent discrimination against Employees. This extends to recruitment, hiring, determination of salaries, wages, benefits, training, further training and other incentives, delegation, termination of legal relationships and other employment-related measures. Furthermore this includes any kind of discrimination whatsoever against Employees, especially based on their age, sex, family status, nationality, race, origin, religion or political conviction. Any case of discrimination that arises out of necessity and clearly results from the nature or characteristic of any employment is an exception to this principle. The Employer pays special attention to prevent and eliminate any direct or indirect discrimination that may result from the age, sex, nationality, family status or health of any Employee.

   The data on racial, national identity or nationality or ethnical origin or health is special personal data, therefore such data may only be managed if the data subject provides such information voluntarily. No-one may be required to make any declaration but an Employee may only participate in any support scheme if he/she consents to the recording and management of his/her data in adherence to the Data Privacy Act.

   The Employer undertakes not to discriminate against women, people over 40, Romanies, disabled or married Employees in respect of benefits that are mandatory or may be given under the employment laws (the Labour Code) in order to promote equal opportunity for Employees, especially when it comes to the determination of salaries, professional promotion, training, working conditions and benefits related to the raising of children and the parental role.

   The Employer undertakes to implement the requirement of equal treatment in the course of employment in accordance with the provisions of Sections 21-23 of the Equal Opportunity Act as prescribed in its Section 21:

a) in getting a job, especially in public job advertisements, hiring, terms and conditions of employment;
b) in measures related to the procedure that precedes and facilitates the establishment of an employment relationship or any other work-related legal relationship;
c) in the establishment and termination of an employment relationship or any other work-related legal relationship;
d) in relation to training preceding any work or taking place in the course of work;
e) in establishing and providing the conditions for work;
f) in determining and providing any benefits that can be given on the basis of the employment relationship or any other work-related legal relationship, including without limitation the salary set out in Section 142/A of Act XXII of 1992 on the Labour Code;
g) in relation to membership or participation in employees' organisations;
h) in the promotion scheme;
i) in the course of the assertion of liability for damages.

In application of paragraph f) any indirect negative discrimination against sex, racial origin, colour, nationality or national or ethnical minority as a characteristic violates the requirement of equal treatment in any single event.

2. Respect for Human Dignity

In the course of employment Employees' human value, dignity and individuality must be respected. Taking into consideration and harmonising its own and Employees' interests, the Employer endeavours to create such working conditions, circumstances and atmosphere at work that contribute to the preservation and strengthening of these basic values.

3. Partnership and Cooperation

The Employer endeavours to implement the principle of partnership in the framework of the employment relationship. For this purpose the Employer elaborates transparent contractual relationships, bearing in mind the provision of mutual benefits.

4. Social Solidarity

In the course of employment or any other activity of social benefit no Employee is any more valuable than the other for the society, irrespective of their age, sex, nationality, family status or health. It is in the interest of our Company to strengthen solidarity which can greatly facilitate the possibility of disadvantaged groups for employment and personal success.

5. Fair and Flexible Treatment

The prohibition of discrimination and the principle of equal treatment are not suitable to eliminate all existing inequality that Employees encounter in the course of their employment. The Employer takes positive, fair and flexible measures that help individuals to keep and improve their positions at work.

6. Disadvantaged Groups

This Policy extends to disadvantaged groups and individuals that are employed by the Employer irrespective of the nature of employment, working hours or the term of employment. The Employer treats the following groups as disadvantaged groups in accordance with the laws and regulations:

a) women;
b) Employees over 40,
c) Romanies,
d) the disabled,
e) Employees raising two or more children under 10 or single Employees raising a child under 10.

III. INTERPRETATION

Violation of the principle of equal treatment shall mean

1. direct negative discrimination;
2. indirect negative discrimination;
3. harassment;
4. unlawful segregation;
5. reprisal and any instruction for reprisal.

1. Any measure as a result of which any individual or group receives, has received or would receive less favourable treatment than another person or group in a comparable situation because of his/her
   a) sex;
   b) racial origin;
   c) skin colour;
   d) nationality;
   e) national or ethnic minority;
   f) mother tongue;
   g) disability;
   h) health;
   i) religious or ideological conviction;
   j) political or other views;
   k) family status;
   l) maternity (pregnancy) or paternity;
   m) sexual orientation;
   n) sexual identity;
   o) age;
   p) social origin;
   q) financial situation;
   r) part time nature or definite term of his/her employment relationship or other work-related legal relationship;
   s) membership in any interest representative organisation;
   t) his/her other condition, characteristics or feature (hereinafter "his/her characteristics")

   constitutes **direct negative discrimination**.

2. **Indirect negative discrimination** shall mean any measure that does not constitute direct negative discrimination and seems to come up to the requirement of equal treatment, but which puts the individuals or groups with the characteristics listed in Section 1 more at a disadvantage on a greater scale than in which condition the persons or group in a comparable situation were, are or would be.

3. **Harassment** means behaviour of sexual or other nature that offends human dignity that is related to the characteristic of the relevant person listed in Section 1 for the purpose or with the result that a bullying, terrorising, hostile, humiliating, intimidating or aggressive environment is created against such a person.

4. **Unlawful segregation** means such behaviour which segregates individuals or a group of individuals with the characteristics listed in Clause 1 from the persons or group in a comparable situation without expressly permitted by the Equal Opportunity Act.

5. **Reprisal** means such behaviour that gives rise to or is aimed at or threatens with the violation of law against any individual who objects to, commences any proceedings or assists in any proceedings because of the violation of the principle of equal treatment.

No behaviour, measure, condition, omission, instruction or practice (hereinafter the "measure") violates the requirement of equal treatment that restricts any basic right of any party suffering from a disadvantage in unavoidable cases in order to assert another basic right provided that the restriction is suitable and proportionate to achieve such a goal.

It shall not mean the violation of the requirement of equal treatment

a) any proportionate discrimination that is justified as a result of the characteristics or nature of any work on the basis of all essential and lawful conditions that are relevant to employment;

b) any discrimination based on proportionate and real employment requirements that is justified by the content or nature of the relevant employment and is based on religious or other ideological conviction or national or ethnic origin and indirectly arises out of the spirituality that basically determines the nature of the organisation.

TEBODIN EC
Consultants & Engineers

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PHASE I ENVIRONMENTAL SITE ASSESSMENT AND LIMITED PHASE II SOIL AND GROUNDWATER INVESTIGATION

of AGROGRAIN Site in Dunaföldvár; Hungary

Client	**Ethanol Europe**
status	Original
Project No.	
revision	0
date	10-04-2009
author	Károly Oelberg

Authorization:

Author: Károly Oelberg

Authorized by: Károly Ecker

Budapest, 10-04-2009

PROJECT ETHANOL EUROPE

PHASE I ENVIRONMENTAL SITE ASSESSMENT AND LIMITED PHASE II SOIL AND GROUNDWATER INVESTIGATION

(Draft Report)

Client:		**Ethanol Europe**
1.	**Site Name**	AGROGRAIN Site; a greenfield area located in the northern edge of the town of Dunaföldvár; Hungary.
2.	**Site Address**	The site is only referenced by land registry numbers.
3.	**Ownership**	The subject site consists of three areas registered under separate land registry titles. These plots are referenced in the land registry as follows: • **HRSZ 0111/26**; owned by AGROGRAIN Zrt; • **HRSZ 0109**; owned by the Municipality of Dunaföldvár; • **HRSZ 0116/5**; property of AGROGRAIN Zrt. Notes: 1. The eastern part of plot HRSZ 0116/5 which includes the logistical facilities of AGROGRAIN is not subject to the transaction planned by the Client and thus, it was beyond the scope of the current investigation. 2. Easement is established on the AGROGRAIN-owned areas in favour of the local the electrical and natural gas service provider companies (E.ON and ÉGÁZ-DÉGÁZ).
4.	**Site Size (m^2)**	According to recent land registry excerpts the sites of the respective plots are: • HRSZ 0111/26: 80.000 m^2 ; • HRSZ 0109: 3.651 m^2; • HRSZ 0116/5: 99.691 m^2 (including the area that will remain the property of AGROGRAIN.
5.	**Site Representative**	Mr. István Holl, District Director; AGROGRAIN Zrt.
6.	**Persons interviewed**	Mr. István Holl, District Director; AGROGRAIN Zrt. Mr. Andor Lajkó, Head of Construction and Technical Office; Municipality of Dunaföldvár. Mrs. Beáta Németh-Bárdos, Environmental Officer; Municipality of Dunaföldvár.
7.	**Auditors**	Mr. Károly Oelberg, Lead Auditor; AACM Central Europe Mr. Mihály Porosz, EIA Specialist; AACM Central Europe
8.	**Date of site visits**	31st March 2009 – initial site walk through; identification of borehole locations relevant to S&GW sampling for environmental purposes; interview with the Site Representative. 2nd April 2009 – interviews with the representatives of the Municipality of Dunaföldvár. 7th April 2009 – site walk through with special attention on ecological sensitivities.

9.	**Description of the Site**	The site area is shown in Annex B. area referenced as HRSZ 0111/26 is partially under agricultural use and partially vacant. The eastern site portion is currently leased by an agricultural enterprise, and is used as a plough land. The western site portion is currently not under use. It includes predominantly open areas covered with grass and weeds, and a small afforested area. The most western part is levelled, and reportedly, used as a truck parking area. Except two traditional concrete-lined shallow groundwater wells no permanent or provisional structure is present. The area referenced as HRSZ 0109 is an approximately south-to-north oriented earth road which borders the above area from the east. It is the property of the Municipality of Dunaföldvár. The area referenced as HRSZ 0116/5 is located on the other –eastern- side of the earth road. The western site portion is not developed. It is covered with grass and weeds, and its mainly northern part with shrubs. Significant quantity of soil is deposited in the north-western part of the area. The soil is mixed with construction debris. Soil gained through the development of the eastern site portion is deposited in its northern part. The eastern site portion was developed by AGROGRAIN. The site is bordered from the east by the River Danube. A narrow stripe along the river is classified by the Urban Management Plan of Dunaföldvár as a bio-corridor. This costal area belongs to a special registered habitat area called “Tolnai-Duna” (registration No. HUDD 200023) according to the provisions of the Decree of the Ministry of Environment and Water No. 45/2006. (XII. 8.) that concerns the nature conservation areas of European importance. However, the area is not listed as part of NATURA 2000. Consequently, it is not subject to any restriction from the point of you of nature conservation. (Nevertheless, given the habitat registration the necessity of a more detailed ecological survey in the EIA phase may be assumed.) According to the Urban Management Plan of Dunaföldvár none of the three plots concerned are listed as known archaeological locality (Local Construction Regulations, Annex 3).
10.	**Production**	Except the agricultural use there is no commercial activity taking place on-site.
11.	**Date of operation start/ construction**	N/A
12.	**Location/ surroundings**	The site is located in the northern suburbs of the town of Dunaföldvár (refer to Annex A). The site surroundings are described as follows. **To the north:** agricultural land (the area is designated by the Urban Management Plan as a future industrial development area).

		The site is located in the northern suburbs of the town of Dunaföldvár. The site surroundings are described as follows. **To the north:** agricultural land (the area is designated by the Urban Management Plan as a future industrial development area). **To the east:** AGROGRAIN facility followed by the River Danube. **To the south**: the site is border by a public road (access road of AGROGRAIN and LUKOIL); and beyond: • **To the south-east::** LUKOIL site followed by a watercourse called Fok-patak; beyond a vacant industrial site (a former hemp factory); • **To the south-west:** vacant partially forested area; beyond the watercourse (Fok-patak) followed by a residential area. **To the west**: a restaurant followed by a LUKOIL petrol station followed by the country road No. 6; beyond a former military base currently utilised as a mixed residential, commercial and institutional area.
13.	**Extra-site activities**	**N/A**
14.	**Historical usage**	Information on site history were obtained from Geohidroterv studies and interviews with the representative of AGROGRAIN and the Municipal Office of Dunaföldvár The **eastern site portion** (registered as HRSZ 0116/5) used to form one joint parcel with the current LUKOIL tank farm, and was under the use of the Soviet army until 1990. Reportedly, the site used to include a locator station, a shooting range, ammunition and fuel storage, as well as a vehicle maintenance workshop. The northern part currently owned by AGROGRAIN used to include the locator unit, and was also used for temporal stationing of wheeled air defence vehicles. (The Soviet military site nearby was a specialised air defence missile base.) It is assumed based on visual inspection the AGROGRAIN site portion was not under intensive development. The remains of a limited amount concrete slabs and structural elements were observed during the site walk-through. The current LUKOIL area (southern part) used to include a shooting range, ammunition storage bunkers (remains are still identifiable), fuel tanks (in the area of the current tank farm) and maintenance workshops (building still exists).

		After the withdrawal of Soviet troops from Hungary the site became the property of the State Property Agency that sold AVANTI (later called as AVA) in 1992. Reportedly, the area was cleared from ammunitions and other explosives before this transaction. AVANTI/AVA operated the site until 2002. The area was split into two parts, and the northern part was sold to AGROGRAIN and the southern part to LUKOIL. AGROGRAIN purchased the area in June 2004. It is understood that AVANTI/AVA erected the currently existing two halls with a footprint are of 1,200 m^2 each, and operated three aboveground storage tanks located adjacent to the River Danube. Reportedly, the two halls have only been used for grain storage since. The other buildings and fencing were developed by AGROGRAIN in 2006. Before the purchase by AGROGRAIN a Phase II soil and groundwater investigation and ammunition clearing were completed by a local environmental firm, Geohidroterv Kft in June 2004 (for details refer to Point 16). The corresponding report includes a certification by a specialised firm, Detektor Plussz 11 Kft the area is free of ammunitions up to a depth of 2 m. The **western site portion** (registered as HRSZ 0111/26) was the property of the Municipality of Dunaföldvár. One part has been used as a plough land, and is currently under cultivation, as well. The other part located westerly from the cultivated area used to include small private orchards before the purchase by the Municipality. This area is currently not cultivated. The most western part of the area includes two levelled areas used for parking trucks. The Municipality sold the area to private firm (Master Base) in 2005 from which AGROGRAIN purchased it in July 2007.
15.	**Geology/ hydrogeology/ hydrology**	The site area is build up by a loess formation consisting of predominantly silty sand meal combined with more consistent silt and clay as well as with course porous sand layers. There is a shallow groundwater aquifer. Its depth ranges between 4 and 10 m. In the north middle part of the site no groundwater was encountered up to 12 m. The groundwater flow is generally oriented towards the south-east (refer to Annex D) The nearest surface water body is a west-to-east oriented water course called Fok-patak running southerly of the site, and joins the River Danube in the vicinity of the southern site border of the LUKOIL site.

16.	**Potential Soil and Groundwater Contamination**	Two previous studies both completed by Geohidroterv Kft and the result of a recent Phase II investigation conducted by Tebodin Kft were available to assess the on-site soil and groundwater (S&GW) conditions. The first Geohidroterv study (July 2004) include the investigation of the entire area of plot of HRSZ 0116/5. In total 14 boreholes were developed throughout the site. Soil and groundwater samples were collected and analysed for total petroleum hydrocarbons (TPH), benzene, toluene, ethyl-benzene and xylenes (BTEX) and other alkyl benzenes. In addition, the physico-chemical parameters and inorganic material content of the groundwater samples were determined. The investigation by Geohidroterv demonstrated that most of the investigated components corresponded to the respective background concentrations, and only in few cases there was a slight elevation against the respective S&GW limit values. No any follow-up measures were suggested. It is to be noted, that the report refers to a previous study focusing on the costal area where significant elevation of TPH concentration was identified. This area is located outside and down-gradient to the area planned to be purchased by the Client. Geohidroterv was commissioned in April 2007 to conduct a limited Phase II S&GW investigation focusing on the most western part of the plot HRSZ 0111/26 where two adjacent truck parking area are located. The corresponding report states that contamination neither in the soil nor in the groundwater was identified. Tebodin has completed a combined geotechnical, environmental and geodetic survey of the subject area covering the vacant part of plot HRSZ 0116/5, the plot HRSZ 0111/26 entirely as well as the earth road separating the two areas (HRSZ 0109; the property of the Municipality of Dunaföldvár). Soil and groundwater samples were collected from five boreholes referenced in Annex C as TDF-01, TDF-02, TDF-03, TDF-07; and TDF-08. From each of these boreholes a shallow soil sample (depth: 0.5 m below the ground level), a deep soil sample (depth: 2.5 m below the ground level) and a groundwater sample were collected, and sent for laboratory analysis. The following components were determined by the laboratory: TPH, BTEX, toxic metals, halogenated aliphatic and aromatic compounds. In addition, inorganic compounds were determined in the groundwater samples. The sampling and analytical measurements were carried out Bálint Analitika Kft that is duly accredited for sampling and laboratory analysis of the given components. The assessment is based on comparison with component specific “B” limit values applicable for soil and groundwater as stipulated in the Joint Ministry Decree (KöM, EüM, FVM, KHVM) 10/2000 (VI.2.) setting limit values for S&GW contamination, as appropriately amended by the Government Decree 219/2004 (VII.21.) concerning the protection of subsurface water resources. The results of the laboratory tests and the relevant “B” limit values are set out in Annex E. No in-compliance against the regulatory standards was revealed. Consequently, the area is assumed to be free of contamination.

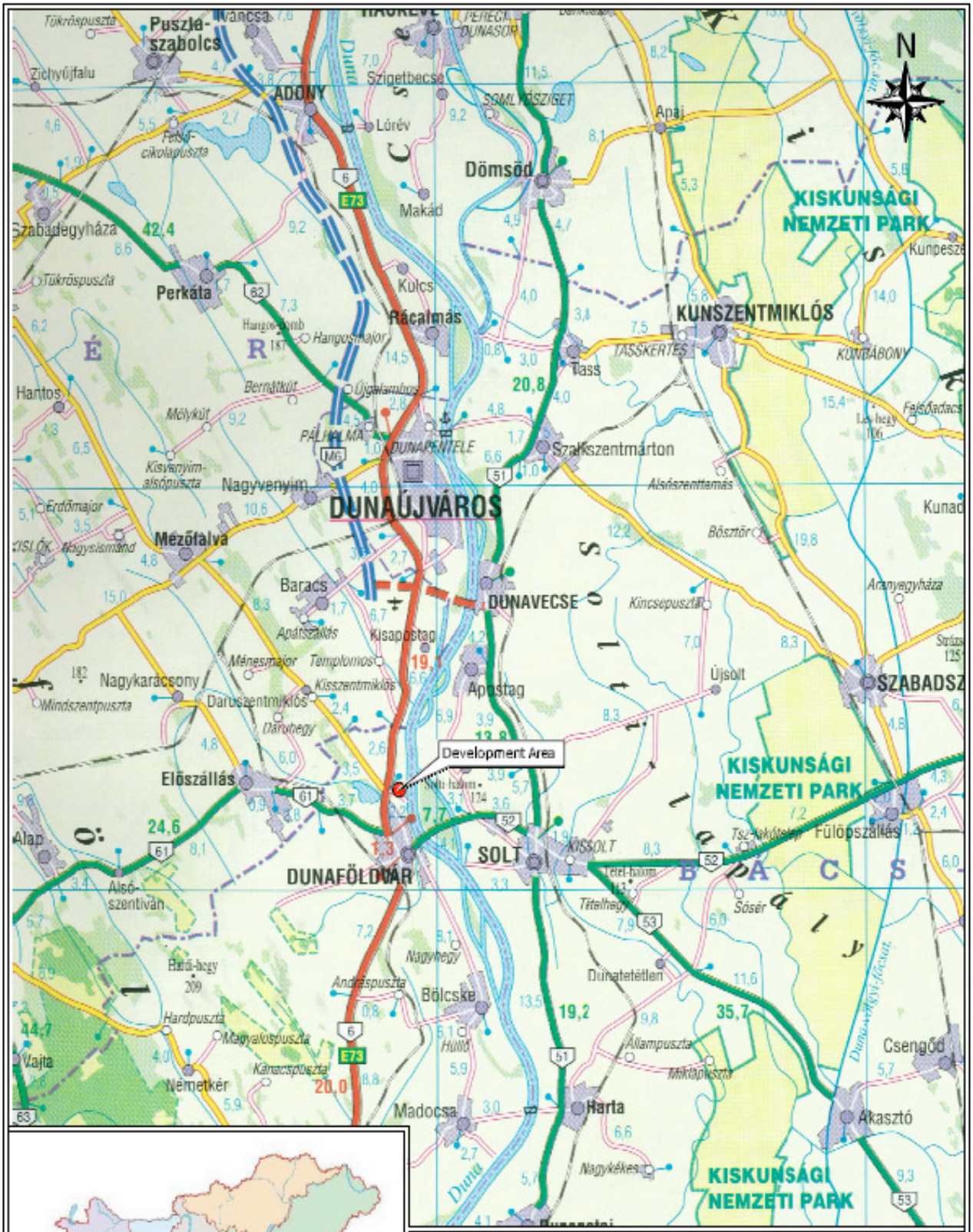
17.	**General permits issues**	The planned bioethanol facility is subject to an integrated environmental permit (IPPC) as regulated by the Government Decree No. 314/2005 on the Environmental Impact Assessment (EIA) and the Integrated Environmental Use (IPPC) Permitting. A bioethanol facility is subject to an IPPC permit on the criteria "4.1. (b) Chemical installations for the production of basic organic chemicals, such as: oxygen-containing hydrocarbons such as alcohols, aldehydes, ketones, carboxylic acids, esters, acetates, ethers, peroxides, epoxy resins" as stipulated in Annex 2 of the Decree. Prior to submission of the IPPC permit application a Preliminary EIA is to be submitted and approved by the Environmental Regulator (Middle-Transdanubian Environment, Nature Conservation and Water Inspectorate; Székesfehérvár). The Preliminary EIA provides the opportunity to present alternative solutions such as the option for water production (river versus on-site wells). In accordance with Annex 3 of the above Decree No. 314/2005 the Environmental Regulator may request the preparation a Detailed EIA based on the criteria "Production of chemicals (except peroxides) above the production of 20.000 tons of finished product a year". Given the planned production volume and the complexity of the investment (effect of Seveso regulations, separate permitting for water production) it is highly likely that a full EIA is unavoidable.
18.	**Environmental regulatory issues**	***Air emissions*** Emissions into the ambient air are regulated by the Government Decree 21/2001. (II. 14.) concerning the rules of air protection. Application to operate air emission sources (fugitive and confined air stream) should be based on the Decree (as part of the integrated permit application dossier). In response the Environmental Regulator establishes air emission limits. As for the confined air stream emissions the applicable component-specific limit values are set out in the Joint Ministry Decree (KöM-EüM-FVM) No. 14/2001. (V.9.). The minimisation of fugitive emissions should be ensured by the application of best available techniques. ***Water supply*** The water need of the planned facility cannot be provided by the municipal water supply system. There are two options to produce water in the required quantity: (i) taking water directly from the River Danube or (ii) installing groundwater abstraction wells. Given the high water quantity the probability is assessed relatively high that the authorities will be reluctant to accept groundwater abstraction. (It is recommended to address both options in the Preliminary EIA). The water permitting assumes a parallel permitting process based on the Decree of the Ministry of Transport, Telecommunication and Water No. 18/1996. (VI. 13.) <u>Note:</u> The costs of taking surface water from the river can be substantially reduced if the facilities (pipeline, pump station, water reservoir) are established avoiding the high loess walls i.e. in the AGROGRAIN area near the LUKOIL facility.

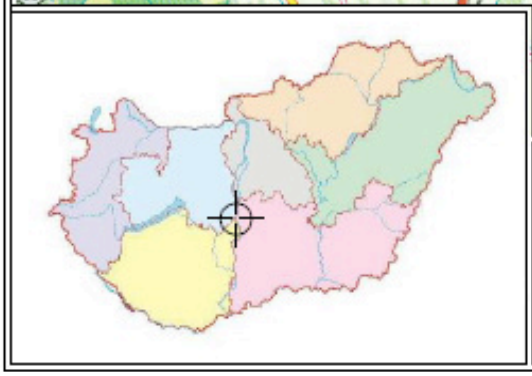
		Wastewater It is understood that no process water is generated by the planned facility. The water produced in the cooling process can be discharged into the river. The discharge into the watercourse running nearby may also be considered for economic reasons. It will be necessary to prepare a water discharge study. The stormwater may be discharged together with the cooling water. The runoff from covered surfaces must be pre-treated via oil interceptor and can only be combined with the cooling water afterwards. The quality of the water discharged into a surface water needs to comply with the provisions of the Government Decree No. 220/2004. (VII.21.) concerning the protection of the quality of surface waters. ***Material handling and storage*** There is no special permit requirement. There is a declaration required on the use of hazardous materials. In addition, there are several detailed rules on handling, storage and use of hazardous materials. In case Seveso regulation applies there is a separate permitting process. ***Waste management*** Specific requirements apply to waste collection and storage of accumulated waste on-site including secondary containment, establishment of dedicated waste storage areas, documentation and annual statutory reporting. Waste transport and final disposal can only be carried out by licensed waste management firms. (In Hungary after handling over the waste to an authorised firm the ownership of the facility ceases to exist.) The Government Decree 98/2001. (VI.15.) regulates the activities concerning hazardous waste. ***Noise*** Government Decree No. 284/2007. (X. 29.) specifies the protection measures against noise and vibration. The applicable limits are set out in the Joint Ministry Decree (KvVM and EüM) 27/2008. (XII. 3.). Given that there are no buildings to be protected in the vicinity of the area as well as the site is included in an industrial area meeting the noise standards can most probably be achieved without any specific protection measures. A base line noise assessment will required for the permitting. ***Regulated materials*** The use of asbestos and PCBs are banned in Hungary. Restrictions apply to the use of ozone depleting substances.	
19.	**Assessment Basis (✓/✗)**	✓	Documents provided the facility
		✓	Public data and authority interview
		✓	Site visit

20.	**Assessment**	***Presence of a public earth road (HRSZ 0109)*** The area of the planned investment includes a public earth road that connects the current sealed access road with the planned industrial area located to north of the subject site. The possible relocation of this earth road needs to be addressed with the owner i.e. the Municipality of Dunaföldvár. ***Restrictions in land use*** • The costal zone of the River Danube is a registered bio-corridor. However, this status does not involve any restriction in the use. • There is no known archaeological locality present in the subject site. (Given the size of the investment a Heritage Protection Plan will be required.) ***Historic soil and groundwater (S&GW) impacts*** Based on two previous Phase II S&GW investigation and current limited survey the site area is assumed to be clean, and no further investigation are recommended in this respect. One of the previous studied provide the evidence that area used by the Soviet army has been cleared from ammunitions. ***Water production*** The water need of the planned facility exceeds the capacity of the municipal water supply system. The remaining two options: (i) taking water directly from the River Danube or (ii) installing groundwater abstraction wells should be addressed by the Preliminary EIA. However, it is felt at this stage that the groundwater abstraction will be a less acceptable option for the authorities.

List of relevant environmental documents reviewed

- Land registry excerpts dated 6 April 2009
- Urban Management Plan of the Town of Dunaföldvár effective as of 1st January 2007
- Environmental Assessment of AVANTI/AVA Site; prepared Geohidroterv in June 2004
- Environmental Assessment of plot HRSZ 0111/24; prepared Geohidroterv in April 2007
- Preliminary laboratory data provided by Bálint Analitika Kft; April 2009
- Historic and current maps
- Aerial photography and satellite images





TEBODIN
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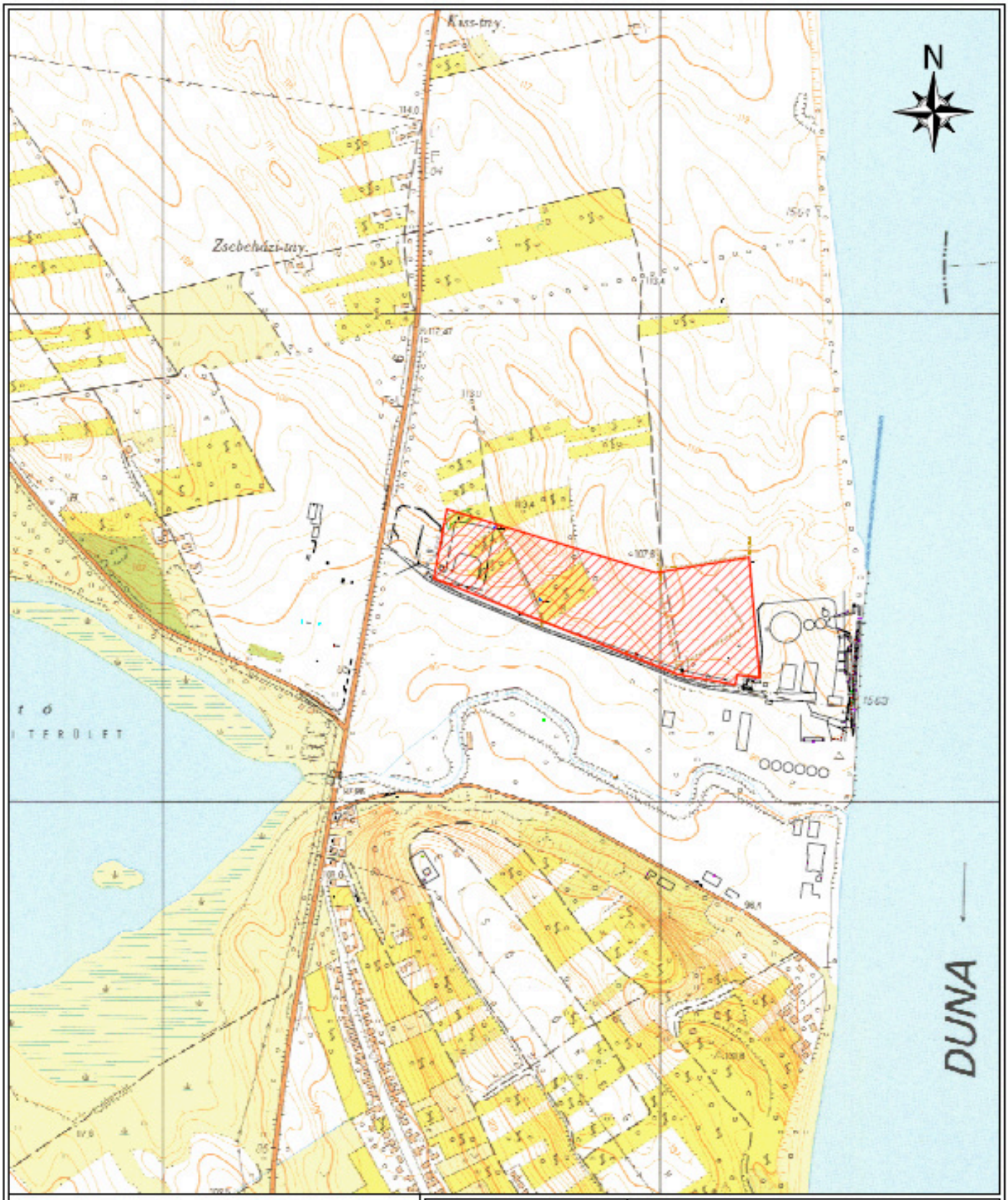
Project: Geotechnical Report Development Area of EthanolEurope Dunaföldvár / South Hungary		
Drawing's title: General Map		
Date: April 2009	Scale: 1 : 300 000	Figure's No: 1.



LEGEND:

Development Area

0 m 250 m 500 m

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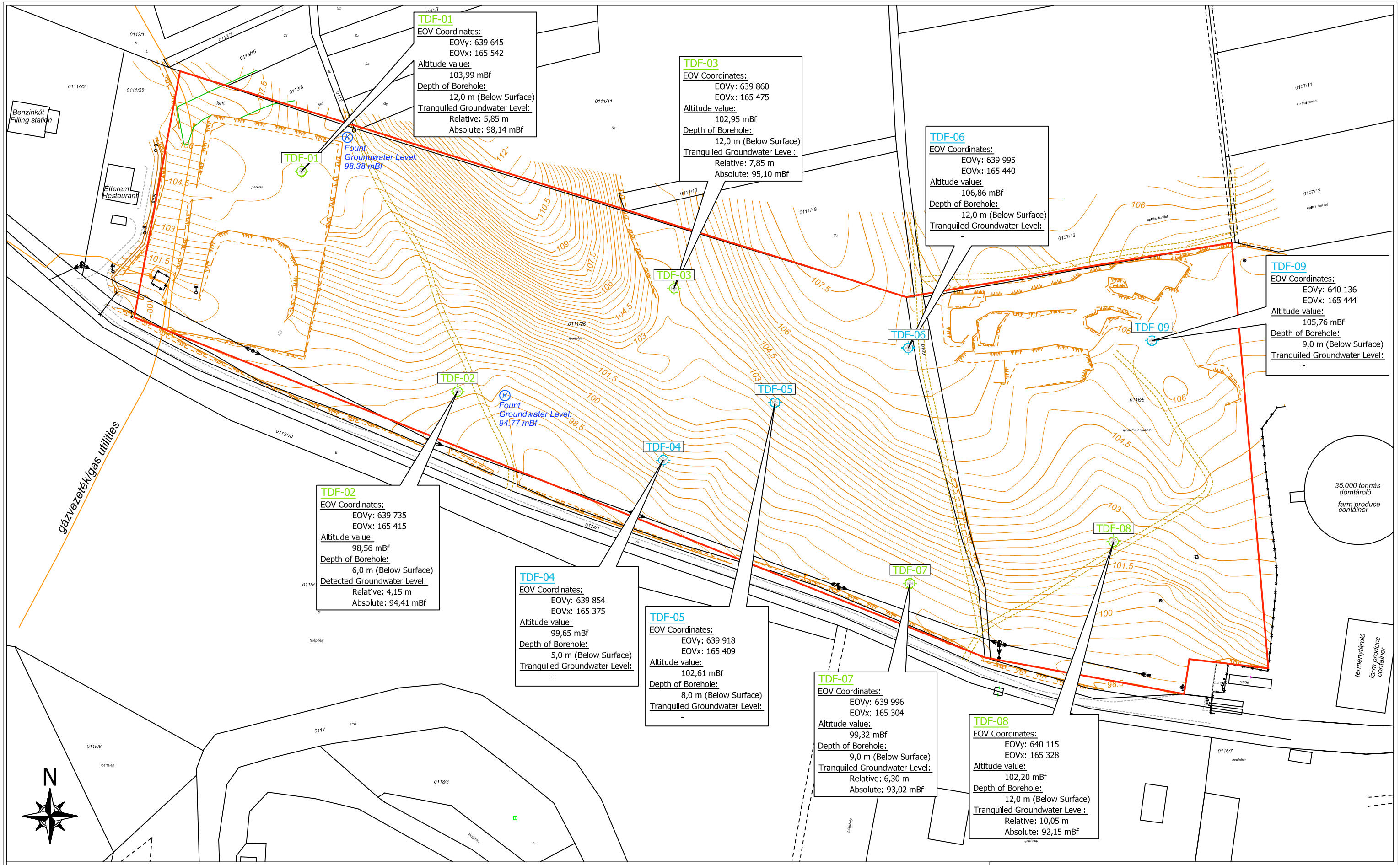
Project:
Geotechnical Report
Development Area of EthanolEurope
Dunaföldvár / South Hungary

Drawing's title:
General Layout

Date:	Scale:	Figure's Nr.:
April 2009	1 : 10 000	2.



LEGEND:

Border of Development Area

0 m 50 m 100 m

TDF-01 Environmental and Geotechnical Drillings (31. 03. 09.)

TDF-04 Geotechnical Drillings (31. 04. 01.)

The showed altitude values are based on Baltic Base Plane.

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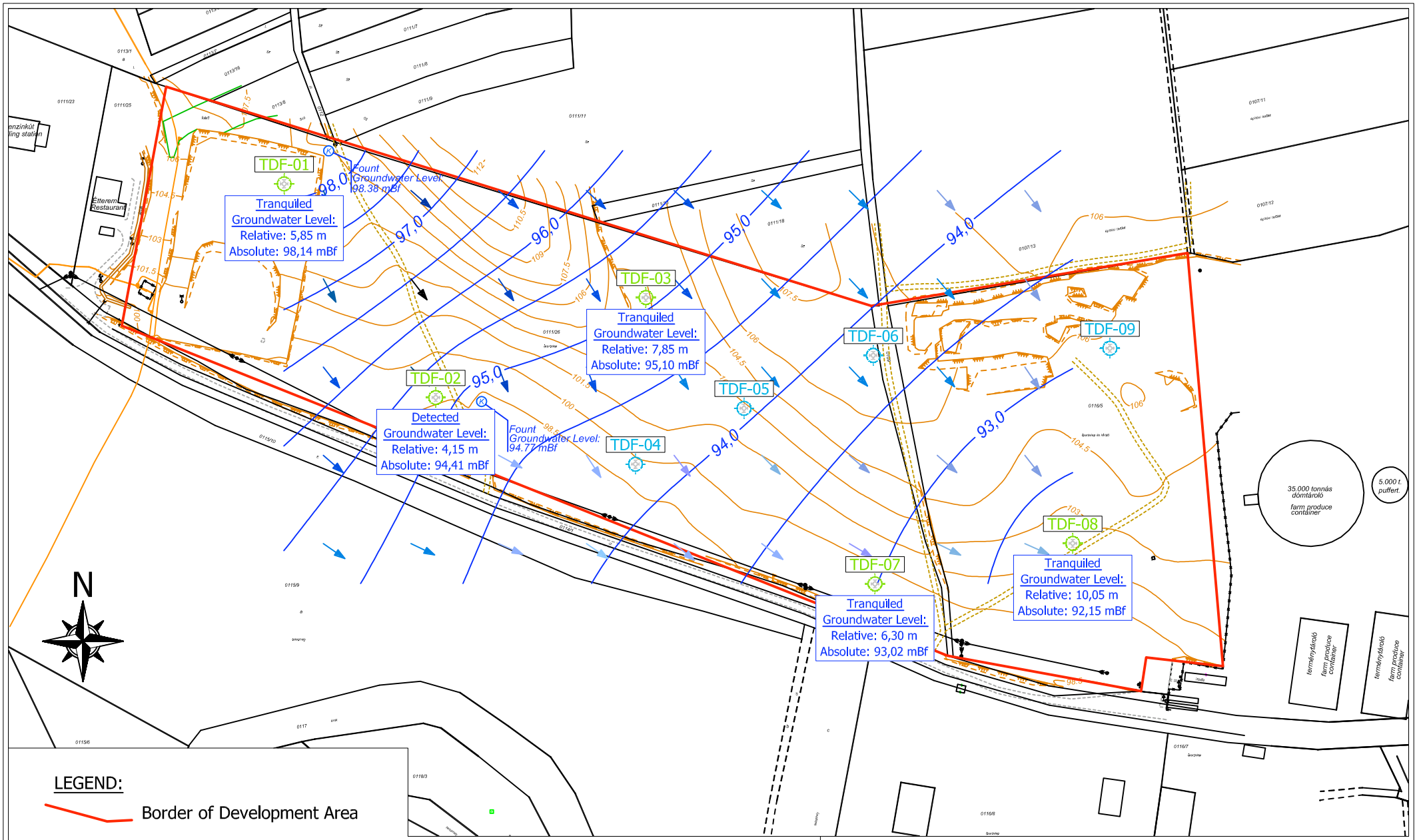
Project: Geotechnical Report Development Area of EthanolEurope Dunaföldvár / South Hungary		
Drawing's title: Documentary Layout		
Date: April 2009	Scale: 1 : 2 000	Figure's Nr.: 3.



LEGEND:

Border of Development Area

TDF-01 Environmental and Geotechnical Drillings (31. 03. 09.)

TDF-04 Geotechnical Drillings (31. 04. 01.)

94,0 Groundwater Contour Line (01. 04. 09.)

Groundwater Flow Direction (01. 04. 09.)

0 m 100 m

The showed altitude values are based on Baltic Base Plane.

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Project: Geotechnical Report Development Area of EthanolEurope Dunaföldvár / South Hungary		
Drawing's title: Groundwater Flow Map		
Date: April 2009	Scale: 1 : 3 000	Figure's Nr.: 4.

PRELIMIMARY LABORATORY RESULTS
(Signed laboratory record not yet released)

Groundwater samples

(on-site measurements)

Lab code		09-49/27	09-49/28	09-49/29	09-49/30	09-49/31
Sample Ref.		**TDF-01**	**TDF-02**	**TDF-03**	**TDF-07**	**TDF-08**
Date of on-site measurement		**31. 03. 2009**				
pH		**7.86**	**7.28**	**7.48**	**7.37**	**7.55**
Conductivity	µS/cm	**571**	**949**	**839**	**768**	**690**

Inorganic components in groundwater samples

Date of receipt: 01. 04 . 2009

Lab code		09-49/27	09-49/28	09-49/29	09-49/30	09-49/31
Sample Ref.		**TDF-01**	**TDF-02**	**TDF-03**	**TDF-07**	**TDF-08**
Date of sample preparation/End of analysis		**01. 04. 2009 / 02. 04. 2009**				
Hydrogen carbonate	mg/l	**244**	**384**	**470**	**458**	**415**
Carbonate	mg/l	**<1**	**<1**	**<1**	**<1**	**<1**
Total alkality	mmol/l	**4.0**	**6.3**	**7.7**	**7.5**	**6.8**
Total hardness	CaO mg/l	**182**	**286**	**256**	**226**	**206**
COD_p	mg/l	**0.90**	**0.68**	**2.06**	**0.60**	**3.0**
Sulphate	mg/l	**130**	**230**	**74**	**64**	**55**
Nitrate	mg/l	**15.6**	**41**	**48**	**39**	**41**
Nitrite	mg/l	**0.05**	**0.01**	**0.07**	**0.01**	**0.05**
Chloride	mg/l	**3**	**11**	**19**	**13**	**12**
Phosphate	mg/l	**0.20**	**0.18**	**0.06**	**0.10**	**0.10**
Ammonia	mg/l	**0.25**	**0.03**	**0.06**	**<0.01**	**0.10**
Iron	mg/l	**0.21**	**0.18**	**0.12**	**0.21**	**0.09**
Manganese	mg/l	**0.12**	**<0.01**	**0.02**	**0.06**	**0.01**
Sodium	mg/l	**4.50**	**20.2**	**12.1**	**21.7**	**16.4**
Potassium	mg/l	**0.64**	**0.77**	**0.99**	**0.83**	**1.17**
Magnesium	mg/l	**19.6**	**34.6**	**40.6**	**42.4**	**37.0**
Calcium	mg/l	**97.8**	**147**	**116**	**91.8**	**86.4**

Toxic metals in groundwater samples

Date of receipt: 01. 04 . 2009

Lab code		09-49/27	09-49/28	09-49/29	09-49/30	09-49/31	**"B" limit value**
Sample Ref.		**TDF-01**	**TDF-02**	**TDF-03**	**TDF-07**	**TDF-08**	
Date of sample preparation/End of analysis		**01. 04. 2009 / 02. 04. 2009**					
Ag	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	**10**
Al	µg/l	15.3	9.96	9.66	2.54	5.11	**-**
B	µg/l	25.3	23.3	41.5	55.3	55.4	**500**
Ba	µg/l	87.1	51.5	69.7	105	57.6	**700**
Br	µg/l	2.91	7.54	8.66	9.28	7.52	**-**
Cd	µg/l	0.02	<0.01	0.02	0.02	0.01	**5**
Co	µg/l	0.24	0.15	0.14	0.11	0.13	**20**
Cr	µg/l	0.30	9.79	0.46	4.99	1.18	**50**
Cu	µg/l	0.54	1.40	1.82	1.16	2.64	**200**
Mo	µg/l	2.65	0.18	1.22	0.63	1.00	**20**
Ni	µg/l	0.05	0.26	0.49	0.05	0.33	**20**
Pb	µg/l	0.38	0.24	0.27	0.35	0.34	**10**
Sb	µg/l	0.41	0.08	0.21	0.08	0.16	**-**
Se	µg/l	1.97	3.81	1.62	2.81	1.48	**5**
Sn	µg/l	0.05	<0.01	0.03	<0.01	<0.01	**10**
Zn	µg/l	5.80	5.08	6.83	5.41	8.57	**200**

Toxic metals in soil samples

Date of receipt: 01. 04 . 2009

Lab code **Sample Ref.**		09-49/32 **TDF-01/ 0.5m**	09-49/33 **TDF-01/ 2.5m**	09-49/34 **TDF-02/ 0.5m**	09-49/35 **TDF-02/ 2.5m**	09-49/36 **TDF-03/ 0.5m**	09-49/37 **TDF-03/ 2.5m**	**"B" limit value**
Date of sample preparation/End of analysis		**01. 04. 2009 / 02. 04. 2009**						
Ag	mg/kg	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	**2**
B	mg/kg	3.64	8.28	2.91	4.33	10.3	11.5	**-**
Ba	mg/kg	34.1	77.8	49.8	41.6	168	176	**250**
Br	mg/kg	4.46	6.11	6.88	1.88	6.14	4.81	
Cd	mg/kg	0.04	0.11	<0.01	0.03	0.17	0.11	**1**
Co	mg/kg	2.39	6.01	3.48	2.48	5.74	7.72	**30**
Cr	mg/kg	9.61	21.3	11.9	11.5	26.0	29.5	**75**
Cu	mg/kg	5.62	13.1	11.9	6.38	15.3	22.2	**75**
Mo	mg/kg	0.02	0.18	0.02	0.03	0.16	0.16	**7**
Ni	mg/kg	12.2	21.9	13.8	8.97	19.0	25.5	**40**
Pb	mg/kg	3.37	8.77	5.81	3.61	12.1	10.5	**100**
Sb	mg/kg	0.55	0.72	0.40	0.30	0.58	0.59	**-**
Se	mg/kg	0.24	0.44	0.30	0.26	0.48	0.15	**1**
Sn	mg/kg	1.12	1.18	0.68	0.50	1.24	1.20	**30**
Zn	mg/kg	29.3	64.2	49.0	40.5	67.4	80.0	**200**

Toxic metals in soil samples

Date of receipt: 01. 04 . 2009

Lab code **Sample Ref.**		09-49/38 **TDF-07/ 0.5m**	09-49/39 **TDF-07/ 2.5m**	09-49/40 **TDF-08/ 0.5m**	09-49/41 **TDF-08/ 2.5m**	**"B" limit value**
Date of sample preparation/End of analysis		**01. 04. 2009 / 02. 04. 2009**				
Ag	mg/kg	<0.01	<0.01	<0.01	<0.01	**2**
B	mg/kg	10.7	7.42	16.5	12.7	**-**
Ba	mg/kg	131	77.2	154	120	**250**
Br	mg/kg	8.55	4.34	2.98	6.45	**-**
Cd	mg/kg	0.11	0.06	0.17	0.08	**1**
Co	mg/kg	6.28	4.10	6.44	6.04	**30**
Cr	mg/kg	24.7	18.2	27.7	24.5	**75**
Cu	mg/kg	15.8	8.96	102	14.0	**75**
Mo	mg/kg	0.16	0.06	0.16	0.18	**7**
Ni	mg/kg	21.2	14.4	21.5	20.2	**40**
Pb	mg/kg	9.68	5.37	14.2	7.56	**100**
Sb	mg/kg	0.53	0.40	0.72	0.52	**-**
Se	mg/kg	0.28	0.27	0.15	0.63	**1**
Sn	mg/kg	0.99	0.76	1.47	1.01	**30**
Zn	mg/kg	65.2	43.7	104	54.7	**200**

Total petroleum hydrocarbons in groundwater samples (TPH-GC method)

Date of receipt: 01. 04 . 2009

Lab code	**Sample Ref.**	***Date of sample preparation/End of analysis***			**TPH-GC (*µg/l*)**
09-49/27	**TDF – 01**	02. 04. 2009 / 07. 04. 2009	C5-12 C13-40	6.2 19.7	**25.9**
09-49/28	**TDF – 02**	02. 04. 2009 / 07. 04. 2009	C5-12 C13-40	4.4 13.5	**17.9**
09-49/29	**TDF – 03**	02. 04. 2009 / 07. 04. 2009	C5-12 C13-40	1.8 17.3	**19.1**
09-49/30	**TDF – 07**	02. 04. 2009 / 07. 04. 2009	C5-12 C13-40	2.9 17.4	**20.3**
09-49/31	**TDF – 08**	02. 04. 2009 / 07. 04. 2009	C5-12 C13-40	2.6 19.1	**21.7**
"B" limit value					**100**

Detection limit: 0.5 µg/l

Accuracy: (±) 10%

Total petroleum hydrocarbons in soil samples (TPH-GC method)

Date of receipt: 01. 04 . 2009

Lab code	**Sample Ref.**	***Date of sample preparation/End of analysis***			**TPH-GC (*mg/kg*)**
09-49/32	**TDF – 01/0.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.2 3.5	**3.7**
09-49/33	**TDF – 01/2.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.4 2.9	**3.3**
09-49/34	**TDF – 02/0.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.4 3.7	**4.1**
09-49/35	**TDF – 02/2.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.4 1.4	**1.8**
09-49/36	**TDF – 03/0.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.5 6.7	**7.2**
09-49/37	**TDF – 03/2.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.4 5.6	**6.0**
09-49/38	**TDF – 07/0.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.2 4.2	**4.4**
09-49/39	**TDF – 07/2.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.3 1.0	**1.3**
09-49/40	**TDF – 08/0.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.4 5.3	**5.7**
09-49/41	**TDF – 08/2.5 m**	**02. 04. 2009 / 07. 04. 2009**	C5-12 C13-40	0.4 2.2	**2.6**
“B” limit value					**100**

Detection limit: 0.5 mg/kg

Accuracy: (±) 10%

BTEX in groundwater samples

Date of receipt: 01. 04 . 2009

Lab code	09-49/27	09-49/28	09-49/29	09-49/30	09-49/31	**"B" limit value**
Sample Ref.	**TDF – 01**	**TDF – 02**	**TDF – 03**	**TDF – 07**	**TDF – 08**	
Date of sample preparation/End of analysis	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	
Components	***µg/l***	***µg/l***	***µg/l***	***µg/l***	***µg/l***	***µg/l***
Benzene	nd	nd	nd	nd	nd	**1**
Toluene	nd	nd	nd	nd	nd	**20**
Ethyl-benzene	nd	nd	nd	nd	nd	**20**
Xilenes	nd	nd	nd	nd	nd	**20**
Other alkyl-benzenes	nd	nd	nd	nd	nd	**20**

Detection limit: 0.01 µg/L P/T

Accuracy: (±) 10%

BTEX in soil samples

Date of receipt: 01. 04 . 2009

Lab code	09-49/32	09-49/33	09-49/34	09-49/35	09-49/36	09-49/37	09-49/38	09-49/39	09-49/40	09-49/41	
Sample Ref.	**TDF – 01 0.5 m**	**TDF – 01 2.5 m**	**TDF – 02 0.5 m**	**TDF – 02 2.5 m**	**TDF – 03 0.5 m**	**TDF – 03 2.5 m**	**TDF – 07 0.5 m**	**TDF – 07 2.5 m**	**TDF – 08 0.5 m**	**TDF – 08 2.5 m**	**"B" limit value**
Date of sample preparation/End of analysis	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	02. 04. 2009 / 07. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***
Benzene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**0.2**
Toluene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**0.5**
Ethyl-benzene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**0.5**
Xilenes	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**0.5**
Other alkyl-benzenes	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**0.5**

Detection limit: 0.01mg/kg P/T

Accuracy: (±) 10%

Halogenated aliphatic hydrocarbons in groundwater samples

Date of receipt: 01. 04 . 2009

Lab code	09-49/27	09-49/28	09-49/29	09-49/30	09-49/31	
Sample Ref.	**TDF – 01**	**TDF – 02**	**TDF – 03**	**TDF – 07**	**TDF – 08**	
Date of sample preparation/End of analysis	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	**"B" limit value.**
Components	***µg/l***	***µg/l***	***µg/l***	***µg/l***	***µg/l***	***µg/l***
1.1- Dichloroethilene	nd	nd	nd	nd	nd	**10**
1.2- Dichloroethilene	nd	**0.36**	nd	nd	**0.30**	
Dichloromethane	nd	nd	nd	nd	nd	**10**
Trichlorfluoromethane	nd	nd	nd	nd	nd	**-**
1.1.2- Trichlorotrifluoro-methane	nd	nd	nd	nd	nd	**10**
1.1- Dichloroethane	nd	nd	nd	nd	nd	**1**
1.2- Dichloroethane	nd	nd	nd	nd	nd	
Chloroform	nd	nd	nd	nd	nd	**5**
2-Chloroethanol	nd	nd	nd	nd	nd	**5**
Carbon tetrachloride	nd	nd	nd	nd	nd	**2**
1.2-Dichloropropane	nd	nd	nd	nd	nd	**20**
2.3-Dichloropropilene	nd	nd	nd	nd	nd	**20**
Bromodichloremethane	nd	nd	nd	nd	nd	**30**
Bromoform	nd	nd	nd	nd	nd	
Trichloroethylene	0.09	0.30	0.08	0.12	0.27	**10**
Epichlorhydrin	nd	nd	nd	nd	nd	**0.1**
2-Chloroethyl Vinyl Ether	nd	nd	nd	nd	nd	**5**
cis-1.3- Dichloropropilene	nd	nd	nd	nd	nd	**10**
trans-1.3-Dichloropropilene	nd	nd	nd	nd	nd	
1.1.1- Trichloroethane	nd	nd	nd	nd	nd	**-**
1.1.2-Trichloroethane	nd	nd	nd	nd	nd	**30**
Dibromochloreethane	nd	nd	nd	nd	nd	**30**
1.2-Dibromeethane	nd	nd	nd	nd	nd	**0.3**
Tetrachloroethylene	nd	nd	nd	nd	nd	**10**
1.1.2.2-Tetrachlorethane	nd	nd	nd	nd	nd	**10**
Total halogenated aliphatic hydrocarbons:	0.09	0.66	0.08	0.12	0.57	**40**

Vinyl chloride	nd	nd	nd	nd	nd	**0.1**

Detection limit: 0.01 µg/l P/T; for Vinyl chloride: 0.001 µg/L (nd: not detected)

Accuracy: (±) 10%

Halogenated aromatic hydrocarbons in groundwater samples

Date of receipt: 01. 04 . 2009

Lab code	09-49/27	09-49/28	09-49/29	09-49/30	09-49/31	**"B" limit value**
Sample Ref.	**TDF – 01**	**TDF – 02**	**TDF – 03**	**TDF – 07**	**TDF – 08**	
Date of sample preparation/End of analysis	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***µg/l***	***µg/l***	***µg/l***	***µg/l***	***µg/l***	***µg/l***
Bromobenzene	nd	nd	nd	nd	nd	**0.1**
Chlorbenzene	nd	nd	nd	nd	nd	**1**
1.2-Dichlorobenzene	nd	nd	nd	nd	nd	**0.5**
1.3- Dichlorobenzene	nd	nd	nd	nd	nd	
1.4- Dichlorobenzene	nd	nd	nd	nd	nd	
1.2.4- Trichlorobenzene	nd	nd	nd	nd	nd	**0.1**
1.2.3- Trichlorobenzene	nd	nd	nd	nd	nd	
1.3.5- Trichlorobenzene	nd	nd	nd	nd	nd	
Total halogenated aromatic hydrocarbons:	nd	nd	nd	nd	nd	**2**

Detection limit: 0.01 µg/L P/T (nd: not detected)

Accuracy: (±) 10%

Halogenated aliphatic hydrocarbons in soil samples

Date of receipt: 01. 04 . 2009

Lab code	09-49/32	09-49/33	09-49/34	09-49/35	
Sample Ref.	**TDF – 01 0.5 m**	**TDF – 01 2.5 m**	**TDF – 02 0.5 m**	**TDF – 02 2.5 m**	**"B" limit value**
Date of sample preparation/End of analysis	0. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***
1.1- Dichloroethilene	nd	nd	nd	nd	-
1.2- Dichloroethilene	nd	nd	nd	nd	-
Dichloromethane	nd	nd	nd	nd	-
Trichlorfluoromethane	nd	nd	nd	nd	-
1.1.2- Trichlorotrifluoro-methane	nd	nd	nd	nd	-
1.1- Dichloroethane	nd	nd	nd	nd	-
1.2- Dichloroethane	nd	nd	nd	nd	-
Chloroform	nd	nd	nd	nd	-
2-Chloroethanol	nd	nd	nd	nd	-
Carbon tetrachloride	nd	nd	nd	nd	-
1.2-Dichloropropane	nd	nd	nd	nd	-
2.3-Dichloropropilene	nd	nd	nd	nd	-
Bromodichloremethane	nd	nd	nd	nd	-
Bromoform	nd	nd	nd	nd	-
Trichloroethylene	nd	nd	nd	nd	-
Epichlorhydrin	nd	nd	nd	nd	-
2-Chloroethyl Vinyl Ether	nd	nd	nd	nd	-
cis-1.3- Dichloropropilene	nd	nd	nd	nd	-
trans-1.3-Dichloropropilene	nd	nd	nd	nd	-
1.1.1- Trichloroethane	nd	nd	nd	nd	-
1.1.2-Trichloroethane	nd	nd	nd	nd	-
Dibromochloreethane	nd	nd	nd	nd	-
1.2-Dibromeethane	nd	nd	nd	nd	-
Tetrachloroethylene	nd	nd	nd	nd	-
1.1.2.2-Tetrachlorethane	nd	nd	nd	nd	-
Total halogenated aliphatic hydrocarbons:	**nd**	**nd**	**nd**	**nd**	**0.1**
Vinyl chloride	**nd**	**nd**	**nd**	**nd**	**0.001**

Detection limit: 0.01 mg/kg P/T; for Vinyl chloride: 0.001 mg/kg (nd: not detected)

Accuracy: (±) 10%

Halogenated aliphatic hydrocarbons in soil samples

Date of receipt: 01. 04 .2009

Lab code	09-49/36	09-49/37	**"B" limit value**
Sample Ref.	**TDF – 03 0.5 m**	**TDF – 03 2.5 m**	
Date of sample preparation/End of analysis	0. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***
1.1- Dichloroethilene	nd	nd	-
1.2- Dichloroethilene	nd	nd	-
Dichloromethane	nd	nd	-
Trichlorfluoromethane	nd	nd	-
1.1.2- Trichlorotrifluoro-methane	nd	nd	-
1.1- Dichloroethane	nd	nd	-
1.2- Dichloroethane	nd	nd	-
Chloroform	nd	nd	-
2-Chloroethanol	nd	nd	-
Carbon tetrachloride	nd	nd	-
1.2-Dichloropropane	nd	nd	-
2.3-Dichloropropilene	nd	nd	-
Bromodichloremethane	nd	nd	-
Bromoform	nd	nd	-
Trichloroethylene	nd	nd	-
Epichlorhydrin	nd	nd	-
2-Chloroethyl Vinyl Ether	nd	nd	-
cis-1.3- Dichloropropilene	nd	nd	-
trans-1.3-Dichloropropilene	nd	nd	-
1.1.1- Trichloroethane	nd	nd	-
1.1.2-Trichloroethane	nd	nd	-
Dibromochloreethane	nd	nd	-
1.2-Dibromeethane	nd	nd	-
Tetrachloroethylene	nd	nd	-
1.1.2.2-Tetrachlorethane	nd	nd	-
Total halogenated aliphatic hydrocarbons:	**nd**	**nd**	**0.1**
Vinyl chloride	**nd**	**nd**	**0.001**

Detection limit: 0.01 mg/kg P/T; for Vinyl chloride: 0.001 mg/kg (nd: not detected)

Accuracy: (±) 10%

Halogenated aliphatic hydrocarbons in soil samples

Date of receipt: 01. 04 .2009

Lab code	09-49/38	09-49/39	09-49/40	09-49/41	
Sample Ref.	**TDF – 07 0.5 m**	**TDF – 07 2.5 m**	**TDF – 08 0.5 m**	**TDF – 08 2.5 m**	**"B" limit value**
Date of sample preparation/End of analysis	0. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***
1.1- Dichloroethilene	nd	nd	nd	nd	-
1.2- Dichloroethilene	nd	nd	nd	nd	-
Dichloromethane	nd	nd	nd	nd	-
Trichlorfluoromethane	nd	nd	nd	nd	-
1.1.2- Trichlorotrifluoro-methane	nd	nd	nd	nd	-
1.1- Dichloroethane	nd	nd	nd	nd	-
1.2- Dichloroethane	nd	nd	nd	nd	-
Chloroform	nd	nd	nd	nd	-
2-Chloroethanol	nd	nd	nd	nd	-
Carbon tetrachloride	nd	nd	nd	nd	-
1.2-Dichloropropane	nd	nd	nd	nd	-
2.3-Dichloropropilene	nd	nd	nd	nd	-
Bromodichloremethane	nd	nd	nd	nd	-
Bromoform	nd	nd	nd	nd	-
Trichloroethylene	nd	nd	nd	nd	-
Epichlorhydrin	nd	nd	nd	nd	-
2-Chloroethyl Vinyl Ether	nd	nd	nd	nd	-
cis-1.3- Dichloropropilene	nd	nd	nd	nd	-
trans-1.3-Dichloropropilene	nd	nd	nd	nd	-
1.1.1- Trichloroethane	nd	nd	nd	nd	-
1.1.2-Trichloroethane	nd	nd	nd	nd	-
Dibromochloreethane	nd	nd	nd	nd	-
1.2-Dibromeethane	nd	nd	nd	nd	-
Tetrachloroethylene	nd	nd	nd	nd	-
1.1.2.2-Tetrachlorethane	nd	nd	nd	nd	-
Total halogenated aliphatic hydrocarbons:	**nd**	**nd**	**nd**	**nd**	**0.1**
Vinyl chloride	**nd**	**nd**	**nd**	**nd**	**0.001**

Detection limit: 0.01 mg/kg P/T; for Vinyl chloride: 0.001 mg/kg (nd: not detected)

Accuracy: (±) 10%

Halogenated aromatic hydrocarbons in soil samples

Date of receipt: 01. 04 .2009

Lab code	09-49/32	09-49/33	09-49/34	09-49/35	
Sample Ref.	**TDF – 01 0.5 m**	**TDF – 01 2.5 m**	**TDF – 02 0.5 m**	**TDF – 02 2.5 m**	**"B" limit value**
Date of sample preparation / End of analysis	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***
Bromobenzene	nd	nd	nd	nd	-
Chlorbenzene	nd	nd	nd	nd	-
1.2-Dichlorobenzene	nd	nd	nd	nd	-
1.3- Dichlorobenzene	nd	nd	nd	nd	-
1.4- Dichlorobenzene	nd	nd	nd	nd	-
1.2.4- Trichlorobenzene	nd	nd	nd	nd	-
1.2.3- Trichlorobenzene	nd	nd	nd	nd	-
1.3.5- Trichlorobenzene	nd	nd	nd	nd	-
Total halogenated aromatic hydrocarbons:	**nd**	**nd**	**nd**	**nd**	**1**

Detection limit: 0.01 mg/kg P/T (nd: not detected)

Accuracy: (±) 10%

Halogenated aromatic hydrocarbons in soil samples

Date of receipt: 01. 04 .2009

Lab code	09-49/36	09-49/37	**"B" limit value**
Sample Ref.	**TDF – 03 0.5 m**	**TDF – 03 2.5 m**	
Date of sample preparation / End of analysis	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***
Bromobenzene	nd	nd	-
Chlorbenzene	nd	nd	-
1.2-Dichlorobenzene	nd	nd	-
1.3- Dichlorobenzene	nd	nd	-
1.4- Dichlorobenzene	nd	nd	-
1.2.4- Trichlorobenzene	nd	nd	-
1.2.3- Trichlorobenzene	nd	nd	-
1.3.5- Trichlorobenzene	nd	nd	-
Total volatile halogenated aromatic hydrocarbons:	**nd**	**nd**	**1**

Detection limit: 0.01 mg/kg P/T (nd: not detected)

Accuracy: (±) 10%

Halogenated aromatic hydrocarbons in soil samples

Date of receipt: 01. 04 .2009

Lab code	09-49/38	09-49/39	09-49/40	09-49/41	**"B" limit value**
Sample Ref.	**TDF – 07 0.5 m**	**TDF – 07 2.5 m**	**TDF – 08 0.5 m**	**TDF – 08 2.5 m**	
Date of sample preparation / End of analysis	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	02. 04. 2009 / 06. 04. 2009	
Components	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***	***mg/kg***
Bromobenzene	nd	nd	nd	nd	-
Chlorbenzene	nd	nd	nd	nd	-
1.2-Dichlorobenzene	nd	nd	nd	nd	-
1.3- Dichlorobenzene	nd	nd	nd	nd	-
1.4- Dichlorobenzene	nd	nd	nd	nd	-
1.2.4- Trichlorobenzene	nd	nd	nd	nd	-
1.2.3- Trichlorobenzene	nd	nd	nd	nd	-
1.3.5- Trichlorobenzene	nd	nd	nd	nd	-
Total halogenated aromatic hydrocarbons:	**nd**	**nd**	**nd**	**nd**	**1**

Detection limit: 0.01 mg/kg P/T (nd: not detected)

Accuracy: (±) 10%

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BIOETHANOL PLANT
AND
POWER CENTRE

DUNAFÖLDVÁR (HRSZ.: 0111/26, 0109, 0116/5)

ENVIRONMENTAL IMPACT STUDY AND INTEGRATED ENVIRONMENT USE PERMIT DOCUMENTATION

SINGLE PROCEDURE

2010
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Professionals performing the expertise:

Sub-field of the IPPC documentation	Name of the sub-field's expert	Expert License Number	Description of the special field/sub-field included in the Expert License
Air	Kaleta, János	SZKV/07-0789	Environmental protection / 1.2. air purity protection
Waters	Kaleta, János	VZ-Sz/07-0789	Water engineering expert
Soil	Kovalóczy, György	GT-T/01-7507	Geotechnical designer
Waste	Kaleta, János	SZKV/07-0789	Environmental protection / 1.1. waste management
Noise	Sipos, László	Sz-806/2007	K-K Noise and vibration protection
Environmental protection	Dr Seregélyesné Csomós, Ágnes	Sz-409/2006	K-T Environmental protection

Expert responsible for the preparation of the entire IPPC documentation: Kaleta, Jánosné.

Expert licenses:

- Expert License of the Chamber of Engineers of Fejér County: No. SZKV/07-0065; environmental protection fields:
  - 1.1 waste management
  - 1.2. air purity protection
  - 1.3 water and soil protection
  - 1.4 noise and vibration protection
- Expert License of the Chamber of Engineers of Fejér County: No. VZ-SZ/07-0065: Water engineering expert
- Nature and landscape protection expert license of the National Inspectorate for Environment, Nature and Water, SZTV: wildlife protection

PREAMBLE

Pannónia Ethanol Zártkörűen Működő Részvénytársaság (1050 Budapest, Zrínyi utca 16. 3. em. 10.; Trade Reg. No.: 01-10-046437/8) intends to implement a bioethanol plant and a power centre able to supply its heat and electric energy requirements in Dunaföldvár (HRSZ: 0111/26, 0109, 0116/5).

Data characterizing the volume of the operations:

Bioethanol production capacity:	***186 000MT/year***
Heat input capacity of power centre:	***75MW$_{th}$***
Technological water requirement (from subsurface waters)	3000m^3/day
Electric power production	1.5MW$_e$

Based on the above data and according to Govt. Decree 314/2005. (XII. 35.) on Environmental Impact Studies and Integrated Environment Use Permits, the following activity categories are subject to preliminary survey and require integrated environment use permit:

a) Activity categories subject to environment use permit

According to Annex 2 of Govt. Decree 314/2005. (XII. 25.)

1.	1.1. Combustion equipment with heat input capacity exceeding 50MW$_{th}$
4.	Only for industrial scale production: 4.1. Chemical plants for basic organic chemicals, namely *b)* oxygen containing carbohydrates, such as alcohols, aldehydes, ketones, organic acids, esters, acetates, ethers, peroxides, epoxy-compounds

b) Activity categories subject to preliminary survey

According to Annex 2 of Govt. Decree 314/2005. (XII. 25.)

37.	Production of chemicals (except for peroxides) over 20,000MT/year finished product
78.	Heat energy (steam and hot water) producing plants above heat output capacity of 50MW

In compliance with Article 3 (1) of the Decree:

The environment user has to initiate a preliminary survey at the Inspectorate if implementation of activities is envisaged that are:

a) specified in Annex 1 or Annex 3, or

b) specified in Annex 2 and qualify as new activities according to Article 2 (3) paragraph a) and still have no integrated environment use permit.

License holder has performed the preliminary survey, closed by resolution No. 8407/10 of The Middle Transdanubian Inspectorate for Environmental Protection, Natural Protection and Water Management, attached hereto under *Annex 3.*

In the course of the preliminary survey, the Inspectorate has established that remarkable environmental impacts might be generated from the implementation of the envisaged operations, therefore it required preparation and submission of an impact study documentation beyond the integrated environment use permit application.

In virtue of Article 24 of Govt. Decree 314/2005. (XII. 25.), license holder decided to contract the environmental impact study and the integrated environment use permit procedures.

TEBODIN Hungary Kft. (1119 Budapest, Bikszádi utca 6/A) as general designer has employed PROGRESSIO Mérnöki Iroda Kft. (1025 Budapest, Galgóczy köz 6/C.) for preparing the preliminary survey documentation.

Data, plans, maps and official documents required for the preparation of the environmental impact study and integrated environment use permit documentation have been made available to contractor by Customer.

PROGRESSIO Mérnöki Iroda Kft. has compiled this documentation in compliance with the applicable legal rules, standards and technical guidelines, as well as with the requirements of the Good Engineering Practice.

List of the legal rules:
The following legal rules have been observed during preparation of the preliminary survey:

Table 1: Legal rules observed during preparation of the application for permit

No.	Description of the legal rule
1.	1995. évi LIII. törvény a környezet védelmének általános szabályairól
2.	1996. évi LIII. törvény a természet védelméről
3.	1995. évi LVII. törvény a vízgazdálkodásról
4.	2000. évi XLIII. törvény a hulladékgazdálkodásról
5.	2001. évi LXIV. törvény a kulturális örökség védelméről
6.	314/2005. (XII. 25.) Korm. rendelet a környezeti hatásvizsgálati és az egységes környezethasználati engedélyezési eljárásról
7.	220/2004. (VII. 21.) Korm. rendelet a felszíni vizek minősége védelmének szabályairól
8.	219/2004. (VII. 21.) Korm. rendelet a felszín alatti vizek védelméről
9.	6/2009. (IV. 14.) KvVM-EüM-FVM együttes rendelet a földtani közeg és a felszín alatti víz szennyezéssel szembeni védelméhez szükséges határértékekről és a szennyezés méréséről
10.	123/1997. (VII. 18.) Korm. rendelet a vízbázisok, a távlati vízbázisok, valamint az ivóvízellátást szolgáló vízilétesítmények védelméről
11.	38/1995. (IV. 5.) Korm. rendelet a közműves ivóvízellátásról és a közműves szennyvízelvezetésről
12.	21/2001. (II. 14.) Korm. rendelet a levegő védelmével kapcsolatos egyes szabályokról
13.	4/2002. (X. 7.) KvVM rendelet a légszennyezettségi agglomerációk és zónák kijelöléséről
14.	27/2008. (XII. 3.) KvVM-EüM együttes rendelet a zaj- és rezgésterhelési határértékek megállapításáról
15.	93/2007. (XII. 18.) KvVM rendelet a zajkibocsátási határértékek megállapításának, valamint a zaj- és rezgéskibocsátás ellenőrzésének módjáról
16.	284/2007. (X. 29.) Korm. rendelet a környezeti zaj és rezgés elleni védelem egyes szabályairól
17.	14/2001. (V. 9.) KöM-EüM-FVM együttes rendelet a légszennyezettségi határértékekről, a helyhez kötött légszennyező pontforrások kibocsátási határértékeiről
18.	45/2004. (VII. 26.) BM-KvVM együttes rendelet az építési és bontási hulladék kezelésének részletes szabályairól
19.	253/1997. (XII.20.) Korm. rendelet az országos településrendezési és építési követelményekről

1. BACKGROUND SUMMARY

1.1. IDENTIFICATION DATA OF APPLICANT

Name: PannoniaEthanol Zrt.
Address: 1050 Budapest, Zrínyi utca 16. 3. em. 10.
KÜJ (environmental client ID): 102532425
KTJ (environmental regional ID): 102053840
HCSO ID: 14858019-3520-114-01

Licenses of the experts preparing the survey are attached in Annex 1 hereto.

1.2. DATA OF THE IMPLEMENTATION SITE

The plant will be implemented in Dunaföldvár Industrial Park, located in the northern inner belt area of Dunaföldvár municipality.
The area available for the project is of 9.5 hectares (94,809m^2).

The project area is located in the properties having the following topographical lot numbers:

- 0116/5: (actual area: 99,691m^2; to be divided)
- 0109: (actual area: 3,651 m^2; to be merged)
- 0111/26 (actual area: 80,000m^2; to be divided)

The lot No. 0116/5 owned by Cargill/Agrograin, where Cargill/Agrograin's grain management logistics centre is located, will be divided. The objects of Cargill/Agrograin are located on the eastern part of the area; the western part to be involved in the ethanol plant project is unbuilt, mainly covered by weeds and shrubs.

The lot No. 0109 is actually owned by Dunaföldvár Municipality, functioning at present as a field road. With its Council Resolution 111/2009. (V. 26.), the Municipality granted for the development company possibility to involve this area into the project, against other area in exchange.

The lot No. 0111/26 is also owned by Cargill/Agrograin. The eastern part of the area is at present cultivated, while its western part is uncultivated.

Annex 11 highlights the boundaries of the project implementation area.

The development area is located on the north periphery of Tolna County, within the administrative territory of Dunaföldvár Municipality. The prevailing Uniform Urban Development Plan of Dunaföldvár has been approved by the Municipality's representative body by resolution 18/2006. (XII. 05.).
The project area is located in the "B2" interior zone section. The plant construction area may be qualified as interior zone following implementation of the land office proceedings required for interior zone categorization as to Article 12 of the Local Building Regulations.

Annex 4 includes extract of the Regulation Plan.

The envisaged operation is in compliance with the Region's development concept and with the regulation plan of Dunaalmás Municipality.

1.2.1. OPINIONS OF THE INSPECTORATE AND OTHER SPECIAL AUTHORITIES AND REMARKS MADE BY THE PUBLIC DURING THE PRELIMINARY ENVIRONMENTAL IMPACT STUDY PROCEDURE

The preliminary assessment documentation approved by resolution 8407/10 of The Middle Transdanubian Inspectorate for Environment, Nature and Water concerned the implementation of the bioethanol plant and power centre.

The Middle Transdanubian Inspectorate for Environment, Nature and Water has made provisions based on the remarks of the Inspectorate and of the competent authorities during the preliminary assessment procedure.

The relevant provisions are detailed in the following table, specifying also the integrated environment use permit and the Chapter of the documentation containing exposition of the relevant answers.

Table 2: Official remarks emerged during the preliminary assessment procedure

Official provision		IPPC (Chapter)
2.01.	Treatment methods of the water withdrawn from the wells have to be presented.	4.4.2.
2.02.	Composition, typical contaminants and temperature of the high salt content blow-down waters generated during water treatment and to be discharged into the Danube, the method of discharge into the recipient (coastal or stream), the extent of mixing and the impacts on the recipient's water quality, as well as the ratio of these data to the regional limit values concerning discharge into surface waters are to be specified.	6.3.2.3.
2.03.	The rainfall runoff network of the Cargill/Agrograin plant diverting the waste waters and the rain waters has to be presented, specifying its hydraulic capacity and the declaration of acceptance of its managing entity has to be submitted.	6.3.2.4. Annex 8
2.04.	Declaration of approval allowing discharge of waste waters into the Danube of The Middle Danube Valley Directorate of Environment and Water Management is to be submitted.	Annex 9
2.05.	It has to be certified that recirculated process waters utilized also in the cooling towers will not by any means discharged into the Danube.	4.2. 6.3.2.3.
2.06.	The intended water-saving measures are to be presented.	4.2., 5., 6.3.
2.07.	Disposal method of the communal waste waters (collection and removal or construction of discharge network up to the sewage trunk line) is to be presented.	Annex 9 6.3.2.3.
2.08.	It has to be specified, in what events the excess quantity of rain waters accumulated in the containment area of the ethanol tank park will be pumped into the rainfall runoff system and what sampling and quality testing will be performed prior to the discharge, and what rain waters will be used for watering.	6.3.2.4. 6.3.2.5.
2.09.	It has to be stated, whether development of a monitoring system is envisaged for monitoring the quality of the high salt content blow-down waste waters discharged into the surface water.	
2.10.	Data supply and the relevant annexes require for the establishment of the noise emission limit value in compliance with the prevailing legal rules are to be submitted.	6.1.5. 6.2.5. 6.3.5. Annex 10
2.11.	Based on Article 2, Section (2) of Decree 93/2007. (XII. 18.) of the Ministry of Environment and Water *on the methods of establishing the noise emission limit values and of checking noise and vibration emission* (hereinafter: KvVM Decree) the noise and vibration protection impact area of the bioethanol plant has to be determined and also delineated on a map in compliance with provisions of Govt. Decree 284/2007. (X. 29.) *on certain rules of the protection against environmental noise and vibration* (hereinafter: Noise Decree).	
2.12.	Topographical lot numbers and urban development zoning of the areas and addresses,	

Official provision		IPPC (Chapter)
	topographical lot numbers and classification according to the list of constructions to be protected against noise and located within the impact area are to be specified.	
2.13.	Based on Article 2, Section (2) of the KvVM Decree, results of the background load assessment preceding the envisaged future conditions and the calculation results of the impact area are to be submitted.	
2.14.	Industrial and leisure-related noise sources in the vicinity of the plant area with impact area overlapping that of the bioethanol plant have to be listed in the acoustic expert opinion and marked on a map.	
2.15.	The indirect impact area connected with the transport activities has to be determined in compliance with the Noise Decree; the permit application documentation to be submitted has to include the calculation results.	
2.16.	Extract of the regulation plan of Dunaföldvár Municipality including the development area and the number of the Municipality's resolution approving such regulation plan are to be attached.	Annex 4
2.17.	Impacts of the envisaged water withdrawal to the water base protection zone, the subsurface water stock and to the direct environment are to be assessed in detail and presented.	4.4.1., 6.1.2. 6.2.2., 6.3.2. Annex 5
2.18.	It has to be certified that emissions of the bioethanol production technology, with special regard to the emission of volatile organic compounds (VOC) and solid air pollutants, as well as air pollutant emissions of the heat supply equipment serving the heat requirement of the bioethanol production technology comply with the technological emission limit values specified in the prevailing legal rule.	6.3.1.2.
2.19.	The actual basic air pollution of the project area is to be demonstrated in detail by the available measurement protocols and source indication of other data.	Annex 6
2.20.	Detailed calculations have to demonstrate that the basic air pollution in the direct impact area of the point sources to be implemented will not exceed, even with the emissions of the newly implemented air polluting point sources the annual air pollution limit values specified in Annex 1.1. of joint Decree 14/2001. (V. 9.) of the Ministries of Environment, Health and Agriculture and Rural Development *on the air pollution limit values and emission limit values of stationary polluting point sources.*	6.3.1.5.
2.21.	Compliance with the best available techniques has to be demonstrated, beyond the basic activity, also for the open-air storage, transport and other supporting activities.	5.
2.22.	As in virtue of Article 6, Section (1) of Govt. Decree 21/2001. (II. 14.) *on certain rules concerning air protection*, based on Section A/4.1.b./ of Annex 2, protection zone of 500 to 1000m is to be established, the actual size of the protection zone has to be determined, furthermore, through proper representation on map, the borders of the protection zone to be established have to be determined and the topographical lot numbers and proprietors of the plots concerned by the protection zone are to be specified.	6.3.1.7.
2.23.	The envisaged planting on the site may exclusively be made by use of native species.	4.4.4. 6.1.6. 6.2.6. 6.3.6. Annex 11
2.24.	The plantation plan has to be submitted to the Inspectorate latest in the course of the environmental impact study and integrated environment use permit application procedure.	

1.3. STUDY PREPARATION METHOD

During elaboration of this environmental impact study and IPPC documentation, we have proceeded according to the following method:

- Performance and analysis of measurements
- Evaluation of the measurement results

- Detailed technology analysis
  - Emission analysis
  - Determination of the impact areas, evaluation of the results
- Checking compliance with the best available techniques
- Assembling the documentation
  - Application of the statutory thematic
  - Integration of the provisions of resolution 8407/10
- Reconciliation with the authorities

1.4. BASIC DATA OF THE PRELIMINARY ASSESSMENT DOCUMENTATION, CHANGE TRACKING

The annual material flow of the technology has been corrected against the basic data specified during the preliminary assessment. The ethanol production capacity of 200,000MT/year indicated in the preliminary assessment documentation has been modified to 186,000MT/year.

The following Table recapitulates the emission data indicated in the preliminary survey but corrected during the integrated environment use permit application procedure.

Table 3: Emission data indicated in the preliminary survey

No.	Operation	Chimney height [m]	Chimney surface [m^2]	Exit gas temp. [K]	Volume flow rate [Nm^3/h]	Composition	Output conc. [mg/Nm^3]	Mass flow [kg/h]
P1	Corn entry	25	0.35	283	63927	Solids	12.6	0.81
P2	Mill	25	0.35	283	45897	Solids	12.6	0.58
P3	DDGS cooling	25	0.35	300	40020	Solids	14.6	0.58
P4	DDGS loading	25	0.35	283	6147	Solids	12.5	0.08
P5	Gas washer	25	0.35	300	9278	VOC	131.2	1.22
P6	Power center	30.5	2.21	453	112642	CO	83	9.35
						NO_x	93.2	10.50
						SO_x	20.2	2.28
						VOC	20.8	2.34

Table 4:Modified emission data used in the IPPC proceeding

No.	Operation	Chimney height [m]	Chimney surface [m^2]	Exit gas temp. [K]	Volume flow rate [Nm^3/h]	Composition	Output conc. [mg/Nm^3]	Mass flow [kg/h]
P1	Corn entry	41.5	1.43	299	60522	solids	45.0	2.71
P2	Mill	41.5	0.71	303	28949	solids	45.0	1.29
P3	DDGS cooling	41.5	0.64	327	49028	solids	45.0	2.12
P4	DDGS loading	12	0.64	310	4613	solids	45.0	0.20
P5	Gas washer	25	0.35	283	9689	VOC	135.0	1.29
P6	Power center	30.5	2.21	420	163955	CO	36.6	6.00
						NOx	36.6	6.00
						SOx	12.8	2.10
						VOC	54.9	9.00
						solids	1.8	0.30

It may be established that for point source marked P6, having determinative effect for the overall emissions, the mass flow – and consequently the environmental impact – of the emission have further decreased in comparison to that specified during the preliminary survey.

2. BASIC DATA OF THE ENVISAGED ACTIVITY

2.1. PURPOSE OF THE ACTIVITY

The resources of the traditional fossil fuels are not inexhaustible and their exploitation is not always economical. Researches are in course for satisfying the energy requirements by using materials that can be produced in large volume and at low cost.

Experiments for driving explosion engines by other fuels than petroleum derivatives occurred already following the fuel shortage at the beginning of the previous century. Production of biomass as fuel (additive) came to the limelight during the recent decade, as its large-scale production technology developed.

The production of bio-fuels contributes to better utilization of the agricultural products, thus may lead to increasing the number of those employed in the agricultural sector, improving security of the production and its profitability.

Also the EU guidelines urge development of the domestic bio-fuel production, making the use of alternative fuels obligatory.

The primary purpose of the implementation of the plant consists in the production of bioethanol additive to be mixed as engine fuel for (partially) replacing petroleum derivatives, in a quantity of 186,000MT/year, through utilization of agricultural products available in large volumes. The secondary purpose consists in selling the DDGS (195,000MT/year) generated as by-product during the operation for animal feeding.
Corn kernels will serve as raw material for the manufacturing process.

2.2. VOLUME OF THE ACTIVITIES

The envisaged activity would be implemented on the properties HRSZ 0111/26, 0109 and 0116/5 in Dunaföldvár. The total area of the properties amounts to 18.33 hectares, of which the planning area covers 9.5 hectares. Copies of the title deeds of the properties are attached in *Annex 2.*
The plot division of the properties is already in course; the plot division will not influence the size of the planning area.

Envisaged capacity of the plant: 186,000MT/year bioethanol without denaturants.

Corn kernels will serve as raw material for the manufacturing process, of which annually 600,000MT will be processed for manufacturing the above-mentioned quantity of bioethanol. Beyond the main product, about 195,000MT/year Dried Distillers' Grains with Solubles (DDGS) will be generated.

The main parameters of the production process are as follows:

- Envisaged annual operating days: 352
- Daily production volume: 538MT ethanol
- Number of shifts: 3 (continuous operation)

Natural gas fuelled combustion equipment will be installed for satisfying the ethanol plant's heat and electric energy requirements and for drying the DDGS produced, with 75MW input heat capacity.

The technological water requirement of the ethanol production and of the power centre of 3,000m^3/day will be granted from deep groundwater wells located within the plant.

Section 4.2. includes detailed description of the technology.

3. BEST AVAILABLE TECHNIQUES

The EU Member States had to implement in their national legislation the Council Directive 96/61/EC on Integrated Pollution Prevention and Control (IPPC Directive) until 30 October 1999.

In compliance with the harmonization of the Hungarian law and with the EU requirements, the IPPC Directive has been adopted by the Hungarian legal system through amendment of Act LIII of 1995 on General Rules of the Environmental Protection (Kvt.) and enactment of Govt. Decree 193/2001. (X. 19.), laying down the detailed rules of the integrated environment use permit procedure; then, as of 1 January 2006, Govt. Decrees 20/2001. (II. 14.) and 193/2001. (X. 19.) on the environmental impact study procedure have been replaced by Govt. Decree 314/2005. (XII. 25.) on environmental impact study and integrated environment use permit procedure. By 31 October 2007, all operators (permit holders) had to fully comply with the provisions of the integrated environment use permit.

Annex 9 of Govt. Decree 314/2005. (XII. 25.) specifies all conditions allowing both the authority issuing permits and permit holders (environment users) to establish, what is to be considered as BAT.

No Reference Document on BAT (BREF) has been prepared for the bioethanol production technology. Compliance with the best available techniques has been established on the basis of the following documents:

- Draft BAT Guidance Note on Best Available Techniques for the Brewing, Malting & Distilling Sector
- Reference Document on Best Available Techniques in the Food, Drink and Milk Industries

Industrial scale bioethanol production from renewing energy sources is under introduction throughout the world. The main source of production is usually constituted of high starch containing grains, such as wheat, corn or barley.

Several engineering bureaus offer procedures and technologies for the implementation of such plants. However, the basic concept of all these solutions is highly similar.

For analyzing the best available techniques of the gas furnaces of the power centre, the following directives have been taken as basis:

- Govt. Decree 314/2005. (XII.25.), Annex 9

- Reference Document on Best Available Techniques for Large Combustion Plants
- Reference Document on the General Principles of Monitoring
- Reference Document on Best Available Techniques for Energy Efficiency

We have paid special attention to the parts on technologies that were comparable with the natural gas burning technology of the envisaged power centre.

3.1. BEST AVAILABLE TECHNOLOGY – BIOETHANOL PLANT

3.1.1. Primary procedures

3.1.1.1.Delivery, storage, preparation

High volumes of solid commodities are usually transported in bulk. These are mainly used immediately or stored in silos. The solid raw material may be conveyed pneumatically (powders or grains) or on conveyor belts, by feeder devices, screw feeders or by using pumps.

The engines of the trucks may cause remarkable noise load during operation. This may be avoided by stopping the engine during loading and parking. If electricity is required for the loading, it may be granted from external sources.

3.1.1.2.Milling

Several milling or breaking technologies are used during processing of the different food derivatives. Milling may be made in dry or wet condition. During wet milling or grinding smaller grain size can be obtained. The dry technology is often combined with grading through sieving or air blasting, thus obtaining a better grain size distribution. These milling systems are usually completed with a separation device (usually some cyclone), returning the dusts thus recovered into the process.

Breaking methods used in the bioethanol sector are similar to those applied in other sectors of the food industry. This mainly implies the use of hammer, globe, cylinder or laminar mills. Hammer mills are consisted of cylindrical chambers, with breaker blades mounted on their surface; the rotating hammers break the material through hitting against such blades. The grain size depends on the rotation rate and on the balls' size. In a cylinder mill, two or more opposing cylinders break the material. The grinding fineness may be controlled by adjusting the distance between the cylinders. Laminar mills are consisted of two blades, one stationary and a rotating, or both counter rotating.

3.1.1.3.Dissolution

Dissolution means mixing of the dust-like substances with solvents, while they are dissolved or constitute a suspension. Several processes and devices are used, from the different batch fed mixing tanks up to the continuous mixers, where liquid is added to the dust-like substance or the dust is introduced into the solvent.

The most common systems are:

- A blender injects the dust into the solvent. The method can be used up to about 25% dry material content.
- A Venturi-tube nozzle sprays the material into the solvent. The method can be used up to about 30% dry material content.
- Dissolving tank with high-speed mixer. The method can be used up to about 70% dry material content.
- Dissolving tank with high-speed mixer, under vacuum. The method can be used up to about 70% dry material content.

3.1.1.4.Fermentation

Decomposition of the monosaccharides into alcohol is called alcoholic fermentation. Fermentation is generated by yeast, mainly by *Saccharomyces sp,. cerevisae* or *bayanus*, which produce alcohol and some organic substance from the carbohydrates. The transformation may be characterized by the following process:

$C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2$

(glucose) = (ethyl alcohol) + (carbon dioxide)

This is an anaerobic process, not requiring the presence of oxygen. The fermentation occurs usually at a temperature between 8 and 30°C. The temperature influences the efficiency of conversation, and also the formation of the odor and flavor components of the end product. Also the pH value is controlled during fermentation, indispensable for the necessary efficiency. The yeast strain used has also a determinative role for the efficiency of fermentation and for the escort substances, therefore it is always selected for the special purpose. There are strains developed for increasing the alcohol yield. Nitrogen source, vitamins and trace elements are also added as additional nutrient. Traditional fermentation occurs in open kettles, however fermentation may also occur in closed fermentors, through simultaneous recovery of the CO_2. In such cases, development of the starter cultures is the only sensitive step, because the risk of superinfection is minimal in the closed fermentors. Therefore, the cultures used for inoculation are produced in a separate room provided with air filters, where continuous overpressure is granted. Proper cleaning of the fermentor should be provided for already during design and construction, because residues of the previous fermentation cycle may infect the new strain. During application of strains with similarly high hygienic requirements, also proper temperature control is important; usually a preliminary heat treatment and then cooling is required, therefore energy and cooling water requirement should be taken into account.

Fermentation – Recovering and cleaning of the carbon dioxide

The carbon dioxide generated during fermentation can be recovered. Following cleaning, compression, drying and refinement, it can be condensed for later utilization.

The carbon dioxide passes through the fermentor, exiting into the recovery unit. Here the carbon dioxide contains all volatile components present or generated during fermentation, such as oxygen, fusel oil, sulphur-bearing compounds and hydrogen sulphide. Therefore, the carbon dioxide has to be purified for the sake of future utilization. Foam separator, gas washer, desulphurizer, activated carbon filter, deoxygenator and liquefying unit can be used during the cleaning and conditioning process. Thus the liquefied carbon dioxide can be stored and later utilized.

3.1.1.5.Distillation

Distillation is a method for separating liquid mixtures through evaporation. Concentration of the more volatile components of the original mixture is higher in the vapor phase, while the less volatile components are concentrated in the liquid phase.

Fundamentally the procedure can be performed in two types of processing units: in a distilling still or in a column. The distillation devices can be operated alone or in a group. Separation of the alcohol and water can be attained through introduction of sufficient heat. The condensed liquid alcohol, in form of raw spirit, can be recovered from the head of the distillation device, while the fraction poor in alcohol accumulates on the bottom of the device. The distilling still can be

operated in cycles or continuously. In the previous case, the mixture is put into the still then, while applying heat treatment, the generated vapors are removed continuously, gathered and condensed until the desired average concentration is attained. In continuous operation, the mixture is fed into the still and the quantity of vapor and liquid removed is supplemented. In a column-type distillation equipment the liquid entered is heated by the vapors.

Each equipment usually corresponds to a theoretical plate, meaning that the liquid and vapor phases are balanced. The pure (95%) alcohol can be removed at the top of the column and then rectified in a further column, separating the alcohols with high number of carbon atoms.
A water mixture or stillage is entered on the bottom of the first column. The residues removed from the bottom of the second column are highly contaminated with organic substances, while the alcohol on the top of the second column has a degree of purity of 95%. From it, by using different technologies, anhydrous alcohol can be obtained. These methods include hetero-azeotropic distillation, when a third substance is added to the mixture, application of a molecular sieve or membrane dehumidification.

3.1.1.6.Boiling-down

During boiling-down, steam, vapor or fume is used for drying, usually as heat-transfer agent. The latent heat in the substance is transferred during condensation to the medium to be boiled down, warming up the water up to its boiling point and evaporating it. Thereafter, the vapor departs from the surface of the hot liquid. Sometimes it is expedient to apply low temperatures that can be attained mainly through vacuum application. The temperature used for boiling down is usually between 50 and 100°C, but as much as 130°C is even used in the sugar industry. The simplest way of implementation is the atmospheric evaporation, for example by an immersion heater. In the universal praxis however multistage tubular or laminar evaporators are used. Tubular evaporators can be gravitation or forced flow type. When boiling down special, highly viscous liquids, wiped film or scraping knife type evaporators are also used, where fewer problems emerge.
The following Table shows the average dry-substance content that may result by using the different evaporation methods. The resulting dry-substance content depends not only on the evaporator type but also on the characteristics of the substance to be boiled down.

Table 5: Comparison of the different evaporators

Evaporator type	Dry-substance at input (%)	Dry-substance at output (%)
Multistage, tubular	5 – 25	40 – 75
Plate-type, multistage	5 – 25	40 – 75
Vacuum evaporator	60 – 70	80 – 85
Centrifugal evaporator	5 – 25	40 – 60
WFE, single stage	40 – 50	70 – 90

Combined evaporators are generally used when the energy requirement of the evaporation is remarkable. These evaporators primarily use raw steam or fumes of other processes, then the vapor generated during evaporation is also utilized at an other site with lower pressure, where its heat can also be recovered. Thus a vacuum series can be created. The liquid to be processed proceeds against the heat energy flow, therefore, the vapor introduced into the first evaporator can supply three to six evaporators in all.

Additional heat energy savings can be made through compression of the steams, which can be made in thermal or mechanic manner. However, this may lead to contamination of the steam, thus it cannot be used again in the boiler, thus increasing the water consumption and waste water discharge. Vapor generated at the last evaporator has to be either condensed or its heat energy can be used at other processes, or even the condensed vapor as industrial water.

During the operation, deposits are continuously formed on the evaporators' walls. This reduces the efficiency of heat transfer and results in heat loss. Depending on the substance to be evaporated, the deposit may be organic or inorganic matter. For this reason the equipment needs periodic cleaning, thus preventing considerable heat losses or the deterioration of the product's quality.

3.1.1.7.Centrifuging and settling

Centrifuging allows separation of two or more phases, one of which is a continuous phase. The centrifuges can be operated according to two basic principles: as continuous systems and as batch cleaning systems. In continuous operation, the sludge may be removed continuously. The driving force of separation is the difference of density of the phases, accelerated due to the centrifugal force. The force generated depends on the speed and size. In the distilling industry, the stillage is separated, and pure stillage is obtained through centrifuging. Most frequently hydrocyclone is used, where separation occurs under tangential flow.

Centrifuges may be divided into four categories:

- tube or plate type centrifuges,
- drum centrifuges with lip or valve feeding,
- belt drum, plunger or basket type centrifuges,
- hydrocyclones, cyclones.

In a belt drum centrifuge, the belt rotates by 25 rpm. quicker than the solid wall, thus it is suitable for separating liquids or slurries with high solid matter content. The solid matter accumulates at the smaller, while the liquid at the higher diameter end of the centrifuge. Plunger type separators are used for sensitive and frail matters, such as crystals. Here the matter to be separated enters into the rotating drum from a hopper rotating with similar speed; then the peripheral speed of the separator is gradually accelerated, thus decreasing the effects of lateral forces. The liquid phase exits through the wall perforations. When the solid phase is deposited in a thick layer, it is removed by a plunger arm. The basket type centrifuge is consisted of perforated baskets, containing the liquid to be separated and rotated at 2000 rpm speed. Separation occurs within 5 to 30 minutes. The process is performed in three steps: first, the matter to be separated is fed into the baskets; second, the baskets are rotated at gradually increasing speed; and in the third step the rotation is braked then the filter cakes removed. Up to 90,000L/h capacity may be attained with similar devices.

3.1.1.8.Drying

Drying methods based on two different principles may be differentiated: hot air blasting and the method based on surface drying by heat conduction. In the case of hot air drying, the hot air itself heats up the liquid matter directly or indirectly. The water content of the matter evaporates due to

the heat. In the case of the heat conduction drying method the heat carrying medium has no direct contact with the food to be dried. The heat is transferred by conduction through the surface then by convection from the hot surface to the food product for evaporating and removing water from the entire phase. This has two main advantages compared to hot air dryers: due to the smaller volume, thermal efficiency is higher, and the process may be carried out in the absence of oxygen.

As regards their design, the dryers may be spray, drum or vacuum type dryers. In spray drying, the material to be dried is suspended in air, where the moisture evaporates quickly due to the large surface area. The air saturated with moisture is led into a hot drying chamber, where the residual quantity of the separated moisture is also removed. The solids are recovered in form of dry powder.
Air inlet temperatures of up to about 250°C or even higher (depending on the type of product) are used, but due to evaporation, the air temperature drops very rapidly to a temperature of about 95°C (outlet temperature of the air). The product temperature will be 20 to 30°C below the air outlet temperature. Heating the drying air can be accomplished by steam or by direct gas-fired air heaters or by indirect heaters fired by gas, liquid or solid fuels.
These drying systems are usually completed with a separation system (usually some type of cyclone) and the dust thus recovered is incorporated back in the product.

In case of drum drying, a thin film of material is applied to the smooth surface of a continuously rotating metal drum heated from inside. The film of the dried material is continuously scraped off from the drum surface by a stationary knife. Single drums or drum pairs may be applied. The applied steam pressure in the drums can vary from 4 to 8 bars.

If vacuum chamber drying is applied, lower temperatures may be used, thus allowing drying of more sensitive substances.

3.1.2. BAT – General preventive measures

The following procedures may be considered as BAT:

- Operation of an environment-oriented management system (recycling of waste waters and of lost energies);
- Substitution or decrease of utilization of auxiliary products, such as chemical substances, in order to minimize the environmental impacts (in the case of DunaBio: use of enzymes instead of acids for the yeast transformation);
- Application of good work organization practices.

3.1.2.1. Minimizing water consumption

The following procedures may be considered as BAT:

- Applying proper methods for decreasing water consumption (reuse of waste waters);
- Acquisition of good quality water in sufficient quantity;
- Optimization of water utilization, where possible (reuse of waste waters, using and recycling treated waste water instead of fresh water supply);
- Application of good work organization practices;
- Recycling/reusing process waters, where possible.

3.1.2.2.Minimizing energy consumption

The following procedures may be considered as BAT:

- Application of proper methods for improving energy efficiency (in the case of DunaBio: fully integrated energy system);
- Application of energy management system;
- Good organization and process optimization; optimizing consumption of public utilities such as compressed air, steam, cooling and electricity;
- Application of energy-efficiency techniques: heat recovery, combined heat and energy production for satisfying both electric and caloric requirements; biogas generated during anaerobic rotting may also be used for energy recovery; application of improved frequency engines; insulation of the pipe network in order to minimize heat and energy losses;
- Application of an energy monitoring system (integrated into the process control system).

3.1.2.3.Minimizing emissions into air

The following procedures may be considered as BAT:

- Applying control strategy for identifying the proper methods, determining quantities and selecting the best solutions for decreasing air pollutant emissions;
- Examining the odor emission for the sake of identifying and characterizing its sources and defining the necessary measures;
- Application of proper storage and treatment technologies for the sake of restraining emissions, such as dust generation;
- Collecting vent gases at their source, where possible;
- Selecting technologies granting the maximum possible product yield at minimum environmental emissions;
- Optimizing starting up, shut down and other special operating procedures;
- Decreasing the quantity of waste gases, for example through recycling of the used gas flows, with regard to the hygienic requirements;
- At duty-cycle processes with shut-off or by-pass the waste gas treating systems have to be designed and operated with low emission levels and provided with a monitoring system recording the most important process parameters;
- Emergency plans are to be developed, specifying the necessary measures for the failure of the emission control systems, in order to immediately control any such emissions;
- Ventilation and covering of the sewage treatment plant in order to avoid odor emission where necessary, or application of anaerobic rotting in the sewage treatment.

3.1.2.4.Minimizing emissions into waters

The following procedures may be considered as BAT:

- Applying methods for decreasing water consumption;
- Granting regular maintenance of the public utility network;
- Optimization of water consumption;
- Selection of the proper matters/chemical substances used for cleaning. Optimizing the cleaning processes and providing relevant training; for example CIP cycles should not be applied on time basis but as required;
- Application of proper storage and treatment techniques in order to control dust pollution generated during loading/unloading, transport and storage; e.g. granting closed-system forwarding of liquid matters, low temperature storage of dust-like substances and utilization of transport systems. Preventing overfilling of the treatment tanks, as their content may have extremely high COD values, thus minimizing spills during storage and transport.
- Granting recycling or reuse of the water, thus decreasing emissions. Returning into the process the mother liquids or recovering them for animal feed or other utilization purposes, where feasible.
- It has to be prevented that yeast gets into the sewer, as it has an extremely high COD value and is prone to form organic acids. Grills are to be used on the floor drains, in order to prevent grain to get into the sewer system.
- Multi-stage vacuum evaporators are to be used in the distillation process, then the residual matter processed for recovering liquid stillage that may be sold for agricultural use.

- For preventing overfilling, products have better to be fed into the tanks, instead of brimming them.

3.1.2.5.Protection of the surface and underground waters
The following procedures may be considered as BAT:
- Application of overfill protection for bulk storage tanks;
- Using tanks with containment device or double-wall tanks for bulk storage;
- Waterproofing of the bottom and side walls of the waste water tanks.

3.1.2.6.Minimizing waste generation
The following procedures may be considered as BAT:
- Applying a waste minimization program;
- Application of good management practices;
- Improving the operating practices. Optimizing process control; through measuring certain parameters, such as temperature, pressure or flow, decreasing generation of rejects and products non complying with the specification, in order to decrease water consumption and other losses;
- Recycling or reusing solids and the generated sludge;
- Decreasing the overfill values to 0.03 – 0.1%, through application of control scale series or intelligent filling equipment in the storage and treatment;
- Application of proper storage and treatment techniques in order to control dust pollution generated during loading/unloading, transport and storage, for example through integration of containment devices, low temperature storage of dust-like substances and utilization of transport systems.

3.1.2.7.Noise emission prevention
The following procedures may be considered as BAT in controlling noise emission:
- Using silencers in the ventilation systems;
- Granting flexible connection between ventilators and pipes;
- Using pipes with better sound-proofing characteristics;
- Increasing wall thickness of the pipes;
- Using wrapped pipes, insulating mechanical/thermal steam compressors;
- Fixing machines to the ground with rubber bearings;
- Holding windows and doors closed.

3.1.3. BAT – preventive measures for the specific elementary processes

Beyond universal measures, the following provisions can be considered as BAT for each of the essential basic processes:

3.1.3.1.Reception and preparation of raw materials
Controlling dust pollution generated during loading/unloading, transport and storage and decreasing emission, for example through application of local exhaust system and containment devices in the storage of liquid chemicals.

3.1.3.2.Breaking, mixing, shaping
Particulate materials (dust) are often generated, that should be recovered from the exhaust air and reused in the process, where possible.

Noise emission may occur in the breaking technologies, like crushing and milling. Where possible, all noisy equipment should be insulated and closed in sound-proofed buildings.

3.1.3.3.Separation
Use of highly efficient separation technologies for maximizing recovery of the alcohol from the fermentation process.

Multi-stage vacuum evaporators are to be used in the distillation process, then the residual matter processed for recovering liquid stillage that may be sold for agricultural use.

Part of the stillage is recyclable, if there is a recovery system in the distillation process. The rest may be processed into animal feed mixture.

The filtrate and cake, or even the filter aid may be reused (for example as animal feed).

3.1.3.4.Processing of the product
It has to be prevented that yeast gets into the sewer, as it has an extremely high COD value and is prone to form organic acids.

Spent yeast and grain may be used as animal feed. Yeast can also be utilized in the food industry.

The quantity of waste gases may be decreased for example through air recirculation, paying special attention to maintenance of the hygienic requirements.

3.1.3.5.Heat treatment
The organic odor components have to be removed from the evaporating pipes combined with energy recovery system, through condensing down the steam.

3.1.3.6.Evaporation
Application of a proper reduction technology for decreasing dust emission from the drying process of malting and recycling into the processes or utilization as animal feed.

Decreasing the energy consumption through pre-evaporation or dehumidification prior to dehydration.

Utilization of the hot water generated during cooling of the alcoholic liquid.

3.1.3.7.Cooling
Use of heat recovery systems.

3.1.3.8.Cleaning and disinfecting

- Selecting proper substances/chemical agents for cleaning;
- Reuse of the wash-water following chemical precipitation and sedimentation;
- Reuse of the hot water from cooling of the stillage;
- Optimization of the cleaning processes for the sake of decreasing the waste water load; for example, the CIP cycles should not be applied on time basis but as required;
- Managing and minimizing consumption of water, energy and cleaning agents.

3.1.4. Techniques for decreasing emissions

3.1.4.1.Managing air polluting emissions

According to the BAT, quantity of the generated air polluting and odorous substances has to be minimized through application of the measures specified in the previous Section, and, if necessary, air polluting emissions have to be managed as follows:

- Particulate matters may be removed from the exhaust air by the help of dynamic bag filters or electrostatic separators. Proper operation of the system may also prevent odor emissions.
- Biofilters or bio-gas washers have to be used for removing odorous matters from the final gas.
- Absorption systems, for example filled or plate-type absorbers may be used for removing odorous matters from the final gas.
- Adsorption systems, such as activated charcoal, may be used for removing odorous matters from the final gas.
- Thermal boiling-down or catalytic treatment can be used for controlling final gas emissions.
- Removal of the organic odor components from the evaporators through condensing down the steam, combined with energy recovery.
- Covering or ventilating the sewage treatment plants for the sake of decreasing odor emission, where necessary.

3.1.4.2.Sewage treatment

According to the BAT, quantity of the generated waste water has to be minimized through application of the measures specified in the previous Chapter, then the waste water generated is to be managed as follows:

Waste waters may be treated at their source, in a central treatment plant within the site or in a treatment plant outside the site.

- Process water is to be separated from the non-contaminated flows and from other waters in order to allow reuse of the non-contaminated water or its utilization for diluting the waste water prior to discharge.
- Filtering of solids prior to letting the waste water into the treatment system.
- Application of pre-treatment – process water conditioning and neutralization etc.
- Applying secondary purification for treating biodegradable organic matters with the help of a biological treatment system:
    - Anaerobic purification of concentrated waste water;
    - Aerobic cleaning;

- Application of combined anaerobic/aerobic system for the treatment of condensed steams and of waste waters generated during the distillation/rectification process.

- Application of tertiary cleaning for removal of further organic and inorganic matters in the case of discharge into water flows or if reuse of the purified waste water is necessary.
- Regular laboratory testing of the waste water composition and recording of the relevant data.

3.1.4.3.Waste treatment and disposal

According to the BAT, quantity and load of the generated wastes has to be minimized through application of the measures specified in the previous Chapter, then the wastes generated are to be managed as follows:

- Composting of the solid organic wastes;
- Agricultural utilization and biological filtering of the wastes suitable thereto;
- Where possible, recycling/reuse/recovery of the
  - generated liquid stillage, stillage and other fermentation by-products for utilization as animal feed. Yeast may also be used in the food industry. The concrete industry can use the spent silica gel.
- In the treatment of the sewage sludge, the following technologies may be used independently or in combination:
  - Thickening;
  - Dehumidification;
  - Stabilization through chemical, thermal or biological (aerobic or anaerobic rotting) methods;
  - Desiccation;
  - Burning.

3.1.5. The best attainable emissions

3.1.5.1.Air pollutant emission

Emission values associated with the BAT for air pollutants are as follows:

Table 6: Emission values for air pollutant emissions

Constituent group or parameter	Emission value (mg/m^3)	Mass flow limit value (g/h)[1]
Dust	5-50 150	>200
Organic carbon[2]	50	500

Remarks:

[1] The mass flow quantities refer to the maximum measurable in an hour. Where the mass flow of the raw final gas exceeds the mass flow limit value specified in the Table, decreasing the emission below the relevant emission limit value or the mass flow of the emission below the threshold value is necessary.

[2] For emissions that include solvent emissions (bonding, labeling etc.).

3.1.5.2.Odor emission

The installation has to be carried out in a manner that odor emission does not result in a remarkable decrease and/or considerable disturbance to the comfort feeling or to the environment beyond the borders of the plant site.

3.1.5.3.Emission to waters

The following Table includes the emission values attainable through application of the BAT related to waste water treatment. It has to be granted in the case of direct discharge into surface waters and of the rainwater discharge that the quality of the resulting water is not damaging or does not exceed the quality standards of environmental protection.

Table 7: Emission values for discharge into waters associated with BAT

Constituent group or parameter	Emission value	Remark
pH	6-9	
Toxicity (TU)	5	[1]
BOD_5	>90% removal[3] or 20-40mg/l	
COD	>75% removal[3] or 125-250 mg/l	
Dry matter	50 mg/l	
Total ammonia (as N)	10-15 mg/l	
Total nitrogen (as N)	>80 % removal[3] or 5-25 mg/l	[2,4]
Total phosphor (as P)	>80 % removal[3] or 2-5 mg/l	[4]
Oils, fats and lubricants	10-15 mg/l	
Mineral oil (before the oil trap)	20 mg/l	
Mineral oil (from biological treatment)	1.0 mg/l	

Remarks:

[1] The toxic units (TU) = 100/x hours EC/LC50 in the ratio of percentages by volume, implying that higher value means higher toxicity. In the case of test organisms where death is difficult to establish, the cessation of movement has to be taken into consideration.

[2] The total nitrogen is the sum of Kjeldahl nitrogen, nitrate-N and nitrite-N.

[3] Decrease referred to the load of the input flow.

[4] The limit value depends on sensitivity of the recipient.

3.1.5.4.Emission to the soil

In the IPPC documentation relating to the spreading of organic waste on the ground, the guidance of the environmental authority and the guidelines of the Ministry of Agriculture have to be referred to.

3.2. BEST AVAILABLE TECHNIQUES – GAS BURNING FURNACES

3.2.1. Gas burning technologies

3.2.1.1.Gas burning furnaces and air heaters

If designed for gas burning, the combustion chamber is somewhat smaller, but in most cases these furnaces are also suitable for co-burning or, in case of emergency, even for burning liquid fuels. The heat generated by the burned fuel is used for producing superheated steam that, expanded in a steam turbine, drives a generator. For ensuring efficiency of the energy transformation from steam into electric energy, the gas furnaces work at supercritical steam parameters (> 221.2bar; > 374.15°C) that allows attaining up to 48% efficiency in condensation mode, and 93% efficiency in combined heat and electricity production mode. These high efficiency rates may be attained through double reheating and supercritical steam parameters (e.g. 290bar and 580°C).

Another field of application of gas burning furnaces is that of using as secondary boiler for assisting starting-up, including cold starting, of the different types of thermal power plants. Secondary boilers are also used in most of the electric power plants for heating buildings and equipment during shut-down periods. These boilers produce slightly overheated steam of relatively low pressure. In this document these small boilers are not discussed.

Gas boilers are widely used in the processing industry and distant heating. Most of them are of medium performance (between $50MW_{th}$ and $300MW_{th}$). The increasing restriction of the SO_2 and NO_x emissions has lead to the increased use of natural gas in the furnaces of similar heat performance. A considerable part of these furnaces may be operated also by using liquid fuels in emergency conditions or in case of co-burning. The burning technology systems of the gas furnaces are similar to those of coal or oil fuelled boilers.

3.2.1.2. Combined heat and power production (combined energy production – CHP)

Only 40 to 60% of the fuel material (calculated at heating value – LHV) can be transformed into electric energy in power plants producing exclusively electric power. The rest is lost, because the low temperature waste heat is emitted into the air or into the water or both. As end users need large quantity of heat for distant heating and for several industrial processes, the question emerges, how the lost heat of the condensation power plants could be utilized. A simple thermodynamic answer may be given to this question: let increase the temperature of the lost heat up to the useful level, for example to 70-120°C for distant heating or to 120-200°C for the industrial processes. This is made however to the detriment of power production.

Combined heat and power production is a way for improving energy efficiency, to be influenced by the structure of the input energy system. The combined energy production implies in all cases fuel saving compared to separate heat and electric power production. If the local heat load is sufficiently high, and consequently the related production is also quite high, money saving may also be made. Technically all power plants may be transformed for producing combined heat and electric power. Suitability of the gas turbine in case of combined heat and power production is partly connected with the relatively low investment costs and with the attainable high cycle efficiency.

The heat of the flue gas from the gas turbine is used for steam production in the heat recovery boiler. The entire quantity of the steam may be used for power production as in the case of the combined cycle, or partially (sometimes entirely) taken off and used for steam supply to consumers; in such cases, consumers may use the steam for the purposes of their own processes or for other purposes, for example for distant heating.

Several possible configurations exist for satisfying the requirements specified for the power plant. Depending on the heat and power requirements, the followings are the most frequent solutions:

- gas turbine with heat recovery boiler, taking-off the heat produced for steam consumers;
- gas turbine with heat recovery boiler and back pressure steam turbine, taking-off the heat produced for steam consumers;
- gas turbine with heat recovery boiler, steam take-off for consumers and/or utilization of the taken-off steam for heating purposes and vacuum steam condenser. This solution usually allows greater flexibility as regards the ratio of electric power and heat;
- gas turbine cycle with steam injection (STIG), where the steam is also produced by using the heat of the combustion gas but it is partly injected into the gas turbine (see: Cheng-process). This is principally used at aeroderivative gas turbines, without steam turbine. This cyclical process is mainly applied in combined heat and power production for satisfying periodical industrial steam requirements.

3.2.2. Emissions when using gaseous fuels

3.2.2.1. Emission of air polluting substances

During gas fuelling, and especially in the case of gas turbines, the NO_x emission appears in the form of thermal NO_x, influenced by the following parameters:

- By increasing the hydrogen content of the fuel, the NO_x emission is increasing too;
- Through burning of the fuel and air in proper ratio high temperatures can be obtained, resulting also in higher NO_x emission;
- The holding time may be decreased by increasing the number of burners. This NO_x emission decreasing method was applied in the early development period;
- Increasing the humidity of the air to be burned helps to decrease the NO_x emission. In consequence thereof, the temperature of the flame diminishes, leading to the same result as by injecting water or steam into the combustion chamber;
- However, there is an inverse relationship between efficiency increase of the gas turbine and NO_x emission decrease. Namely, as explained in the previous Section, the high brining temperature increases the efficiency of the gas turbines, while increasing also the NO_x emission. Consequently, decreasing NO_x emission results in lower efficiency. Therefore, operational conditions have to be developed that balance the two adverse effects. The newly constructed high efficiency combined power production units, with their low NO_x burners may produce NO_x emission between 20 and 50mg/Nm^3 without "pipe-end" devices. The firing equipments already in operation present NO_x emission between 50 and 75mg/Nm^3, while it is difficult to remain below 75mg/m^3 emission at older plants. It has to be mentioned however, that low NO_x emission implies high CO emission.
- Through application of low NO_x burners, NO_x emission of 18 to 84mg/Nm^3 (corrected to 15% O_2) may be attained in case of gas firing, and of 84 to 180mg/Nm^3 for oil firing.

- Regarding NO_x emission of gas engines, the combustion temperature of the gas is the most important parameter. One of the methods for decreasing the combustion temperature consists in the application of lower fuel/air ratio; in such case, the specific heat quantity released by the burning of the fuel warms up higher volume of fume, resulting in lower burning temperature and NO_x emission. This primary NO_x emission decreasing method is called high excess air burning and is mainly applied in gas engines. The alternative fuelled engines with spark ignition and high excess air factor are often provided with oxidation catalytic converter, principally for preventing generation of CO and non-methane volatile organic compounds (NMVOC). In gas fuelled engines, the emission of NMVOC depends also on the composition of the natural gas.
- In case of efficient burning of gas fuels there is no solid matter emission, even though the solid matter content of the input air may influence the emission in case of gas turbines.

3.2.2.2.Process water and waste water emissions

During operation of gas-fired furnaces and turbines, the following types of waste waters are generated:

Washing waters

These waste waters have to be discharged usually through oil separators because are contaminated by oil. The maximum quantity is of 150m^3/h. The compressor blades of the gas turbines have to be washed 8 to 12 times in a year with detergent-containing water. The volume of the contaminated washing water is of 2-3m^3. If the washing water contains some matters implying environmental hazards, such as heavy metals, the waste water is to be treated as dangerous waste and may only be removed by duly authorized transporters.

Boiler water

The boiler water is let down during maintenance and, after neutralization if necessary, it may be discharged into the surface waters. Its annual quantity amounts to about 100-200m^3. The boiler water is desalinated water conditioned by some chemical agents. The salinity of this water is very low for the sake of avoiding deposit formation in the evaporating and overheating pipes and to prevent flow accelerated corrosion (FAC). In order to satisfy the requirements for granting the desired degree of salinity, regular blow-down of the drum is necessary. The quantity of blow-down water amounts to 1 – 1.4MT/h. The water from the drum may be discharged into the surface waters following neutralization.

Waste waters from the desalting plant

In the desalting plants almost all salt content is removed from the raw water – mostly constituted of surface water or drinking water in Hungary. Desalination may occur for example through ion exchange or microfiltration and reverse osmosis, or their combination. In the desalting plant the chemicals used for regeneration or for cleaning the equipment have to be neutralized in a basin or tank, and they may be discharged into the public sewer only thereafter. During regeneration of the ion exchangers high salinity reclaims are produced, therefore, they may be discharged into surface waters only properly diluted even after neutralization. The limit values of discharge into public sewer or surface waters have to be taken into account during design.

3.2.2.3. Power plant wastes in case of gas-firing

Solid and liquid wastes

Only small quantities of solid and liquid wastes are generated during gas-firing. Most wastes are generated during the auxiliary activities, such as maintenance or water treatment. Waste generated during the auxiliary activities in major quantities include: metal scraps, used oil, packaging waste, waste liquids used for compressor washing, ion-exchange resin and activated charcoal.

Used oil

Under normal conditions, the lubricating and turbine oils are to be changed every ten years. The quantity of the oil filling in case of a 400 MW_e unit amounts to 30,000 to 40,000 liters.

Cleaning liquids

The cleaning liquids (water-soluble synthetic substances) are used for washing the compressor and the turbine. These liquids are used for removing from time to time contaminations and fats deposited on the turbine blades. The generated used cleaning liquids, in a quantity that may amount to several cubic meters in a year, are to be treated as dangerous waste.

Chemicals for treating desalinated water

Activated charcoal, resin and chemical residues are generated during desalination of the water. Chemical substances used in the ion-exchange equipment usually include hydrochloric or sulphuric acid and lye. The activated charcoal has to be replaced every 2 years, the resins every 3 to 8 years. The activated charcoal and resin waste generated in the desalination plants usually does not constitute dangerous industrial waste, in function of the water treated. The quantity of the chemicals and resins used depends on the type of equipment, the raw water quality and the quantity of the generated desalted water.

3.2.2.4. Noise emission

As in most EU countries, the law regulates the emission of environmental noise also in Hungary.

Typically, the definition of the allowed noise emission rate os subject to the land use zoning, such as residential, institutional or industrial zone. In addition, the allowed noise emission rate depends also on the time of the day; this has importance especially in the case of residential areas. Night-time and day-time are differentiated in this respect, where night-time is the period between 10:00 p.m. to 06:00 a.m. In industrial and institutional areas usually no noise emission limit values are established for the night-time period.

When establishing the environmental noise limit values, the zoning classification according to the Regulation Plan of the neighboring properties has primary importance.

When the noise impact of a new power plant has to be determined, other noise sources in its vicinity are to be taken into account. Extras expended for noise reduction may be avoided through determination of reasonable noise emission limit values.

Main noise sources of the power plants include: fans (e.g. draught enhancing fans of chimneys), air inlet valves, pumps, turbines, the steam system, the cooling towers and the different safety valves and transformers.

3.2.3. Emission control technologies of gas-fired furnaces

3.2.3.1. Decreasing NOx emission of gas-fired furnaces

Following possibilities exist for decreasing NO_x emission of gas-fired furnaces:

Application of low-NO_x burners

If the combustion temperature is low in the primary combustion zone and the fume is retained for sufficiently long time in the combustion chamber for being totally burned, this may decrease the flame temperature and thus generating less NO_x.

Fume recycling

It may be efficient in cases, where a remarkable portion of the emission consists in thermal NO_x. This may decrease both the flame temperature and the oxygen concentration.

Multi-stage burning

Multi-stage burning decreases the reaction between the oxygen and the nitrogen of the air during the combustion process. For the sake of maintaining low NO_x emission, the air has to be transferred to the burners in a very precise manner.

Water injection

Maintenance of the low flame temperature for granting low NO_x emission can be attained through injecting water.

3.2.3.2.Water and waste water treatment

Gas turbines and heat recovery boilers require desalted water for the following purposes:

- Desalted water is required for supplementing waters let down from the heat recovery boiler's drum during drainage (blow-down, leeching). If steam or water is injected into the combustion chamber of the gas turbines for the sake of decreasing NO_x emission, the large water loss needs to be supplemented, too. The water quality has to comply with the requirements prescribed by the boiler manufacturers.
- Usually desalted water is used for washing the gas turbine's compressor blades. For washing during shut down (so-called offline washing), detergents are also added to the desalted water in order to increase the efficiency of washing.

Waste waters from the gas turbine and heat recovery boiler may include the following waters:

- Escaped waters and drained waters from the boiler's circulation system, for maintaining the quality of the boiler water. For the sake of the boiler's corrosion protection, alkalizing agents, such as aqua ammonia, caustic soda and/or phosphates are used for properly adjusting the boiler water's pH-value. In the praxis these waters are cooled down and, following neutralization if necessary, are discharged into the sewer system.
- Waste waters deriving from the washing process of the gas turbine during shut down (off-line washing) are to be examined for hazards. If qualified as dangerous, they have to be treated as dangerous waste. It is possible to use ceramic cartridge filters in order to decrease the quantity of washing waste waters.
- Waters or other liquids contaminated with oils are treated as dangerous wastes, separated from any other substances. If they do not contain emulsifying agents, the oily waters may be treated in oil separators.
- Other waste waters generated in the plant, such as floor washing water, are usually discharged into the sewage system.

Waste waters deriving from the gas turbine and heat recovery boiler have to comply with the requirements included in the permit concerning discharge of waste waters.

3.2.3.3. Decreasing noise emission

The large units of the gas-fired power plants may increase noise emission and also the vibration of the equipment implies noise. The following methods are available for diminishing noise emissions:

- Providing the turbines and generators with noise protection casing;
- Using low-noise fans for ventilating the casing;
- Proper orientation of the turbine machine room's doors;
- Noise protection of the building's air inlet devices;
- Providing the steam turbine's auxiliary equipment with covers;
- Installation of mufflers on the flue-gas outlet;
- Installation of mufflers on the boiler steam blasting devices;
- Installation of the boiler's feed pumps in covered spaces;
- Construction of pump house over the cooling water circulating pumps;
- Installation of low-noise fans in the cooling towers (to be noted: noise emission of forced circulation cooling water systems is smaller than that of cooling towers).

3.2.4. Best available techniques – BAT – in gas-fired power plants

3.2.4.1. Efficiency of the gas-fired equipment

The energy efficiency may refer to the specific heat consumption (input combustion heat/energy produced) and also to the power plant's efficiency, being in this case the inverse of the heat consumption, that is: energy/input fuel ratio.

Among gas-fired combustion devices, the combined cycle energy production, able to generate both heat and electric energy is principally considered as BAT process. Its implementation is reasonable in sites, where there is a sufficiently high heat requirement. Computer control of the combustion equipment may also be considered as BAT, because it may grant high boiler performance and reduced emission.

An other possibility for improving efficiency includes pre-heating of the natural gas prior to inlet into the combustion chamber. The heat used for warming up may be recovered from the fume discharged from the cooling system.

The gas engine driven power plants are suitable for decentralized heat and electric power production, attaining typically a total efficiency rate of 60 to 70%. With auxiliary firing (when fuel is burned also in the fume exhausted from the engine), also higher pressure steam may be produced. In case of hot water production (with output temperature between 70 and 120°C) the total efficiency may even attain 90%.

The following measures are required for increasing the efficiency:

- Minimizing energy losses due to unburnt gases;
- Highest possible pressure and temperature of the gas or steam operating medium;

- Granting the highest possible pressure drop of the steam turbine's low-pressure side, through the lowest possible temperature of the cooling water (fresh water cooling) in boilers and combined cycle power plants;
- Minimizing heat losses through minimizing heat loss by exhaust gases (utilization of the residual heat or distant heating);
- Minimizing heat losses due to heat conduction and radiation, through insulation;
- Minimizing self consumption through proper measures (e.g. application of water pumps of higher efficiency);
- Pre-heating of the fuel and of the boiler feed water;
- Improving design of the turbine blades.

3.2.4.2. Solid matter and SO_2 emission of gas-fired equipment

Solid matter and SO_2 emission of the gas-fired plants (if natural gas is used) is very low. In case of natural gas firing, the emission of solid matters remains below 5 mg/Nm^3 and even the SO_2 emission should not exceed 10 mg/Nm^3 (referred to 15% O_2) without any additional technical measures.

3.2.4.3. NO_X and CO emission of gas-fired equipment

As a general rule it may be stated that any of the techniques listed in the previous Section can be considered as BAT for decreasing NO_x. The relevant nitrogen components include nitrogen oxide (NO) and nitrogen dioxide (NO_2), referred to together as NO_x.

For newly built gas turbines, the dry low-NO_x pre-mixing burners are considered as BAT. Most of the existing gas turbines may be converted to the dry low-NO_x pre-mixing burner technology, but sometimes water and steam injection may be a better solution. This has always to be decided in view of the concrete conditions.

Full burning constitutes the BAT for minimizing CO emission, requiring good firing plant design, the application of high performance monitoring and process control technologies and good maintenance of the entire combustion system. Beyond the burning conditions, a properly optimized system allows reduction of the NO_x emission and maintenance of the CO levels below 100 mg/Nm^3. Furthermore, as regards CO, application of an oxidation catalyst in the case of operation in a densely populated urban area can be considered as BAT.

A summary of the BAT-related decision for preventing and reducing NO_x and CO emissions and the relevant emission values are to be found in the Tables below. The fumes of the turbines and gas engines usually contain 11 to 16% O_2, therefore the application of BAT in connection with emission levels of turbines and engines is based on O_2 level amounting to 15 percentages per volume, and takes into account steady conditions as point of reference. In gas-fired boilers 3 percentages per volume of O_2 constitutes the usual reference level. The BAT emission levels are based on daily average, steady conditions and usual load rate. In the event of peak loads, during starting-up and shutting down periods, as well as due to operational disturbances of the fume purification system and short duration peak periods the levels may be higher and these conditions have to be taken into account.

3.2.4.4. Water pollution

In gas-fired combustion equipment different waste waters are generated. Production of polluted (washing) waters in small quantities from time to time cannot be prevented in the power plants. Oil separators are usually sufficient for preventing environmental damages.

3.2.4.5. Combustion products

The industry has paid great attention to recycling of the combustion products and by-products even up to now, for avoiding their disposal in deposits. Recycling and reuse is therefore the best possible solution.

4. DETAILED DESCRIPTION OF THE OPERATION

4.1. CONSTRUCTIONS REQUIRED FOR THE OPERATION

The main data for the area's building-in are summarized in the following table.

Table 8: Ground-space of the envisaged infrastructure

No.	Area use	Ground-space (m^2)
1.	Administration building	317
2.	Processing plant and fermentors	2,883
3.	Maintenance building	352
4.	Turbine building	132
5.	Power centre, drier	1,571
6.	Wet DDG store	659
7.	Water treatment building	703
8.	Cooling tower	640
9.	Corn reception and DDGS loading station	555
10.	Corn store and grinding mill	253
11.	DDGS storage building	4,073
12.	Tank farm	6,740
13.	Internal road network	12,322
	Total:	**31,200**

Annex 11 presents the location of the different buildings.

4.2. DESCRIPTION OF THE IMPLEMENTATION OF THE ENVISAGED TECHNOLOGY

4.2.1. Description of the bioethanol production technology

Main technological steps

1. Corn preparation, DDG delivery
2. Hydrolysis
3. Saccharification
4. Yeast reproduction
5. Fermentation
6. Carbon dioxide washing system
7. Distillation
8. Molecular sieve system
9. Centrifuge system
10. Evaporation
11. Dehydration
12. Biogas system
13. Enzyme system
14. Ethanol storage
15. CIP system

4.2.1.1. Corn preparation, DDG delivery

From the three truck terminals one is intended only for corn reception, one processes jointly corn reception and DDG delivery and one serves only for DDG delivery.

The arriving trucks empty their load into one of the two grate-covered reception bunkers. From here, a delivery conveyor forwards the grain corn to a common transport conveyor, which transports the corn to the bottom chamber of a bucket elevator, which forwards it to the top of the

storage silo. Alternatively, grain corn arriving from Agrograin, is forwarded by an other transport conveyor to the elevator's bottom chamber.

The silo is suitable for the storage of corn sufficient for approximately three-day' operation. From here, a screw conveyor scoops the grains onto a feeder conveyor, feeding the rotating drum-type husking-cleaning device. The drum separates the corn grains from the refuses, which are forwarded by a refuse conveyor to the deposit. The clean grains are forwarded by a bucket elevator to the top of the mill's feed tank; from its conic bottom, a cell wheel feeds the grains to the two hammer mills in controlled rate.

From the collecting tray located below the hammer mills, the grist is forwarded to the bottom chamber of a bucket elevator. The elevator forwards the grist to a conveyor belt transporting it to the technology building and downloading onto the feed screw at the mezzanine floor , which will feed the grist already into the boiling system's pulp mixer in proper rate.

The pneumatically forwarded distillers' dried grain (DDG) is separated in a cyclone provided with dust filter from the carrying air stream. From the bottom of the cyclone, it is forwarded by a cell wheel to a screw conveyor, transporting the product into the bottom chamber of a bucket elevator. Sampling facility is provided on the way for quality testing.
The elevator forwards the product onto the bulk flow conveyor of the store room; from its bottom, through opening of the relevant slide-valves, the product may be let down into series of heaps. The flat store is able to receive DDG production of approximately two weeks.

The material to be delivered is pushed by loading machines into one of the two grate-covered bunkers; from the bottom thereof, a conveyor transports it into the feeding chamber of a bucket elevator. The product is transported by the elevator to the upper floor, dropping it into a horizontal feeding screw, from where it gets into the buffer tank on the top of the weighing device. The tank on the weighing plate may be closed by slide valve on top and on the bottom for the time of weighing; thereafter the product is emptied in the lower buffer tank, from where is forwarded by a conveyor to the public road loading station. The controlled quality and weighed DDG is loaded by a bulk flow conveyor onto the trucks.
The dust exhaust system makes integral part of the technology; it consists of a central exhaust fan and of three local exhaust fans and of the pertaining four dust filter bags, four blowers and of the suction pipes branching-off at the points where danger of dust escape exists. The fans blow the already filtered air into their own flue.

4.2.1.2. Hydrolysis

The corn is carried by a conveyor belt to the mezzanine floor of the shop building, from where it is forwarded by a feeding screw to the inside, into the pulp mixer. The pulp mixer has the task of mixing the ground grain, the boiling water and the alpha enzyme into a uniform pulp. Here only a quantity of enzyme is added, which is sufficient for transforming the mixture into an easily pumpable pulp, because this enzyme is deactivated later in the steam injector.
Mixing is short in duration but powerful enough for thoroughly blending the components, preventing their deposition on the bottom of the suspending tank.
In the suspending tank the mixture is warmed-up to 85°C through direct steam injection. At this temperature the starch contained in the ground corn takes up water and is pectized.
The alpha-amylase enzyme initiates transforming the starch into long chain sugars, while decreasing viscosity of the pulp. Anhydrous ammonia is added into the suspending tank for adjusting the pH-value (maintained at about 5.8). This value is optimal for the enzyme's efficiency. When using ammonia for pH adjustment, free nitrogen is also generated (this is an

important component for the yeast). The pulp flows continuously through the suspending tanks. Two tanks are serially connected for granting 25-30 min. retention time.

From the suspending tanks the pulp is injected into the steam injector and the tubular reactor. In the injector the pulp is warmed by steam up-to 107°C (or as determined by the QC laboratory). The steam directly heats and sterilizes the pulp. At the same time it deploys and breaks the long chain starch molecules. The optimal shear effect in the injector is created at Delta P of around 2.8bar. This pressure difference may be adjusted through forward or backward movement of the injector's pipe.

From the injector the sterilized pulp gets into the tubular reactor. The tubular reactor is simply a cylindrical device, which allows boiling of the pulp under pressure of about 0.7bar and grants retention time of approximately 10 minutes.

The pulp flows from the tubular reactor into the expansion tank. Here the pressure drops and the flash steam gets into the stripping column. The temperature is diminished to between 82 and 88°C. The heat deriving from the expansion tank is the main heat source of the stripping column and any change in the boiling may influence distillation occurring there.

4.2.1.3. Saccharification

The second amount of alpha-amylase enzyme is added to the pulp immediately after the expansion tank. The mixture is pumped into the two liquefying tanks. Feeding occurs at the bottom of the first tank and the substance overflows at the top of it into the second tank. The mixture exits at the bottom of the second tank. Both tanks are provided with mixer.
The main purpose of the liquefying tanks consists in granting sufficient retention time for the enzyme to transform most of the starch into dextrine (long chain sugar). Temperature is about 85°C and approximate retention time is of 2.5 hours.
Always remains a small quantity of untransformed starch, because full conversion would imply excessive costs. The QC laboratory defines the quantity of unconverted starch still acceptable.

Grinding in the hammer mills, quantity of the alpha amylase, efficiency of the steam injector's shearing – all are important factors in determining the quantity of the residual starch.

After the liquefying tanks, unprocessed thin stillage (recycled) can be added. The recycled stillage dilutes the pulp and decreases the pH-value of the matter forwarded to fermentation. It also reduces the heat requirement of the boiling and evaporating system, however it may also be a contamination source of the fermentors, if the thin stillage is not pure.

After the liquefying pump, adjustment of the final pH-value occurs through injection of sulphuric acid in a static mixer. The pH-meter regulates continuously the quantity of the sulphuric acid added.

The pulp is cooled on two serially connected coolers; the first one is the stillage pre-heater, the second one a water cooler. In the stillage heat exchanger the already fermented stillage is prepared for distillation. In the pulp cooler the pulp is further cooled down to about 30°C.

After adjusting the pulp's temperature in the heat exchangers, a side stream may be diverted therefrom to the yeast tank for yeast reproduction.

4.2.1.4. Yeast reproduction

Yeast reproduction starts in the mixing tank, where the dry yeast is mixed with water and warmed-up by the heating ejector of the mixing tank. An overhead elevating device facilitates the operation of the mixing tank.

The yeast – water mixture is injected in one of the two yeast tanks, where it is mixed with the stillage flow branched-off from the fermentors' main input pipe. In its way, the stillage receives a glycol-amylase injection for generating sugar for the yeast reproduction.

The content of the mixing tank may be injected in any of the fermentors under filling. In addition, the mixing tank may be used for injecting additional enzymes, carbamide or other yeast components, or eventually antibiotics into the fermentors.

The temperature in the yeast tanks has to be maintained around 30°C and its pH-value around 3.8 for best reproduction.

The temperature may be increased by the help of the yeast tempering ejector or decreased by the yeast cooler.

The pH-value can be reduced by adding sulphuric acid.

The yeast reproducing tank may be mixed with the help of the yeast pump and the air blender. The air has a mixing effect, thus granting the oxygen required for the yeast reproduction.

When the yeast is ready, the content of the tank is injected into the fermentor's filling pipe, where, under way, it is mixed with the stillage to be fermented.

Usually 30% of the content of the yeast tank is retained for the next reproduction cycle. The tank is filled-up with fresh stillage and the reproduction process is repeated.

If the tank is infected, it will be entirely emptied, subject to a CIP process and started again with a fresh batch.

4.2.1.5. Fermentation

Following the admixture of the glycol-amylase enzyme, the conditioned stillage flows into the fermentor.
Fermentation is a cyclical process, while the preceding boiling and the subsequent distillation are continuous processes.
Four fermentors are connected to a main feed pipe and they are filled one after another.
All fermentors are filled-up approximately during 18 hours. Each fermentor is added at least one tank quantity of yeast for inoculation.
When a fermentor is filled to 5%, recirculation of the stillage is started. When the filling arrives to 15%, mixing is started up for the sake of accelerating the yeast's activity, while ethanol, CO_2 gas and heat are generated. The total retention time, from starting of the filling until total discharge is about 55 hours.

The content of the fermentor is recirculated through a heat exchanger in order to remove the heat generated during fermentation and to maintain the fermentor's temperature at approximately 32°C. The operator can follow the fermentation process by the help of samples taken through the sampling valve.

Anhydrous ammonia is led to each fermentor, allowing dosage in case of necessity.

The fermentor is emptied initially by the help of the recirculation pump, followed and completed by the fermentor discharge pump. When the fermentor is emptied, cleaning (CIP) is performed with lye solution.

The fermented stillage is injected in the stillage buffer tank. The function of the buffer tank consists in storing the stillage between fermentation and distillation, but fermentation may also continue here to some extent.
The stillage buffer tank serves also as collection point for CO_2 in its way to the washer. The stillage buffer tank is similar to a fermentor, however it is never emptied and cannot be cooled or cleaned-in-place.

When discharging the stillage from the buffer tank, sulphuric acid may be added for decreasing the pH-value. The stillage is prepared in the stillage/pulp heat exchanger prior to distillation (see liquefying system).

4.2.1.6. Carbon dioxide washing system

The carbon dioxide generated during fermentation is gathered in the stillage buffer tank, from where it is forwarded in pipes to the bottom of the wash tower.

The CO_2 washer efficiently removes 99% of the volatile organic compounds (VOC), thus decreasing the plant's emission, while recovering the ethanol fractions from the warm CO_2 gas.

The internal structure of the wash tower includes two 5.8m high random packing beds, two liquid distributors above the beds and a mist trap at the top. The washing water is gathered at the bottom of the tower, from where a pump returns it to the boiling water tank for reuse in the process.

4.2.1.7. Distillation

The plant includes three distillation towers: one stillage column, one side stripper and a rectifying tower. All three towers are operating under vacuum, produced partially by condensation of the ethanol vapors and partially by the vacuum pump.
The typical pressures are: 0.56-0.70bara in the kettle and 0.52-0.63bara in the head.
Temperatures in the stillage column and in the side stripper are 88°C in the kettle and 77°C in the head, while in the rectifying tower 71°C in the kettle and 60°C in the head.

The stillage column has two heat sources. On the one part, it absorbs heat in the stillage/pulp heat exchanger (see liquefying system) and on the other part it utilizes the steam exhausted from the evaporators (see evaporating system).

The pre-heated stillage is fed on the top of the column and it slowly flows down through 19 trays. The steam from the evaporators is entered below the bottom tray. The alcohol is concentrated on the top trays and is removed from the head in form of vapor. The stillage, downflowing through the plates, gradually loses its alcohol content and is gathered in the kettle, from where is removed into the slop tank.

The side stripper is operating parallel to the rectifying column, in order to concentrate the vapors exiting from the stillage column.
The side stripper is partly heated by the flash steam of the expansion tank (see boiling system) and partly by the boiler's steam. The low concentration bottom product exiting at the bottom of the rectifying column is pumped to the top of the side stripper and flows down here through 16 trays.

The flash and the boiler steam are entered below the bottom tray.

The alcohol is concentrated on the top trays and exits in form of vapor from the column's head. The liquid accumulated on the bottom of the column is almost pure water and may be used for boiling.

The rectifier is the last column of the distillation process. Its heating sources include the steams from the stillage column and the side stripper, as well as the 50% alcohol steam from the molecular sieves (regeneration). The high purity reflux flows into the head of the rectifier and from here flows down through a packing bed and then through the four trays located below.

The steams from the side stripper and the stillage column enter into the tower below the trays. The recovered liquid is let in above the first tray.

96% ethanol containing vapor exits from the column head and is condensed on the vacuum condenser and the vent condenser. After condensation the 96 degree alcohol enters into the reflux tank, from where part of it is returned onto the top of the rectifier and the rest is transferred into the 95% ethanol tank. The liquid let out on the bottom of the rectifier still contains some alcohol is injected on the top of the side stripper.

The fusel oils (higher alcohols generated during fermentation) are removed from the first or third tray of the rectifying column by the help of the fusel oil pump.

4.2.1.8. Molecular sieve system

The ethanol forms an azeotrope with the water, preventing production of a concentration above 95% during distillation. Further concentration is necessary for producing fuel quality ethanol. This is performed in the plant by the help of molecular sieves. The molecular sieves contain a bed of desiccating agent, absorbing selectively only the water molecules but not the larger alcohol molecules while under pressure.

The molecular sieves are regenerated under vacuum, thus removing the water from the sieve bed. Approaching the end of the regeneration cycle, the sieve bed is washed by anhydrous alcohol, which, forming an azeotrope, helps to remove the residual water. At any moment two beds are dehydrating the alcohol, two are in course of being regenerated under vacuum and two are in the course of being exposed to pressure again. These cycles have duration of 6 to 8 minutes.

The 95% ethanol to be dehydrated is injected from the 95% ethanol tank located in the tank park. It is warmed in the sieve's pre-heating unit by the help of the hot 100% ethanol being in its way to the 100% ethanol tank of the tank park. The 95% ethanol is warmed up to approximately 138°C in the sieve's evaporator by boiler steam. The medium pressure condensation water flows to the evaporators, where it is reused for heating the process (see evaporation system).

From the head of the evaporator, the overheated ethanol steam flows to the molecular sieves. It proceeds downward through the dehydration bed and exits as 100% ethanol steam at the bottom. This steam is a heat source for the evaporators (see evaporation system).

The vacuum drawing-off the molecular sieves is produced by the regeneration condenser, ejector, tank and pump.

The liquid accumulating in the regeneration tank is a concentration of approximately 50% and is returned into the rectifying column for reconcentration. Part of this stream, which is cooled down in the regenerator's cooler, is used as seal water at the distillation's vacuum pump.

The 100% ethanol returning from the evaporation system flows into the 100% flash reception tank and from here to the 100% ethanol tank. The vapors escaping from the flash tanks are condensed on the distillation system's vacuum condenser.

The 100% product pump discharges the 100% product through the sieve pre-heater and the wet aftercooler to the tank park.

4.2.1.9. Centrifuge system

The thick slop arriving from the bottom of the stillage column is pumped into the thick slop tank. The thick slop tank is continuously mixed for maintaining the solid matters in suspension.

The thick slop tank has to buffer store the material between the continuous distillation and the cyclical desiccation processes.

From the tank, the thick slop is fed to one of the four centrifuges. The solid matters fall out from the centrifuge with about 64% moisture content. This product flow is called wet distillation grains or wet filtrated. The liquid exiting from the centrifuge flows to the filtrate tank. The filtrate tank serves as a collection point of the process's venting lines and the filtrate blower forwards the VOC and other vapors deriving from the process to the thermal oxidation boiler for destruction.

The filtrate pump injects the recovered liquid into the thin slop tank, the liquefying system (if recovery occurs) and into the agitator as boiling water.

The thin slop tank and pump supply the evaporation system.

4.2.1.10. Evaporation

The evaporating system concentrates the thin slop (the liquid part of the distillation kettle's residual product) into syrup that may then be sold as animal feed. In addition, it recovers the process water contained in the thin slop for recycling.

The evaporation system consists of two stages. The steam evaporated in the first stage heats the evaporators of the second stage. The multistage evaporation reduces the heating demand required for evaporation of the water.

Each evaporation column is a falling film shell-and-tube heat exchanger, with a separation head on the top. The thin slop is fed into the head of the evaporator, it flows down on the tube walls and exits at the bottom of the vessel. The vapors of the thin slop are removed near the top of the vessel. Heating medium inlet and condensate outlet occur only on the top barrel.

As pumped though all of the eight evaporators, the thin slop gradually concentrates and exits form the system in form of syrup.

The first stage evaporators (#1 - 4) have three heat sources: the ethanol steam from the molecular sieve system, flash steam from the expansion of the medium pressure condensation water exiting the molecular sieve system and the boiler steam. The boiler steam and the ethanol vapor are reduced nearly to atmospheric pressure through injection of condensation water and of liquid ethanol into the relevant steam pipes.

The Evaporator #1 utilizes only alcohol steam, Evaporator #2 either ethanol steam or boiler steam, Evaporators #3 and #4 only boiler steam.

The ethanol steam from condensation returns to the molecular sieve system, while the water steam from condensation accumulates in the condensation water tank, from where it is reinjected into the deaerator for being reused in the boiler.

The second stage evaporators have a single heat source, the steam of the thin slop from the first stage evaporators. This steam is condensed in the upper section of the second stage evaporators and accumulates in the reception tank as process condensate. This condensate is not as pure as the condensation water of the first stage evaporators, therefore it is treated in the methanator before being reused as washing water.

The steam coming from the second stage evaporators constitutes heat source for the stillage column.

4.2.1.11. Desiccation

There are deflectors within the rotating drum for lifting the product in order to expose it to the drying air and to move it forward through the desiccator.

The dropping chamber is the place, where the dry product and the wet air exit from the desiccator.

Cyclones serve for recovering solid particles carried by the drying air.

A 150kW ID fan produces the air stream flowing through the desiccator.

The air loaded with wet VOC passes through the thermal oxidation boiler for destroying the VOC content.

The wet distillation residue is transferred from the centrifuges to the feeder of desiccator “A”, where it is mixed with the partially desiccated product prior to entering into the desiccator.

The product exits from desiccator “A” with approximately 30% moisture content. From here it gets into the wet granulate dispenser for being sold as modified wet granulate, or forwarded into the mixer of desiccator “B”. The mixer blends the modified wet granulate, the syrup and a partial stream of the fully dry product into a material of uniform consistency, prior to entering desiccator “B”. The product exits from desiccator “B” with approximately 11% moisture content. From here it may be forwarded either to the DDG store building or to the wet granulate dispenser.

4.2.1.12. Biogas system

Process condensate of the evaporating system is gathered in the methanator’s feed tank and the methanator feed pump doses it into the methanator.

Methanators are designed for transforming organic matters equivalent to 3,628kg/day of COD into methane, what may be used in the process as fuel.

If the COD load of the process condensate is too low, thin slop may be added to the methanator’s feed stream in order to generate methane equivalent to the full load.

The methanator’s feed material enters into the recirculation tank, where it is mixed and warmed-up with direct stream to approximately 38°C.

The recirculation tank is the site, where the iron and phosphate nutrients are added for granting optimal methane production.

The mixed feed is then pumped into the bottom of the methanator for COD removal.

A digestive upflow anaerobic sludge blanket is formed in the methanators; they have no moving parts.

The biogas and the overflow water exit at the top of the methanator.

The collected biogas is conditioned in the biogas washer and is used as fuel in the burner of desiccator "A".

The overflow water is degassed in the decarbonator tank and is returned to the boiler water tank for being reused in the process.

4.2.1.13. Enzyme system

The alpha and glycol-amylase enzymes are supplied in liquid form by tank vehicles into the plant.

Unloading of the enzymes occurs outside the building, at the sulphuric acid unloading station for public road transport. Following unloading, the discharge pipe is blown out by air.

There are two serially connected tanks each for the alpha and glycol enzymes.

Mixing of the stored enzymes is granted by mixing pumps and injectors for preventing demixing.

Three feeding pumps are used for dosing-in the alpha enzymes. The first one feeds the alpha enzyme into the agitator, the second one injects the enzyme into the pipe section after the expansion tank during boiling, and the third one is a relief pump that may be used for different purposes.

Similarly, three feeding pumps are used for dosing-in the glyco enzymes. Two of them, operating simultaneously, inject the glyco enzymes into the pulp transported for fermentation, while the third one inject glyco enzymes into the branching-off pipe towards the yeast reproduction tank.

4.2.1.14. Ethanol storage

The plant's ethanol storage system is constituted of five tanks; two product storage tanks, an EtOH95%, an EtOH100% storage tank and a tank for the fuel additive.
The EtOH95% tank serves as buffer between distillation and molecular sieves.
The EtOH100% storage tank allows quality control prior to transferring it into the product tank. If the water content of the ethanol is too high, it is returned to the EtOH95% tank for additional dehydration on the molecular sieves. If the quality is satisfactory, the fuel additive is mixed-in during transfer to the product storage tank.

The ethanol delivery pump forwards the product ethanol to the public road or barge loading station.

4.2.1.15. CIP system

The concentrated lye supplied in tank vehicles is unloaded into a storage tank. The concentrated lye is transferred into the CIP tank through diluting it under way by fresh water in a static mixer with proportionate dosing control. The diluted lye is warmed-up to the required temperature on a circulation-type heat exchanger, and then forwarded on through the distributing system to the site to be cleaned.

The returning contaminated solution is filtered by the CIP filter, the clean filtrate returned to the CIP tank. The residual phase on the filter is dosed to the suspending devices as boiling water.

The returning diluted lye may also be transferred from the CIP tank to the contaminated lye tank, from where it can be pumped into the thin slop tank or into the methanator.

The residual lye from in the pipes may be neutralized by acidic CIP solution.

The washing water is dosed into the acid-containing CIP tank and circulation is started through the ejector. The ejector's suction piece of the ejector is connected to a feed cone, into which the acidic additive is poured. The ejector gradually dilutes and discharges the dosed additive into the tank. Thereafter, the ready acidic CIP solution may be forwarded to the relevant place throughout the distributing system.

4.2.2. Energy production

For satisfying the bioethanol plant's process steam requirement, a power center will be implemented within the project site. Main elements of the energy production include:

- Natural gas fuelled boiler with 43MW input heat capacity for granting steam to the process (and, to a smaller extent, supplying electricity to the plant by a steam turbine);
- Natural gas fuelled boiler with 2×16MW input heat capacity for desiccation of the DDGS.

4.2.2.1. Gas-receiving station of the power plant

The pressure of the medium pressure natural gas pipeline is reduced by the gas-receiving station implemented within the power plant to the pressure required by the gas boilers' burners. The low-pressure gas is forwarded to the burners by a piping system. Safety quick-action stop valves and manual gas checks before the entry of the gas pipes into the building allow disconnection of the gas from each section and provide proper security.

The gas accounting metering point is the site of entry into the gas-receiving station, but the single consumption sites will also be provided with separate meters.

4.2.2.2. Technology of the gas boilers

Dimensioning of the gas-fired boilers granting 100% of the plant's steam requirement, is based on the quantity of steam and electric power required by the plant.
The steam parameters have been established in a manner to satisfy the technological requirements.

The boilers are of double flue tube, large water chamber design and are provided with standard manufacture natural gas burner with separate air blower. The air blowers of the 43MW boiler use the VOC containing hot air discharged from the DDGS desiccator, while the DDGS desiccators use the air from the boiler house. In the latter case gas-fired calorifers are installed in the air pipes allowing proper warming-up of the combustion air for the event of extremely cold weather. The blower, the burner and the entire control unit and fittings (including also the safety devices), as well as the instrumentation constitute accessories of the boiler. Due to the slight overheating, the overheater is installed in the most possible simple manner, at the flue-gas exit, on the backside of the boiler.

Alkaline cleaning of the boilers is connected to a common expander; the steam generated is outlet into the air, while the residual water – following proper cooling – is discharged into the run-off system. The internal condensates are led directly into the feed tank with degasser.

The supply aggregate of standard design, common for the four boilers, constitute part of the boiler battery. The supply aggregate includes a feed tank with degasser, feed pump with the pertaining controls and the instrumentation consisting of transmitters for normal operation and of the local instruments. The condensate of the bioethanol plant and the make-up water required for supplementing non-returned condensates from the steam consumers are also let into the feed tank of the boiler house.

4.2.3. Material flow of the technology

The following diagram represents the annual material flow of the envisaged bioethanol plant of 186,000MT/year annual capacity:

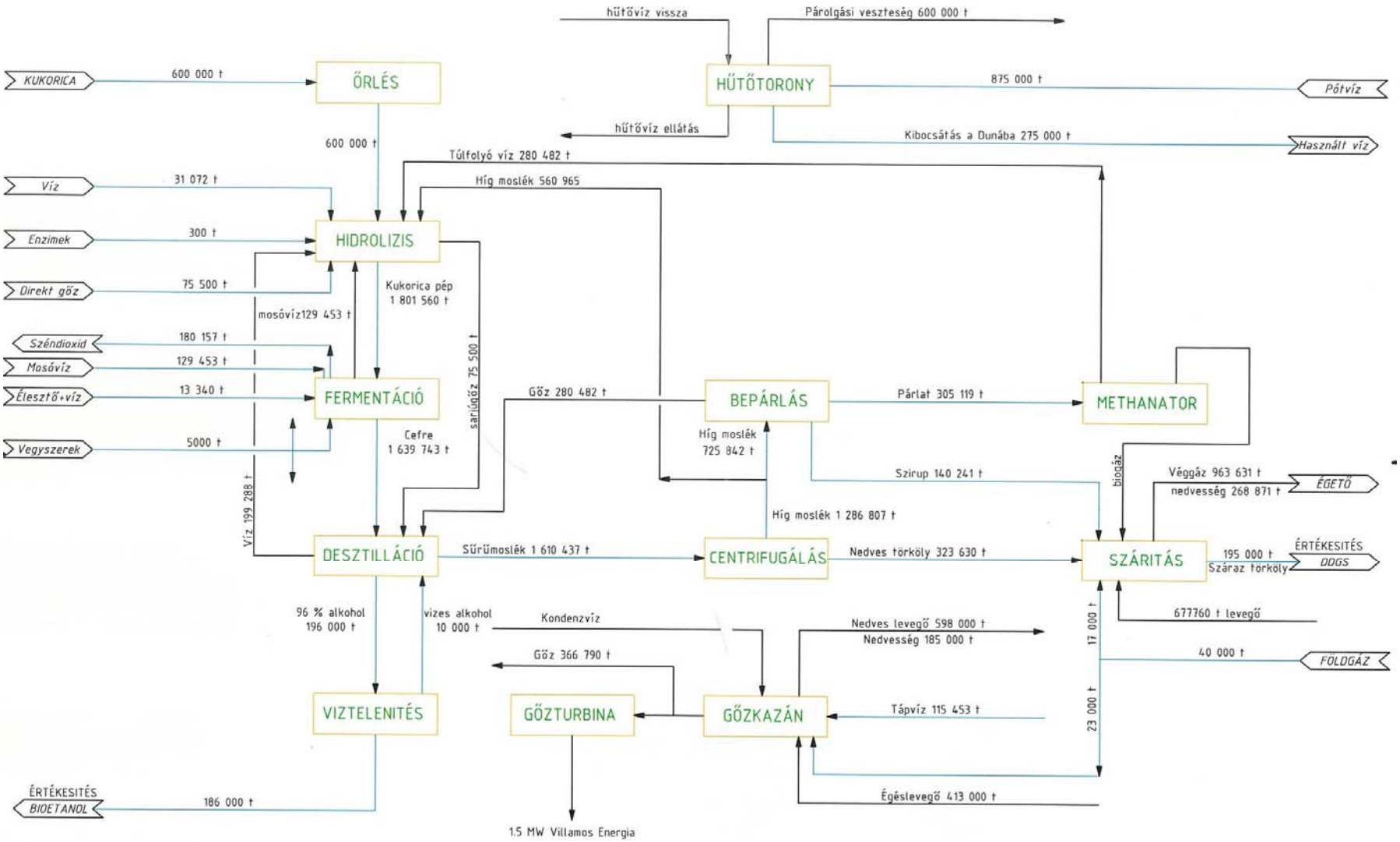


Figure 1: Material flow of the technology

Table 9: Material flow of the technology

Technological process	INPUT (MT/y)		OUTPUT (MT/y)	
1. Milling	**Corn**	**600 000**	Ground corn	600 000
2. Hydrolysis	Ground corn Water Escape water Thin slop Enzymes Direct steam Washing water	1 877 060	Corn pulp Flash steam	1 877 060
3. Fermentation	Corn pulp Washing water Yeast + water Chemicals	1 949 353	Stillage Washing water Carbon dioxide	1 949 353
4. Distillation	Hydrous alcohol Stillage Flash steam Steam	2 005 725	96% alcohol Water Thick slop	2 005 725
5. Dehydration	96% alcohol	196 000	**Bioethanol** Hydrous alcohol	196 000
6. Evaporation	Thin slop	725 842	Evaporate Syrup Steam	725 842
7. Methanator	Evaporate	305 119	Biogas Escape water	305 119
8. Centrifuging	Thick slop	1 610 437	Wet DDG Thin slop	1 610 437
9. Desiccation	Wet DDG Syrup Biogas Air Natural gas	1 158 631	DDGS Final gas	1 158 631
10. Steam boiler	Feed water Natural gas Combustion air Condensation water	964 790	Steam Wet air	964 790
11. Cooling tower	Make-up water	875 000	Waste water Boil-off	875 000

4.3. FREIGHT AND PASSANGER TRAFFIC VOLUME

4.3.1. Access on public road

The area accommodating the bioethanol plant can be accessed on main road No. 6 from Dunaföldvár and Dunaújváros settlements, through the access road interconnected at the northern municipal border of Dunaföldvár, near the fuel station located here. The access road is used by vehicles arriving to the plants of LUKOIL and Agrograin/Cargill, this traffic defines the basic conditions. The access road is flanked on both sides by unbuilt agricultural lands.

The transport activities required for the implementation of the envisaged project will concern the available access road and main road No. 6.

4.3.2. Raw material supply

Corn – 600,000MT/year – will be supplied on mechanical conveyor belts to the factory from the adjacent plant of Cargill/Agrograin. At present, corn is transported to Cargill/Agrograin exclusively on public road.

Total corn supply requirement of PannoniaEthanol amounts to about 70 trucks/day, based on the following data:

- 600,000MT/year of corn = approx. 1700MT/day (350 days/year)
- calculated with 25 tons capacity, this implies about 70 trucks/day.

The actual traffic of the access road will increase by the traffic of the additional supply requirement to the adjacent plant, implying – according to estimates – access and exit traffic of about 40 to 50 (25 ton) trucks in daily average.

The supply volume of the neighboring plant was previously of 300,000MT (about 12,000 trucks), that means, 35 trucks/day, calculated with 350 days annually. The supply volume changes with the seasons, in October the traffic approaches 100 trucks a day.

4.3.3. Other raw materials

Supply of the other raw materials (enzymes, acids, bases for pH adjustment) is made through direct transport to PannoniaEthanol. This implies one or two trucks a day, at maximum.

4.3.4. Ethanol delivery

Majority (80%) of the ethanol delivery occurs by barge transport on the Danube, through the port of LUKOIL; the remaining quantity will be expectably transported in tankers.

4.3.5. DGS delivery

The dried distillers' grains (DGS) – 195,000MT/year – will be typically (about 80%) transported on the Danube, loaded on barges in Cargill's grain port. A small ratio (up to 20%) may also be transported on public roads.

4.4. RELATED OPERATIONS

4.4.1. Water acquisition

The envisaged water requirement amounts to 3,000m^3/day.
Purpose of the envisaged water use: technological water supply of the plant.

The expertise on water acquisition has been prepared by Aqua-Care Kft. The expert opinion in full is attached here under *Annex 5.*

Water quality requirements: drinking water quality.

The decision of granting water supply from deep groundwater resources is a necessity deriving from the actual conditions: water supply can be granted either from the public utility network (similarly deriving from deep groundwater but suitably treated and sterilized for public water supply purposes) or from own deep wells.

Reasons rendering impossible application of the other possibilities surveyed are detailed below:

- On the adjacent waterfront properties that could be envisaged for surface or bank-filtered water withdrawal – located upwards in respect of the water flow – including topographical lot Nos. 0107/5-8 and 0107/16, between river kilometer sections 1563.730 and 1564.050 of the Danube, establishment of a port and bitumen terminal is in course. The preliminary assessment has been already performed and in its resolution of File No. 3889-29/2009 the KTVF (Middle Transdanubian Inspectorate for Environmental Protection, Natural Protection and Water Management) stated that the envisaged project had no remarkable environmental impacts and has defined the pre-requisites for the further planning activity.
  Under normal operating conditions the establishment would have evidently no impact to any bank-filtered or surface water withdrawal, but emergency events cannot be excluded and the bioethanol plant needs reliably steady drinking quality water.

- Due to the soil strata conditions, use of the groundwater within the project plant is not possible; the pedological survey has also confirmed that the territory constituted part of the loess plateau. The groundwater bearing layer is constituted of loess and muddy hard fine sand, from which water withdrawal in similar volumes cannot be expected.

Satisfaction of the water demand can only be resolved through establishment of several deep wells arranged in well pairs and locating the well pairs at the greatest possible distance within the property.

The envisaged well establishment scenarios according to the actual knowledge include:

- ***Version "A":*** **2 wells with bottom at 100m depth (envisaged filtering between 50 and 95m) and 2 wells with bottom at 150m (filtering between 120 and 140m);**
- ***Version "B":*** **2 wells with bottom at 150m depth (envisaged filtering between 120 and 140m) and 2 wells with bottom at 200m (filtering between 170 and 190m).**

The actual configuration of strata at the well implementation points will allow determination of the final version to be elected, on the basis of a 200m deep prospective drilling and of the findings of the geophysical profiling to be performed.
All of the existing aquifers are sand layers from the Pliocene (Levantine and Pannon) epoch.

The wells will be implemented in large diameter (ND 225mm with filter pack), with under-reaming and graveling, implying that an enlarged bore of 400-450mm will be prepared for the filter pack and the annular space between the ND 225mm filter pipe and the bore wall will be filled with screened gravel.

The site of deep water extraction will be the property of topographical lot Nos. 0111/26 and 0116/5 in Dunaföldvár; EOV coordinates of the envisaged well pairs are as follows:

Well pair mark	EOV Y	EOV X	KTJ	Top. Lot. No. (Dunaföldvár)
T1	639739	165414	102062152	0111/26
T2	640122	165280	102062163	0116/5

According to available data, the quality of the water to be extracted from the targeted porous layers can be characterized as follows:

- calcium-magnesium-bicarbonate containing type;
- total salt content not too high (specific electric conductivity 550 to 650 microsiemens/cm);
- favorably low ammonium concentration of about 0.1mg/L;
- high Fe and Mn content;
- methane-free;
- total hardness: 170-200mg/L CaO.

The water temperature will be expectably slightly lower in the case of the well pair consisting of shallower members, of about 16-18°C, while unfortunately higher in the case of version containing deeper wells, of around 22°C.
Submergible pumps will be used for extracting the water, as even the stationary water level is expected to be by 8-10 meters below the surface.

4.4.2. Water treatment

4.4.2.1. Purpose of the treatment

Granting water for boiler operation, as well as make-up water for the cooling circuit and process water requirements.

Description of the treatment processes:

- Pre-treatment
- Adding disinfectants
- Iron removal

<u>For the preparation of boiler make-up water the following methods will be used:</u>

Desalination process: desalination through reverse osmosis
Residual hardness removal: subsequent demineralization
Feed water conditioning: addition of chemicals

<u>Preparation of make-up water for the cooling circuit:</u>

Conditioning: addition of chemicals

<u>Capacity requirements:</u>

Cooling circuit make-up water:
- from filtered water: 81.6m^3/h
- from RO permeate: 6.0m^3/h

Process water:	21.6m^3/h
Boiler make-up water supply:	16.8m^3/h

4.4.2.2. Description of the technological processes of the water preparation

Summary of the process' technical content: filtering for removing the iron and manganese content for the preparation of the cooling circuit's make-up water and of the process waters, desalination through reverse osmosis for producing boiler make-up water, then subsequent demineralization for removing the residual hardness, by application of the suitable pre- and post-treatment units.

During the deferrization process, the first step consists in disinfection of the filter pack and in adding disinfecting agents for pre-oxidation of the iron and manganese, therefore follows the removal of the iron and manganese through the packed filtering device. The top part of the device's pack consists in an active catalyst that oxidizes the iron and manganese ions without chemical treatment, by using the dissolved oxygen contained in the water, through the following reaction:

$$Fe(HCO_3)_2 \rightarrow Fe(OH)_2 + 2CO_2$$
$$Fe(OH)_2 + ½\ O_2 + H_2O \rightarrow Fe(OH)_3$$

The oxidized and precipitated iron and manganese content is filtered out by the lower filter pack of the device. The pack may clog during the operation due to the filtered precipitation, thus the resistance of the filter column may increase. Cleaning of the filter is made by countercurrent washing. The frequency of the backwashing process is determined by the operational conditions, but usually its performance is recommended on daily basis.

The iron and manganese content of the produced waste water remains below the limit value specified by Govt. Decree 204/2001. (X. 26.), thus may be directly discharged to the public sewage system.

For removing salt content of the water to be treated, a reverse osmosis device is used together with the necessary chemical dosage units.

The water treatment technology by reverse osmosis (in short: RO) is a typical physical separation method, where the membrane lets through the solvent – water molecules – but retains majority of the dissolved salts. Spiral coil membrane with high permeate flux rate and salt retention and high pressure pump for overcoming the osmotic pressure are used for the process. Depending on the type of membrane used, the devices operating on the principle of reverse osmosis have a salt retention capacity of 98-99%, while the permeate/raw water ratio may be between 72 and 77% in this technology.

The reverse osmosis technology has the function of remarkably decreasing the salt content of the pre-treated water through a process using membrane.

The system includes one RU unit with nominal capacity of 22.8m^3/h.

The equipment includes 8 RO modules and consequently 40 RO membranes. The structural elements of the equipment are installed on corrosion-proof steel frame. Beyond the modules, the devices include the pumps required for the process, the plug-type pre-filter with 1µm gap, the instrumentation, the pneumatically controlled manual shut-off and adjustment valves, as well as the sampling valves.

All processes of the reverse osmosis equipment are automated; the filling-up level of the permeate tank controls the water production processes, while the auxiliary processes are time-controlled. The permeate generated during the process – after quality and quantity control – is forwarded to the subsequent demineralizing device, while the concentrate is discharged into the waste water.

The softening plant has the function of removing the residual hardness from the RO permeate.

The equipment includes two water softener units to be operated either simultaneously or in alternating mode. The ion-exchange tanks of the equipment consist of upright cylinder design columns with polyethylene lining and polyester shell, of the highly acidic synthetic resin pack and of the control fittings and instrumentation granting automated operation.

The units are of alternating cyclical operation; following softening cycles, regeneration, washing and auxiliary processes are performed. The water producing processes are quantity-controlled, while the auxiliary processes are programmed on time basis. The softening process is performed by downstream. Regeneration of the ion-exchange packs is made by using sodium chloride solution.

4.4.3. Terrain correction, site preparation

The project area is at present uncultivated arable land/field area mainly covered by grasses, weeds and shrubs.
The building norms concerning green surfaces applicable for the area have the following provisions:

- smallest green surface: 25%
- paved surface max.: 20%

The envisaged project complies with the above requirements.

During ground grading, exclusively earth work necessary for the construction will be performed.
The existing terrain is in slope. Its highest point is located in the north-western corner of the ground-plot, with about 110.5mBf height. The lowest point is the vicinity of the southern border of the lot, with 97.5mBf height. The steepest slope of the ground is at the western side: here the southward inclination of the ground is 10%.

Upon grading, the altitude of the plant, including that of the internal roads, is planned to be at 103.5mBf, adjusted to the local slope conditions (± 0-10cm). Exceptions are the gas receiving area (101.0mBf) and the parking lot of the administration building (104.0mBf). The “0” levels of the buildings are to be at 103.9mBf, respectively at 104.2mBf for the administration building.

As the building area will be developed as a uniform plane level, the earthwork constitutes a high volume task. The ground grading strives – as far as possible – for earth volume balance. The upper surface of the resulting raw terrain should be brought in a condition allowing performance of the further construction works and preventing damages caused by precipitation water to the earthwork. (Slight sloping, run-off ditches and temporary desiccating surfaces have to be established.)

Quantity of the humus extracted:	23,000m^3 (in majority backfilled on green surfaces)
Envisaged cuttings (rough terrain)	107,000m^3
Envisaged backfills (rough terrain)	84,000m^3 (the difference is to be removed)

Preserving the humus-containing top-soil of the site constitutes an important part of the preparatory works of the project. In average, 30cm thickness may be calculated within the project area. This top-soil has to be extracted by all means on the envisaged building and pavement sites and in all sites concerned by grading. The upper layer of 8-10cm thickness, together with the plants growing on it will be removed or composted, while the remaining humus has to be stored in a proper deposit (up to 2m height) within the project site until utilization, and then backfilled on the intended locations of green surfaces.

4.4.3.1. Design principles

The following fundamental requirements have been taken into account during planning:

a) Access to and exit from, the ground-plot can be controlled by 2 guarded gates/barriers;
b) The third entrance grants entry to the gas receiving station implemented on an elevated platform due to the ground's inclination;
c) Passenger parking and freight traffic are separated within the ground-plot;
d) The passenger parking lot will be implemented on the area in front of the office building for use by employees and visitors;
e) The freight traffic entry and exit gates will be located on the western side of the ground-plot, from the newly implemented exploration road, at a distance of about 90m from each other. The freight traffic is typically consisted of truck and long vehicle circulation. Movement of the vehicles within the ground-plot will be granted always in compliance with the relevant norms (turnaround radius etc.). The ground-plot area is closed to public traffic.
f) The roads within the ground-plot grant circumvention (also for fire-engines) of and access to, each building. Certain technological processes are strictly connected to the roadways and to freight traffic: discharging of raw material (corn) and loading of end-product (ethanol) into transport vehicles, as well as meterage. (Remark: raw material supply and end-product delivery will principally occur through the port; however each unit is apt to receive road vehicles, too.)
g) The parking lot for passenger cars and the road surfaces have simple slope and water discharge conditions.
h) Precipitation water from the passenger car parking lot can only be discharged through approved and properly dimensioned sand and oil trap. The precipitation water thus purified will be led outside the ground-plot, then along its southern, longitudinal side and its continuation through the ground-plot of CARGILL into the Danube, through the discharge system already implemented.
i) In areas of the ground-plot, where occasionally trucks are waiting (tanker filling area, corn receiving station and access area in front of the DDGS loading station), precipitation waters will be discharged from the concerned road sections, provided – similarly to the passenger park – with elevated edge, through sand and oil trap structure.
j) The passenger park's surface will be covered by ornamental stone pavement on CKT concrete base. Also footpaths receive ornamental stone pavement. Washed gravel edgings and footpaths will be implemented around the building. The parking areas will be provided with elevated edge and rain water discharge system (sand and oil trap).
k) In the parking areas, trees will be planted in quantity (1 tree/4 parking place) required by OTÉK (National Town Planning and Construction Regulations).
l) Road surfaces to be used by heavy vehicles will receive multilayer asphalt pavement on CKT base.

4.4.3.2. Technical design principles of the pavements

The envisaged service roads will be executed basically in 7m width. This is sufficient for two lanes, however the roads intended for internal transport will allow one-way traffic. The circumvention road for fire-engine and service purposes along the back (eastern) side of the ground-plot is 6m wide. The width of the parking ways is 6m, the size of the parking places 5×2.5m. Side inclination of the roads is of 2-4%.

Subject to the intended use and load, the paved surfaces within the ground-plot will have the following structures:
The (less favorable) access traffic has to be taken into account. The envisaged internal roads are one-way roads. Design life: 20 years. Traffic load class: “D” – heavy.

Asphalt surface pavement structures (internal road network):

- AC-11 wearing layer (F mark): 4cm
- AC-22 bonding layer (F mark): 10cm
- Ckt-4 stabilization ballast: 20cm
- FZKA improvement and protection layer: 30cm
- Single-layer geotextile: 200g/m^2

Ornamental stone paved structures:

- Ornamental stone: 10cm
- 2/5 fine gravel bed: 3cm
- Ckt-4 stabilization ballast: 20cm
- FZKA 0/32: 30cm
- Single-layer geotextile: 200g/m^2

Basalt concrete pavements with cement-based bonding material base course:

- CP4/3 basalt concrete pavement: 20cm
- Ckt-4 stabilization ballast: 20cm
- FZKA 0/32: 30cm
- Single-layer geotextile: 200g/m^2

Crushed stone surfaces:

- FZKA 0/32 crushed stone: 200mm
- FZKA 0/64 crushed stone: 300mm
- Single-layer geotextile: 200g/m^2

We suggest constructing the traffic lanes of the car parking lots according to the stratification required for “A” traffic load class.

Parking lanes with asphalt pavement:

- AC-11 wearing layer: 4cm
- Ckt-4 stabilization ballast: 20cm
- FZKA improvement and protection layer: 30cm
- Single-layer geotextile: 200g/m^2

Parking places with ornamental stone pavement:

- Ornamental stone: 6cm
- 2/5 fine gravel bed: 3cm

- FZKA 0/32: 55cm
- Single-layer geotextile: 200g/m^2

4.4.3.3. Calculation of parking places

Accommodation of vehicles:

Pursuant to Article 42, Section (1) of Govt. Decree 253/1997. (XII. 20.), accommodation facility for vehicles at least in number and for types as provided in Sections (2) and (4) – subject to any diverging Municipality regulation as to Section (10) – furthermore, in case of regular freight transport, loading places are to be implemented within the ground-plot for the sake of proper use of the buildings, independent dedicated units and areas. In the case of expansion, transformation or modification of the function of existing constructions, accommodation of the additional vehicle number deriving from the expansion, transformation or functional modification has to be granted, by maintaining the existing number of places.

Establishing the number of passenger cars to be accommodated for proper use of the buildings, in compliance with Annex 4 of Govt. Decree 253/1997. (XII. 20.):

One passenger car is to be calculated for:

- every 200m^2, or part thereof, of the manufacturing and mounting areas of the industrial units
- every 500m^2, or part thereof, of the storage areas of store units
- every 20^2, or part thereof, of the net floor-space of the other functional units' main rooms (main area of the office block: 1 parking place for each 20^2, or part thereof, of the offices)

Implementation of a total of 41 parking places is thus required, but, on customer's request, 50 parking places will be established within the ground-plot.

Loading sites for trucks are granted adjacent to or within the buildings. Any short term waiting for meterage, discharging or loading will be possible in the expansion bays connected to the two traffic lanes.

4.4.4. Planting plan

The planting plan takes into consideration the industrial character of the site. Consequently the covering ratio, the surfaces covered by trees and bushes, will only slightly increase, and mainly at the borders of the plot and on areas located near the office building. The regulation plan requires three-layer vegetation at the borders.

This is why smaller bush patches were included for being planted below the tree-lines indicated in the permit application plan. On the lower side, near the road, variegation by some bush species of the large slope is envisaged instead of the bush-line. These are either native, beautiful xeric species or similarly undemanding bedding plants, later probably capable of propagation. Now they may be planted in the grass, but later care has to be used for avoiding them during mowing.

Small number of tree species will be used; from among the deciduous trees several species of lime are envisaged. Beyond their slightly differing ecologic requirements, their apparition also presents slight differences. A greater variety of evergreens and pine species is envisaged. The Leyland cypress develops well even under extreme conditions, becoming with time a large, cone-

shaped pine. Creeping Juniper species are able to cover large areas with time, therefore they are to be planted keeping larger distance between the plants. Together with other xeric species, also some small groups of firs will be planted on the slope. When digging the lay-away pits, it is reasonable to thoroughly mix the lower, poor quality soil layer with the top humus-containing layer. We suggest to plant trees of smaller size of the usual planting size, because this way they can better adapt themselves to the local conditions.
Bushes may be planted in different sizes. Solitary bushes of larger size have to be planted on the slopes. For bush patches, planting quantity amounts usually to 1pc/m^2. In the green belts of the parking lots, low growing, creeping root type flowering shrubs will be planted that are approximately green also in winter. Here the planting quantity suggested is 2pc/m^2.

LIST OF PLANTS

Deciduous trees:		Size	pc
1	Tilia americana Redmond	sf 2xi 12/14	16
2	Tilia cordata	sf 2xi 10/12	86
3	Tilia euchlora	sf 2xi 10/12	45
4	Tilia tomentosa	sf 2xi 10/12	77
	Total:		**224**

Pine trees, evergreens:		Size	pc
A.	Juniperus media Old Gold	60/80	8
B.	Juniperus chinensis Keteleri	80/100	13
C.	Cypressocyparis leylandii	100/150	5
D.	Pinus sylvestris	80/100	28
	Total:		**54**

Bushes, bedding plants:		` Size	pc
a.	Acer campestre	60/80	25
b.	Cotoneaster horisontalis	60/80	305
c.	Cotinus coggygria	60/80	315
d.	Cornus sanguinea	60/80	225
e.	Hypericum patulum	40/60	320
f.	Rhus typhina	60/80	34
	Total:		**1224**

Annex 11 includes a map of the planting plan.

5. EVALUATION OF THE APPLIED TECHNOLOGY TO BAT

When analyzing the applied technologies to the best available techniques, we have used Annex 9 of Govt. Decree 314/2005. (XII. 25.) and the reference documents related to the food industry, ***especially the parts that were comparable to the technology applied by Duna-Etanol Kft.***

In addition to the criteria included in the reference document, we have also taken into consideration the following criteria during the BAT evaluation:

- Processes and other technical solutions for preventing emissions from the establishment, or if emissions are unavoidable, for their mitigation;
- Solutions, if required, for preventing waste generation, recycling of any waste produced and for disposing non-reusable wastes in a manner excluding any environmental pollution and damage;
- All measures that are intended for increasing energy efficiency, safety and avoidance or reduction of pollutions;
- Methods and measures for measuring (monitoring) and continuous control of the emissions deriving from the establishment.

The following Table includes the content elements of the BAT compliance matrix, broken down to the following columns:

Column 1: BAT criteria (extract from the BAT reference document);
Column 2: Technology applied in the plant under study;
Column 3: Compliance of the applied technology with the BAT criteria;
Column 4: Recommendations.

<u>Categorization of the BAT criteria included in the detailed Table</u>

- Techniques to be taken into consideration for defining BAT
- Emission and consumption levels
-

BAT criteria specified in Column 1 have been established on the basis of the relevant reference documents' recommendations.
The lines of Column 2 have been completed on the basis of interviews conducted with the management, designers, technologists and persons in charge of environmental protection.
The techniques applied in the plant have been qualified in Column 3 on the basis of our findings during the site inspections and of the content of the interviews.
Three levels of compliance have been defined: the techniques applied are

- complying,
- partly complying or
- non complying

with the BAT.

In the event, when the technology applied in the plant under study, due to its character, cannot be compared to the BAT criterion, the "non relevant" remark has to be entered in the relevant lines of Column 3.

If the technology applied in the plant is non-compliant or partly complying, the relevant lines of Column 4 contain recommendations for the measures required for granting compliance.

Table 10: BAT compliance of the bioethanol technology

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
Description of the best available techniques				
Supply and storage	Large quantities of solid raw materials are usually supplied in bulk. These are immediately used following supply or stored in silos.	Corn supply is made in bulk, emptied into grate-covered reception bunkers, and transferred from here to the storage silos.	**Complying**	
	Solid raw materials may be transported pneumatically (dust, grains) or on conveyor belt, elevator, screw conveyor or by help of pumps.	Bucket elevator forwards the corn into the technology.	**Complying**	
	The engines of the trucks may cause remarkable noise load during operation. This may be avoided by stopping the engine during loading and parking. If electricity is required for the loading, it may be granted from external sources.	Operation of the trucks will be optimized during materials handling in compliance with the BAT recommendations.	**Complying**	
Milling	Milling may be performed in wet or dry condition. In case of wet milling or grounding, smaller grain sizes can be attained. The dry method is often combined with sizing by sieve or air-flow, resulting in a better particle-size distribution. The milling systems are usually completed by a separation system (some type of cyclone in most cases) and the dust thus recovered is recycled into the process.	The milling is performed by dry process. The grist is transported from the collection tray below the hammer breakers by a screw into the lower chamber of a bucket elevator, then into the boiling system.	**Complying**	
	The breaking methods used in the bioethanol sector are similar to those applied in the other sectors of the food industry. These are usually hammer-, globe-, roller- or blade-type mills.	Hammer mill is used in the technology.	**Complying**	
Dissolution	Several methods and facilities are used, from the different cyclical mixing tanks up to the continuous mixers, where the liquid is added to the dust-like substance, or the dust is introduced into the liquid.	Boiling water and alpha enzyme is added to the ground introduced into the mixer. The process is performed in continuous system.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
Dissolution	The systems most in use include: • A mixing pump injects the dust into the solvent. The method may be used up to approximately 25% dry matter content. • The material is sprayed into the solvent by a Venturi-tube jet. The method may be used up to approximately 30% dry matter content. • Dissolving tank with high speed mixer. The method may be used up to approximately 70% dry matter content. • Dissolving tank with high speed mixer, under vacuum. The method may be used up to approximately 70% dry matter content.	Dissolving tank (suspending tank) is used in the technology, with high speed mixer.	**Complying**	
Fermentation	The temperature influences the efficiency of conversation, and also the formation of the odor and flavor components of the end product. Also the pH value is controlled during fermentation, indispensable for the necessary efficiency. The yeast strain used has also a determinative role for the efficiency of fermentation and for the escort substances, therefore it is always selected for the special purpose.	The fermentation occurs at nearly 32°C. Glyco-amylase enzyme is added for expediting the processes.	**Complying**	
	Proper cleaning of the fermentor should be provided for already during design and construction, because residues of the previous fermentation cycle may infect the new strain.	At the start, the recirculation pump performs emptying of the fermentor, then the fermentor drain pump completes the process. When the fermentor is empty, cleaning (CIP) is started by using lye solution.	**Complying**	
	Proper temperature control is also important; usually a preliminary heat treatment and then cooling is applied; therefore energy and cooling water requirement is to be taken into account.	Temperature control is granted by heat-exchangers.	**Complying**	
	The carbon dioxide generated during fermentation may be collected. Following purification, compression, drying and refining, it can be liquefied and utilized later.	The CO_2 generated is purified in washing towers.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
Fermentation	Here the carbon dioxide contains all volatile components present or generated during fermentation, such as oxygen, fusel oil, sulphur-bearing compounds and hydrogen sulphide. Therefore, the carbon dioxide has to be purified for the sake of future utilization. Foam separator, gas washer, desulphurizer, activated carbon filter, deoxygenator and liquefying unit can be used during the cleaning and conditioning process. Thus the liquefied carbon dioxide can be stored and later utilized.	CO_2 is passed through the gas washer in order to remove the VOC vapors. CO_2 is not stored, it is let into the open air.	**Complying**	
Distillation	The evaporators may be operated alone or in groups.	The technology includes three distillation columns operating under vacuum.	**Complying**	
	Separation of the alcohol and water can be attained through introduction of sufficient heat. The condensed liquid alcohol, in form of raw spirit, can be recovered from the head of the distillation device, while the fraction poor in alcohol accumulates on the bottom of the device.	Sufficient heat is granted partly by the steam from the stillage/pulp heat exchanger, and partly by the steam from the evaporators. In the evaporators, the alcohol is concentrated on the top trays and is removed from the head in form of vapor. As flowing downward through the trays, the stillage slowly loses its alcohol content and is accumulated in the kettle, from where it is transferred to the slop tank.	**Complying**	
	Distilling stills may be operated either cyclically or continuously. In the previous case, the mixture is put into the still then, while applying heat treatment, the generated vapors are removed continuously, gathered and condensed until the desired average concentration is attained. In continuous operation, the mixture is fed into the still and the quantity of vapor and liquid removed is supplemented.	Basically the system is designed for continuous operation, but may be converted to cyclical operation at any time.	**Complying**	
Boling-down	Boiling-down is the utilization of steam, vapor or fume for drying, usually as heat-transfer agent. The latent heat in the substance is transferred during condensation to the medium to be boiled down, warming up the water up to its boiling point and evaporating it.	Boiling-down is performed in a two-stage system. The steam evaporated in the first stage heats the evaporators of the second state. The multistage system reduces heat requirements needed for evaporation of the water.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
Centrifuging	Centrifuging allows separation of two or more phases, one of which is a continuous phase. The centrifuges can be operated according to two basic principles: as continuous systems and as batch cleaning systems. In continuous operation, the sludge may be removed continuously. The driving force of separation is the difference of density of the phases, accelerated due to the centrifugal force. The force generated depends on the speed and size. In the distilling industry, the stillage is separated, and pure stillage is obtained through centrifuging. Most frequently hydrocyclone is used, where separation occurs under tangential flow.	The thick slop arriving from the bottom of the stillage column is fed into one of the four centrifuges. The solid matter drops-out with approximately 64% moisture content from the centrifuges.	**Non relevant**	
Desiccation	Drying methods based on two different principles may be differentiated: hot air blasting and the method based on surface drying by heat conduction. In the case of hot air drying, the hot air itself heats up the liquid matter directly or indirectly. The water content of the matter evaporates due to the heat. In the case of the heat conduction drying method the heat carrying medium has no direct contact with the matter to be dried.	There are deflectors within the rotating drum for lifting the product in order to expose it to the drying air and to move it forward through the desiccator. The drying air is provided by a blower.	**Complying**	
Desiccation	Steam or fume may be directly used for desiccation, or even air heated indirectly (by gas or fuel). These drying systems are usually completed by some separation systems (some type of cyclone, in most cases) and the dust thus recovered is returned into the process.	The drying air is provided by a blower. Cyclones are used for recovering solid particles carried by the drying air.		

Measures for decreasing emissions				
Processes	• Operating an environment-oriented management system (recycling of waste waters and waste energies).	The system is operated under strict maintenance of the environmental provisions.	**Complying**	
	• Substituting or decreasing the use of auxiliary materials, such as chemicals, in order to minimize environmental impacts.	Utilization of enzymes for expediting conversion.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
	o Application of good work organization.	Work processes are optimized.	**Complying**	
Water consumption	• Acquisition of sufficient and good quality water.	Drilled wells are envisaged for drawing the required water quantity.	**Complying**	
	o Optimizing water consumption, where possible (recycling of waste waters and reuse of the treated waste water; recirculation instead of fresh water make-up).	The water consumption is optimized.	**Complying**	
	• Application of good work organization.	According to BAT recommendations.	**Complying**	
	• Application of proper methods for improving energy efficiency.	An integrated energy management system is applied in the plant.	**Complying**	
Energy consumption	• Implementation of an energy management system.			
	• Application of good organization and process optimization; optimizing consumption of public utility supplies, such as compressed air, steam, cooling and electricity.	The plant's energy consumption is optimized.	**Complying**	
	• Application of energy-efficiency techniques: heat recovery, combined heat and energy production for satisfying both electric and caloric requirements; biogas generated during anaerobic rotting may also be used for energy recovery; application of improved frequency engines; insulation of the pipe network in order to minimize heat and energy losses.	Heat recovery methods are applied and the different process steams are used for warming.	**Complying**	
	• Application of energy-monitoring system (may be integrated into the process control system).	The plant is provided with computerized management system that performs continuous monitoring of the energy system.	**Complying**	
	• Application of control strategies for identifying, quantifying and selecting the proper methods for decreasing air polluting emissions.	No continuous emission monitoring is required. Emission is measured on annual basis.	**Complying**	
Air purity protection	• Analyzing odor emissions in order to identify and characterize its sources and to define the necessary measures.	Gases are burned for the sake of avoiding odor emissions.	**Complying**	
	• Application of proper storage and handling technologies for retaining emissions, such as generated dust.	Dusts generated are recovered and recycled into the relevant processes.	**Complying**	
	• Recovering waste gases at their sources, where it is possible by reasonable cost expenditure.	Waste gases are recovered.	**Complying**	
	• Selection of technologies granting the maximum possible product yield and minimal environmental emissions.	BAT recommendations have been taken into consideration for this sake.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
	• Optimization of starting-up, shut-down and other special operations.	The plant is fundamentally designed for continuous operation. Maintenance is performed in the summer period, when fewer raw materials are available.	**Complying**	
	• Decreasing the quantity of waste gases, for example through recycling of the process gases, taking into account the hygienic requirements.	The technology is operated in compliance with the BAT requirements.	**Complying**	
	• At duty-cycle processes with shut-off or by-pass the waste gas treating systems have to be designed and operated with low emission levels and provided with a monitoring system recording the most important process parameters.	Non relevant	**Non relevant**	
	• Emergency plans are to be developed, specifying the necessary measures for the failure of the emission control systems, in order to immediately control any such emissions.	The plant has an emergency plan.	**Complying**	
	• Ventilation and covering of the sewage treatment plant in order to avoid odor emission where necessary, or application of anaerobic rotting in the sewage treatment.	Due to the elected technology, no waste water treatment plant is required.	**Non relevant**	
	• Application of water consumption decreasing methods.	The energy-saving criteria have been taken into consideration during technological planning.	**Complying**	
Emissions into waters	• Granting regular maintenance of the public utility systems.	Regular maintenance of the public utility systems is granted.	**Complying**	
	• Optimization of the water consumption.	The water consumption is optimized.	**Complying**	
	• Proper selection of the substances/chemicals used during cleaning. Optimization of the cleaning processes and granting relevant training. For example maintenance processes have to be performed as needed and not on time basis.	Cleaning processes are performed as required by the BAT.	**Complying**	
	• Application of proper storage and treatment techniques in order to control dust pollution generated during loading/unloading, transport and storage; e.g. granting closed-system for the forwarding of liquid matters, low temperature storage of dust-like substances and utilization of transport systems. Preventing overfilling of the treatment tanks, as their content may have extremely high COD values, thus minimizing spills during storage and transport.	The reaction tanks are operated at a filling-up level lower of the maximum level.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
	• Granting recycling or reuse of the water, thus decreasing emissions. Returning into the process the mother liquids or recovering them for animal feed or other utilization purposes, where feasible.	Practically no process waste water is generated in the plant, because "contaminated" water generated in the technology is recycled into the processes and reused.	**Complying**	
	• It has to be prevented that yeast gets into the sewer, as it has an extremely high COD value and is prone to form organic acids. Grills are to be used on the floor drains, in order to prevent grain to get into the sewer system.	BAT compliance is granted.	**Complying**	
	• Multi-stage vacuum evaporators are to be used in the distillation process, then the residual matter processed for recovering liquid stillage that may be sold for agricultural use.	The distillation columns are operated under vacuum. The wet bottoms are dried for producing modified wet granulate to be sold.	**Complying**	
	• For preventing overfilling, products have better to be fed into the tanks, instead of brimming them.	The feeding system is provided with overfill protection.	**Complying**	
	• Application of overfill protection for bulk storage tanks.	The storage tanks are provided with overfill protection.	**Complying**	
	• Using tanks with containment device or double-wall tanks for bulk storage.	Double-wall or equivalent tanks are used..	**Complying**	
	• Waterproofing of the bottom and side walls of the waste water tanks.	Due to the elected technology, no waste water treatment plant is required.	**Non relevant**	
Decreasing wastes	• Applying programs for minimizing waste generation.	No technological waste is generated during the operation.	**Complying**	
	• Application of good management practices.	Priority is given to environmental protection criteria during operation of the technology	**Complying**	
	• Improving the operating practices. Optimizing process control; through measuring certain parameters, such as temperature, pressure or flow, decreasing generation of rejects and products non complying with the specification, in order to decrease water consumption and other losses.	The operating parameters are continuously controlled and optimized during the operation.	**Complying**	
	• Recycling or reusing solids and the generated sludge.	DDGS generated in the process is sold..	**Complying**	
	• Decreasing the overfill values to 0.03 – 0.1%, through application of control scale series or intelligent filling equipment in the storage and treatment.	The operation of the feeding system is optimized.	**Complying**	

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
	• Application of proper storage and treatment techniques in order to control dust pollution generated during loading/unloading, transport and storage, for example through integration of containment devices, low temperature storage of dust-like substances and utilization of transport systems.	Closed silos are envisaged for the storage, in order to prevent dust generation.	**Complying**	
Noise	• Using silencers in the ventilation systems; • Granting flexible connection between ventilators and pipes; • Using pipes with better sound-proofing characteristics; • Increasing wall thickness of the pipes; • Insulating wrapped pipes; • Insulating mechanical/thermal steam compressors; • Fixing machines to the ground with rubber bearings; • Holding windows and doors closed.	BAT recommendations concerning noise protection criteria have been taken into consideration during planning of the technology buildings and equipment.	**Complying**	
Emission levels				
Air	• According to the BAT, quantity of the generated air polluting and odorous substances has to be minimized through application of the measures specified in the previous Section, and, if necessary, air polluting emissions have to be managed as follows:	The air pollution protection measures are in compliance with the BAT provisions.	**Complying**	
	• Particulate matters may be removed from the exit air by using dynamic or bag-type filters or electrostatic separators. Through proper operation of the system, also emission of odorous substances may be prevented.	Filtering devices are installed in the processes implying dust generation.	**Complying**	
	• Application of biofilters or bio-gas washers for removing odor matters from the final gas.	Thermal treatment is applied for the sake of removal of the odorous substances.	**Complying**	
	• Application of absorption systems, such as packed or tray-type absorbers for removing odor matters from the final gas.			
	• Application of adsorption systems, such as activated charcoal, for removing odor matters from the final gas.			
	• Application of thermal boiling or catalytic treatment for managing final gas emissions.			

	BAT criteria	Envisaged technology in the bioethanol plant	Compliance of the technology	Recommendations
	• Ventilation and covering of the sewage treatment plant in order to avoid odor emission where necessary, or application of anaerobic rotting in the sewage treatment.	Due to the elected technology, no waste water treatment plant is required.	**Non relevant**	

Emission values

Air	Emission values associated with the BAT for air pollutants are as follows: **Constituent group or parameter** / **Emission value (mg/m^3)** Dust: 5-50 150	Average emission level of dust generated during the operation of the technology: **Parameter** / **Emission (mg/m^3)** Dust: 12.6	**Complying**	
	Odor emission The installation has to be carried out in a manner that odor emission does not result in a remarkable decrease and/or considerable disturbance to the comfort feeling or to the environment beyond the borders of the plant site.	Design and operation of the plant will allow maintenance of the environmental provisions.	**Complying**	

<table>
<tr><th></th><th>BAT criteria</th><th>Envisaged technology in the bioethanol plant</th><th>Compliance of the technology</th><th>Recommendations</th></tr>
<tr><td>Water</td><td>Waste water emission
The following Table includes the emission values that may be attained through application of the BAT concerning waste water treatment.
<table>
<tr><th>Parameter</th><th>Emission value</th></tr>
<tr><td>pH</td><td>6-9</td></tr>
<tr><td>Toxicity (TU)</td><td>5</td></tr>
<tr><td>BOD_5</td><td>>90% removal[3] or 20-40mg/l</td></tr>
<tr><td>COD</td><td>>75% removal[3] or 125-250 mg/l</td></tr>
<tr><td>Dry matter</td><td>50 mg/l</td></tr>
<tr><td>Total ammonia (as N)</td><td>10-15 mg/l</td></tr>
<tr><td>Total nitrogen (as N)</td><td>>80 % removal[3] or 5-25 mg/l</td></tr>
<tr><td>Total phosphor (as P)</td><td>>80 % removal[3] or 2-5 mg/l</td></tr>
<tr><td>Oils, fats and lubricants</td><td>10-15 mg/l</td></tr>
<tr><td>Mineral oil (before the oil trap)</td><td>20 mg/l</td></tr>
<tr><td>Mineral oil (from biological treatment)</td><td>1.0 mg/l</td></tr>
</table></td><td>Due to the elected technology, no waste water treatment plant is required.
The quality of the generated high salinity waste water remains within the limit values specified in Decree 28/2004. (XII. 25.) of the Ministry of Environment on the national emission limit values of waste waters directly discharged into surface recipients.</td><td>Complying</td><td></td></tr>
<tr><td>Soil</td><td>Emission to the soil
In the environmental impact study documentation relating to the spreading of organic waste on the ground, the guidance of the environmental authority and the guidelines of the Ministry of Agriculture have to be referred to.</td><td>There are no emissions to the soil.</td><td>Non relevant</td><td></td></tr>
</table>

	BAT criteria	Envisaged technology in the Power Centre	Compliance of the technology applied	Recommendations
Description of the best available techniques				
Supply and storage	Using of loading and unloading devices that minimize the dropping height of the fuel materials into the storage facility, in order to decrease generation of airborne dust, especially during handling small wood and fibrous peat.	Fuelling will be made by using biogas produced from DGS.	**Non relevant**	
	By using water spray system, the quantity of dust generated in the storage facility.	Solid materials are fed continuously; protection against dust release complies with the BAT requirements.	**Complying**	
	Secure installation of the conveyor belt in the open air, above ground, for preventing injuries to the vehicles and other means. Using covered transport vehicles provided with well designed, powerful ventilating and filtering devices at the delivery sites for preventing dust emission.	The BAT requirements have been observed during design.	**Complying**	
	Application of well-organized and well-designed practices and proper maintenance.	Performing periodical maintenance operations.	**Complying**	
	Run-off waters (rainwater) escaping from the surfaces of the biomass and peat storage areas, carrying fuel material particles, have to be collected and treated prior to the discharge.	Storage in covered areas is envisaged. No rainwater comes into contact with the products.	**Non relevant**	
	Quality checking of the supplied fuel material and recording of the relevant data in the central logistics system If different types of biomass are jointly burned, two or more storage facilities are to be used, allowing composition of the fuel mixtures in compliance with the fuel materials' quality.	In the power center the biogas generated in the biogas plant during bioethanol production will be used for desiccation. The quality of the product will be constant, thanks to the own production.	**Complying**	
	Storage areas of biomass and peat have to be monitored by automated systems for detecting any fire – due to spontaneous ignition – and for identifying any risks.	-	**Non relevant**	

	BAT criteria	Envisaged technology in the Power Centre	Compliance of the technology applied	Recommendations
	For handling and storing pure liquid ammonia: pressure tanks >100m^3 for storing pure liquid ammonia are to be designed with double wall and located underground; pressure tanks of or below 100m^3 capacity have to be subject to heat treatment during manufacture. From safety aspects, the utilization of ammonia and water solution implies fewer risks than storage and handling of pure liquid ammonia.	Storage of the auxiliary materials occurs under observation of the BAT requirements.	**Complying**	
	Stable burning conditions, pre-treatment for decreasing the quantity of residual fuel material in the ash and for reducing peak emissions make part of the BAT. Assortment by size and degree of contamination is considered as pre-treatment especially in the case of fuel wood.	Steam requirements of the bioethanol plant are granted by natural gas fuelled boilers with biogas.	**Non relevant**	
Fuelling	Combustion of biomass and peat may be performed through pulverization, fluidized bed combustion (BFBC, CFBC) or by using different grate-firing techniques.		**Non relevant**	
	The application of computerized control system, allowing reduction of the emissions at high boiler performance and improved combustion may also be considered as BAT.	The Power Center is equipped with advanced control system.	**Complying**	
	In case of operation complying with the BAT requirements, the energy efficiency is of 40-42%. The fuel efficiency in case of CHP power plants is between 75 and 90%, equivalent to 1.3-1.1 heating ratio. It is to be noted that the mentioned BAT values cannot be attained in all operation modes. Energy efficiency constitutes the most important element of design. The actual energetic efficiency may change during the operation in function of the fuel material's quality.	The aggregate efficiency of the Power Center complies with the BAT recommendations.	**Complying**	
Emissions	*Dust* According to the BAT, dust removal of the exhaust gases of the existing and projected biomass- and peat-fuelled power centers may be made by filter bag or electrostatic (ESP) method. In the latter case it is to be noted, that the ESP reduction performance potential decreases by the low SO_2 content of the flue gas, if low sulphur-bearing biomass is used.	Dust content of the combustion air exhausted by the desiccator is separated. Beyond dust content of the combustion air, there is no dust emission from the power center.	**Complying**	

	BAT criteria	Envisaged technology in the Power Centre	Compliance of the technology applied	Recommendations
	Heavy metals Subject to the mineral content of the fuel material, it may contain different elements. Biomass and peat contain trace elements and heavy metals in varying concentration. Behavior of the heavy metals during combustion is a result of complex chemical and physical processes. As a rule, majority of the heavy metals evaporate during combustion, precipitating later on the surface of the airborne ash. BAT is therefore considered the removal of heavy metals by the application of bag filters (>99.95%) or of electrostatic settlers (>99,5%); of them, application of the bag filter method constitutes the preferred technology.	No heavy metal emission occurs during the applied technological process.	**Complying**	
	SO_2 Sulphur content of the peat is low and the biomass of wood does not contain sulphur. No desulphurization is necessary if wood-based biomass is burned in FBC boiler.	Natural gas is used for fuelling.	**Complying**	
	NOx Generally, in case of biomass and peat fuelling, primary and/or secondary procedures (e.g.: SNCR, SCR) for reducing NO_x emission are considered as BAT. The essential nitrogen components include: nitrogen oxide (NO), nitrogen dioxide (NO_2) and, principally in case of DBC boilers, dinitrogen oxide (N_2O).	Low NO_x burner is applied for granting proper NO_x concentration levels.	**Complying**	
	Carbon monoxide BAT for minimizing CO covers the entire burning process, from the design of the suitable boiler, through powerful monitoring and process control systems, up to the proper maintenance of the burning system..	The burning control management system optimizes the concentration of CO and CO_2.	**Complying**	
	Hydrogen fluoride and hydrogen chloride Acceptable value for BAT in case of peat and biomass fuelling amounts to <25mg/Nm^3. In the case of fuel materials, where no sorbent injection is required and their bound alkaline content does not attain the BAT requirements, additional alkali injection makes also part of the BAT.	Natural gas is used for fuelling. There is no HF and HCl emission.	**Non relevant**	

	BAT criteria	Envisaged technology in the Power Centre	Compliance of the technology applied	Recommendations
	Ammonia The possibility of ammonia egress constitutes a disadvantage of the SNCR and SCR systems. The ammonia concentration of ammonia emission acceptable by BAT remains below 5mg/Nm^3.	Natural gas is used for fuelling. There is no ammonia emission.	**Non relevant**	
	Dioxins and furans In some power plants fuelled with biomass – principally of wood – dioxin and furan emissions have been detected. As a rule, a value below 0,1 ng/Nm^3 is recommended and attainable.	Biogas is used for fuelling. There is no dioxin and furan emission.	**Non relevant**	
	Noise Special attention has to be paid to noise emission especially if breaking is made. The use of hammer mills may be considered as BAT. The pneumatic transport system constitutes an other critical point for noise.	The power plant has been designed by maximally observing the noise protection criteria.	**Complying**	
	Water pollution Different waste water circuits are used in the biomass or peat fuelled power plants.	Overflow water generated in the power plant is recycled into the hydrolysis technology phase of the bioethanol production.	**Complying**	
	Combustion residues There is interest from the industry for the utilization of combustion residues. Therefore utilization and recycling constitute the best solution, instead of disposal in deposits.	Combustion residues of the biomass boiler operating on the adjacent site are used in the agriculture for soil reclamation.	**Complying**	

Table 10: BAT compliance of gas-fired boilers

	BAT criteria	Envisaged technology of gas-firing	Compliance of the applied technology	Recommendations
Description of the best available techniques				
Technology description	Gas boilers are widely used in distant heating. The increasing restriction of the SO_2 and NO_x emissions has lead to the increased use of natural gas. Remarkable part of these boilers may also be operated by liquid fuels in case of emergency.	The boilers used in the power plant are fuelled by natural gas.	**Complying**	
	The heat generated by the burned fuel is used for producing superheated steam that, expanded in a steam turbine, drives a generator.	The steam produced in the boilers drives a generator through a steam turbine.	**Complying**	
	For ensuring efficiency of the energy transformation from steam into electric energy, the gas furnaces work at high temperatures (> 374.15°C) that allows attaining up to 48% efficiency in condensation mode, and 93% efficiency in combined heat and electricity production mode.	The medium pressure boiler produces steam that, through a turbine and a heat exchanger, generates electric power and hot water. Efficiency of all boilers used in the power plant is about 90% or even higher.	**Complying**	
	Combined heat and power production is a way for improving energy efficiency, to be influenced by the structure of the input energy system. The combined energy production implies in all cases fuel saving compared to separate heat and electric power production performed by the use of fossil fuels.	The heat of the steam outlet from the medium pressure boiler is used for electric power production.	**Complying**	

Measures intended for reducing emissions				
Air purity protection	**Reducing dust emission** If necessary, the dust content of the natural gas is removed during its extraction. Under normal operation and controlled combustion conditions, no dust or particle emission is to be expected in the operation of gas-fired turbines.	No dust emission reduction measures are required, due to the election of the proper fuel.	**Non relevant**	

	BAT criteria	Envisaged technology of gas-firing	Compliance of the applied technology	Recommendations
	Reducing SO_2 emission Sulphur dioxide content of the natural gas deriving from hydrogen sulphide is removed during extraction. Thus, in any application, the quality of the fuel material always grants compliance with the SO_2 emission requirements.	No SO_2 emission decreasing measures are required if natural gas is used for fuelling.	**Non relevant**	
	Reducing NO_x emission For decreasing NO_x emission of gas-fired boilers, the following solutions are available: o *Application of low-NO_x burners* If the combustion temperature is low in the primary combustion zone and the fume is retained for sufficiently long time in the combustion chamber for being totally burned, this may decrease the flame temperature and thus generating less NO_x. o *Fume recycling* It may be efficient in cases, where a remarkable portion of the emission consists in thermal NO_x. This may decrease both the flame temperature and the oxygen concentration. o *Multi-stage burning* Multi-stage burning decreases the reaction between the oxygen and the nitrogen of the air during the combustion process. For the sake of maintaining low NO_x emission, the air has to be transferred to the burners in a very precise manner. o *Water injection* Maintenance of the low flame temperature for granting low NO_x emission can be attained through injecting water.	Solutions applied for gas-fired boilers: Low NO_x burners are used Fume recycling	**Complying**	

Emissions into waters	Waste waters from the and heat recovery boiler may include the following waters: o Escaped waters and drained waters from the boiler's circulation system, for maintaining the quality of the boiler water. For the sake of the boiler's corrosion protection, alkalizing agents, such as aqua ammonia, caustic soda and/or phosphates are used for properly adjusting the boiler water's pH-value. In the praxis these waters are cooled down and, following neutralization if necessary, are discharged into the sewer system. o Waters or other liquids contaminated with oils are treated as dangerous wastes, separated from any other substances. If they do not contain emulsifying agents, the oily waters may be treated in oil separators. o Other waste waters generated in the plant, such as floor washing water, are usually discharged into the sewage system.	o Regenerates from the ion-exchange column are led into a neutralization tank. Other waste waters generated in the plant, such as floor washing water, are usually discharged into the sewage system.	**Complying**	
	Waste waters deriving from the heat recovery boiler have to comply with the requirements included in the permit concerning discharge of waste waters.	The waste waters emitted are controlled by quarterly analyses as approved in the self-control plan at two outlet points of the plant.	**Complying**	
Noise	The following methods are available for diminishing noise emissions: o Providing the turbines and generators with noise protection casing; o Using low-noise fans for ventilating the casing; o Proper orientation of the turbine machine room's doors; o Noise protection of the building's air inlet devices; o Providing the steam turbine's auxiliary equipment with covers; o Installation of mufflers on the flue-gas outlet; o Installation of mufflers on the boiler steam blasting devices; o Installation of the boiler's feed pumps in covered spaces; o Construction of pump house over the cooling water circulating pumps;	Following noise reduction possibilities are applied: o Proper orientation of the turbine machine room's doors; o Providing the steam turbine's auxiliary equipment with covers; o Installation of mufflers on the boiler steam blasting devices; o Installation of the boiler's feed pumps in covered spaces; o Construction of pump house over the cooling water circulating pumps;	**Complying**	

Emission values

<table>
<tr>
<td>Air</td>
<td>Emission values for air polluting substances related to BAT are as follows:
<table>
<tr><th rowspan="2">Equipment type</th><th colspan="4">Emission levels in compliance with BAT (mg/Nm^3)</th></tr>
<tr><th>Solid matter</th><th>SO_2</th><th>NO_x</th><th>CO</th></tr>
<tr><td>Existing gas boilers</td><td><5</td><td><10</td><td>50-100(7)</td><td>30-100</td></tr>
<tr><td>(7)</td><td colspan="4">In Hungary, at most of the existing boilers, the emission level of 100mg/Nm^3 cannot be attained even through application of NO_x emission decreasing methods. Their transformation would imply unreasonably high financial investments. The recommended maximum value is of 200mg/Nm^3.</td></tr>
</table>
</td>
<td>The emissions from the operation of the technology are in compliance with the relevant limit values.</td>
<td>Complying</td>
<td></td>
</tr>
<tr>
<td>Waste water</td>
<td>The waste waters deriving from the heat recovery boiler have to comply with the requirements of the waste water emission permits.</td>
<td>The provisions concerning waste water emission are included in the application for Integrated Environment Use Permit. Compliance with the limit values therein included is controlled in the course of quarterly waste water tests.</td>
<td>Complying</td>
<td></td>
</tr>
</table>

6. DEFINITION OF THE IMPACT AREA BY ENVIRONMENTAL ELEMENTS

6.1. ACTUAL CONDITION

The actual condition of the project site has been inspected from the following aspects:

- Air;
- Soil;
- Water;
- Noise;
- Flora and fauna;
- Built environment.

6.1.1. Air

6.1.1.1. Meteorological conditions

The annual number of sunny hours amounts to 2000 on the north and to 2050 on the south. The southern parts have more sun also in the summer quarter, while 800 hours are probable in the northern parts. Sunshine may slightly exceed 200 hours in the winter quarter.

The annual mean temperature is of 10.2-10.3°C south and of 9.8-9.9°C in the north; the mean temperature in the vegetation period is of 16.1 and 17.0°C respectively. The number of days with mean temperature values exceeding 10°C is 188-189, somewhat more in the southern part. The length of frost-free period is of 186-190 days on NW, 203 days in the central parts and over 207 days along the Danube. Average of the annual maximum temperatures is of 34.0-34.2°C in the southern parts, of 33.6-33.8°C elsewhere. That of the winter absolute minimums is of -16.0°C.

The annual precipitation value remains below 550mm. The highest amount of daily precipitation was of 113mm in Dunaújváros. The average number of days with snow-cover is 30-32; the mean maximum snow thickness is of 20-22cm.

Aridity index: 1.17-1.21.

NW is the most frequent wind direction, the mean wind speed exceeding slightly 2.5m/s. In spring, during soil cultivation works and when the plant cover is still not tight, the NW winds stir up the fine Aeolian soil into high airspaces in dry weather conditions.

6.1.1.2. Air quality categorization of the area under survey

Decree 4/2002. (X. 7.) of the Ministry of Environment and Water specifies air quality categorization of the country's different territories. According to this Decree, the district of Dunaföldvár does not belong to any of the distinguished agglomeration zones; the general air quality requirements relating to the remaining territories of the country are applicable (Zone 10).

According to Zone 10 classification, the settlement's air is not qualified as polluted.

According to Decree 4/2002. (X. 7.) of the Ministry of Environment and Water establishing agglomerations and zones on the basis of air pollution data, Kincsesbánya community belongs to the following category.

Table 11: Air quality classification of the project area

SO_2	NO_2	CO	Solids (PM 10)
F	F	F	E

The classification codes as to the above table are defined here below in compliance with *Annex 4* of the joint Decree 14/2001. (V. 9.) of the Ministry of Environment, Ministry of Health and Ministry of Agriculture and Rural Development:

Group E: areas where the air pollution is between the lower and upper threshold values for one or more air pollutants.

Group F: areas where the air pollution does not exceed the lower threshold value.

5.1.1.2 Air quality background concentrations of the surveyed area
Farming such as field crop production was made previously on the land of the ground-plot concerned by the project. The basic air pollution within the area is determined by emissions deriving from the territory of the remote settlement, from the neighboring agricultural crop storage and fuel storage plants and from the traffic.

No emission metering station is located in the vicinity of the plant site; therefore, the results of the previous measurements performed in the neighboring communities will be taken into consideration.

In February 2006, Progressio Mérnöki Iroda Kft. employed Fővárosi Levegőtisztaságvédelmi Kft. to perform air quality measurements in compliance with the measurement plan approved by the National Inspectorate for Environment, Nature and Water. The assignment covered determination of the concentration values of air pollutants, including CO, NO_x, SO_2 and airborne dust (TSPM: total suspended particulate matter).

The assessment was performed at three sampling sites, during 3 days, for eight hours periods each day (from 08:00 a.m. to 04:00 p.m. on 20.02 and 22.02 and from 09.00 a.m. to 05:00 p.m. on 23.02).
During evaluation, the concentration values of the air pollutants were determined through establishing hourly and eight hours' averages.

Measuring point 1 was set to the south-east from the envisaged project, at the north border of Kisapostag community, in an agricultural area.

Measuring point 2 was set at 200m distance from an industrial railway crossing near an industrial plant. The track of highway M6, under construction, is at about 300m distance from the measurement point.

Measuring point 3 was set at about 400m to the north of the bridge to be constructed within Dunavecse community. Setting of the measuring point had been previously agreed upon with the representative of the local municipality.

Evaluation of the measurement data
The following table summarizes the measurement data.

Table 12: Basic condition emission data

SITE	EOV X	EOV Y	CO	NO_x	TSPM	NO_2	SD	SO_2	Type
			[μg/m^3]						
Kisapostag	173363.00	641068.00	333.00	17.20	16.40	-	-	<3.99	FLÁ
Dunaújváros	175936.00	641636.00	530.70	33.10	44.10	-	-	<3.99	FLÁ
Dunavecse	173693.00	643570.00	496.50	29.10	22.40	-	-	<3.99	FLÁ
Hourly limit value			***10,000***	***200***	***200***	***100***	***-***	***250***	
Annual limit value			***3,000***	***70***	***50***	***40***	***-***	***50***	

In the table the maximum values from among the hourly measurements of FLÁ Kft. and the mean values of the measurement results of the OLM automatic station and of the RIV measuring points are included.

Annex 6 includes the measurement protocols.

6.1.2. Waters

6.1.2.1. Surface waters

Danube River is the determining surface water course of the region. All other watercourses of the region belong to the Danube's catchment area. In front of the project area (on its southern side), in the valley the lower course of the Nagykarácsony creek is to be found. After the river barrage, the slightly meandering creek flows into the Danube with a minimal stream flow. (The manager does not perform flow and water level measurements; therefore no relevant data are available.)

6.1.2.2. Hydrographic data

The area selected for the project is located in line with the 1563 river km section of the Danube. Characteristics of the Danube's hydrological conditions can be specified by using data of the nearest watermark post located in Dunaföldvár (source: Közép-Duna-völgyi Környezetvédelmi és Vízügyi Igazgatóság).

Location of the watermark post: right Danube bank, 1560.600 river km

"0" point altitude: 88.86mBf
Highest water level: 924cm
Lowest water level: -150cm

Design flood typical of the 1563 river km area: 98.23mBf.

The "0" levels of the buildings were set at 103.9mBf altitude and at 104.2mBf for the office building.

Council resolution 191/2006. (XI. 28.) of Dunaföldvár Municipality establishes the high-water bed, the river bank zones and the areas endangered by welling-up groundwaters.

The assigned site of the project falls partially within the line of the high-water bed. Partly due to this fact, and partly for reasonableness of locating the plant buildings and designing the communication roads, the first phase of the construction implies ground-grading. During this process the relatively high level differences will be equaled, thus forming a nearly plane terrain.

<u>The design data allow to state that the Danube's floods do not endanger the plant either directly or indirectly.</u>

6.1.2.3. Underground waters

The region of Dunaföldvár is rich in subsurface waters. Water supply of the town is granted by the wells of the local waterworks settled on the Pannon layers, but their are several other, smaller wells granting local water supply with 70 to 300m deep bores. The open bath is supplied by the 37-38°C water rich in mineral salts and carbonic acids, resurging from the well of more than 600m depth.

Ground-water is to be found within the area everywhere above the top impermeable layer. The ground-water conditions are influenced in the region beyond the actual precipitation quantity also by the water-stage of the Danube and of the Nagykarácsony stream. During floods, the ground-water flowing towards the river is backed up and its water-level elevated. The water-level increase depends on the duration of the flood. The trend of the ground-water level follows the ground level, but with lower gradient.

Consequently the maximum ground-water level may be estimated at 95.5mBf at the deepest point and at 99.5mBf at the top, that is, at 2-4m below the ground level.

The design ground-water level is estimate by 0.5m higher, between levels 96.5 and 100.5mBf, increasing at the same direction together with the ground level's acclivity.

In compliance with Decree 27/2004. (XII. 25.) of the Ministry of Environment and Water on classification of the settlements located in sensitive areas to subsurface waters, the settlement is located in highly sensitive area, as follows:

Table 11: Sensitivity classification of Dunaföldvár settlement

Settlement	Highly sensitive	Sensitive	Less sensitive	Extremely sensitive subsurface area
Dunaföldvár		X		

Dunaföldvár settlement does not lie in a nitrate-sensitive zone as to Govt. Decree 27/2006. (II. 7.) on protection of waters against agricultural nitrate pollution.

6.1.2.4. Definition of the background load

Borings included in Table 4 have attained the ground-water. Also the water levels measured in the two dug wells found within the project area were included in Table 4. The ground-water was at 92.4-98.4mBf depth, 3.4-9.8m below the ground between 31.03 and 01.04.2009. The ground-water level is sloping down towards the Danube, receiving the ground-waters. The Danube's stage in the design period can be estimated at 91.5mBf level. The uncertainty of this estimation is increased by the fact that the Danube's water level increased quickly, growing by more than 2.5m between 28.03 and 06.04.2009.

Table 12: Typical ground-water levels of the project area

Investigation mark	Ground level	Ground-water table	
	mBf	m	mBf
TDF-1	103.99	5.85	98.14
TDF-2	98.56	4.15	94.41
TDF-3	102.95	7.85	95.10

TDF-7	99.32	6.20	93.12
TDF-8	102.2	9.80	92.40

Beyond the actual precipitation quantity, the ground-water stage is also determined by the stage of the Danube and of the Nagykarácsony water stream. The Danube's stage influences also the lower course's stage of the Nagykarácsony stream, as the Danube flood backs up the water flow.

Consequently the maximum ground-water level may be estimated at 95.5mBf at the deepest point and at 99.5mBf at the top, that is, at 2-4m below the ground level.

The design ground-water level is estimate by 0.5m higher, between levels 96.5 and 100.5mBf, increasing at the same direction together with the ground level's acclivity.

Ground-water samples were taken from borings marked TDF-01, TDF-02, TDF-03, TDF-07 and TDF-08, as to *Annex 3*.

During laboratory testing of the ground-water samples, the following components were checked (assessing laboratory: Bálint Analitika Kft.):

- TPH
- BTEX
- Halogenated aliphatic hydrocarbons
- Halogenated aromatic hydrocarbons
- Toxic metals
- Total water chemistry (for subsoil water samples)

The measurement findings were compared to "B" limit values included in Annexes 2 and 3 of joint Decree 10/2000. (VI. 2.) of the Ministries of Environment Protection, Health, Agriculture and Rural Development and of Transport Communication and Water. According to the comparison performed, none of the measured parameters exceeded the relevant "B" limit value. Furthermore, the boring results allowed establishing the flow direction of the ground-water, being S-SE, towards the Nagykarácsony stream and the Danube.

Annex 7 includes the sampling and measurement protocols.

6.1.3. Soil

6.1.3.1. Geographical data, general description of the project area

Dunaföldvár is a small city located in the Southern Transdanubian Region, in the north-east corner of Tolna County, within Paks small region. The city lies in the centre of the country, on the right bank of the Danube River, at about 90 km distance to the south from Budapest. It is located at the meeting point of main roads Nos. 6, 61 and 52; the Beszédes József Bridge overarching the Danube here connects the Transdanubia and the Great Plain.

The area under survey makes part of the Great Plain large region, the Mezőföld mid-region, the Duna-Sárvíz-köze small region group, and, within this, of the Közép-Mezőföld small region. The Mezőföld is located in the territory bordered by the Sió and Danube rivers. In geographical sense it makes part of the Great Plain, though it is not an integrated part thereof

according to popular apprehension. In topographical sense, however, it can be defined as eastern part of the Transdanubia, constituting the western half of the country.

Administratively it lies within the territory of Fejér County. It is prevalently covered by sandy, loess soil; the creeks of the Transdanubian Central Range have formed the landscape with their alluvial deposits. A bigger level difference (terrace) separates it from the remaining parts of the Great Plain. Originally grassland, it is now good quality agricultural area.

According to the Péczely macro-synoptic classification, the climate of the concerned area is moderate warm – moderate dry, while in silvicultural classification, it belongs to the forest-steppe type.

As regards landscape typology, the project area and its environment belongs to the landscape type “moderately continental plain with dominantly agricultural utilization”, and within it, to “culture steppe of grade III grassland soil”.

The small region is a loess-covered colluvium with altitude above Baltic Sea level of 97 to 204m. Its part lying to the south of the Seregélyes valley is the Sárbogárd loess platform, which bluffs with a 50-60m high embankment wall to the Danube. The surface of 150-180mBf altitude is diversified by erosion/derision valleys and other erosion configurations characterizing loess areas.

The envisaged plant will be implemented on a hill-side from 97 to 112mBF levels, sloping down to the south. The internal level difference approaches 15m, therefore, the plant’s site will be partly dug and partly backfilled.

Due to the topographical and soil stratification conditions, typically argillaceous, sandy silt and fine grain sand layers will be excavated from the diggings. This material should be used for backfilling the deep-lying parts.

Mezőföld is an overwhelmingly cultural landscape. Its surface is covered by glacial loess (in 50m width at Dunaújváros), more rarely by sand. Its north-western and southern parts are heavily aggradated marshlands, mainly drained by today (Sárrét, Sárköz). The loess ridges were conserved on the higher surfaces through accumulation of the airborne rock dust. Excellent quality soil has formed on the loess. Its natural vegetation of grassland (steppe) and forest land may be detected by today only in traces. In majority arable lands are found here. As regards soil quality, good quality soil types are most typical. Due to their crumbliness and high humus content, these soils constitute the most important and largest agricultural territory.

On the surface of the project area, fine-grained soil structures: argillaceous, sandy silt, and, in the deeper layers, fluvial sediments with scattered flinty grounds are to be found. The upper soil layers of 0.4-1.2m width are rich in humus; typical width of the top-soil is of 0.5m.

6.1.3.2. Geomorphology

Two large genetic units are distinguishable in the sequence of strata of the settlement: the faulted and folded base of basin and the overlying Neogene-quarternary sedimentary measures of varying width. Only few data are available concerning the structure of the base of basin, merely deductive conclusions from the regional tectonic analyses allow some suppositions concerning the fractures therein included. According to assumptions, the limit of a large fault-line of the basin base of about 3-5km width stretches just below Paks. The

Szolnok macigno zone constitutes the structural limit; similarity of the structural forms found to NW and SE thereof denotes only their identical generation but not any correlation between them.

The SE part (the so-called Tisza Unit) was part of the European plate, breaking away from the Alps during their formation. The NW part (the so-called Hungarian Central Range Unit) separated from the African massive. The main fracture zone separating these two parts had a micro plate limit role during the Jurassic period and at the beginning of the Cretaceous period. At present, along the Central Hungary fracture zone, formations of fundamentally different structure and paleographic development are intercommunicating that might be approached during the Palaeogene through horizontal movement and sliding.

The basin base had been converted in several phases prior to the Alps' formation: it consists of ultrametamorphic, migmatite, gneiss, mica-schist breeds. Above this formations, the Upper Carboniferous-Permian continental structures, the German-type Triassic and the fossil coal Gersten origin Lower Lias series are to be found, followed by intensive submarine alkali basaltic volcanism of the Lower Cretaceous period. The Upper Cretaceous series of strata are built in a discordant manner upon the formations developed in different epochs prior to the Upper Cretaceous period. The marine conglomerate series are dominant. The pre-Tertiary base is fundamentally of sedimentary imbricated structure, however even the effects of horizontal creeps is not negligible.

During the Paleocene, Eocene and Oligocene epochs, the area was probably an emergent continental crust, because no sediments of such epochs are found in deep borings. Transgressions of the Miocene period have however influenced the area, resulting in sediment accumulation. According to the deep-boring data, the thick Pannon sediments were later generally settled on the Mediterranean (Lower and Mid-Miocene) and Sarmatian layers, but quite frequently they constitute cover layer of the Mesozoic substratum.

The accumulations of the Miocene period can be attributed to the so-called geomorphologic inversion starting from the Carpathian stage and completed by the end of the Miocene. As part of this process, the actual plain territories have ever strongly subsided and consequently inundated. The deep-borings have revealed very thick (500-600m) argillaceous-sandy Pannon sequences.

From the Pliocene period on, following regression and fill of the Lake Pannon, the northern part of Mezőföld has considerably emerged and the area transformed mainly into a plateau slightly declining from NW to SE, hardly fractured at the beginning. Denudation had the most important role in shaping this surface at the end of the Pliocene epoch. A longitudinal, SW-NE bearing depression of large size was formed at the end of the Pliocene and the beginning of the Pleistocene.

In consequence of the remarkable structural movements occurred at the beginning of the New Pleistocene, the physiognomy of Mezőföld already similar to the actual one was formed. At that time the area was separated with an abrupt high edge from the Danube plain and the block series, plateau pieces and ridges that still determine the landscape have been elevated.

In the geological construction of the area under survey, blow sand ($_eQp_3^h$) deriving from wind-borne dust often descended on wet surface and fluvial sediments from the Upper Pleistocene epoch have participated. The role of the fluvial sediments ($_fQh_2$) of the Holocene

period is unimportant; they merely appear in the southern part of the project area, in the valley of the Nagykarácsony stream. The geological formations of the natural surface are presented on Hungary's geological map segment.

Also the stratifications of the previously bored water extraction wells provide a picture of the Neozoic formations. During boring of the 311m deep well established in 1973 on the area of the former Soviet barrack square, the following dating was provided:

- 0.0 – 0.5 Holocene
- 0.5 – 75 Pleistocene
- 75 – 121 Levantine
- 121 – 311 Upper Pannon

6.1.3.3. Soil mechanical opinion

The site was formerly cultivated, there were no buildings, it was not mined, there were no perceptible contaminations neither on the surface, nor in soil explorations.

There are no plants to be protected other than agricultural cultures.

The surface is generally covered by a 0.3 - 0.5 m thick arable layer. There can be found a 0.1 m thick slag spreading on boring point TDF-01 and on its surroundings.

It is geotechnically important, that the envisaged plant will be built in a hill-side sloping to the South, between 97 – 112 mBf levels, the inside lift is near 15 meters, therefore the plant will be built partly on aggradation, partly in cutting.

In the geological construction of the area under survey, blow sand ($_eQp_3^h$) deriving from wind-borne dust often descended on wet surface and fluvial sediments from the Upper Pleistocene epoch have participated. The role of the fluvial sediments ($_fQh_2$) of the Holocene period is unimportant; they merely appear in the southern part of the project area, in the valley of the Nagykarácsony stream.

The soil environment was explored by high diameter borings. Bore depths were defined by the topography; we performed deeper borings on higher sites and shallow borings on lower sites, with regard to the need of grading works.

Bores were deepened by a 130 mm, high diameter machine boring, exploring the soil environment to the required depth. The medium grained dispersedly small graveled fluvial soil layers with slightly greater bearing capacity were reached by 6 bores, in 3.2 – 8.4m depth, at 94 - 96 mBf level.

Due to the topographical and soil stratification conditions, typically argillaceous, sandy sludge and fine grain sand layers will be excavated from the diggings. This material should be used for backfilling the deep-lying parts.

6.1.3.4. Definition of the background load

Nine borings were deepened for exploring the near-surface layers. On the surface of the area, fine-grained soil structures: argillaceous, sandy silt, and, in the deeper layers, fluvial sediments with scattered flinty grounds are to be found. The upper soil layers of 0.4-1.2m width are rich in humus; typical width of the top-soil is of 0.5m.

Ground-water samples were taken from borings marked TDF-01, TDF-02, TDF-03, TDF-07 and TDF-08, as to *Annex 7.*

During laboratory testing of the ground-water samples, the following components were checked (assessing laboratory: Bálint Analitika Kft.):

- TPH
- BTEX
- Halogenated aliphatic hydrocarbons
- Halogenated aromatic hydrocarbons
- Toxic metals
- Total water chemistry (for subsoil water samples)

The measurement findings were compared to "B" limit values included in Annexes 2 and 3 of joint Decree 10/2000. (VI. 2.) of the Ministries of Environment Protection, Health, Agriculture and Rural Development and of Transport Communication and Water. According to the comparison performed, none of the measured parameters exceeded the relevant "B" limit value.

6.1.4. Waste

No activities implying waste generation are performed on the project site.

6.1.5. Noise

6.1.5.1. Description of the area from noise protection aspect

The project site is located on the north part of Dunaföldvár city, in an economic area. Economic establishments and unbuilt areas are found in its direct vicinity.

Table 13: Nearest buildings to be protected

Establishment to be protected	Direction	Zoning	Distance from the ground-plot border, m
Residential houses at Hunyadi tér 2. and 3., Napsugár Home for the Elderly at Hunyadi tér 5.	W	Vt	400
Residential houses at Felsőfok utca 2-4-6.	S	Gksz	360
Residential house at Felsőfok utca 1.	SW		560

The area is slightly declining, covered by plants. In the sound propagation calculations, we have taken into account sound-absorbing soil and – for higher calculation security – unobstructed sound propagation.

6.1.5.2. Basic load of the environment

Direct impact area

Based on documentation made us available by Customer, the background load values established by instrumental measurement are as follows:

Table 14: Background load values

Background load on the project site $L_{AH,üzem}$							
Southern border		Western border		Northern border		Eastern border	
Day	Night	Day	Night	Day	Night	Day	Night
40.3dB	34.7dB	37.5dB	30.2dB	39.8dB	34.6dB	44.8dB	38.5dB

Background load in the vicinity of the residential houses $L_{AH,üzem}$							
Hunyadi tér 3.		Felsőfok u. 2-4-6.		Felsőfok utca 7/a-b.		Felsőfok utca 1.	
Day	Night	Day	Night	Day	Night	Day	Night
38.2dB	33.5dB	38.8dB	32.5dB	38.4dB	33.4dB	38.1dB	33.2dB

The measurement results allow establishing that the operational background load of the buildings to be protected is low; loading the buildings by noise is not prohibited.

Indirect impact area

In principle, the indirect impact area may include the primary main road No. 6 and the connected secondary main road No. 61. Noise load calculation of the communication roads was performed in compliance with Annex 2 of Decree 25/2004. (XII. 20.) of the Ministry of Environment and Water.

*Table 15: Traffic data of section 86+500km of main road 6**

Trucks, small trucks	Solo buses	Light trucks	Motorcycles, powered cycles	Articulated buses	Solo heavy trucks	Train trucks	Low velocity vehicles
6220	101	505	61	3	464	999	11

* The relevant traffic data were drawn from the publication of Magyar Közút "Section traffic of the national main roads in 2007 – I".

Calculations have been performed on the basis of the following parameters:
Acoustic roughness: B
Design running speeds: v_1 = 90km/h; v_2 = 70km/h; v_3= 70km/h, constant speed.
Day and night traffic rate: mean night traffic road.

Calculation of 7.5m reference value:

Vehicle category	Component calculation – right side (slope)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	80.2	80.3	80.4	-12.3	-14.8	-21.1
II.	81.8	82.0	82.1	-20.9	-23.5	-29.5
III.	85.2	85.4	85.5	-17.6	-20.2	-25.7

Vehicle category	Component calculation – left side (ascent)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	80.7	80.8	80.8	-12.3	-14.8	-21.1
II.	81.8	82.0	82.1	-20.9	-23.5	-29.5
III.	85.2	85.4	85.5	-17.6	-20.2	-25.7

Period	$L_{Aeq}(7,5)_{q,s,t,i,j}$ dB - right
During day	71.2
Evening	68.8
Night	63.0
Day	70.7
Whole day, (L_{DEN})	72.3

Period	$L_{Aeq}(7,5)_{q,s,t,i,j}$ dB - left
During day	71.4
Evening	69.0
Night	63.1
Day	70.9
Whole day, (L_{DEN})	72.6

Table 16: Traffic data of section 3+744km of main road 61

Trucks, small trucks	Solo buses	Light trucks	Motorcycles, powered cycles	Articulated buses	Solo heavy trucks	Train trucks	Low velocity vehicles
3469	59	128	56	7	215	523	17

Calculations have been performed on the basis of the following parameters:

Acoustic roughness: B
Design running speeds: in residential area, in the vicinity of Előszállási út - v_1 = 50km/h; v_2 = 50km/h; v_3= 50km/h, constant speed.
Day and night traffic rate: mean night traffic road, α = 2.0 ° slope (ascent).

Calculation of 7.5m reference value:

Vehicle category	Component calculation – right side (ascent)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	74.7	74.8	74.8	-12.4	-14.8	-21.2
II.	78.5	78.6	78.7	-24.1	-26.6	-32.6
III.	82.4	82.5	82.5	-19.1	-21.6	-27.1

Vehicle category	Component calculation – left side (slope)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	73.4	73.5	73.6	-12.4	-14.8	-21.2
II.	78.5	78.6	78.7	-24.1	-26.6	-32.6
III.	82.4	82.5	82.5	-19.1	-21.6	-27.1

Period	$L_{Aeq}(7,5)_{q,s,t,i,j}$ *dB - right*
During day	66.1
Evening	63.7
Night	57.9
Day	65.6
Whole day, (L_{DEN})	67.3

Period	$L_{Aeq}(7,5)_{q,s,t,i,j}$ *dB - left*
During day	65.7
Evening	63.3
Night	57.5
Day	65.2
Whole day, (L_{DEN})	66.8

Table 17: Traffic data of section 3+554km of by-road 6228

Trucks, small trucks	Solo buses	Light trucks	Motorcycles, powered cycles	Articulated buses	Solo heavy trucks	Train trucks	Low velocity vehicles
1330	14	96	9	6	106	131	7

Calculations have been performed on the basis of the following parameters:
Acoustic roughness: C
Design running speeds: in residential area, in the vicinity of Hunyadi tér, Daruszentmiklós - v_1 = 50km/h; v_2 = 50km/h; v_3= 50km/h, constant speed.
Day and night traffic rate: low night traffic road.

Calculation of 7.5m reference value:

Vehicle category	Component calculation – right side (ascent)					
	$K_{tnap.}$ (dB)	K_{teste} (dB)	$K_{téj}$ (dB)	K_{Dnapk} (dB)	K_{Dest} (dB)	$K_{Déj}$ (dB)
I.	75.5	75.5	75.6	-13.5	-16.4	-23.1
II.	79.4	79.5	79.5	-24.1	-27.0	-33.4
III.	83.0	83.1	83.1	-20.9	-23.8	-29.8

Period	$L_{Aeq}(7,5)_{q,s,t,i,j}$ **dB**
During day	65.5
Evening	62.6
Night	56.3
Day	64.9
Whole day, (L_{DEN})	66.2

6.1.6. Flora and fauna

6.1.6.1. General description of the inspected area

According to the geobotanical classification, the area belongs to the Pannonia flora region (*Pannonicum*), and within it, to the Great Plain flora sub-region (*Eupannonicum*) and to the Mezőföld and Solt-plain flora district (*Colocense*). In zoogeographical sense the entire small regions belongs to the Great Plain's fauna district (*Eupannonicum*) of the Plain fauna sub-region (*Pannonicum*).

The inspected area is not under nature conservation protection according to Act LIII of 1996 on Nature Protection (referred to hereinafter as TVT), Article 22, paragraphs a) and c), and is not qualified as a nature conservation area according to TVT Article 4, paragraph b) and Article 15, Section (1). Article 6, Section (3) of the TVT has introduced the definition of individual landscape value; at present, the area concerned does not belong to this category. The area under survey does not make part either of the National Ecological Network as defined in Article 12, Section (1) of Act XXVI on the National Country Planning or of the Natura2000 Network defined in Govt. Decree 275/2004. (X. 8.). Elements of the National Ecological Network located in the vicinity of the project area include the Danube river and the water surfaces and the swamps of the Upper Lake and Lake Matild. To the west form the area, the special nature conservation area of particular importance "Tolnai-Duna", recorded under site code HUDD 20023, is located. The water stream discharging the waters of the lakes – even though edged by near-natural habitats – does not make part either of the ecological network or of a nature conservation area.

The nearest protected natural areas of national importance are located to the east of the inspected area – Kiskunság National Park – at about 18km distance and to the west – Dél-Mezőföld Landscape Protection Region – at about 11km distance.

From among the nature conservation areas of special importance specified in Govt. Decree 275/2004. (X. 8.) on nature protection areas of European Community importance, parts of the already mentioned Tolna-Duna SCI area are located to the east and to the north.

The area under examination has been a cultural area for centuries; the original habitat probably consisted of loess oak-woods an of loess meadows. The flora of the area is determined by the agricultural utilization at present. The fallows are occupied by agricultural and roadside wed sorts; adventive species, such as giant goldenrod (*Solidago gigantea*) and common ragweed (*Ambrosia artemisiifolia*) are widespread. Also the fauna is mainly characterized by the dominance of species that tolerate human presence well; instead of resident species, populations in search of food are in majority.

Beyond agricultural utilization, also military activities occurred on the area under study. The large-size biologically inactive and deteriorated spaces and banks overgrown with weeds and adventive tree species are probably due to this latter. Its plant and wildlife is poor in species, also the larger region including the area is a mosaic of cultural habitats without any natural value. At the Danube section in the vicinity of the project area, again smaller or larger buildings, loading ports have been constructed; the riparian forest is also very narrow, of

merely some meters wide. *Annex 8* specifies data of the characteristic plant and wildlife. According to nature protection criteria, the project area and its more expanded environment are already in a remarkably degraded condition, characterized by the dominance of culture- and culture-following species.

6.1.6.2. Habitats

The habitats within the area inspected have been identified and will be described in compliance with the National Habitat Categorization System (NÉR).

Plant sites and scrap areas (NÉR code: U4):

The south-eastern part of the area under inspection belongs here, with large size backfilled surface, where the vegetation is partly missing, while in other places closing of the vegetation has already started (consisting of weeds and grasses tolerating disturbance). Giant goldenrod (*Solidago gigantea*) and mugwort (*Artemisia vulgaris*) are the dominant species. In a mosaic-like pattern, black-locust (*Robinia pseudo-acacia*) individuals appear, while in some parts bushes of wolfberry (*Lycium barbarum*) constitute impenetrable thicket.

Annual and perennial field cultures (NÉR code: T1, T2):

Habitats of the cultivated areas located in the western and northern part of the area under survey. Alfalfa (*Medicago sativa*) is the main industrial crop beyond cereals, while several weed species live in the spacings.

For examining the naturalness of the habitat, the plant species according to the nature protection categorization of Simon have been used. The method is based on the fact that the presence or the lack of the different plant species denotes well the degree of degrading. Unique (U), strictly protected (KV), protected (V), edificators (E), accompanying (K) and natural pioneer (TP species denote natural condition. Disturbance tolerant (TZ), adventive (A) species, weeds (GY) and culture plants (G) are sign of degrading. The degree of degradation of the area under study is reflected in the low proportion (27%) of the species denoting natural condition; the rate of the weed species is nearly two thirds thereof, but the situation is even worse, if the adventive and cultivated species are included. The estimate was made on the basis of the plant list, without taking into account the incidence of the different species. All the same, it shows well the low rate of natural and near-natural species. If the survey would have taken into account also the incidental rates, the degrading would have been even higher.

In summary it may be established that no protected, unique or edificatory plant species are found in the area under survey. The rate of culture plants, weed and disturbance tolerant species is remarkable, while the number of species denoting natural conditions is minor. As regards population, the cultivated plants are dominant.

6.1.6.3. Flora

Potential ecological associations of the region included the loess steppe oak-woods with tatar maples (*Aceri tatarico-Quercetum pubescenti-roboris*) and the oak forests (*Quercetum petraeae-cerris*), with riparian forests (*Fraxino-pannonicae-Ulmetum*), willow and poplar forests (*Salicetum albae-fragilis*), loess grasses (*Salvio-Festucetum rupicolae*) and grazing lands (*Cynodonti-Poëtum angustifoliae*) in the river valley. On the place of the original ecosystems, today typically agricultural lands and “cultural forests” are to be found. Within the area under study and in its surroundings agricultural lands, cultivated and fallow fields are prevailing; the dominant species – especially in the fallows – include agricultural, roadside, ruderal and adventive weeds.

6.1.6.4. Fauna

Regular disturbance due to economic utilization and species-poorness due to monocultures accompanied by low population except for the pestiferous species connected with field cultures characterize also the fauna of the small region belonging in animal geographical aspect to the Great Plain fauna district (Eupannonicum) of the Plain fauna region (Pannonicum). From among the vertebrata some amphibians accepting the dry conditions, for example common toads (Bufo bufo) and agile frogs (Rana dalmatina) live in the area under survey, while some lizard species represent the reptiles. From the bird species mainly those well tolerating human vicinity are found here. The yellowhammer (Emberiza citronella) and the crested lark (Galerida cristata) are nesters of the weedy lands. Frequent species nesting in the nearby forests and bushes include: song thrush (Turdus philomelos), greenfinch (Chloris chloris) and goldfinch (Carduelis carduelis) etc. The turtle dove (Streptopelia turtur) and the wood pigeon (Columba palumbus) are already rarer, the latter is otherwise nesting in forest belts and patches located at greater distance from the road. Due to the intensive cultivation, the number of species and the population of the small mammals, and, as a consequence, also that of the birds of prey, for example of the common buzzard (Buteo buteo) and of the mammals, for example of the European polecat and of the fox (Vulpes vulpes), feeding upon them, are low. The stock of game is primarily presented by the deer (Capreolus capreolus) and by the wild boar (Sus scrofa); from among game birds, pheasants (Phasianus colchicus) are encountered. The animal life of the nearby water habitats is considerably richer, but the envisaged operation has no impact on such habitats.

No directly or actually endangered species are found in the fauna of the area, and only the most frequent of the protected species that tolerate best the human presence and disturbance are present. The most important or more frequently encountered species are listed in a table (Annex 5).

6.1.6.5. Impact on Natura 2000 areas

Govt. Decree 275/2004. (X. 8.) on nature protection areas of European Community importance provides for the protection of the areas listed as Natura 2000 sites, where conservation, maintenance or even recovery of the favorable nature protection conditions of the concerned habitat types, as well as natural conditions have to be granted. Decree 45/2006. (XII. 8.) KvVM issued by the Minister of Environment and Water by way of execution of the Government Decree, in its Annexes lists the land portions concerned by nature protection areas of European Community importance.

To the east of the area under survey, in the direction of the Danube River, the approved nature conservation area of enhanced importance, named Tolnai-Duna and registered under site-code HUDD 20023 is located. Properties of the Dunaföldvár municipality area with the below listed topographical lot numbers belong to this Natura 2000 area:

015, 016/3, 016/5, 017/3, 017/11, 017/24a, 017/24b, 017/38, 018/a, 018/b, 018/c, 018/d, 018/f, 018/g, 018/h,018/j, 018/k, 018/l, 018/m, 018/n, 018/p, 018/r, 019, 021/a, 021/b, 021/c, 021/f, 021/g, 037/63, 040/a, 040/b, 040/c, 040/d, 040/f, 041, 042/a, 042/b, 042/c, 042/d, 042/f, 042/g, 042/h, 043, 044/1, 044/2a, 044/2b, 044/2c, 044/2d, 044/2f, 045, **0105/2a, 0105/2b, 0125/a, 0125/b, 0126/a, 0126/b, 0126/c, 0127/1**, 0128/1a, 0128/1b, 0128/2, 0129, 0130/1, 0130/2, 0130/3, 0136/4, 0137/1, 0137/2, 0137/3, 0138/a, 0138/b, 0139, 0140, 0141, 0142, 0143/a, 0143/b, 0146/2, 0153/1, 0155, 0156, 0159/2, 0160, 0161, 0164/12a, 0164/12b, 0608, 0609, 0610, 0616, 6424/5.

The real estates with the highlighted lot numbers are in the vicinity of the project area. The lots with number 0105 and 0127 designate the Danube River itself, according to the meaning with the mid-water river edge as limit. Areas marked 0125 and 0126 are located in the Danube's riparian zone to the south of the right bank of the Nagykarácsony creek's mouth. Therefore the riparian zone between the Nagykarácsony creek and the crop loading berth of Cargill Kft. does not make part of the Natura 2000 area.

Consequently there are no habitat types or species of enhanced Community importance either on this riverside section or on the reinforced, stone-covered embankment and on the communicating road that would justify classification of this site to the Natura 2000 area.

6.1.6.6. Landscape protection

The area is a cultural landscape being in human use for a long time and making part of Dunaföldvár. Previously arable lands, later other exploitation areas such as military range, more recently fuel station and port were or are located here. By today, even traces of the former wood-steppe typical of the belt between main road 6 and the Danube cannot be found in the area and also the riparian forests of the Danube are discontinued at the port. The already existing constructions disrupt also the quiet cultural landscape character of arable lands and of wooded or shrubby spots.

It may be established that, taking into consideration the impact range of the single impact factors, as well as of the combined impact area, the envisaged bioethanol plant will have no impact on the Natura 2000 area designated within the region.

6.1.7. Built environment

The envisaged project qualifies as major investment project. The license-holder has prepared the heritage protection impact study, which is not attached again, due to reasons of volume. The impact study has identified a single site, where removal of the surface layer should be performed under archeological monitoring

Heritage protection features of the project site are recapitulated below.

"The area under survey is located near the mouth of the Nagykarácsony stream, on its northern side, on the split horsebacks elevating to the north of the plain area, on the hillside looking down to the water-stream. Here already the stream leaves the Upper Lake's area and disembogues into the Danube from the characteristic loess steep bank of the First Old Hill located to the north of Dunaföldvár.

The topographic forms of the area are declining from north to south, and three major N-S bearing land-bridges stretch towards the water-stream, with valleys between them. The project area is located on their southern part. Cargill's plants are located to the east of the site; an asphalt-paved service road leads here from main road 6.

There is a fuel station to the west, along main road 6. The northern side of the road is in a cutting, edged by trees and bushes on both sides. The area under survey begins directly to the north of the road; we have found everywhere fallows here, during site-inspection. Formerly two major rectangular spaces were covered by concrete near the western border, following remarkable earthwork for evening the site horizontally. By today only the concreted spaces, debris and wastes are found here. The excavation slope is well visible; we have inspected it all along, without finding any traces of archeological phenomena. To the east from here, high weed covered the oval surface of the N-S peninsula-like hill; here nothing at all could be seen. A NW-SE dirt road runs at the western piedmont of the hill, edged by some trees, feeding into

the above-mentioned service road, while evanishing to the north. A line of trees is found to the east of the dirt road, and perpendicularly thereto, the remains of a former vineyard, overgrown by shrubs. On former maps it can be well observed that in the past grape was grown on the southern slopes; its traces are still visible.

To the east of the dirt road, again we found fallow land, but it was much less covered by weeds than the previously mentioned one; though with limitation, it was relatively easy to search it. We walked through it until the next N-S oriented dirt road, to the east. Here we have found a few modern potteries and, in a relatively well determinable site, some ceramic fragments of undistinguished historic ages. The modern ceramics are detectable scantily but unequivocally and in a relatively large dispersion area; this could be imputed to the Upper Ferry that was operating here in the modern age and to the large storehouse of the Danube mills located on the river bank.

Almost on the same site, but within it, we have found 10-12 small Paleolithic fragments (Neolithic or bronze age?) and some perhaps identifiable as deriving from the Roman age. The observation conditions were not good in the weedy fallow, but the spreading of the findings was restricted on a relatively narrow area – anyhow smaller of that of the modern age findings – on the south-east terraced side of the western peninsula-like hill. The variety of the ages implies that perhaps the finding site is more extended than its known size; however, despite extended search in the weedy fallow, identification was only possible in the above-described expansion.

To the east of the second dirt road, we again found a land covered by high grasses; here, on the north border of the surveyed area, mounds were located and the site seemed disturbed. There were smaller knolls and heaps of offal here, and the light-colored loess, gritty subsoil was well visible on the surface, while the surface was covered by humus-containing soil to the west therefrom. Presumably this area was disturbed already in the past. In this sector we could make search only in some spots; nothing was found.”

6.2. IMPLEMENTATION

6.2.1. Air

Followings are the activities that may cause air pollution, and thus environment load, are, in connection with the different implementation and construction stages:

- Preparatory earthwork
- Founding, construction,
- Transport and loading.

The quantities of air polluting emissions during the implementation activities may be estimated as follows.

6.2.1.1. Dust emission

The ground-plot area of the ethanol plant and of the auxiliary establishments amounts to about 9.5 hectares. The earthwork implies terrain preparation, terrain correction and foundation preparatory works. During the activities the upper surface rich in humus will be removed in about 50cm thickness in the buildings' and technological equipment's floor space area and along the roads' track. Humus layer will be extracted on an area of about 46,000m^2, and will be stored within the project area. Thus in total, moving of about 23,000m^3 soil will become necessary.

During soil cutting and evolution of the subgrades, the soil will be in earth-moist condition, thus dusting will not be typical.
During demolition of the existing building, setting dust of variable concentration may be expected in a 40 to 50m wide belt, but any dust generated, will be quickly diffused due to the permanent winds.

Setting of fine particles during vehicle movement is typical, consequently dust stirred-up by transport vehicles (heavy trucks) may be expected along the internal traffic paths, in a 70 to 100m wide belt complying with the wind direction. Taking into account the number of heavy duty transport vehicles (6 heavy trucks), the dust concentration increase due to stirring-up may be estimated in some minutes/hour, of a volume of 18-20µg/m^3. The concentration value has been estimated on the basis of measurements performed at strip pit operating under similar conditions.

6.2.1.2. Emissions of moving air pollution sources

Emissions of all machines operating during the construction period within the area are calculated as if continuous work would be performed throughout the entire construction period. That means, the possible maximum emissions are defined.

Facility requirement of the work performance:

- 2 front-end loaders
- 8 heavy-duty vehicles
- 1 grader
- 1 compaction roller
- 3 mixer lorries
- 1 tilting bulldozer

Air pollution emission of the moving air pollution sources is composed of the machines' and transport vehicles' exhaust gases. The following table specifies the specific air polluting emissions in g/vehicle×km unit, based on the data of the Institute for Transport Sciences and of the Ministry of Environment:

Table 18: Basic data of specific emissions of loaded transport vehicles

Specific emission within plant (at 20km/h speed)	**Emission**
CO (g/km)	20.0
NO_X (g/km)	7.09
SO_2 (g/km)	0.4
Particles (g/km)	2.02

Table 19: Basic data of specific emissions of earth-moving machines/power engines

Specific emission within plant (at 20km/h speed)	**Emission**
CO (g/km)	29.4
NO_X (g/km)	8.63
SO_2 (g/km)	1.22
Particles (g/km)	3.44

6.2.1.3. Air impact estimation

During construction, max. 2 front-end loaders, 1 tilting bulldozer, 1 grader, 11 transport vehicles (trucks and mixer lorries) and 1 compaction roller will be operating in the peak hours within the construction site.

From 10 hours working, 8 operation hours for each machine may be calculated in the average. From the 20km average mileage performed during this period, the emission values included in the following table are calculated.

Table 20: Air polluting substance emissions of earth-moving and transport machines (g/h)

Vehicle	**Carbon monoxide CO**	**Nitrogen oxides NO_x**	**Sulphur dioxide SO_2**	**Particles**
Unit	g/h	g/h	g/h	g/h
Earth-moving machine, transport vehicle	917.5	302.85	26.25	98.55

The above-defined quantities of air polluting substances constitute the load of the air as environmental element during the implementation stage.

For the estimation of the activities' impact on the air quality, the so-called "Box-model" has been used. The wind speed taken into account for the determination of dispersion, was the N-NW wind of 3.0m/s average speed, being typical within the area.

Calculated airshed: 95 000 m^2 – project area
taking into account an average mixing height of *5m:*
V= 475 000m^3

Ventilation factor based on the average wind speed: 54×
Air volume modified by ventilation: 54 ×475,000 = 25,650,000m^3

Table 21: Emission concentrations within the plant during implementation

Vehicle	Carbon monoxide CO	Nitrogen oxides NO_x	Sulphur dioxide SO_2	Particles
Unit	μg/m^3	μg/m^3	μg/m^3	μg/m^3
Earth-moving machine, transport vehicle	35.8	11.8	1.0	3.8
Limit value	**10 000**	**200**	**250**	**200**

Considering the limit values specified in Annex 1.1 of joint Decree 14/2001. (V. 9.) of the Ministry of Environment, Ministry of Health and Ministry of Agriculture and Rural Development, it may be established that pollutant concentrations in the airshed of the project area do not exceed any of the limit values included in Annex 1.1 of joint Decree 14/2001. (V. 9.) of the Ministry of Environment, Ministry of Health and Ministry of Agriculture and Rural Development, as amended.

Consequently it may be stated that the air quality impact during the implementation period can be evaluated as tolerable; the impact area does not exceed the borders of the project area and the envisaged construction phase has no influence to the settlement's air quality conditions.

6.2.2. Waters

The envisaged extraction of deep groundwater in 3000m^3/day volume will be performed in a manner that the submergible pump creates depression in the well shaft (well pipe), and, in consequence, the groundwater contained in the porous strata (constituted of finer or coarser sand) will flow toward infiltrate into the well through the well filters.

According to the available data, in the wells, and thus in the well shafts, about 15 to 20m depression should be performed against the original stationary water level of -8-10m below surface, that is creating approximately -25-30m operating water level in order to have about 600 liters of water infiltrating into the well. (A similar water yield by well could grant the required water quantity of 3000m^3/day at daily 20 to 21 hours of continuous operation.)

It is easy to understand that the effect of pumping will be most sensible in the well shaft, at the point of pumping, while with the increase of distance, the depression effect is decreasing. It is also comprehensible that this effect is principally sensible (in direct manner) in the sand layers, from where infiltration into the well pipe occurs, that is, in the layers for which the wells' filters were installed.

During implementation, a max. number of 30 persons is expected to continuously work on the site. The per capita water consumption may be estimated in 80 to 120L/person. Thus the daily quantity amounts to about 3m^3. The required drinking water will be granted through transporting to the site.

No technological water is required during the construction phase.

Mobile toilets, to be replaced on weekly basis, will be installed for serving the needs of the workers.

Water impacts during the construction period are estimated as tolerable.

6.2.3. Soil

During the construction, the top-soil will be removed, thus the animal species living and finding habitat in the upper soil surfaces will partly perish, however they can further live in the soil to be backfilled during grading works.
Remarkable quantity of ground material has to be moved due to the slight inclination of the area, for horizontal arrangement of the buildings and building groups. The humus constituting the top-soil will be deposed separately during implementation and used later for terrain correction and for the development of green surfaces. The terraces of the ground will be designed in a manner allowing nearly identical volume of the soil to be excavated and of that to be backfilled, thus no excess will be produced.
Pipes of the public utilities to be developed in connection with the establishments are designed to be connected to the existing infrastructure of the region.

Preserving the humus-containing top-soil of the site constitutes an important part of the preparatory works of the project. In average, 30cm thickness may be calculated within the project area. This top-soil has to be extracted by all means on the envisaged building and pavement sites and in all sites concerned by grading. The upper layer of 8-10cm thickness, together with the plants growing on it will be removed or composted, while the remaining humus has to be stored in a proper deposit (up to 2m height) within the project site until utilization, and then backfilled on the intended locations of green surfaces.

Quantity of the humus extracted:	23 000 m^3 (to be backfilled on the green areas)
Envisaged cuttings (rough terrain)	107 000 m^3
Envisaged backfills (rough terrain)	84 000 m^3

Pipes of the public utilities to be developed in connection with the establishments are designed to be connected to the existing infrastructure of the region.
The envisaged public utility network extension has no impact on the surrounding areas.

Any accumulating earth and humus-containing soil quantities will be temporarily deposited in designated areas. The detailed humus management plan will be submitted in knowledge of the exact construction designs, during the building permit application process.

Soil impact during the implementation period is qualified as <u>constituting load.</u>

6.2.4. Waste

Following waste types may be generated during the implementation, requiring disposal:

1. Inert waste
2. Dangerous waste
3. Communal waste

Inert waste
It may include offal generated during construction works initiated on the site or (in minimal quantity) demolishing waste. The quantity of the similar waste can be defined by estimation, because waste produced during construction work will be selected and, as far as possible, reused in other sites. Recycling depends on the waste's quality and on the investor's requirements. The quantity of waste is estimated in 1,400m^3. License-holder will dispose of

the generated waste through employment of licensed freighters, in compliance with the legal provisions.

- Wrecked concrete (EWC 17 01 01) – estimated quantity: 5MT
- Broken asphalt (EWC 17 03 02) – 1-2MT
- Wood waste (EWC 17 02 01) – estimated quantity: 2-3MT
- Metal waste (EWC 17 04 02, 07 04 05, 07 04 07) – estimated quantity: 3-5MT
- Plastic waste (EWC 17 02 03) – estimated quantity: 6MT
- Mixed construction waste (EWC 17 09 04) – estimated quantity: 30MT

Dangerous waste
Maintenance of the construction machinery will be made at the contractor's plant. No dangerous waste can be generated on the project site from the operation of the machines. Small quantity of dangerous waste may derive from the packaging material of the special building materials or paints. Any dangerous waste generated during demolition and construction work will be collected in an on-site container designed in compliance with the legal requirements and removed within the shortest possible time.

Table 22: Quantity of dangerous waste incidentally produced during implementation

EWC code	Description	Quantity (kg)
080409	Waste of adhesive or sealing compounds containing organic solvents or other dangerous substances	100
150110	Packaging waste containing residues of or contaminated with, dangerous substances	200

Communal waste
During implementation, a max. number of 30 construction workers is expected to be present on the site. The quantity of communal waste produced by them may be estimated in 80L/day. Contractor will locate 2 pieces of collection bins of 100L capacity each for collecting communal waste. The bins will be emptied regularly, on weekly basis, by a specialized contractor provided with the relevant permit.

The impact of waste, as independent impact factor, during implementation may be qualified as <u>tolerable</u>, if contractor maintains proper working discipline.

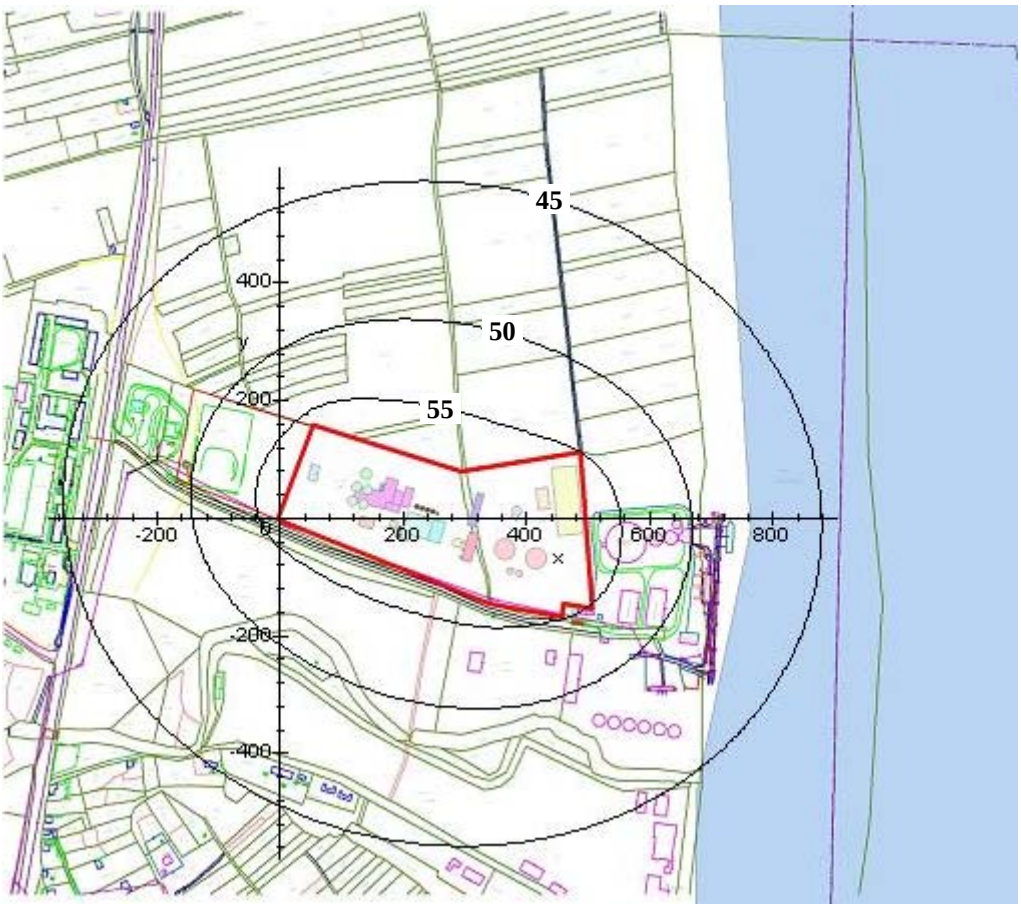
6.2.5. Noise

In knowledge of the area, it is presumable that the development of the site (earth-moving work, public utility development) would imply the most remarkable noise emission, because the noise of the machines is propagating practically unobstructed.

5.2.1.1 Table 23: Noise sources, noise emission

Construction phase	Estimated A-weighted equivalent sound-level by unit area, dB	Destination transport traffic by unit area, vehicles/day
Earthwork (dozer, grader, clamshell trucks)	108-110	10

The unit area means a unit of about 1-2 hectares.
Presuming unobstructed sound propagation and sound absorbing soil, the L_{Aeq}(dB) curves calculated in compliance with norm MSZ 15036:2002, through modeling with 10 point sources and with L_{WA} = 110+10*log(5) dB noise power level, are shown in the following Figure, with exactitude of informative character.



Noise load of the nearest buildings to be protected with K_h = 0.5dB correction:

- Felsőfok utca 2-6: L_{Aeq} = 46.7dB
- Hunyadi tér 2-3: L_{Aeq} = 46.1dB

6.2.5.1. Evaluation

Noise load limit values according to Annex 2 of joint Decree 27/2008. (XII. 3.) KvVM-EüM

No.	Area to be protected against noise	Limit value (L_{Th}) for L_{AM}, evaluation level* (dB) in case of construction work duration					
		1 month or less		1 month to 1 year		over 1 year	
		Day 6-22	Night 22-06	Day 6-22	Night 22-06	Day 6-22	Night 22-06
1.	Recreation area; from among the special areas: health sites	60	45	55	40	50	35
2.	Residential areas (of small town-garden-city-, village- or estate-like design); from among the special areas: sites of the educational institutions, cemeteries, green areas	65	50	60	45	55	40
3.	Residential areas (of metropolitan-like design), mixed purpose areas	**70**	**55**	**65**	**50**	**60**	**45**
4.	Economic areas	**70**	**55**	**70**	**55**	**65**	**50**

Based on the calculations, maintenance of the noise load limit values is expected during daytime. In night the limit values will not be exceeded even in the case of duration over 1 year, because in that stage already construction and mounting works will be performed that represent lower noise output limits.

Direct impact area
Determination of the direct impact area is quite complicated in the case of constructions, because it depends on the different stages of the works and also on the limit value changes.
On the basis of the calculation figure, it may reach the residential area in case of night work.

Indirect impact area
Taking into account the construction volume, daily transport traffic exceeding 40 to 50 heavy trucks/day is not probable. The additional daily load concerning main road 6, constituting the principal transport path, of 50 trucks/day amounts under the same parameters specified at the description of the actual conditions:

$$L_{Aeq}(7.5) = 55.7\text{-}58.7\text{dB}$$

The order of increase of 0.1-0.4dB is negligible.
The noise impact during implementation may be considered as <u>tolerable.</u>

6.2.6. Flora and fauna

The area under survey is a cultural landscape with unfavorable ecological conditions; its poor flora and fauna include overwhelmingly non-protected species; no strictly protected or directly or actually endangered species are encountered within the area.

The envisaged operation will imply changes in habitats of low natural value, already modified by centuries of human influence. An increase of disturbance is expectable in consequence of the growth in the vehicle traffic due to the construction and to the human presence, however it is to be noted that the environment is already loaded by remarkable transport traffic from the operation of the loading berth. Removal of the plant species that are undesirable from nature protection aspect, such as wolfberry, ragweed and goldenrod, may bring favorable changes.

The flora transformed during the implementation (parks and grass surfaces) will replace the present vegetation without any value. Plantation of native plant species adapted to the landscape has to be strived for in the parks to be established.

Cutting of trees and bushes is only allowed beyond the nesting period, between 15 August and 1 February.

From plant species resistant to the area's conditions protective forest of 5m width will be planted alongside the envisaged side and backward gardens. Where the features of the ground do not make it possible, disparted forests will be planted.
In zones or near activities with risk of explosion, at most shrubs may be planted in the parts concerned.

All unpaved surfaces of the ground-plot will be covered by grass.
Planting of deciduous trees is envisaged in the parking lot and along the ground-plot borders (or perhaps evergreens). In consideration of the 1 tree / 4 parking places rule, at least 13 trees are to be planted in the parking area.

The final planting plan including the list of plants will be prepared together with the execution plans.
Plant species well tolerating the local conditions will be preferred.

It is reasonable to dig the planting pits prior to spreading the humus, because the dug-out soil has to be spread on site. It is suggested to plant smaller trees of the currently usual size, because like this, they can better adapt themselves to the local conditions. Overage trees (2xi 12/14) are only envisaged in the parking lot.

According to the concept, the deciduous trees will be selected from among the following plants in the execution plan preparation phase.

Table 24: Envisaged native tree species for planting

No.	Deciduous tree	Size
1.	Acer platanoides	SF 10/12
2.	Acer platanoides Deborah	SF 10/12
3.	Corylus colurna	PF 150/200
4.	Fraxinus angustifolia Raywood	2xi SF 12/14
5.	Fraxinus excelsior	200/250
6.	Malus John Downii	PF 10/12
7.	Padus avium	PF 10/12
8.	Parrotia persica	2xi PF 250/300
9.	Populus alba Pyramidalis	PF 10/12
10.	Populus canadensis Kopeczky	SF 10/12
11.	Prunus cerasifera Woodi	2xi SF 12/14
12.	Quercus cerris	PF 150/200
13.	Sorbus aria Lutescens	PF 10/12
14.	Sorbus vértesensis	PF 150/200
15.	Tilia cordata	PF 150/200

Works related to the project implementation will considerably change the actual landscape. During the construction period, existence of large disturbed surfaces for longer durations is unavoidable.

The effects exercised on the flora and fauna in the implementation stage are of <u>improving</u> character.

6.2.7. Built environment

The envisaged project qualifies as major investment project. Heritage protection impact study will be prepared in respect of the project site prior to the implementation. Should any archeological phenomena be detected during the earth-moving activities, investor is bound to proceed according to the relevant provisions of Article 24 of Act LXIV of 2001 on Protection of the Cultural Heritage, and to comply with all related obligations.

The implementation-related works have <u>neutral</u> effect to the built environment.

6.3. OPERATION

6.3.1. Air

6.3.1.1. Air uses

Compressed air will be used at different technological sites.

Two air compressors will be used for producing compressed air (~ 8 barg) that will be stored in a 4.0m^3 capacity buffer, after being passed through a twin-drier.

6.3.1.2. Point sources

The following Table represents the typical point sources of the different envisaged technological phases.

Table 25: Typical point sources of the envisaged technology

	No.	EOV X EOV Y	Chimney height [m]	Chimney surface [m^2]	Exit gas temp. [K]	Wet volume flow rate [Nm^3/h]	Wet gas O_2%	Humidity %	Composition	Output concentration [mg/Nm^3]	Relative output conc.* [mg/Nm^3]	Limit value (mg/Nm3)
Corn reception	P1	640088 165413	41.5	1.43	299	60522	20.90	0.50	solid matter	45	45	50
Mill	P2	640067 165392	41.5	0.71	303	28949	20.90	1.00	solid matter	45	45	50
DDGS cooling	P3	640173 165364	41.5	0.64	327	49028	20.90	3.90	solid matter	45	45	50
DDGS loading	P4	640109 165428	12	0.64	310	4613	20.90	2.10	solid matter	45	45	150
Gas washer	P5	639839 165452	25	0.35	283	9689	0.3	1.10	VOC	135	135	150
Power center	P6	639894 165375	30.5	2.21	420	163955	5.17	40.51	CO	36.6	90	100
									NO_x	36.6	90	100
									SO_x	12.8	31.5	35
									VOC	54.9	135	150
									solid matter	1.8	4.5	5

**Referred to dry gas volume flow rate and 3% O_2 content only for P6 point source, in compliance with the provisions of Decree 10/2003. (VII. 11.) KvVM.*

Data of the previous Table demonstrate that the ethanol plant has actual emissions exclusively during entry of the raw materials and cleaning of the DDGS.

6.3.1.3. Diffuse sources

The ethanol plant has no steady diffuse emission pollution sources

6.3.1.4. Line sources

Examining the transport activities in one hour duration during peak period, the following calculation parameters have been taken into account:

- 15 transport vehicles, proceeding with a speed of 20km/h, 0.5 hours of effective work;
- 5 work/power engines, proceeding with 10km/h speed, 0.5 hours of effective work.

On the above basis, the emissions of the ethanol plant due to transport activities are included in the following Table.

Table 26: Emissions of the transport vehicles serving the ethanol production technology

Vehicles	Pc	CO (g/h)	NO_x (as NO_2) (g/h)	SO_2 (g/h)	Particles (g/h)
Transport vehicles	15	3000	106.4	60	302
Work/power engines	5	735	216	30.5	86
Total	**20**	**3735**	**322.4**	**90.5**	**388**

6.3.1.5. Diffusion modeling

Diffusion calculations have been performed for each main component emitted within the plant. Also one hour calculations under the most frequent meteorological conditions and annual average calculations for the main components have been prepared. Comparing the thus resulting diffusion maps, we have evaluated the plant's impact on the air quality.

The transmission calculations have been performed in compliance with norms MSZ 21459 and MSZ 21457, for 3.0m/s wind speed and neutral air stability conditions. Consequently the exponent of the p wind profile equation has been established in 0.27. The point sources have been assumed as continuously operating during the annual diffusion calculations. The terrain has been considered as homogeneous in compliance with the surface roughness parameter, estimated to be of 1.0m.

Parameters of the point sources – height, diameter exit gas rate, temperature, emission – are detailed in Table 3. The locations of the point sources were taken into account with their own EOV coordinates, and also the diffusion concentration contour maps were plotted in the Uniform National Projection System.

Provisions of Govt. Decree 21/2001. (II. 14.) have been observed while defining the limits of the air quality impact area.

The legal rule applies three definitions for the determination of the direct impact area of an air polluting source. From among them, in each case the largest area will be considered as the concerned impact area.

During calculations, all of the three conditions have been examined for determining the impact area:

a) The area defined by concentration values exceeding 80% of the one hour maximum value;

b) The area defined by concentration values exceeding 10% of the one hour air pollution limit value;
c) The area defined by concentration values exceeding 20% of the loadability limit (loadability: difference of the air pollution limit value and of the basic air pollution value).

During annual diffusion calculations, items a) and b) are not interpretable, therefore, in such cases we have proceeded according to item c). Based on the thus performed calculations, no interpretable and delineable impact areas resulted for any of the components.

In the case of the calculations concerning short duration (one hour average under the most frequent meteorological conditions), for the components only the definition as to item a.) leads to an interpretable impact area.

Of course, the definition as to a.) provides in all cases interpretable impact area concentration values, therefore this has been performed and also figured for each component.

When representing the impact areas, due to the different spatial emissions by components, we have also displayed the impact areas by components. From among these areas, the largest resulting area has been taken into account as impact area.
In our case this means a circle of 1125m radius according to definition a.) for nitrogen oxides, carbon monoxide and sulphur dioxide..

Also the long term transmission calculations in compliance with the annual average meteorological conditions have been performed.

The following boundary conditions have been established for the model:

- calculation of annual average concentration,
- application of dispersion parameters relating to countryside areas,
- calculation of additional chimney height,
  - plain ground.

The following meteorological parameters have been taken into account:

- annual mean temperature: 10°C,
- thickness of the average mixing layer: 600m
- annual wind direction frequencies as specified in Figure 1,
- atmospheric stability values according to Pasquill categorization, represented in Figure 2.

Annual distribution of the Pasquill stability categories taken into account during our model calculations

The diffusion patterns have been presented on a mape by help of geographic information system.

The following Table recapitulates the system of conditions for the impact area determination.

Represented impact area	**NOx**		
	Annual limit value	70	µg/m^3
	One hour limit value	200	µg/m^3
	Impact area		
X	a.)	6.66 *0.8=5.33	µg/m^3
-	b.)	200*0.1=20	µg/m^3
- -	c.)	(70-21)*0.2=9.8 :annual (200-60)*0.2= 28:hourly	µg/m^3

Represented impact area	**CO**		
	Annual limit value	3000	µg/m^3
	One hour limit value	10000	µg/m^3
	Impact area		
X	a.)	6.66 *0.8=5.33	µg/m^3
-	b.)	200*0.1=20	µg/m^3
- -	c.)	(70-21)*0.2=9.8 :annual (200-60)*0.2= 28:hourly	µg/m^3

Represented impact area	**SO_2**		
	Annual limit value	50	µg/m^3
	One hour limit value	250	µg/m^3
	Impact area		
X	a.)	2.33*0.8=1.87	µg/m^3
-	b.)	250*0.1=25	µg/m^3
- -	c.)	(50-5)*0.2=9 (250-25)*0.2=45	µg/m^3

Represented impact area	**Airborne dust**		
	Annual limit value	50	µg/m^3
	One hour limit value	200	µg/m^3
	Impact area		
X	a.)	12.24*0.8=9.79	µg/m^3
-	b.)	200*0.1=20	µg/m^3
- -	c.)	(50-20)*0.2=6 (200-80)*0.2=24	µg/m^3

Represented impact area	**Ethanol**		
	24 hour design guidance value	5000	µg/m^3
	One hour guidance value	5000	µg/m^3
	Impact area		
X	a.)	16.8*0.8=13.44	µg/m^3
-	b.)	5000*0.1=500	µg/m^3
-	c.)	(5000-500)*0.2=900	µg/m^3

The diffusion patterns are displayed on maps by the help of geographical information system:

JELMAGYARÁZAT

- Pontforrások

CO hatásterületi konc.(µg/m3)

- a.) 5.33 µg/m3

CO immissziós konc.(µg/m3)

- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5
- 5 - 5.5
- 5.5 - 6
- 6 - 6.5
- 6.5 -
- Létesítmények

METEOROLÓGIAI ADATOK:
- szélirány: ÉÉNy-i,
- szélsebesség: 3 m/s,
- Stabilitás: "D" Pasquill.

N

0 400 800 1200 Meters

A SZÉN-MONOXID TERJEDÉSI KÉPE

- órás átlag -

JELMAGYARÁZAT

- Pontforrások

NOx hatásterületi konc.(µg/m3)
- a.) 5.33 µg/m3

NOx immissziós konc.(µg/m3)
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5
- 5 - 5.5
- 5.5 - 6
- 6 - 6.5
- 6.5 -
- Létesítmények

METEOROLÓGIAI ADATOK:
- szélirány: ÉÉNy-i,
- szélsebesség: 3 m/s,
- Stabilitás: "D" Pasquill.

N

A NITROGÉN-OXIDOK TERJEDÉSI KÉPE
- órás átlag -

JELMAGYARÁZAT

- Pontforrások

por hatásterületi konc.(µg/m3)
- a.) 17.95 µg/m3
- b.) 20 µg/m3

por immissziós konc.(µg/m3)
- 3.5 - 5.5
- 5.5 - 7.5
- 7.5 - 9.5
- 9.5 - 11.5
- 11.5 - 13.5
- 13.5 - 15.5
- 15.5 - 17.5
- 17.5 - 19.5
- 19.5 - 21.5
- 21.5 -
- Létesítmények

METEOROLÓGIAI ADATOK:
- szélirány: ÉÉNy-i,
- szélsebesség: 3 m/s,
- Stabilitás: "D" Pasquill.

N

0 400 800 1200 Meters

A SZÁLLÓ POR TERJEDÉSI KÉPE

- órás átlag -

JELMAGYARÁZAT

- Pontforrások

SO2 hatásterületi konc.(µg/m3)

a.) 1.87 µg/m3

SO2 immissziós konc.(µg/m3)

- 1 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2
- 2 - 2.2
- 2.2 -
- Létesítmények

METEOROLÓGIAI ADATOK:
- szélirány: ÉÉNy-i,
- szélsebesség: 3 m/s,
- Stabilitás: "D" Pasquill.

N

0 400 800 1200 Meters

A KÉN-OXIDOK TERJEDÉSI KÉPE

- órás átlag -

JELMAGYARÁZAT

- Pontforrások
- VOC hatásterületi konc.(µg/m3)
  - a.) 13.44 µg/m3
- VOC immissziós konc.(µg/m3)
  - 4 - 5.5
  - 5.5 - 7
  - 7 - 8.5
  - 8.5 - 10
  - 10 - 11.5
  - 11.5 - 13
  - 13 - 14.5
  - 14.5 - 16
  - 16 -
- Létesítmények

METEOROLÓGIAI ADATOK:
- szélirány: ÉÉNy-i,
- szélsebesség: 3 m/s,
- Stabilitás: "D" Pasquill.

N

0 400 800 1200 Meters

A VOC-k TERJEDÉSI KÉPE
- órás átlag -

JELMAGYARÁZAT

- Pontforrások
- Létesítmények

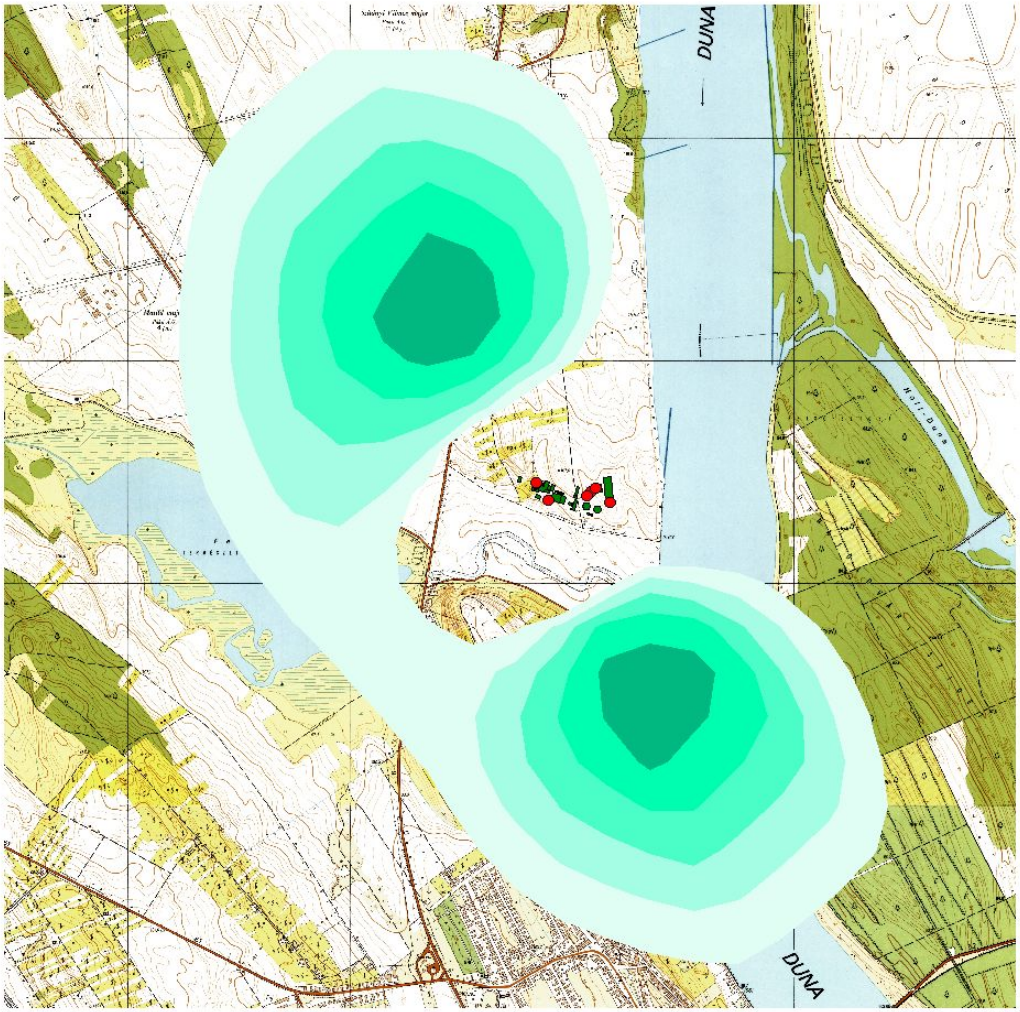
NOx immissziós konc.(µg/m3)

- 0.2 - 0.22
- 0.22 - 0.24
- 0.24 - 0.26
- 0.26 - 0.28
- 0.28 -

METEOROLÓGIAI ADATOK:
- éves átlag

N

0 600 1200 1800 Meters



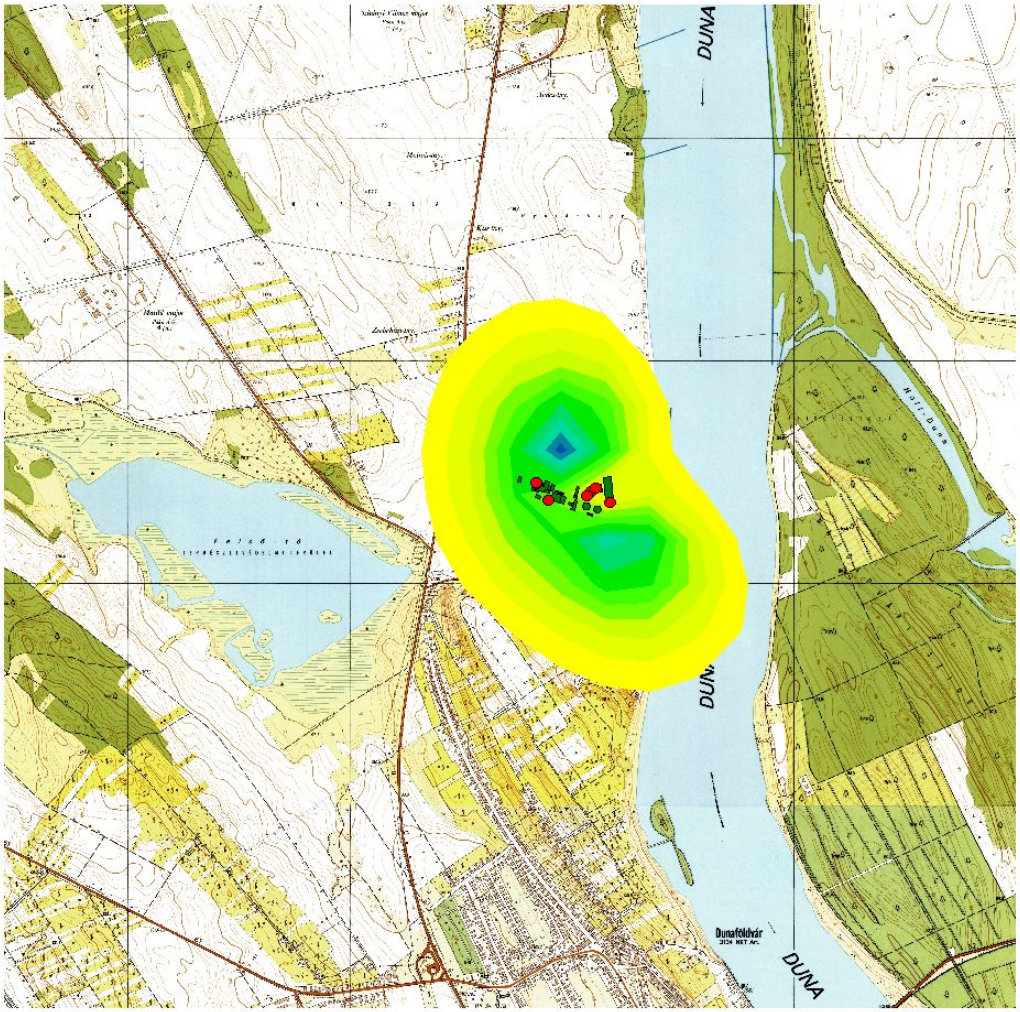
A NITROGÉN-OXIDOK TERJEDÉSI KÉPE
- éves átlag -

JELMAGYARÁZAT

- Pontforrások
- Létesítmények

por immissziós konc.(µg/m3)

- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 3.2
- 3.2 -



METEOROLÓGIAI ADATOK:
- éves átlag

N

0 600 1200 1800 Meters

A SZÁLLÓ POR TERJEDÉSI KÉPE

- éves átlag -

6.3.1.6. Evaluation of the resulting immission concentrations

The following Table represents the maximum hourly immission concentrations due to the operations within the project site, based on overestimates (as the peak immission concentrations of the traffic and of the point emission sources are not coinciding in the space).

Table 27: Excess loads due to imissions from the activities during operation

Vehicle	Carbon monoxide CO	Nitrogen oxides NO_x	Sulphur dioxide SO_2	VOC (ethanol)	Particles (airborne dust)
Unit	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
Background load	496.5*	29.1*	4*	500**	22.4*
Work machines/ transport vehicles	145.6	12.6	3.52	0	15.12
Diffusion modeling	6.66	6.66	2.33	16.8	22.44
Total	**648.76**	**48.36**	**9.85**	**516.8**	**37.56**
Limit value	***10 000***	***200***	***250***	***5 000***	***200***

*Measurement results: 2006, Dunavecse
**Background load index

By this calculation method the expectable concentration had been overestimated. Therefore, it may be stated with high security that the above overestimated expectable loads are within the limit values specified in Annex 1.1 of joint Decree 14/2001. (V. 9.) of the Ministry of Environment, Ministry of Health and Ministry of Agriculture and Rural Development; the impact thus exercised is qualified as <u>tolerable.</u>

6.3.1.7. Protection zones of the point sources

The results of the diffusion modeling have demonstrated that the air load impact of the envisaged operation is not remarkable. The radius of the protection zone to be defined will be established in compliance with Article 6 of Govt. Decree 21/2001. (II. 14.):

> *(6) In the course of the environmental impact study and of the uniform environment use licensing procedure, the environmental authority may also determine a protection zone that is smaller than the smallest protection zone provided for in items A) to D) of Annex 2, if any and all air protection requirements are met. However, the radius of the protection zone to be defined cannot be less than 300m in the case of activities listed in item A), of 200m for activities under item B) and of the direct impact area of the air polluting source listed in items C) to D).*
>
> *(7) In the event of a new source to be established in an existing plant, the environmental authority may also define a distance even smaller of those provided for in Section (6) in a special procedure.*

In virtue of Article 6, Section (7) of the Decree, we request definition of the protection zone of the envisaged power plant in 300m. There are non establishments to be protected within the limits of the suggested protection zone.

Description and owners of the real estates located within the protection zone are recapitulated in the following table.

Table 28: Properties within the protection zone

HRSZ	Name and address of proprietor
0107/8	Holl István 7020 Dunaföldvár, Béke tér 8. 1/2.
0107/9	Cargill Magyarország Kereskedelmi Zrt. 1134 Budapest, Váci u. 37.
0107/10	
0107/11	
0107/12	
0107/13	
0107/14	
0107/15	
0111/5	
0111/6	
0111/7	
0111/8	
0111/9	
0111/11	
0111/13	
0111/14	
0111/18	
0111/25	Cargill Magyarország Kereskedelmi Zrt. 1134 Budapest, Váci u. 37.
0111/26	Cargill Magyarország Kereskedelmi Zrt. 1134 Budapest, Váci u. 37.
0113/1	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0113/5	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0113/6	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0113/7	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0113/8	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0113/16	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0114/1	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0115/9	Kovács Imre 1112 Budapest, Beregszászi u. 56/b.
0115/10	Hungarian State National Land Fund
0116/5	Cargill Magyarország Kereskedelmi Zrt. 1134 Budapest, Váci u. 37.
0116/7	Lukoil Magyarország Kft 1145 Budapest, Újvilág u. 50-52.
0116/8	Master Vase Kereskedelmi Kft 2112 Veresegyháza, Szentkorona u. 4.
0117	Hungarian State MoA- Tolna County FMH 7100 Szekszárd, Augusz Imre. u. 7.
0118/3	Hungarian State National Land Fund
0118/4	Kovács Imre 7000 Sárbogárd, Táncsics M. u. 33. Nagy Antal 6136 Harkakötöny, Kötöny u. 3.
0109	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L. u. 2.
0119	Hungarian State
0120/4	ADUVIÉP 6500 Baja, Déri Frigyes sétány 13.
0127/1	Hungarian State

6.3.1.8. Definition of the impact area

Based on the impact area determination, it may be established that the largest area results for nitrogen oxides, carbon monoxide and sulphur dioxide in short period, according to definition as to item a).

The impact area thus resulting represents a 1125m radius circular area**.**

6.3.1.9. Monitoring

Emission monitoring

Performing emission measurements once in a year for point sources P1 – P5 and twice in a year for P6 point source is justified.

Immission monitoring

Diffusion modeling demonstrates only a small load to the environment. Performing immission basic condition survey is justified. Performance of measurements twice a year (in winter and in summer) is justified in the first 3 years of the operation. If the results of the diffusion modeling are validated, no more immission measurements will be justified.

JELMAGYARÁZAT

- Pontforrások
- Határterület határa R=1125m

NOx hatásterületi konc.(µg/m3)

- a.) 5.33 µg/m3

NOx immissziós konc.(µg/m3)

- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5
- 5 - 5.5
- 5.5 - 6
- 6 - 6.5
- 6.5 -
- Létesítmények

METEOROLÓGIAI ADATOK:
- szélirány: ÉÉNy-i,
- szélsebesség: 3 m/s,
- Stabilitás: "D" Pasquill.

N

0 400 800 1200 Meters

A HATÁSTERÜLET HATÁRA
- órás átlag -

6.3.2. Water

6.3.2.1. Effects of water extraction

It is recommended to obtain water from 4 wells, always only two of them installed on identical depth ranges, with 100m and 150m or 150m and 200m bottom depth.
If an aquifer of sufficient thickness is present, the required water quality could be obtained with the help of two well pairs (1+1 of 100m and 1+1 of 150m depth). It would be reasonable to locate the well pairs apart, at the borders of the ground-plot.

For assessing the water extraction's impacts, a simplified model has been prepared. *Annex 5* contains the results of the model calculation. Based on the calculations performed, it may be established that the depression due to the envisaged water withdrawal of 3,000m^3/day is of 14m in the vicinity of the wells and of 0.5m at a distance of 1,150m.

Direct impact is consequently expectable in the production layers, constituted (subject to the actual stratification to be revealed at the site)

- either sands between 50 and 95 and between 120 and 140m (version "A") or
- those between 120 and 140 and between 170 and 190m (version "B").

The extent of the direct impact's diminution in the production sand layers with increasing distance from the site of pumping, has been determined by way of preliminary modeling; its initial data, details and findings are expounded in the next Chapters.

Before starting the effective well construction, the initial data will be exactly determined at the site concerned. An exploratory well will be drilled, providing factual data, beyond the exact stratification, also on the sand layers' coefficient of permeability, the volume of recharge and on the hydraulic relationship between the superimposed layers. These factual data, through detailed modeling, will allow unequivocal quantification of the scenario presumed in the actual forecast; thus, also the direct impact area will be exactly determined and the data obtained from the exploratory well will determine the location of the monitoring wells required for monitoring the environmental impacts.

The water-bearing sand layers are separated by rock dust containing, muddy and argilleous layers from each other. The efficiency of separation, that is the water seal is not complete: these separating muddy and argillaceous layers operate as water barrier only for a short time period and up to a certain difference in pressure; what more, they are not homogeneous. Therefore, leakage to the sites of production sand layers (depressed through pumping) starts (to the well) not only laterally, within the layer concerned, but – subject to the pressure difference – also from upstairs, through the muddy and argillaceous layers (from the shallow aquifers and from the groundwater).

It is easy to understand that vertical leakage is much less and slower than the lateral one, consequently the **indirect impact** area, where effects of the water extraction could be sensed above the production layers in the shallow aquifers and groundwater-bearing layers (water level degradation) remains within the direct impact area. Its dimension will be biggest near the wells and will depend on the actual depression required for the production of the required water yield. This will be quantifiable on the basis of the exploratory well's factual data.

Estimation of the **direct impact area** has been made by a simplified hydraulic model generated through consideration of the data contained in Sections 2.1 and 2.2, by the help of a PMWIN (Processing Modflow for Windows) application.

As horizontal filtration coefficient for the groundwater-bearing layer the average value of 0.7m/day applicable to coarse silt (loess), while for the aquifers exploited by wells an average value of 1.8m/day has been taken as basis.

The expert opinion attached under *Annex 5* presents the area and the extent of the foreseeable direct impact of a water extraction of 3000m^3/day by the use of two well pairs.

In the expectation of long term operation, the area concerned by water level degradation of at least 0.5m in the exploited layers may be approximated by an ellipse having a major axis of 2250m and a minor axis of 2150m.

Within the space concerned, there is a single approved subsurface water usage, namely the well of the asphalt mixing plant of Vegyépszer Építő és Szerelő Zrt. (depth: 105m, filtering between 80 and 86m) with allowed water withdrawal of 1m^3/day. Here the estimated water level degradation is between 1 and 2m. No data are available on the well's actual standing and operational water level, but the actual data have to be measured on the site – as initial data and basic condition assessment – for the detailed modeling to be attached to the water withdrawal's water right implementation permit application.

The direct impact area does not concern any other allowed water usages.
The wells of settlement's water works have no designated protective zone; the border line of the bioethanol plant's estimated direct impact area is at about 1000-1200m distance from the location of the waterworks' wells.
The **indirect impact area** concerning the groundwater bearing layer and the shallow aquifer remains within the direct impact area.

In knowledge of the above explained facts, the possible consequences of the effects from deep groundwater withdrawal can be summed up as follows:

- In the case of the existing water withdrawals, operating water level deeper of the actual one may be required for the production of the previous water yield. This requires relocation of the submersible pump at a deeper level and implies additional energy consumption (in an extreme case, when the pump is hardly able to perform the actual pressure need, even replacement of the pump may be necessary).
- As already mentioned above, there is a single licensed water withdrawal site within the pre-estimated impact area; its present parameters (actual stationary water level, working water level, operating water yield, well structure, type, characteristics and depth of installation of the submersible pump) have to be measured and used for the detailed modeling and survey. In order to avoid future discussions, it would be reasonable to involve the well into the monitoring, perform or make perform regular observations also during the future operation of the bioethanol plant. It seems to be reasonable to come to an agreement with the owner in this respect.
- In the indirect impact area located within the direct impact area, degradation of the groundwater level is to be expected, at an extent decreasing with the increase of distance from the axis of water withdrawal. Of course, the biggest degradation will occur within the bioethanol plant requiring attention in soil mechanical respect: during foundation planning of the building parts implying serious load, the permanent dewatering has to be taken into account; the load bearing layer and the method of foundation have to be selected in compliance therewith, taking into account the groundwater conditions developing in the future. (The exact quantitative data from the detailed survey of the water withdrawal effects will be available already at that time.)

- Any degradation of the groundwater level beyond the plant area to the N or NW of the property does not impair the condition of the existing foundations: due to the higher relief, the groundwater level has been already deep, at 10-15m even until now.
- From among agricultural land uses, forest, wine culture and fruit farming could be concerned by the effects of the groundwater degradation, because, due to the groundwater table being already located too deep, water resources stored in the soil could be taken into account – beyond watering – for other cultures even until now. The envisaged usage of the areas concerned is anyhow industrial park.
- Through implementation and operation of the monitoring system to be implemented in compliance with the preliminary water rights permit, and through evaluation of the data obtained, the actual water level degradations will be traceable and predictable. This grants sufficient safety also for the neighboring water usages (even those located farther off), as the extent of water withdrawal could be limited in extreme necessity and the pressure levels may recover through decreasing any production that proves to be excessive.

Annex 5 includes the maps delineating the impact area.

6.3.2.2. Water usages

Social-purpose water use

Drinking water supply serves for satisfying workers' demand for drinking water and other sanitary purposes. The daily requirement for drinking water amounts to 10.7m^3.

Technological water use

The daily quantity of 3,000m^3 of water required for the ethanol production and for the operation of the power center will be obtained from 4 wells to be implemented along the Danube.

30% of the daily water requirement of 3,000m^3 will depart from the system as waste water (high saline content blow-down water from the power center's cooling circuit).
The technology is of semi-closed system; used waters generated are recirculated or utilized in the cooling towers of the bioethanol technology.

Considering the complete ethanol production technology, the technical design is water saving.

6.3.2.3. Used water treatment

Process waste water

Practically no process waste water is generated in the plant, as "contaminated" water from the processes are recirculated and reused.

It is envisaged to lead the high saline content blow-down water produced in large volume due to the technology, into the Danube, through the Cargill/Agrograin plant. Quantity of the water outlet will be of 780m^3/h in the average, peak discharge 1000m^3/day.

The quality of the waste water remains within the limit values specified in Decree 28/2004. (XII. 25.) of the Ministry of Environment and Water on the national regional emission limit values of the waste waters directly discharged into surface reception waters. No process-specific limit value is to be established for bioethanol technology, because no waste water discharge occurs from the water-saving production technology.

Table 29: Recommended limit values for the Danube outlet point (for typical parameters)

Component	Limit value
pH	6-9.5
Salt content	7 000mg/l
Temperature	30ºC

Environmental impact of the water discharged is not sensible taking into account the Danube's stream flow of 2,000,000 to 28,000,000m^3/h. The dilution ratio is 2,400-times (calculating with half of the Danube's minimal water stream).
With regard to the high dilution rate, implementation of special monitoring system is not necessary. Quality of the water to be drawn is still not known, therefore the salinity of the blow-down waters has been taken into account, constituting overestimation.

Position papers and acceptance statements concerning water supply and used water discharge into the Danube are attached under Annex 9.

Escaped water management in the operation stage

- In the factory building, power center and dryer continuous industrial floor, drain holes and collecting shafts will be implemented. All escaped waters (including cleaning water) will be entirely recirculated into the technological process (boiling water container).
- Containment shafts and surfaces of the outdoor tanks: all escaped waters and rain waters will be recirculated into the technological process.
- Any local process leakages (at the ethanol tanker loader) from the ethanol loading station will be collected from the inclined surface through the discharge hole (passing through an oil and sediment trap) to the containment facility of the tank farm.
- Ethanol tank farm: it is a properly dimensioned capacity, recessed containment platform with continuous HDPE plastic plate insulation covering the entire surface. Any leakages (produced only in case of contingency!) and precipitation waters from here will be recirculated into the process or, in case of smaller quantities, evaporated. (Otherwise, if precipitation waters accumulate in excessive quantity, upon sampling and registration, the excess will be pumped into the storm-downpipe through an oil-trap. It may also be used for watering.) The ethanol tanks, leakproof metal tanks specially manufactured for this purpose, will have floating roof.
- Certain tanks designated for storing raw materials (e.g. sulphuric acid) will be equipped with independent water-proof concrete containment basin. Leakages, escaped materials or rain waters accumulated here will be –if necessary – gathered and removed for disposal by freighters authorized to transport dangerous materials or recirculated into the process (including generated or residual rain waters).
- Also sealed containment shaft will be constructed for gathering oil-containing leakages originated in the maintenance building. Leakages from here will be removed by freighters authorized to transport dangerous materials.
- Precipitation waters from the universal parking surfaces will be discharged through qualified sand trap and oil separator. They will be discharged into the Danube by a properly dimensioned rain pipe through the adjacent CARGILL plant. (Modification of the water right permit will be necessary.) Precipitation waters of the normal road surfaces (not destined for parking) will be directly discharged into the rain-pipe system. (See also description of public utilities.)

Communal waste water

At present, no sewage network is still implemented in the vicinity of the development area, therefore collection and disposal of any generated waste waters has to be resolved by the plant operator.

For collecting communal waste waters, a closed and sealed concrete tank will be constructed, or the sewage network built-out until the existing backbone pipeline alongside main road 6. Contract for regular removal – as required – of the waste waters will be concluded with the specialized company, Településtisztasági Kft. Volume of the generated communal waste water amounts to 9m^3/day.

Acceptance statement of the service provider is attached under Annex 9.

6.3.2.4. Rainwater management

Plant area

Rainwater from the buildings' roofs, road pavements and green surfaces is to be discharged. According to the system developed in other projects of investor, rainwater from surfaces where no oil contamination occurs will be discharged to the green surfaces. It is partly desiccated here. Any residual rainwater will be discharged through gullies located at the deepest points of the green surfaces into a closed channel system.

Parking areas

Rainwater from surfaces, where contamination with oil products is probable – parking lots, loading stations – will be discharged into the channel system through an oil trap.

The channel discharges the waters thus collected into the recipient. The recipient is the storm-sewer previously implemented on the adjacent ground-plot of CARGILL, discharging the collected waters into the Danube. The sewer system of Cargill is provided with permits of KDT KTVF (The Middle Transdanubian Inspectorate for Environmental Protection, Natural Protection and Water Management) (implementation: Application No.: 18379/2006, File No.: 82289/2006; operation: Application No.: 6419/2007, File No.: 52322/2009, water registry No.: 72/8004-17065).

In summary, it may be established that, if proper technological discipline is maintained, neither surface nor sub-surface waters are endangered within the project area during the operation period.

During the operation, no loading of the surface or sub-surface waters occurs, the impacts will be considered as tolerable.

The size of the impact area will be the surface segment of the area delineated by the contour line of the water table depression of 0.5m caused by water extraction.

6.3.2.5. Technology monitoring

Due to the technical design the different establishments, the operation of the technology implies minimal environmental risk; the 3 monitoring wells to be implemented provide sufficient information on any environmental pollution. The location of the monitoring wells is defined in the Annex.

Regular measurement (every three months) of the following components is justified in the monitoring wells:

- pH,
- Conductivity,
- Salinity,
- Ammonia-ammonium-nitrogen,
- Nitrate,
- Sulphate
- TPH

Sampling and measurements at the monitoring sites will be performed by an accredited, duly authorized professional company.

Testing of the discharged used waters is envisaged at two self-checking sites:

1. At the point of cooling water discharge into the sewer system,
2. At the point of delivery to Cargill.

On the above basis it may be established that the operation will not imply any load impacts either to the surface waters or to the subsurface waters, therefore the impact is classified as <u>tolerable.</u>

6.3.3. Soil

The envisaged activity has no impact to the surrounding areas. Contamination of the soil layers below the humus-containing top layer is not expected in the operation period, due to the high technical level of the activity and public utility supply of the area.

However, due to the space occupation of the establishments implemented during the construction period, the land remains unable to provide its natural functions, therefore – applying overestimation – the impacts on soil are qualified as <u>constituting load</u>.

6.3.4. Waste

No process-related waste will be produced during operation of the bioethanol plant. The corn dust generated during dust separation following milling will be recycled into the production process. No husking residues are generated during the process, because the corn kernels will be supplied in cleaned quality, containing no wastes.

The DDGS (by-product) generated during the production process will be sold as animal feed.

Typical maintenance waste includes: spent oil, oily rags, oily condensates, storage batteries, residual paints and packaging materials, used air filter cartridges, oil filters, broken light tubes, dry batteries, metal scraps and communal waste.

Table 30: Estimated process waste quantities

Waste type	Estimated annual quantity	Qualification	Treatment
TECHNOLOGICAL PROCESS WASTE			
-			
MAINTENANCE WASTE			
13 02 06* Spent oil	100kg/year	Dangerous	Incineration in waste burner
16 01 07* Oil filters	20kg/year	Dangerous	Depositing in dangerous waste disposal site
15 02 02* Oily rags	100kg/year	Dangerous	Incineration in waste burner
13 05 02* Oily sludge from oil traps	30kg/year	Dangerous	Incineration in waste burner
15 02 02* Absorbing material for oils	400kg/year	Dangerous	Incineration in waste burner
15 01 11* Other mixed dangerous wastes (paint residues, packages)	Depends on maintenance work performed	Dangerous	Depositing in dangerous waste disposal site or incineration
05 01 01 Other mixed non-dangerous wastes (packaging materials)	Depends on maintenance work performed	Non-dangerous	Deposition in communal waste deposit

An on-site dangerous waste collection facility will be erected for gathering dangerous waste. The on-site waste collection facility's design will be in compliance with the technical requirements specified in Govt. Decree 98/2001. (VI. 15.).

Mowing waste generated on the green surfaces will be cut as necessary and mixed back into the soil for composting.

The principle of waste generation prevention or at least minimization has been kept in eye during planning of the ethanol production technology; therefore waste is only produced during the operation.

The impact of waste as an independent environmental factor is <u>neutral</u> in the operation stage.

6.3.4.1. Measures taken for decreasing quantity and dangerousness of wastes

The measures envisaged during technology design for decreasing the quantity and dangerousness of the generated wastes include:

- Continuous maintenance, organization of trainings;
- Empties will be returned to manufacturers for refilling;
- As regards the materials to be used, materials have to be preferred that are suitable for the technological purposes but wastes generated from their utilization are not qualified as dangerous wastes.
- Through continuous monitoring of the purchases, registering the quantities of the wastes generated in compliance with the relevant provisions, the process may be well regulated and any necessary correction measures taken in due time.

6.3.4.2. Measures taken for preventing waste generation

The first step for preventing waste generation includes continuous control and analysis of the processes serving the technology. Continuous registration of the quality and quantity of the

wastes generated allows definition of the system's points, where prevention of waste generation is justified.

6.3.4.3. Monitoring system

Recording of the (dangerous and non-dangerous) wastes is made in compliance with the provisions of Govt. Decree 164/2003. (X. 18.). According to the legal provisions, the Kft. prepares annual declarations regarding the wastes produced.

The impact of waste as an independent environmental factor is <u>neutral</u> in the operation stage.

6.3.5. Noise

6.3.5.1. Evaluation of the expectable noise conditions

In compliance with the preliminary plans, the following main groups of noise sources are expectable. The typical noise output levels are based on evaluation of Principal's data supply and on examination of the conditions implying the highest noise load.

Table 31: Main noise source groups

Noise source group	
Description	**Estimated noise output level, $L_{WAi(eq)}$(dB)**
Storage entry, conveyor system	95
Mill	105
Fermentor	100
Saccharification, dehydration, distillation	95
Drying, air handling system	105
Ethanol extraction system	101
Finished product storage	90
DDGS cooling, storage	100
Cooling tower	92
Water treatment	100
Boiler house	90
Turbine	100
Transport traffic within plant	95
Passenger car parking lot	65
Office building (central cooler)	85
Maintenance building ventilation	80

Calculations have been performed in compliance with norm MSZ 15036:2002. From among the correction factors, we have taken into account the air absorption, the soil/meteorological effects, the acoustical reflection from vertical surfaces and the partial noise shielding effect of the buildings within the plant. We have calculated with -5dB in case of fully shielded and with -3dB in case of partially shielded noise sources.

6.3.5.2. Calculation results

Point of calculation: before the E front of the residential houses at Hunyadi tér 2-3.

Noise source description	Noise output level, dB(A)	Equivalent height, m	Distance from the theoretical border of the residential area, m	Corrections, dB					10.log(D)	L_{Aeqi},dB
				K_d	K_h	Kt-m	Ká	K_l		
Storage entry, conveyor system	95	20	700	-67.9	2	-4.3	-3.0	-1.3	0	20.5
Mill	105	10	700	-67.9	2	-4.5	-3.0	-1.3	0	30.3
Fermentor	100	10	410	-63.3	2	-4.3	0.0	-0.8	0	33.7
Saccharification, dehydration, distillation	95	10	480	-64.6	2	-4.4	0.0	-0.9	0	27.1
Drying, air handling system	105	10	500	-65.0	2	-4.4	0.0	-1.0	0	36.7
Ethanol extraction system	101	5	700	-67.9	2	-4.6	-3.0	-1.3	0	26.1
Finished product storage	90	10	700	-67.9	2	-4.5	-3.0	-1.3	0	15.3
DDGS cooling, storage	100	10	730	-68.3	2	-4.5	-3.0	-1.4	0	24.8
Cooling tower	92	5	600	-66.6	2	-4.6	-5.0	-1.1	0	16.7
Water treatment	100	4	600	-66.6	2	-4.6	-5.0	-1.1	0	24.7
Boiler house	90	5	500	-65.0	2	-4.6	-3.0	-1.0	0	18.5
Turbine	100	4	490	-64.8	2	-4.6	0.0	-0.9	0	31.7
Transport traffic within plant	90	1	400	-63.0	2	-4.7	0.0	-0.8	3	26.5
Passenger car parking lot	65	0.5	320	-61.1	2	-4.7	0.0	-0.6	3	3.6
Office building (central cooler)	85	1	330	-61.4	2	-4.7	0.0	-0.6	0	20.3
Maintenance building ventilation	80	5	410	-63.3	2	-4.5	0.0	-0.8	0	13.4

Aggregate value: L_{Aeq} = 40.7dB

Point of calculation: before the NE front of the residential houses at Felsőfok utca 2-6.

Noise source description	Noise output level, dB(A)	Equivalent height, m	Distance from the theoretical border of the residential area, m	Corrections, dB					10.log(D)	L_{Aeqi},dB
				K_d	K_h	Kt-m	Ká	K_l		
Storage entry, conveyor system	95	20	650	-67.3	2	-4.2	-3.0	-1.2	0	21.3
Mill	105	10	650	-67.3	2	-4.5	-3.0	-1.2	0	31.0
Fermentor	100	10	500	-65.0	2	-4.4	0.0	-1.0	0	31.7
Saccharification, dehydration, distillation	95	10	510	-65.2	2	-4.4	0.0	-1.0	0	26.5
Drying, air handling system	105	10	520	-65.3	2	-4.4	0.0	-1.0	0	36.3
Ethanol extraction system	101	5	500	-65.0	2	-4.6	0.0	-1.0	0	32.5
Finished product storage	90	10	500	-65.0	2	-4.4	-3.0	-1.0	0	18.7
DDGS cooling, storage	100	10	650	-67.3	2	-4.5	-3.0	-1.2	0	26.0
Cooling tower	92	5	550	-65.8	2	-4.6	-3.0	-1.0	0	19.6
Water treatment	100	4	500	-65.0	2	-4.6	-3.0	-1.0	0	28.5
Boiler house	90	5	450	-64.1	2	-4.5	0.0	-0.9	0	22.5
Turbine	100	4	450	-64.1	2	-4.6	0.0	-0.9	0	32.5
Transport traffic within plant	90	1	420	-63.5	2	-4.7	0.0	-0.8	3	26.0
Passenger car parking lot	65	0.5	560	-66.0	2	-4.7	0.0	-1.1	3	0.0
Office building (central cooler)	85	1	560	-66.0	2	-4.7	0.0	-1.1	0	15.3
Maintenance building ventilation	80	5	450	-64.1	2	-4.5	0.0	-0.9	0	12.5

Aggregate value: L_{Aeq} = 41.1dB

6.3.5.3. Evaluation

Noise load limit values in compliance with Annex 1 of Decree 27/2008. (XII. 3.) KvVM-EüM

No.	Area to be protected from noise	Limit value (L_{TH}) for L_{AM} evaluation level* (dB)	
		Daytime 06-22	**Nighttime 22-06**
1.	Recreation area; from among the special areas: health sites	45	35
2.	Residential areas (of small town-garden-city-, village- or estate-like design); from among the special areas: sites of the educational institutions, cemeteries, green areas	50	40
3.	Residential areas (of metropolitan-like design), mixed purpose areas	**55**	**45**
4.	Economic areas	**60**	**50**

According to the calculations, compliance with the noise load limit values is expected.

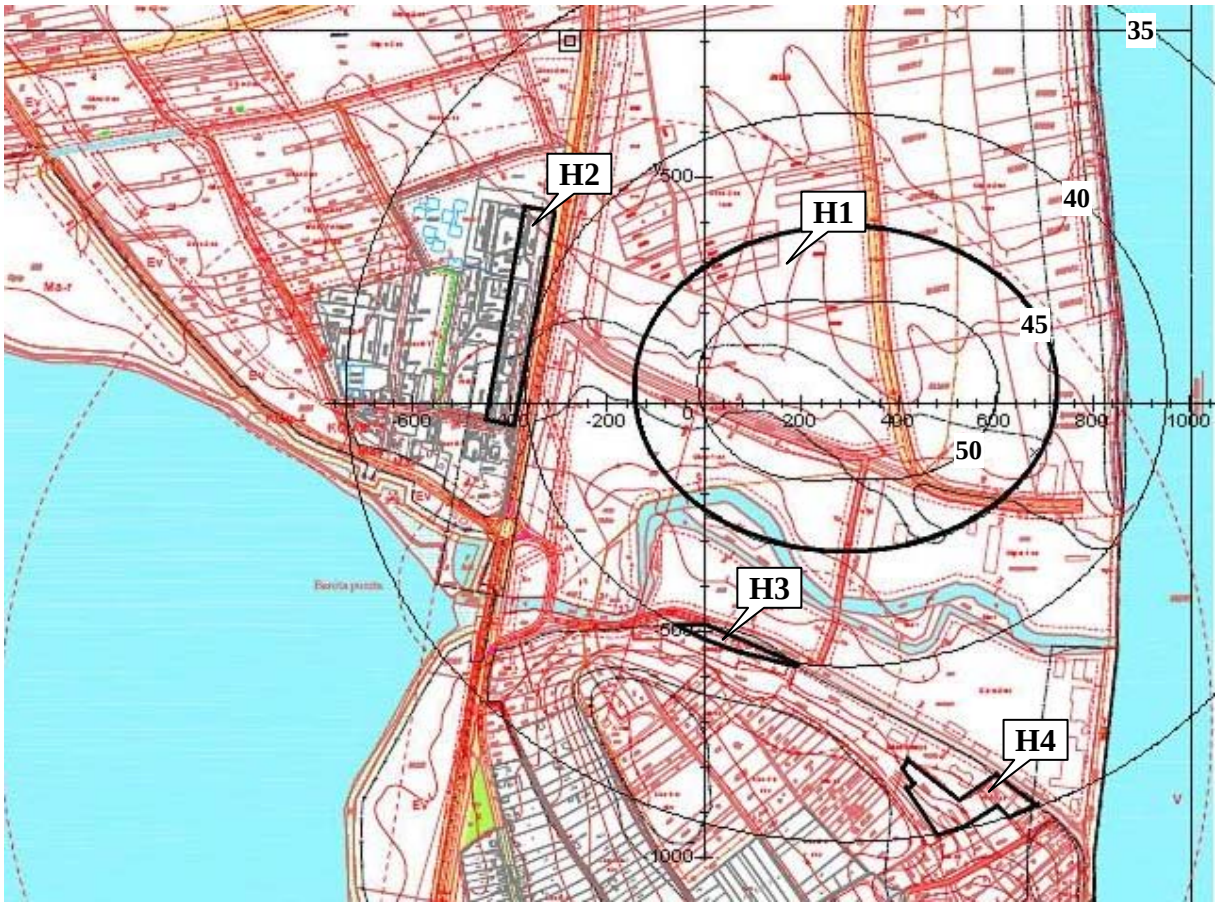
During preparation of the construction plans, the necessity of the following technical measures is to be deliberated through involvement of an acoustic expert:

- Provision of noise screening covers (shields) for the climatic and air conditioning systems to be installed on the buildings' roofs;
- Installation of sound dampers into the inlet and outlet apertures of air ducts of high volumetric flow rate;
- Avoiding, if possible, any apertures without acoustic treatment (free apertures) in buildings with high internal noise level (e.g. mill), opening towards the residential buildings;
- In the case of transport lines with high internal flow rate and friction, installation of double shell may also be necessary.

It is to be noted that the Inspectorate of Environment Nature Protection and Water Management of the Central-Transdanubia has established a noise emission limit value for Agrograin Zrt. (File No.: 70880/08) and the impact areas are overlapping at the buildings of Felsőfok utca 7-12. In virtue of Annex 1 of Decree 93/2007. (XII. 18.) of the Ministry of Environment and Water this implies that a limit value lower by 5dB may be imposed on the envisaged project.

Direct impact area

The following figure represents the equal-loudness curves L_{Aeq} (dB), with informative character.



H1 impact area – economic area without building to be protected (L_{Aeq} = 45 dB)
H2 impact area – mixed character area (L_{Aeq} = 35 dB)
H3 impact area – economic area with buildings to be protected (L_{Aeq} = 40 dB)
H4 impact area – mixed character area (L_{Aeq} = 35 dB)

Upon examining the basic conditions it could be established that the maximum expansion of the impact area as defined by Article 6 of Govt. Decree 284/2007. (X. 29.) are determined by the following values:

- to the West: L_{Aeq} = 35dB
- to the North: L_{Aeq} = 45dB
- to the East: L_{Aeq} = 45dB
- to the South: L_{Aeq} = 40dB

The calculation diagram allows establishing that:

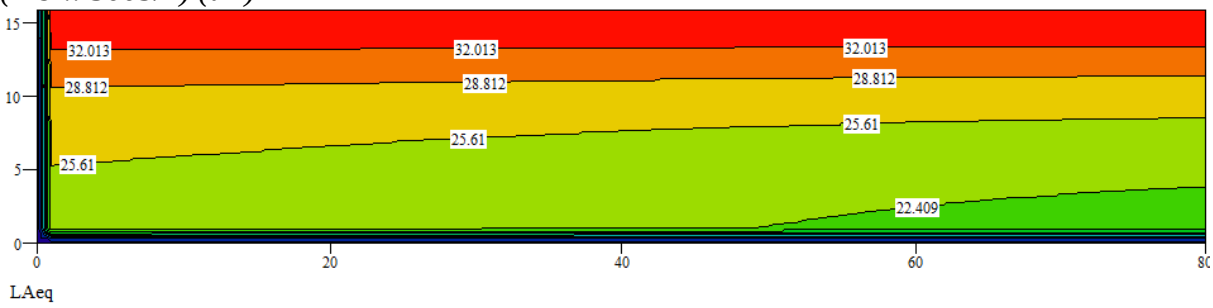
- the impact area reaches the residential area to the W and to the S
- it may slightly extend to (non economic purpose) areas beyond the project area.

We have examined in detail the noise load charging the partially screened buildings of Hunyadi tér (hrsz: 5003/1, 5003/2) for deciding, whether such buildings are located within the impact area.
We have taken into account two typical sound propagation paths:

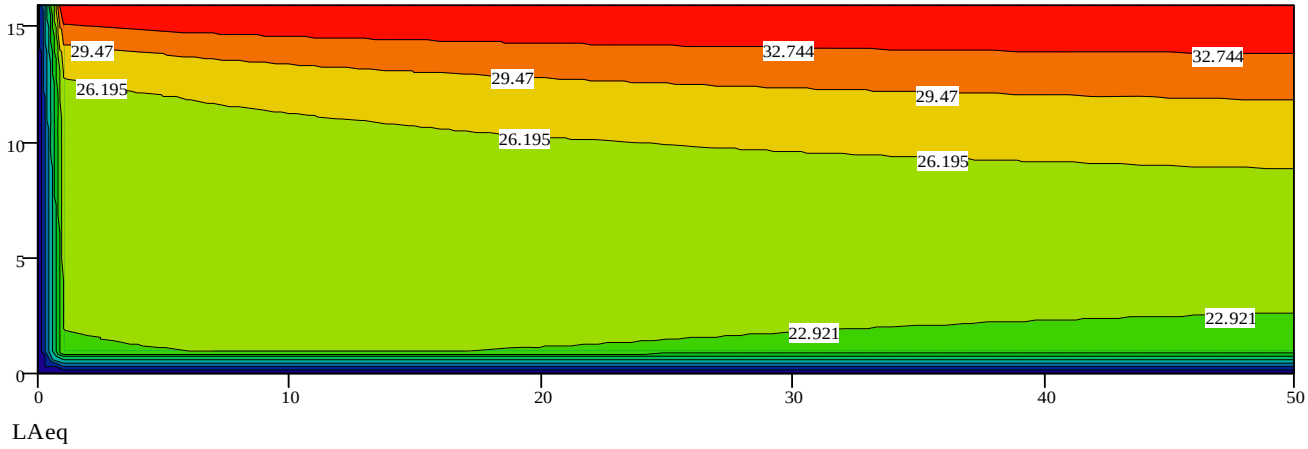
- The first one is the acoustic field partially screened by the buildings along road No. 6 (hrsz. 5003/3, 5003/);
- The second one is the acoustic field generated by the aperture between buildings hrsz. 5003/3, 5003/ 51, as hypothetic radiation surface.

Graphical display of the acoustic field produced is shown in the following Figures.

Noise load of the E front of the residential building of GF+4 floors under Hunyadi tér 4. (hrsz.: 5003/1) (dB)



Noise load of the S front of the residential building of GF+4 floors under Hunyadi tér 3. (hrsz.: 5003/2) (dB)



The most important result deriving from the calculations is that the noise load calculable in the height of the buildings' critical point (h ≈14.5m) does not attain the L_{Aeq} = 35 dB value defining the maximum extension of the impact area. The building of hrsz: 5003/1 (at Hunyadi tér 4.) is located already beyond the impact area. However the non-protectable (E) front of building 5003/2 (Hunyadi tér 3. wall number) is attained by the impact area.

Indirect impact area

The following estimates may be given in respect of the destination traffic connected with the envisaged operation on the basis of the actually available data:

- corn supply: 35 trucks/day
- raw material supply: 2 trucks/day

- bioethanol delivery on public road: 8-10 trucks/day
- DDGS delivery on public road: 8-10 trucks/day

Total increase of the destination transport traffic: 50-60 trucks/day – in daytime.
The additional daily load concerning main road 6 of 60 trucks/day amounts, under the same parameters specified at the description of the actual conditions:

$L_{Aeq}(7.5)$ = 56.4-59.4 dB– subject to the angle of vision

The order of increase of 0.3-0.6dB – negligible.

Partial transport activities may also occur on roads Nos. 61 and 6228. Assuming a daily traffic of 15 trucks on each of them:

The order of increase of 0.1-0.3dB – negligible.

The overwhelming majority (80-90%) of the deliveries is made on the Danube. Water transport on the Danube occurs on 1100-1300MT capacity barges, implying a 50-times specific transport capacity compared to trucks (1 to 2 barges daily). The traction power is about 1000HP, with an estimable noise output level of $L_{WA} \approx$ 105-110dB.

Calculation of the noise load is made by the following approximation formula:

$$L_{Aeq} = L_{WA} + 10 \cdot \log(N) + 10 \cdot \log(\int_l \frac{1/l}{x^2 + d^2} dx) - 8 + 0.5$$

Where ‘N’ is the number of transports relating to the estimation period, ‘l’ is the length of travel during ‘T’ estimation time (l = v*T, where ‘v’ is the rate of travel), ‘d’ is the distance between the axis of the road and the point of calculation (areas to be protected). The water surface is considered as sound-reflecting; other corrections are neglected.
Numerically:
In case of: L_{WA} = 110dB, d = 200m, v = 10km/h
L_{Aeq} = 38.8dB.

Noise load of the water transport is negligible, thanks to the low traffic and the high protection distance.

Upon analyzing the noise impacts of the envisaged project, we have established that:

- **Maintenance of the noise load (noise emission) limit values is expectable;**
- **The change of the noise load from the operation will be sensible in the residential area, but no remarkable disturbing effects are to be expected;**
- **The destination traffic of the site causes only an unimportant noise load increase in relation to that of the actual traffic.**

The noise load of the operation remains within the relevant limit values, its impact is <u>tolerable.</u>

Annex 10 includes the application for the establishment of noise emission limit value.

6.3.6. Flora and fauna

The envisaged activity has no impact on the soil of the surrounding areas, because no contamination substances able to reach the surrounding agricultural – still cultivated – lands or the Natura 2000 area, or having any damaging effects are emitted into the air.
The unbuilt and unpaved plant areas will be developed into green surfaces according to the landscaping plans. For this purpose, the humus-containing top soil, separately deposited during construction, will be used. The structure of the earth material thus spread and cultivated will recover within one or two years and will have the same characteristics of the original soils both as regards its composition and its utilization.

The impacts on the flora and fauna are neutral in the operation stage.

6.3.7. Built environment

In despite of the fact that the technology units to be constructed constitute a remarkable bulk, the final arrangement will be a highly ordered modern economic environment.

The tree lines and woods will continue to grant coverage of the objects, thus the impact is classified as neutral.

6.4. ABANDONMENT

The expected life of the ethanol plant and power center is at least of 50 years, but, in all probability, the plant will continue to operate as an industrial area even thereafter. Thus, the term of abandonment is not interpretable due to the project's character. During reconstruction works, to be performed expectably after several decades, such activities will have to be executed under observation of the actual legal regulations, with the smallest possible impact on the environmental elements.

6.4.1. Air

Abandonment and complete demolition of the envisaged establishment is not a realistic alternative. If, however, due to economic or business policy considerations a change of operation would occur, all expectable effects thereof could be identified and the necessary measures taken, under the permit application procedure provided by the law. Demolition of buildings and structures is an activity subject to permit; this allows performing of the demolishing works and disposing of the thus generated wastes in compliance with the requirements provided for in the laws and regulations, in an environmentally acceptable manner and with tolerable impacts.
Air pollution generated during demolition work will be probably approaching the extent of air pollution during construction work. The impact is tolerable.

6.4.2. Waters

Abandonment and complete demolition of the envisaged establishment is not a realistic alternative. If, however, due to economic or business policy considerations a change of operation would occur, all expectable effects thereof could be identified and the necessary measures taken, under the permit application procedure provided by the law. Demolition of

buildings and structures is an activity subject to permit; this allows performing of the demolishing works and disposing of the thus generated wastes in compliance with the requirements provided for in the laws and regulations, in an environmentally acceptable manner and with tolerable impacts.

Air pollution generated during demolition work will be probably approaching the extent of air pollution during construction work. The impact is tolerable.

6.4.3. Soil

Reclamation of the project site will not occur according to the actual concepts.

However, if it would happen, the soil will be able to serve its original function following demolition of the buildings. Therefore, soil impacts due to abandonment will be of **improving** effect.

6.4.4. Waste

During demolishing works implied by the abandonment, large volumes of tearing waste will be generated. The quantity of the waste cannot be estimated. Waste produced during demolition will have to be removed and recycled or treated in compliance with the then prevailing legal rules. **The impact is tolerable.**

6.4.5. Noise

The extent of noise load from demolishing and removal works in the abandonment period will be probably identical to that of the implementation phase. **The impact is tolerable.**

6.4.6. Flora and fauna

Effects similar to those experienced during the construction period will occur in consequence of the demolishing work if abandonment would occur. Thereafter a terrain correction will be performed, thus repairing the landscape damage caused by the envisaged operation and leading to more near-natural conditions.

The impact on the flora and fauna will be of improving effect.

6.4.7. Built environment

Demolishing works upon abandonment of the operation will have **neutral** impact on the built environment.

6.5. CONTINGENCIES

6.5.1. Air

In case of any fire starting in the plant, large quantities of air polluting substance may get into the atmosphere. Protection against similar contingency implies granting of sufficient fire water and fire water network; preparation of a fire protection plan is a legal requirement.

There is little probability of any large fire, if the above facilities and proper technological discipline are granted.

The air polluting substances discharged to the atmosphere in case of a contingent fire will be diluted due to the almost steady wind direction, however pollutant concentrations over the

hygienic limit values may be expected even in this case in the vicinity of the surrounding properties.

6.5.2. Soil

Due to improper operation, breakdown or accident of the motor vehicles and work machines, fuel may only spill onto the paved surfaces. Soil contamination may therefore be excluded even if similar events occur.

Accidents may be prevented through observing the traffic rules applicable within the plant area and maintaining the factory regulations.

6.5.3. Waters

Through the rainwater run-off system implemented within the ground-plot, contaminations getting onto the pavement may be washed away together with the rainwater into the system. However the sand-box and oil trap implemented on the border of the industrial plant will prevent getting of the contaminating substances into the surface waters.

If similar events occur, spreading of the contaminants and their getting into the rainwater run-off system has to be prevented by immediate intervention.

6.5.4. Waste

In case of contingency – that is, in the events described in the previous Sections – generation of dangerous waste (principally of absorbing material) is to be expected.

Provisions of Govt. Decree 98/2001. (VI. 15.), as amended several times, on the conditions of performing activities connected with dangerous wastes are to be complied for collecting and storing these materials.
Through observation of these provisions, also collecting and temporary storage of the dangerous wastes can be performed in a manner excluding any environmental pollution.

During the remediation period following the intervention, disposal of the dangerous materials generated has to be granted through involvement of contractors duly authorized for the necessary removal and treatment activities.

6.5.5. Noise

Noise effects of any contingencies occurring in the different operational stages constitute a transitory, short duration event.

6.5.6. Flora and fauna

The possible contingency events are of short duration, therefore their impact to the wildlife is negligible.

Excessive overcrowding of rodents qualifies as a contingency from the wildlife's aspect. Merchantable rodenticides with marketing authorization are used for control and, if intervention is necessary, a duly licensed professional company may perform rodent extermination.

6.5.7. Built environment

Thanks to the active and passive security systems, local damages to buildings may only be expected in case of a contingency event.

7. DETERMINATION OF THE COMBINED IMPACT AREA

7.1. DEFINITION OF THE IMPACT ACTIONS AND IMPACT AREAS

According to the provisions of Article 6, Section (1), the environment use has to be organized and performed in a manner to cause the smallest possible environmental load and stress; the environment pollution has to be prevented and environment damages excluded.

The nature's basic condition constitutes the reference base to be compared with the quantitative and qualitative characteristics of the expectable situation; thereafter the results are assessed and evaluated. Evaluation and qualification of the difference between the environmental basic condition and the condition expectable due to the implementation of the envisaged operation provides an objective starting point for qualifying the environmental impacts.

The first table of the technical directive MI-10-504-1:1992 – displayed below – has been taken as basis for qualifying the expectable impacts.

Table 32: Qualification criteria of the expectable environmental impacts

Qualification category code	Denomination of the qualification category	Description of the changes compared to the basic condition	Characterization of the relative position against limit values
J	Improving	Measurable or perceptible improvement	Below limit value
H	Reclaiming	Reconstitution of the environment into its original condition – in a measurable or perceptible manger	Below limit value
S	Neutral	No changes can be measured or perceived	Below limit value
Z	Disturbing	No changes can be measured, but psychological effects are present	Below limit value
E	Tolerable	The changes remain well below the limit value or the expectations of the trade	Below limit value
T	Loading	Short term effects do not cause significant symptoms, but the long term ones do. The environmental impact is remarkable, but it ceases with termination of the influence.	Temporarily above or near the limit value
V	Endangering	Also short term impact	

		may cause significant changes that do not cease with termination of the influence.	Near or at limit value
K	Damaging	Impact exceeding the norms or the professional expectations for short or long time	Above limit value

Table 33: Extent of the expectable impacts due to the environmental load from the envisaged project

Environmental element	Implementation	Operation	Abandonment*
Air	Tolerable	Tolerable	Tolerable
Water	Tolerable	Tolerable	Neutral
Soil	Loading	Loading	Improving
Built environment	Neutral	Neutral	Neutral
Waste	Tolerable	Neutral	Tolerable
Noise	Tolerable	Tolerable	Tolerable
Flora and fauna	Improving	Neutral	Improving
Contingency	Loading	Loading	Loading

*The expected life span of the establishments to be implemented during the investment is at least 50 years. Abandonment or demolition of the establishments is not expected in the foreseeable future.

7.2. DETERMINATION OF THE COMBINED IMPACT AREA

Table 34: : Estimation of the expectable extent of the environmental load

Environmental elements	Impact factors	Direct impact	Impact action, indirect impacts	Combined impact area
Air	Implementation	Emissions of vehicles	Diffusion of the emitted pollutants	Within the borders of the development area
	Operation	Air pollutant emissions of vehicles and boilers		1,125m radius surroundings of the point sources
	Abandonment	Emissions of vehicles		Within the borders of the development area
Waters	Implementation	Waste water generation	Discharging of the generated waste waters	Impact area delineated in the water acquisition expertise
	Operation	Waste water generation		
	Abandonment	Waste water generation		
Soil	Implementation	Earthworks	Management of the excavated soil	Newly occupied areas
	Operation	-		-
	Abandonment	Earthworks		Sites of the establishments constructed
Built environment	Implementation	-	-	-
	Operation	-	-	-
	Abandonment	-	-	-
Waste	Implementation	Waste generation	Waste treatment	Within the borders of the development area
	Operation	Waste generation		
	Abandonment	Waste generation		
Noise	Implementation	Noise effects of work-machines and technological equipment	Noise load	Delimited noise protection impact area
	Operation			
	Abandonment			
Flora and	Implementation	Earthworks	Extinction of habitats	Establishment sites, within the
	Operation	-	-	

Environmental elements	Impact factors	Direct impact	Impact action, indirect impacts	Combined impact area
fauna	Abandonment	Earthworks	Recovery of habitats	borders of the development area

Annex 11 **represents the combined impact area.**

8. ESTIMATION AND EVALUATION OF THE EXPECTABLE ENVIRONMENTAL IMPACTS

8.1.1. CHARACTERIZATION OF THE INTERVENING ENVIRONMENTAL CONDITION CHANGES BY THE ENVRIONMENTAL ELEMENTS AND SYSTEMS CONCERNED

8.1.2. Strength, endurance, reversibility, spatial extension and distribution in time, favorable or adverse character of the impact

We have paid particular attention to the assessment of the envisaged activity to the environment in respect of the air load and of the water acquisition. The environmental impact of the contaminants emitted during operation has been calculated through modeling. The effects caused are reversible, the environmental load will be eliminated upon stopping of the activity.

8.1.3. Can the impact be added to the effects of other activities?

In the case of the impacts to the air, addition to other effects may be possible. We have established the effects of the emissions from the industrial activities conducted within the region through performing immission measurements and elaborating the data of the immission measuring stations.

The diffusion modeling has been performed thereafter, allowing establishment of the excess load deriving from the envisaged activity. When evaluating the immission limit values, we have taken into consideration the effects of the industrial establishments operating in the region (evaluation of the immission basic condition measurement data) and the excess load of the envisaged activity (diffusion modeling).

8.1.4. Degree of protection, change of the environmental, natural or landscape protection functions of the environmental element or system concerned

The envisaged activity **does not cause** changes in the degree of protection, environmental, natural or landscape protection functions of the environmental systems.

8.1.5. Changing of the settlement's character (settlement image or structure)

The envisaged activity **does not cause** changes of the settlement's character.

8.1.6. Changes of the landscape, landscape use or structure

The envisaged activity will be implemented in an industrial area. The constructions to be implemented are matched to the actual land use and **do not cause** remarkable changes in the landscape, landscape use or structure.

8.1.7. Rarity and replaceability of the endangered or expectably damaged or annihilated values of the natural and built environment

The envisaged activity **does not cause** any danger or damage to the natural or built environment.

8.1.8. Replaceability of the endangered or expectably damaged or annihilated natural resources

The envisaged activity **does not cause** any danger or damage to the natural resources.

8.1.9. Possibilities for avoiding or mitigating environmental damages

Avoidance of the environmental damages has been taken into consideration already at selecting the technology. The technologies of the envisaged power plant are in compliance with the requirements of the best available technique and with the relevant legal rules. Upon analysis of the requirements and of the envisaged technology, it may be established that the measures taken for avoiding environmental damages **are complying** with the relevant regulations.

8.2. ENVIRONMENTAL HEALTH IMPACTS

Prior to starting the activities, license holder will perform registration of the plant in compliance with the REACH provisions, furthermore, will report any substances to be used in the factory and provided with hazard symbols to the ÁNTSZ (Hungarian National Public Health and Medical Officer Service), in compliance with the prevailing regulations.

Examining the effects of the envisaged activity to human health it may be stated that – based on comparison of the Hungarian legal provisions with the WHO values – the relevant limit values included in the recommendations have been adopted partially or entirely in the Hungarian legislation in respect of the air polluting substances.
Thus the values remaining below the limit values do not cause any health damage with high security and supported by experiments.

Also the limit values established in the legal rule have been specified in compliance with the WHO recommendations, therefore the emissions of the ethanol plant and power center remaining considerably below these values constitute environmental-health risks reassuringly below the acceptable level.

8.3. ESTIMATION OF THE EXPECTABLE DIRECT ECONOMIC AND SOCIAL CONSEQUENCES DUE TO THE CHANGES OF THE ENVIRONMENTAL CONDITIONS

8.3.1. Intervening damages and emerging costs

Under normal operation the envisaged activity has **no effects** that could result in environmental damages.

8.3.2. Changes of the impact areas' use and usability and contingent life quality and life style changes in their consequence

The envisaged activity **does not cause** any changes in the use and usability of the impact area.

9. OTHER DATA

9.1. TYPICAL DATA OF THE STUDY

9.1.1. Source of the data used in the study

Design data supply by the technology supplier and technical documentations of the different special designing companies constitute sources of the data utilized in this study.

9.1.2. Methods applied, their limits and application conditions

Selection of the methods applied has been made on the basis of the envisaged technology and in compliance with the provisions of the relevant legal regulations and technical rules.

9.1.3. Validity limits (probability) of the prognoses

Forecasts are based on analysis of the technological and technical parameters.
Estimation of the environmental emissions have been made through observation of the principle of prudence and under consideration of the safety factors.
Due to application of overestimates, the environmental conditions expectably shaping will in all probability more favorable of that estimated in the study.

9.1.4. Difficulties and uncertainties emerged in connection with the information required for the compilation of the study

During preparation of the study, basic data and technical plans with sufficient detail were available for the authors.
No difficulties or uncertainties have emerged during preparation of the study.

9.2. LIST OF THE PAPERS USED AND METHOD OF ACCESS

Typical data of the literature used during preparation of the environmental study are summed up in the following Table.

Table 35: Literature

Title of the study	Author	Accessibility
Bioethanol Plant and Power Center *Technical plans*	Tebodin Kft.	Pannonia Ethanol Zrt. – for inspection
Bioethanol Plant and Power Center *Preliminary Assessment*	PROGRESSIO Kft.	Middle Transdanubian Inspectorate for Environmental, Natural Protection and Water Management
Reference document related to power plants (Reference Document on Best Available Techniques for Large Combustion Plants) Reference document on monitoring (Reference Document on the General Principles of Monitoring) Reference document on energy efficiency (Reference Document on Best Available Techniques for Energy Efficiency)	European Commission	Progressio Kft.

10. DATA SECRECY DECLARATION

The data included in this documentation are not qualified as state or military secrets. Detailed technological plans of the envisaged project are protected.

11.INTELLECTUAL PROPERTY RIGHTS

The authors of this environmental impact study reserve all intellectual property rights without restriction.

ANNEXES

1. Experts' licenses
2. Title deeds
3. Resolution concluding the preliminary assessment procedure
4. Abstract of the regulation plan
5. Water acquisition expertise
6. Basic air pollution of the project area
7. Soil and underground water measurement results
8. Proprietor's approval for the use of the rainwater run-off system
9. Official approvals and declarations
10. Application for establishment of noise emission limit value
11. Attached maps

Annex 1

Experts' licenses

Annex 2

Title deeds

Annex 3

Resolution concluding the preliminary assessment procedure

Annex 4

Abstract of the Regulation Plan

Annex 5

Expertise on water acquisition

Annex 6

Basic air pollution of the project area

Annex 7

Soil and underground water measurement results

Annex 8

Proprietor's approval for the use of the rainwater run-off system

Annex 9

Official approvals and acceptance declarations

Annex 10

Application for establishment of noise emission limit value

APPLICAITON
for the establishment of noise emission limit value of an industrial establishment

To the **Middle Transdanubian Inspectorate of Environmental Protection, Natural Protection and Water Management**, as environmental protection authority of first instance.
In virtue of **Article 10, Section (1) of Govt. Decree 284/2007. (X. 29.)**, I hereby apply for the establishment of the noise emission limit value for the industrial/leisure-oriented noise source described below.

1. Applicant (operator)
   Name: Pannonia Ethanol Zrt.
   HCSO code: 14858019-3521-114-01
   Seat: 1050 Budapest, Zrínyi utca 16. 3. em. 10.
   Person in charge: Zoltán Reng
   Phone No.: +36308572052
   KÜJ No.: 102532425

2. **Industrial noise source**, for which noise emission limit value is to be established:
   Description: Bioethanol Plant and Power Center
   EOV co-ordinates of the plant: x = 165390 m ; y = 639705m
   KTJ No.: 102053840

3. Purpose of the application:
   a) **implementation of new industrial noise source.**

4. Short description, presentation of the noise source (activity conducted in the envisaged or existing establishment, technologies applied, stationary or mobile equipment, activity qualified as industrial or leisure-oriented noise source) on the basis of the IPPC documentation.

5. Operation schedule of the industrial noise source:
The **dominant noise sources listed below operate in three-shift order:**

Noise source marking	**Description of noise source**
SZP	Conveyor
101	Storage entry
102	Milling
103	Loading
104	DDGS storage
105	DDGS cooling
106	Desiccation
107	Centrifuging
108	Dehydration
109	Final product storage

Location of the noise sources according to the preliminary plans

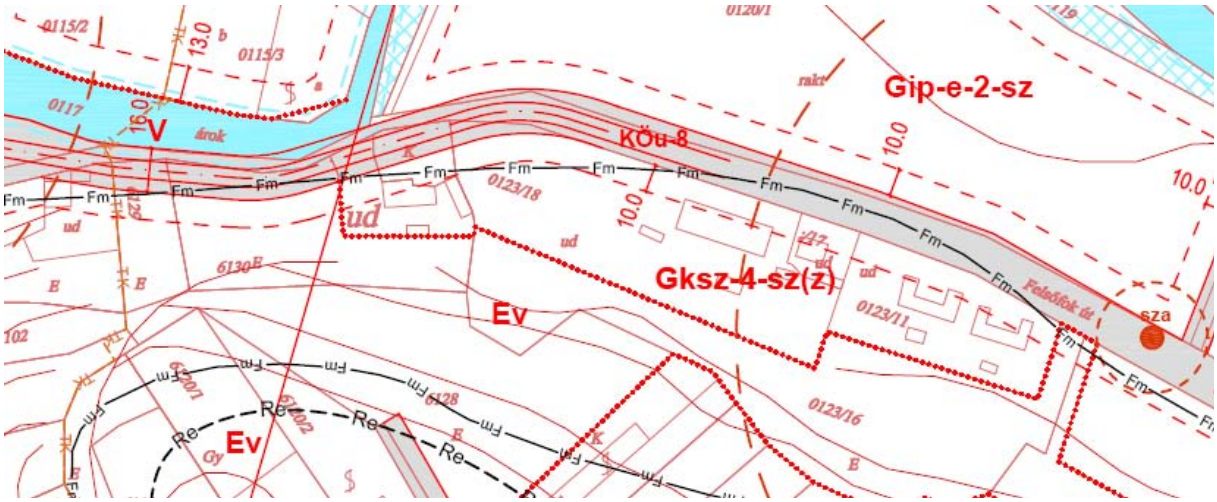
6. List of the properties located within the impact area of the noise source:

Top. lot No. of the property	Name of public space	House No.	Classification of the buildings to be protected according to the List of Buildings
5003/1	Hunyadi tér	4	Multi-unit residential building 1122
5003/2		3	Multi-unit residential building 1122
5003/3		2	Multi-unit residential building 1122
5003/51		5	Napsugár Home for the Elderly 1130
5003/9		4	Eszterlánc Kindergarten and School 1163
5003/8		3	Multi-unit residential building 1122
6101	Felsőfok utca	1	Single-unit residential building 1110
6130		2	Single-unit residential building 1110
0123/18		6	Multi-unit residential building 1122
0123/17		5	Wreck building, unknown function
0123/11		4	Multi-unit residential building 1122
0123/11		3	Multi-unit residential building 1122
0123/12		7, 8	Multi-unit residential building 1122
0123/10		9	Multi-unit residential building 1122

Data specified in this application are true and correct.

Attached maps

Surroundings of Hunyadi tér



Surroundings of Felsőfok utca – Economic area

Surroundings of Felsőfok utca – Mixed destination area

Annex 11

Attached maps

Map 1: General plan of site
Map 2: General layout plan
Map 3: Detailed layout plan
Map 3.b: Planting plan
Map 4: Hydrography and water bases
Map 5: Genetic soil types
Map 6: Soil formatting rocks
Map 7: Natural protection areas
Map 8: Combined impact area

KÖZÉP-DUNÁNTÚLI KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI ÉS VÍZÜGYI FELÜGYELŐSÉG

Our reference No.: 11400/2010.
Our file No.: 50127/2010.
Official in charge: Ferenc Mohácsi
Dr. Eszter Buda

Attachments:
Annex 1: Emission limit values of air pollutants
Annex 2: Data of the protection zone
Annex 3: Noise emission limit values

Subject: Integrated Environment Use Permit of Pannonia Ethanol Zrt.

RESOLUTION

1. Name of Licensee, identification numbers

1.1 Name of Licensee: Pannonia Ethanol Zártkörűen Működő Részvénytársaság (hereinafter: Licensee)

1.2 Seat of Licensee: 1050 Budapest, Zrínyi utca 16. 3. em. 10.

1.3 Address of the plant concerned by the permit:

real estates at 7020 Dunaföldvár, top. lot Nos.: 0111/26, 0109, 0116/5

1.4 Environmental Client Code: **101532425**

1.5 Environmental Regional Code: **102053840**

1.6 HCSO ID: **14858019-3521-114-01**

1.7 EOV coordinates: **X = 165390m, Y = 639705m**

1.8 NOSE-P code: 101.02, 105.09

1.9 PRTR code: 4.1 and 1.1

1.10 ERC of the establishment: 102135652

1.11 Qualification of the permitted activity:

1.11.1 Manufacture of other chemical products n.e.c.: TEÁOR 20.59

1.11.2 Steam supply: TEÁOR 35.40

2. Licensed activity

2.1 Under the conditions included in this resolution, Licensee is granted

integrated environment use permit on

- **Chemical installations for industrial scale manufacturing of basic organic substances, namely oxygen-containing carbon hydrates, namely alcohols, manufacturing of chemical substances, over 20,000MT/year final product,**
- **Combustion equipment with input heat capacity over 50MW$_{th}$, installation of a heat energy generating equipment (for producing steam and hot water) with output capacity over 50MW$_{th}$ on the project site concerned,**

as principal activity, and on the auxiliary activities listed below:

activities and technologies related with:

- water acquisition,
- water treatment and
- supply of basic and auxiliary materials and delivery of the final product and DDGS.

2.2 By granting the integrated environment use permit, the following permits applied for by Licensee **are deemed as granted** – as provided for in a separate legal rule:

2.2.1 **Implementation permit** for the stationary air polluting **point sources marked P1 to P6**, by imposing the emission limit values specified in Annex 1 and under consideration of the operational requirements as to Article 9 **of** this Resolution.

2.2.2 **Noise emission limit values** of the bioethanol plant and of the power station.

2.3 By granting the integrated environment use permit, the following permits applied for by Licensee **are not deemed as granted** – as provided for in a separate legal rule:

2.3.1 **Operation permit** for the stationary air polluting **point sources marked P1 to P6.**

2.3.2 **Permit for disposing contaminating substances** as to Government Decree on protection of the subsurface waters.

2.3.3 **Approval of the operation plan** related to the activities to be performed within the plant.

2.3.4 The **water rights implementation and operation permit** concerning the plant's water projects.

2.4 The integrated environment use permit remains in force until **30 June 2020.**

The activities licensed hereby have to be reviewed in compliance with the regulations applicable to the environmental audit and to the presentation of the best available techniques and the relevant **environmental audit documentation has to be submitted to the Inspectorate by 31 January**

2015. On the basis of the audit documentation, the Inspectorate will perform revision of the requirements and prescriptions included in the integrated environment use permit.

3 General data of the project site and of the licensed activities

3.1 Volume of the activities

The envisaged activity will be implemented on ground-plots top. lot Nos. 0111/26, 0109 and 0116/5 in 7020 Dunaföldvár. Total area of the real estates amounts to 18.33ha, of which 9.5ha (94,809m^2) is the project site.

The envisaged capacity of the plant amounts to 186,000MT/year of bioethanol, containing no denaturants. Grain corn constitutes the raw material for bioethanol production; for manufacturing this quantity of bioethanol, 600,000MT/year of grain corn will be processed. Beyond the principal product, about 195,000MT of dried distillers' grain (DDGS) will also be generated.

Main parameters of the manufacturing process include:

- envisaged days of operation: 352/year
- daily production volume: 538MT/day of ethanol
- number of shifts: 3 (continuous operation)

For granting heat and electricity requirements of the ethanol plant and for drying the DDGS produced, natural gas fired combustion equipment with 75MW$_{th}$ input heat capacity will be installed.

Process water requirement of the ethanol production technology and of the power centre amounts to 3,000m^3/day that will be granted from deep groundwater wells to be implemented within the plant.

Table 1 presents the material balance of the technology:

Table 1

Technological process	INPUT (MT/y)		OUTPUT (MT/y)	
1. Milling	Corn	600 000	Ground corn	600 000
2. Hydrolysis	Ground corn Water Escape water Thin slop Enzymes Direct steam Washing water	1 877 060	Corn pulp Flash steam	1 877 060
3. Fermentation	Corn pulp Washing water Yeast + water Chemicals	1 949 353	Stillage Washing water Carbon dioxide	1 949 353
4. Distillation	Hydrous alcohol Stillage Flash steam Steam	2 005 725	96% alcohol Water Thick slop	2 005 725
5. Dehydration	96% alcohol	196 000	Bioethanol	196 000

			Hydrous alcohol	
6. Evaporation	Thin slop	725 842	Evaporate Syrup Steam	725 842
7. Methanator	Evaporate	305 119	Biogas Escape water	305 119
8. Centrifuging	Thick slop	1 610 437	Wet DDG Thin slop	1 610 437
9. Desiccation	Wet DDG Syrup Biogas Air Natural gas	1 158 631	DDGS Final gas	1 158 631
10. Steam boiler	Feed water Natural gas Combustion air Condensation water	964 790	Steam Wet air	964 790
11. Cooling tower	Make-up water	875 000	Waste water Boil-off	875 000

3.2 Description of the technology

3.2.1 Corn preparation, DDGS delivery

The arriving trucks empty their load into one of the two grate-covered reception bunkers. From here, a delivery conveyor forwards the grain corn to a common transport conveyor, which transports the corn to the bottom chamber of a bucket elevator, which forwards it to the top of the storage silo. The silo is suitable for the storage of corn sufficient for approximately three-day' operation. From here, a screw conveyor scoops the grains onto a feeder conveyor.

A drum separates the corn grains from the refuses, which are forwarded by a refuse conveyor to the deposit. The clean grains are forwarded by a bucket elevator to the top of the mill's feed tank.

From the collecting tray located below the hammer mills, the grist is forwarded to the bottom chamber of a bucket elevator. The pneumatically forwarded distillers' dried grain (DDG) is separated in a cyclone provided with dust filter from the carrying air stream. From the bottom of the cyclone, it is forwarded by a cell wheel to a screw conveyor, transporting the product into the bottom chamber of a bucket elevator.

The elevator forwards the product onto the bulk flow conveyor of the store room. The flat store is able to receive DDGS production of approximately two weeks.

The material to be delivered is pushed by loading machines into one of the two grate-covered bunkers; from where the product is transported by an elevator to the upper floor, dropping it into a horizontal feeding screw. From here the product is forwarded by a conveyor to the public road loading station. The controlled quality and weighed DDGS is loaded by a bulk flow conveyor onto the trucks.

3.2.2 Hydrolysis

The corn is carried by a conveyor belt to the mezzanine floor of the shop building, from where it is forwarded by a feeding screw to the inside, into the pulp mixer, mixing the ground grain, the boiling water and the alpha enzyme into a uniform pulp.

In the suspending tank the mixture is warmed-up to 85°C through direct steam injection. At this temperature the starch contained in the ground corn takes up water and is pectized. The alpha-amylase enzyme initiates transforming the starch into long chain sugars, while decreasing viscosity of the pulp. Anhydrous ammonia is added into the suspending tank for adjusting the pH-value (maintained at about 5.8). This value is optimal for the enzyme's efficiency. The pulp flows continuously through the suspending tanks. Two tanks are serially connected for granting 25-30 min. retention time.

From the suspending tanks the pulp is injected into the steam injector and the tubular reactor. In the injector the pulp is warmed by steam up-to 107°C. The steam directly heats and sterilizes the pulp.

From the injector the sterilized pulp gets into the tubular reactor. The tubular reactor is simply a cylindrical device, which allows boiling of the pulp under pressure of about 0.7bar and grants retention time of approximately 10 minutes.

The pulp flows from the tubular reactor into the expansion tank. Here the pressure drops and the flash steam gets into the stripping column. The temperature is diminished to between 82 and 88°C.

3.2.3 Saccharification

The second amount of alpha-amylase enzyme is added to the pulp immediately after the expansion tank. The mixture is pumped into the two liquefying tanks.

The main purpose of the liquefying tanks consists in granting sufficient retention time for the enzyme to transform most of the starch into dextrin (long chain sugar). Temperature is about 85°C and approximate retention time is of 2.5 hours.

After the liquefying pump, adjustment of the final pH-value occurs through injection of sulphuric acid in a static mixer.

The pulp is cooled on two serially connected coolers to about 30°C.

After adjusting the pulp's temperature in the heat exchangers, a side stream may be diverted therefrom to the yeast tank for yeast reproduction.

3.2.4 Yeast reproduction

Yeast reproduction starts in the mixing tank, where the dry yeast is mixed with water and warmed-up by the heating ejector of the mixing tank. The yeast – water mixture is injected in one of the two yeast tanks, where it is mixed with the stillage flow branched-off from the fermentors' main input pipe. In its way, the stillage receives a glycol-amylase injection for generating sugar for the yeast reproduction.

The temperature in the yeast tanks has to be maintained around 30°C and its pH-value around 3.8 for best reproduction.

The yeast reproducing tank may be mixed with the help of the yeast pump and the air blender. The air has a mixing effect, thus granting the oxygen required for the yeast reproduction. When the yeast is ready, the content of the tank is injected into the fermentor's filling pipe, where, under way, it is mixed with the stillage to be fermented. Usually 30% of the content of the yeast tank is retained for the next reproduction cycle. The tank is filled-up with fresh stillage and the reproduction process is repeated.

3.2.5 Fermentation

Following the admixture of the glycol-amylase enzyme, the conditioned stillage flows into the fermentor. Four fermentors are connected to a main feed pipe and they are filled one after another.

All fermentors are filled-up approximately during 18 hours. Each fermentor is added at least one tank quantity of yeast for inoculation. When a fermentor is filled to 5%, recirculation of the stillage is started. When the filling arrives to 15%, mixing is started up for the sake of accelerating the yeast's activity, while ethanol, CO_2 gas and heat are generated. The total retention time, from starting of the filling until total discharge is about 55 hours.

The content of the fermentor is recirculated through a heat exchanger in order to remove the heat generated during fermentation and to maintain the fermentor's temperature at approximately 32°C.

The fermented stillage is injected in the stillage buffer tank. When discharging the stillage from the buffer tank, sulphuric acid may be added for decreasing the pH-value.

3.2.6 Carbon dioxide washing system

The carbon dioxide generated during fermentation is gathered in the stillage buffer tank, from where it is forwarded in pipes to the bottom of the wash tower. The CO_2 washer efficiently removes 99% of the volatile organic compounds (VOC), thus decreasing the plant's emission, while recovering the ethanol fractions from the warm CO_2

gas. The washing water is gathered at the bottom of the tower, from where a pump returns it to the boiling water tank for reuse in the process.

3.2.7 Distillation

The plant includes three distillation towers: one stillage column, one side stripper and a rectifying tower. All three towers are operating under vacuum, produced partially by condensation of the ethanol vapors and partially by the vacuum pump. The typical pressures are: 0.56-0.70bara in the kettle and 0.52-0.63bara in the head. Temperatures in the stillage column and in the side stripper are 88°C in the kettle and 77°C in the head, while in the rectifying tower 71°C in the kettle and 60°C in the head.

The pre-heated stillage is fed on the top of the column and it slowly flows down through 19 trays. The steam from the evaporators is entered below the bottom tray. The alcohol is concentrated on the top trays and is removed from the head in form of vapor. The stillage, downflowing through the plates, gradually loses its alcohol content and is gathered in the kettle, from where is removed into the slop tank.

The rectifier is the last column of the distillation process. Its heating sources include the steams from the stillage column and the side stripper, as well as the 50% alcohol steam from the molecular sieves (regeneration). The high purity reflux flows into the head of the rectifier and from here flows down through a packing bed and then through the four trays located below. The steams from the side stripper and the stillage column enter into the tower below the trays. The recovered liquid is let in above the first tray. 96% ethanol containing vapor exits from the column head and is condensed on the vacuum condenser and the vent condenser.

After condensation, the 96 degree alcohol enters into the reflux tank, from where part of it is returned onto the top of the rectifier and the rest is transferred into the 95% ethanol tank. The liquid let out on the bottom of the rectifier still contains some alcohol is injected on the top of the side stripper.

The fusel oils (higher alcohols generated during fermentation) are removed from the first or third tray of the rectifying column by the help of the fusel oil pump.

3.2.8 Molecular sieve system

The ethanol forms an azeotrope with the water, preventing production of a concentration above 95% during distillation. Further concentration is necessary for producing fuel quality ethanol. This is performed in the plant by the help of molecular sieves. The molecular sieves contain a

bed of desiccating agent, absorbing selectively only the water molecules but not the larger alcohol molecules while under pressure.

The 95% ethanol is warmed up to approximately 138°C in the sieve's evaporator by boiler steam. From the head of the evaporator, the overheated ethanol steam flows to the molecular sieves. It proceeds downward through the dehydration bed and exits as 100% ethanol steam at the bottom. The 100% product pump discharges the 100% product through the sieve pre-heater and the wet aftercooler to the tank park.

3.2.9 Centrifuge system

The thick slop arriving from the bottom of the stillage column is pumped into the thick slop tank. The thick slop tank is continuously mixed for maintaining the solid matters in suspension.

From the tank, the thick slop is fed to one of the four centrifuges. The solid matters fall out from the centrifuge with about 64% moisture content. This product flow is called wet distillation grains or wet filtrated.

The filtrate pump injects the recovered liquid into the thin slop tank, the liquefying system and into the agitator as boiling water. The thin slop tank and pump supply the evaporation system.

3.2.10 Evaporation

The evaporating system concentrates the thin slop (the liquid part of the distillation kettle's residual product) into syrup that may then be sold as animal feed. In addition, it recovers the process water contained in the thin slop for recycling. The evaporation system consists of two stages. The steam evaporated in the first stage heats the evaporators of the second stage. The multistage evaporation reduces the heating demand required for evaporation of the water.

Each evaporation column is a falling film shell-and-tube heat exchanger, with a separation head on the top. The thin slop is fed into the head of the evaporator; it flows down on the tube walls and exits at the bottom of the vessel. The vapors of the thin slop are removed near the top of the vessel. Heating medium inlet and condensate outlet occur only on the top barrel. As pumped through all of the eight evaporators, the thin slop gradually concentrates and exits form the system in form of syrup.

The ethanol steam from condensation returns to the molecular sieve system, while the water steam from condensation accumulates in the condensation water tank, from where it is reinjected into the deaerator for being reused in the boiler. The second stage evaporators have a single heat source, the steam of the thin slop from the first stage

evaporators. This steam is condensed in the upper section of the second stage evaporators and accumulates in the reception tank as process condensate.

This condensate is not as pure as the condensation water of the first stage evaporators; therefore it is treated in the methanator before being reused as washing water. The steam coming from the second stage evaporators constitutes heat source for the stillage column.

3.2.11 Desiccation

There are deflectors within the rotating drum for lifting the product in order to expose it to the drying air and to move it forward through the desiccator. The dropping chamber is the place, where the dry product and the wet air exit from the desiccator.

Cyclones serve for recovering solid particles carried by the drying air. The air loaded with wet VOC passes through the thermal oxidation boiler for destroying the VOC content.

The wet distillation residue is transferred from the centrifuges to the feeder of desiccator “A”, where it is mixed with the partially desiccated product prior to entering into the desiccator.

The product exits from desiccator “A” with approximately 30% moisture content. From here it gets into the wet granulate dispenser for being sold as modified wet granulate, or forwarded into the mixer of desiccator “B”. The mixer blends the modified wet granulate, the syrup and a partial stream of the fully dry product into a material of uniform consistency, prior to entering desiccator “B”. The product exits from desiccator “B” with approximately 11% moisture content. From here it may be forwarded either to the DDG store building or to the wet granulate dispenser.

3.2.12 Biogas system

Process condensate of the evaporating system is gathered in the methanator’s feed tank and the methanator feed pump doses it into the methanator. Methanators are designed for transforming organic matters equivalent to 3,628kg/day of COD into methane, what may be used in the process as fuel.

The methanator’s feed material enters into the recirculation tank, where it is mixed and warmed-up with direct stream to approximately 38°C, where the iron and phosphate nutrients are added for granting optimal methane production.

The biogas and the overflow water exit at the top of the methanator. The collected biogas is conditioned in the biogas washer and is used as fuel in the burner of desiccator “A”. The overflow water is degassed in

the decarbonator tank and is returned to the boiler water tank for being reused in the process.

3.2.13 Enzyme system

The alpha- and glyco amylase enzymes are supplied in liquid form, in tank vehicles to the plant. There are two serially connected tanks each for the alpha and glycol enzymes.

Three feeding pumps are used for dosing-in the alpha enzymes. The first one feeds the alpha enzyme into the agitator, the second one injects the enzyme into the pipe section after the expansion tank during boiling, and the third one is a relief pump that may be used for different purposes.

Similarly, three feeding pumps are used for dosing-in the glyco enzymes. Two of them, operating simultaneously, inject the glyco enzymes into the pulp transported for fermentation, while the third one inject glyco enzymes into the branching-off pipe towards the yeast reproduction tank.

3.2.14 Ethanol storage

The plant's ethanol storage system is constituted of five tanks; two product storage tanks, an EtOH95%, an EtOH100% storage tank and a tank for the fuel additive.

The EtOH95% tank serves as buffer between distillation and molecular sieves. The EtOH100% storage tank allows quality control prior to transferring it into the product tank. If the water content of the ethanol is too high, it is returned to the EtOH95% tank for additional dehydration on the molecular sieves. If the quality is satisfactory, the fuel additive is mixed-in during transfer to the product storage tank. The ethanol delivery pump forwards the product ethanol to the public road or barge loading station.

3.2.15 CIP (Clean in Place) system

The concentrated lye supplied in tank vehicles is unloaded into a storage tank. The concentrated lye is transferred into the CIP tank through diluting it under way by fresh water in a static mixer with proportionate dosing control. The diluted lye is warmed-up to the required temperature on a circulation-type heat exchanger, and then forwarded on through the distributing system to the site to be cleaned.

The returning contaminated solution is filtered by the CIP filter, the clean filtrate returned to the CIP tank. The residual phase on the filter is dosed to the suspending devices as boiling water. The residual lye from in the pipes may be neutralized by acidic CIP solution.

3.3 Energy production

For satisfying the bioethanol plant's process steam requirement, a power center will be implemented within the project site. Main elements of the energy production include:

- Natural gas fuelled boiler with 43MW input heat capacity for granting steam to the process (and, to a smaller extent, supplying electricity to the plant by a steam turbine);
- Natural gas fuelled boiler with 2×16MW input heat capacity for desiccation of the DDGS.

3.3.1 Gas-receiving station of the power plant

The pressure of the medium pressure natural gas pipeline is reduced by the gas-receiving station implemented within the power plant to the pressure required by the gas boilers' burners. The low-pressure gas is forwarded to the burners by a piping system. Safety quick-action stop valves and manual gas checks before the entry of the gas pipes into the building allow disconnection of the gas from each section and provide proper security.

The gas accounting metering point is the site of entry into the gas-receiving station, but the single consumption sites will also be provided with separate meters.

3.3.2 Technology of the gas boilers

Dimensioning of the gas-fired boilers granting 100% of the plant's steam requirement, is based on the quantity of steam and electric power required by the plant. The steam parameters have been established in a manner to satisfy the technological requirements.

The boilers are of double flue tube, large water chamber design and are provided with standard manufacture natural gas burner with separate air blower. The air blowers of the 43MW boiler use the VOC containing hot air discharged from the DDGS desiccator, while the DDGS desiccators use the air from the boiler house. In the latter case gas-fired calorifers are installed in the air pipes allowing proper warming-up of the combustion air for the event of extremely cold weather. The blower, the burner and the entire control unit and fittings (including also the safety devices), as well as the instrumentation constitute accessories of the boiler. Due to the slight overheating, the overheater is installed in the most possible simple manner, at the flue-gas exit, on the backside of the boiler.

Alkaline cleaning of the boilers is connected to a common expander; the steam generated is outlet into the air, while the residual water – following proper cooling – is discharged into the run-off system. The internal condensates are led directly into the feed tank with degasser.

The supply aggregate of standard design, common for the three boilers, constitute part of the boiler battery. The supply aggregate includes a feed tank with degasser, feed pump with the pertaining controls and the instrumentation consisting of transmitters for normal operation and of the local instruments. The condensate of the bioethanol plant and the make-up water required for supplementing non-returned condensates from the steam consumers are also let into the feed tank of the boiler house.

3.4 Volume of freight and passenger traffic

The area accommodating the bioethanol plant can be accessed on main road No. 6 from Dunaföldvár and Dunaújváros settlements, through the access road interconnected at the northern municipal border of Dunaföldvár, near the fuel station located here. The transport activities required for the implementation of the envisaged project will concern the available access road and main road 6.

Corn – 600,000MT/year – will be supplied on mechanical conveyor belts to the factory from the adjacent plant of Cargill/Agrograin. At present, corn is transported to Cargill/Agrograin exclusively on public road.

Total corn supply requirement of the activity amounts to about 70 trucks/day, based on the following data:

- 600,000MT/year of corn = approx. 1700MT/day (350 days/year)
- calculated with 25 tons capacity trucks, this implies about 70 trucks/day.

The actual traffic of the access road will increase by the traffic of the additional supply requirement to the adjacent plant, implying – according to estimates – access and exit traffic of about 40 to 50 (25 ton) trucks in daily average. The supply volume of the neighboring plant was previously of 300,000MT (about 12,000 trucks), that means, 35 trucks/day, calculated with 350 days annually. The supply volume changes with the seasons, in October the traffic approaches 100 trucks a day.

Supply of the other raw materials (enzymes, acids, bases for pH adjustment) is made through direct transport to PannoniaEthanol. This implies one or two trucks a day, at maximum.

Majority (80%) of the ethanol delivery occurs by barge transport on the Danube, through the port of LUKOIL; the remaining quantity will be expectably transported in tankers.

The dried distillers' grains (DGS) – 195,000MT/year – will be typically (about 80%) transported on the Danube, loaded on barges in Cargill's grain port. A small ratio (up to 20%) may also be transported on public roads.

3.5 Location of the stationary air polluting point sources to be implemented

Table 2 specifies the EOV co-ordinates of the stationary air polluting point sources to be implemented:

Table 2

Description of the point source	Mark of the point source	EOV (X)	EOV (Y)
Corn reception	P1	165413	640088
Mill	P2	165392	640067
DDGS cooling	P3	165364	640173
DDGS loading	P4	165428	640109
Gas washer	P5	165452	639839
Energy centre	P6	165375	639894

3.6 The operation's impact area consists in a circle of **1,125m radios** drawn around point source marked P6 as centre.

4 Scope of the regulation

4.1 In order to prevent environment pollution and to decrease the environmental load, environment user has to perform its activities, through application of the best available techniques, and has to operate all equipment and technologies in a manner that the emissions comply with the provisions included in the integrated environment use permit.

4.2 Any considerable changes occurring in the operation, in its conditions or functions, in the size or capacity of the project have to be reported to the Inspectorate latest within 15 days following such changes.

4.3 This permit may not be interpreted in any manner contrary to the prevailing regulations.

5 Rules concerning implementation of the Best Available Techniques

5.1 The operation of the establishment **will comply with the requirements concerning application of the Best Available Techniques** with the technological, production and capacity data specified in Articles 3.1 to 3.4 and under observation of the emission limit values included in this Resolution.

Beyond the technological emission limit values, the operational conditions, the applied technology and the solutions for decreasing emissions are complying with the **requirements for the application of the Best Available Techniques**, because the production technology satisfies both the EU and the domestic regulatory provisions and comply with the BAT recommendations as follows:

5.1.1 Corn storage/milling:

During material movement, corn supply occurs in bulk; the corn is forwarded into the technology on elevator conveyor belt. Dry milling is applied, and a conveyor screw transports the ground corn from the collector tray into the bottom chamber of a bucket elevator and than into the boiling system.

5.1.2 Dissolution:

Boiling water and alpha enzyme is added to the ground corn. The process is performed in continuous system. Dissolving (suspending) tank, provided with high speed agitator is used in the technology.

5.1.3 Fermentation:

Fermentation occurs at nearly 32°C. Glyco-amylase enzyme is added for expediting the processes. At the start, the recirculation pump performs emptying of the fermentor, and then the fermentor drain pump completes the process. When the fermentor is empty, cleaning (CIP) is started by using lye solution. Temperature control is granted by heat-exchangers. The CO2 generated is purified in washing towers. CO2 is passed through the gas washer in order to remove the VOC vapors.

5.1.4 Distillation/evaporation:

The technology includes three distillation columns operating under vacuum. Sufficient heat is granted partly by the steam from the stillage/pulp heat exchanger and partly by the steam from the evaporators. Basically the system is designed for continuous operation, but may be converted to cyclical operation at any time. The multistage evaporation reduces heat requirements needed for evaporation of the water.

5.1.5 Centrifuging/desiccation:

There are deflectors within the rotating drum for lifting the product in order to expose it to the drying air and to move it forward through the desiccator. The drying air is provided by a blower.

5.1.6 Decreasing emissions

The work processes and the consumption of water and energy are optimized. An integrated energy management system is applied in the plant. Gases are burned for the sake of avoiding odor emissions. Waste gases are recovered. Process waters are recycled. The feeding system and the storage tanks are provided with overfill protection. DDGS generated in the process is sold. No process waste is produced during the operation Dangerous wastes are generated only during the maintenance operations.

5.1.7 Technology of the power station

For the sake of cutting natural gas consumption, the biogas generated from DDGS is burned. Computerized process control system is used in the power centre for optimizing the CO and CO_2 emissions. No heavy metals are emitted during the technology to be applied. Low NO_x burners are used in the power centre.

5.2 For preventing contamination of the environment and controlling the environmental load, Licensee has to take measures, through application of the Best Available Techniques, for the sake of:

- decreasing consumption of materials required for the operation that may imply environmental load;
- efficient use of the materials and of the energy required for the operation;
- preventing, or at least minimizing, as far as possible, the emissions;
- preventing generation of waste and decreasing the quantity and mitigating dangers imposed by any waste generated; on utilization and disposal of wastes;
- preventing any accidents having environmental impacts and decreasing environmental consequences, should such accidents occur;
- avoiding environmental pollution and environmental damages when the operation is abandoned, as well as for reconstruction of the environment in case of any damages.

5.3 In order to decrease the risks that might damage human health and the environment, Licensee has to minimize the quantity of any wastes generated and any environmental emissions of the technology, through continuous development activity. For attaining this goal, prevention of pollution from bioethanol manufacturing and energy production has to be granted. For this sake, the documents listed below, prepared previously, have to be continuously updated:

- detailed technological description, rules of procedure on observing and making observe the technology;
- task/responsibility matrix concerning maintenance of and making observe the technology;
- measurement program describing the order and methods for controlling emissions.

5.4 Through complying with the Best Available Techniques and continuous development for the sake of decreasing any impacts influencing the human environment, Licensee has to strive for applying technologies working by the application of environment-friendly chemicals and has to minimize the quantity of wastes generated and emissions of the technology to the environment.

6 Rules of the operation

6.1 Licensee shall employ an environmental protection agent having the required qualifications in compliance with the prevailing legislation.

6.2 Licensee shall maintain and continuously update an environmental development program for the sake of minimizing water consumption and pollutant emissions and for safe operation of the technologies connected with bioethanol manufacture and energy production, allowing:

- continuous optimization of the energy consumption, raw material use, water consumption and of the emissions;

- in order to avoid contingencies and troubles in the operation (exceeding the emission limit values specified in this permit), the maintenance plan has to be updated.

7 Rules applicable during the operation

7.1 Protective measures

7.1.1 Licensee has to develop an order of procedures during the operation that allows taking the necessary measures in case of any divergences from the provisions of the permit. In the event of any diversion form the permit's provisions, the authority may initiate further inspections and measures for establishing observation of the rules relating to responsibilities and competences.

7.2 Stand-by and training

7.2.1 Licensee has to develop proper procedures for assessing training needs and for granting proper continuative training for all staff members, the work of which may have remarkable influence to the environment. Adequate records are to be kept on the training activities.

7.2.2 Staff members performing personally assigned duties shall have adequate knowledge based on qualifications and/or practical experiences.

7.3 Responsibility

7.3.1 Licensee has to grant availability of the environmental protection agent, subject to the provisions of the Decree concerning employment and training requirements, to the inspectors of the Inspectorate, should any environmental issues emerge in connection with the plant site.

7.4 Reporting

7.4.1 Licensee has to comply with its data supply obligation within term and with data content as specified in the purview of this Resolution, in compliance with the content and formal requirements provided for in the relevant legislation.

7.4.2 On request, Licensee has to inform the population within due time on the environmental impacts of its operation.

8. Notification

8.1 Licensee is bound to inform the Inspectorate or the authority designated by the Inspectorate, within the shortest possible term, on occurrence of any of the following events:

8.1.1 Operating condition diverging from the normal operation (trouble, exceeding the emission limit values specified in this permit);

8.1.2 Emissions from the operation not covered by this permit;

8.1.3 Any other event that may endanger or contaminate the surface or subsurface waters, the air or the soil and requires or is susceptible to require urgent intervention.

8.2 In this notification, Licensee has to specify the date and exact time of the occurrence, its details and the measures taken for mitigating the emissions to the possible minimum and for avoiding repetition of the event. Licensee has to record any events specified in Article 8.1. The report submitted to the Inspectorate has to

detail the reasons and circumstances of the occurrence and the measures taken for minimizing the environmental impacts.

8.3 In connection with any events specified in Article 8.1, Licensee has to inform the following authorities within the shortest possible time upon the occurrence:

- Közép-dunántúli Környezetvédelmi, Természetvédelmi és Vízügyi Felügyelőség
  8000 Székesfehérvár, Hosszúsétatér 1.
  Phone: 22/514-300, Telefax: 22/313-564
  - in the event of endangering or contamination of the air, soil, ground water or surface waters;

- Tolna Megyei Katasztrófavédelmi Igazgatóság
  7100 Szekszárd, Mikes u. 16-22.
  Phone: 74/504-700, Telefax: 74/504-712
  - in the event of fire or emergency conditions;

- Állami Népegészségügyi és Tisztiorvosi Szolgálat,
  Dél-dunántúli Regionális Intézete
  7400 Kaposvár, Fodor József tér 1.
  Phone: 82/528-400, Telefax: 82/319-444
  - in case of any accident or operational conditions endangering the human health.

9 Provisions for protecting air purity

9.1 As from the date of entry into force of this Resolution, I establish the process emission limit values specified in Annex 1 for the project's stationary air polluting point sources, to be observed following putting into operation of the plant. Application for the permit on operation of point sources marked **P1 to P6** has to be submitted to the Inspectorate **within 60 days following commissioning,** together with the LAL change report.

9.2 During the activities performed within the plant, the total emission quantity relating to the year concerned for sulphur dioxide and nitrogen oxides provided for in the prevailing resolution of the National Inspectorate for Environment, Nature and Water has to be observed.

9.3 Operators of air polluting sources have to grant operation of the air polluting sources through application of the Best Available Techniques and observation of the prevailing legal rules. The air pollution has to be prevented or at least mitigated to the smallest possible extent by performing technical measures based on the Best Available Techniques during the implementation.

9.4 The emissions of the air polluting point sources P1-P6 to be implemented are to be checked by measurements performed by an accredited laboratory **within 60 days following their putting into operation.** Exclusively an institute of measurement having accreditation for such activity may perform these measurements. The measurement protocol has to be attached to the LAL change report.

9.5 Operators are bound to submit an annual report on the actual extent of air polluting emissions through submission of the relevant data sheet (LM) **by 31 March of each year,** until subsistence of the activities implying air load.

9.6 Control of the air pollutant emissions by the stationary air polluting point sources marked **P1 to P5,** connected with the manufacturing technologies of the

bioethanol plant to be implemented, has to be performed by periodic measurements. Licensee has to perform the periodic tests **annually for two years** following putting into operation – under normal operation mode. After two years' of operation, on request of the operator and subject to the measurement results and the operating conditions, the frequency of the measurements may be modified.

9.7 Control of the air pollutant emissions by the stationary polluting point source marked **P6**, connected with the power station to be constructed, has to be performed by periodic measurements. Licensee has to perform the periodic tests **every six months for two years** following putting into operation – under normal operation mode. After two years' of operation, on request of the operator and subject to the measurement results and the operating conditions, the frequency of the measurements may be modified.

9.8 The periodic tests may be performed by institutes of measurement complying with the provisions of the legal rule on stationary air pollutant sources and on their control.

9.9 The measuring points for periodic measurements are to be established in a manner that grants possibility for standardized and safe measurement.

9.10 The length of the pipe section of uniform cross-section before the measuring port after the equipment to be measured should be at least the quadruple of the hydraulic cross-section and that of the pipe section after the measuring port, at least the triple of the hydraulic cross-section.

9.11 The operator has to keep continuous records on the point sources specified in this Resolution and on the operation of the pertaining technological equipment, in compliance with the relevant legislation.

9.12 The measurement protocols of the periodic tests have to be submitted to the Inspectorate **by 31 March of the year following the year concerned.**

9.13 The operator is bound to retain the data and the partial results of the emission controls and the operation records of the point sources, as well as the annual reports for five years.

9.14 In case of any operational conditions diverging from the normal operation (trouble), the operator has to inform the Inspectorate immediately, enter the details into the operation record and simultaneously start the damage control activities.

9.15 The Inspectorate will impose air protection fine on the operator for non-compliance within term with the obligations related to the submission of the annual report on the extent of air pollution, of the air purity protection change report, if data of the datasheet are changed, as well as related to the performance of control measurements of the air pollutant emissions of the air polluting point sources.

9.16 I hereby establish a **protection zone delimited by the 300m radius circles** drawn around the point sources connected with the project. Licensee has the obligation to develop the protection zone. Proprietors and topographical lot numbers of the real estates concerned by the protection zone to be implemented are included in Annex 2.

9.17 No residential houses, recreation buildings, educational, health car, social and administrative buildings may be located within the designated protection zone, expect for any constructions connected with the operation of the air polluting sources to be implemented or already in operation.

9.18 Costs connected with the development of the protection zone are to the charge of the pollutant.

9.19 If the protection zone is property of the pollutant, the costs of its maintenance as protection zone are to the charge of the pollutant. If the protection zone does not constitute property of the pollutant, and other persons utilize it, such exploiters have to born the costs of maintenance as protection zone for the area exploited, and the pollutant in lack of utilization.

10 Provisions on waste management

10.1 Collection and further treatment of the wastes and dangerous wastes generated during the activity has to be ensured in compliance with the legal provisions.

10.2 The quantity of the waste collected within the plant at a given time may not exceed the volume capacity of the selective collection facilities of the single wastes separated by their quality.

10.3 At the dangerous waste collection site within the plant, the dangerous wastes are to be collected selected by their nature, through application of properly dimensioned collection vessels in sufficient number. Dangerous wastes may not be mixed with each other or with other refuses.

10.4 The in-plant collection site for dangerous wastes is to be developed in compliance with the legal provisions.

10.5 Individual waste management plan is to be prepared and submitted to the Inspectorate for approval in the event, when dangerous waste in excess of 10MT/year is generated during the operation of Licensee, or the total annual quantity of wastes – including dangerous and non-dangerous wastes – generated annually exceeds 200MT.

10.6 Waste produced within the plant may be consigned for treatment exclusively to organizations licensed and authorized for the treatment of the waste in question.

10.7 Recycling or disposal of the waste may be made in the nearest facility suitable for the treatment, selected under consideration of the environmental and economic efficiency criteria.

10.8 Licensee is obliged to keep up-to-date records and supply data on the quantity and assortment of the wastes generated during its operation or otherwise getting into its possession, as well as of any wastes received from others and treated by Licensee or of wastes handed over to others.

10.9 Recycling the maximum possible rate of the wastes and dangerous wastes generated within the plant is to be ensured.

11 Provisions on noise and vibration protection

11.1 The operator is obliged to **always maintain following taking effect** of the integrated environment use permit the limit values include in Annex 3.

11.2 Exceeding of the noise emission limit value established in Annex 3 after the term of compliance will imply the obligation of noise fine payment.

11.3 The operator has to report to the Inspectorate, within 30 days and making reference to the number of this Resolution, any changes occurring within the area of the noise source and within the impact area that could result in changing of the noise load.

11.4 The noise emission limit value established in Annex 3 remains in force until the plant concerned remains in operation or until occurrence of any changes resulting in modification of the noise emission limit value.

12 Provisions on surface water protection

12.1 It is forbidden to outlet substances of any consistence into the surface waters or into their bed that could cause contamination of the water, except for emissions remaining within or below the limit values applicable to the authorized water projects.

12.2 Water usages and interventions intended for water protection are to be performed – taking into consideration the requirements concerning prevention of contaminations – in a manner to avoid any water pollution through application of the Best Available Techniques and to diminish to the lowest possible extent the environmental load, while granting economic water consumption and efficient energy utilization.

12.3 During operation of establishments implying waste water discharge:

- material, water and energy utilization has to be granted that does not result in exceeding the different emission limit values, while being in compliance with all other environmental protection requirements;
- continuous workmanlike operation of the sewage purification and waste water treatment facilities and their regular maintenance has to be granted;
- water pollution should be prevented by observation of the technological prescriptions and by avoiding operational troubles.

12.4 In lack of a sewage system, collection of the waste waters generated within the plant in a closed, leakproof container and removal to an authorized discharge site has to be cared for.

12.5 Emptying of the sewage shafts has to be granted with sufficient frequency for avoiding overflowing.

12.6 If the sewage discharge system would be constructed to the backbone pipeline along main road 6, water rights implementation and operation permit has to be applied for in respect of the implementation and operation of the discharge network and for purification and discharge into the Danube of the water extracted from the wells.

12.7 Water rights implementation and operation permit, or resolution establishing sewage discharge limit value has to be applied for at the Inspectorate in respect of the sewage/rainwater pre-purification equipment to be implemented within the plant.

12.8 For measuring the quantity and quality of the rain- and used waters discharged through the rainwater run-off system of the adjacent plant of Cargill Magyarország Kereskedelmi Zrt. (hereinafter: Cargill plant) into the recipient, sampling sites have to be implemented and maintained.

12.9 Licensee is bound to develop a monitoring system for measuring quantity and quality of the waste waters discharged into the Danube river through the rainwater discharge system of the Cargill plant, an thus perform self-audit by observation of the relevant legal regulations. The self-audit system has to include sampling points for taking samples from the sewage of all sewage pipes collecting the used waters of the plant and discharging them into the rainwater discharge system of the Cargill plant.

12.10 Licensee is obliged to supply data on the characteristics of the waste water discharge and on the operation of the technological processes and to prepare annually a summary report, submitting it **by 31 March of the year following the year concerned** to the Inspectorate.

12.11 Maintenance of the discharge limit values as provided for by the legal regulations is obligatory for any purified rainwater and process water outlet into the Danube river as recipient through the rainwater discharge system of the Cargill plant.

13 Provisions on subsurface water protection

13.1 Licensee has to obtain permit of the Inspectorate for the wells serving for granting the water demand by submitting the documents specified in the legal rule on the application and its attachments for requiring water rights implementation permit.

Detailed study on the impacts to the subsurface water base and to the permitted water acquisitions of the envisaged water withdrawal has to be attached to the permit application documentation of the water rights implementation permit.

13.2 According to the proposals included in the documentation, a monitoring system consisting of three stable groundwater monitoring wells provided with water rights implementation permit implemented at the sites indicated in the documentation has to be developed and operated.
31 December 2011 is the time-limit for developing the monitoring system.

13.3 Operation of the monitoring system provided with water rights implementation permit has to be granted in the following manner:
Following water sampling by an accredited organization, the groundwater level has to be measured every six months and the general water chemistry characteristics, pH value, specific conductance, salt content, ammonia-ammonium-nitrogen, nitrate, sulfate and TPH content established through accredited laboratory testing.

13.4 Evaluation of the results has to be performed by the standard measurement method as to the joint Decree of the Ministries of Environmental Protection and Water Management, Health and Agriculture and Rural Development 6/2009. (IV. 14.) KvVM-EüM-FVM for (B) contamination limit value. The test results are to be submitted to the Inspectorate.
Time-limit: 31 March 2012 is the term for submitting the first water test results, thereafter 31 March of each subsequent year.

13.5 The FAVI ENG sheets are to be submitted to the Inspectorate as prerequisite for issuing the permit for the disposal of the polluting matter.
Time-limit: simultaneously with submittal of the application for granting the permit of occupancy.

14 Provisions on landscape and nature protection

14.1 The plantation within the project site has to be performed in compliance with the attached plantation plan; continuous care of the plants should be granted.
Time-limit for the plantation: 31 December 2011.

15 Provisions on stopping and abandoning operation of the

15.1 An abandonment plan concerning the abandonment of the permitted activities within the plant, closing down of the plant and re-utilization of the area, including the time schedule and also a cost estimate has to be prepared and submitted to the Inspectorate for approval.

15.2 Recycling or disposal of the entire quantity of wastes and hazardous wastes gathered at the in-plant collection sites is to be cared for.

16 Data recording and data supply to the Inspectorate

16.1 Licensee is obliged to keep records on all sampling, laboratory analyses, measurements, tests and maintenance activities, performed in compliance with the provisions of the permit.

16.2 Licensee has to record any emergency conditions occurring during the activities, with special regard to any events implying environmental hazards, damages or disasters.

16.3 Any and all records, sampling, assessment and laboratory measurement reports prepared in compliance with the regular data collection and supply obligation in compliance with the provisions of this Resolution under the permit have to be submitted to the Inspectorate.

17 Avoidance and prevention of technical damages

17.1 Licensee has to comply with the procedures related to "Accidents and contingencies requiring urgent intervention" (hereinafter: Damage Remediation Plan) that enumerates any contingencies that may occur within the plant. The Damage Remediation Plan has to cover and **update** the methods and measurements for minimizing or mitigating as far as possible any environmental impacts caused by contingencies.

17.2 In order to prevent and to remediate any environmental damages that may occur within the plant, Licensee has to prepare an **operation plan** in compliance with the legal provisions and submit it to the Inspectorate for approval.
Time-limit: within two month upon taking effect of the permit of occupancy.

18 Provisions imposed by the competent authorities

18.1 In its position filed under 440/1726/001/2010, the **South-Transdanubia Branch of the National Office of Cultural Heritage** has stipulated as follows:

Upon review of the planning application documents received on 23 April 2010 in the subject-matter of the environmental impact study and integrated environment use permit procedure concerning the envisaged bioethanol plant to be implemented on ground-plots top. lot Nos. 011/26, 0109 and 0116/5, within the territory of a registered archeological site, I hereby grant approval of the cultural heritage authority with the following stipulations:

1. *Prior to starting construction, on the territories concerned by the registered archeological site, full preventive archeological survey has to be performed, subject to the results of the sondages.*
2. *Contract has to be concluded with a duly authorized institution for performing the archeological tasks.*
3. *Sondage and preventive excavations may only be initiated in possession of an excavation permit.*
4. *Construction works ma only be initiated following performance of the relevant archeological tasks in the areas concerned by the archeological sites.*
5. *Written notification is to be sent to the National Office of Cultural Heritage on starting the work, 8 working days in advance.*
6. *Should any object, wall, building etc. of archeological age and worth for conservation be found during the trial excavation, preventive archeological survey or the archeological monitoring, this should be*

reported in writing to the Office. Following conciliation, the Office will decide whether the object is to be conserved.

7. *Upon completion of the archeological tasks, contracting parties (investor/building contractor/institution performing archeological research) have to inform my Office on that fact.*

Legal remedy against my position may be required through submission of an appeal against the first instance resolution taken in the merits of the matter by the authorizing authority, or in lack thereof, against the order stopping the proceedings.

18.2 In its position as competent authority, the **Tolna County Agricultural Office, Directorate of Plant and Soil Protection**, filed under No. 26.2/533/2-TAL/2010, has made the following stipulations:
Environmental permit may be granted to the envisaged activities with regard to the soil protection criteria, with implementation and operation as described in the attached documentation.

18.3 In its position 11.3/3042/1/2010 as competent authority, the **Baranya County Central Agricultural Office, Directorate of Forestry,** has made the following stipulations:
Upon request of the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management (8000 Székesfehérvár, Hosszúsétatér 1.) of the above-mentioned reference number, I hereby provide our position as competent authority as follows to the environmental impact study and integrated environment use permit procedure related to the envisaged bioethanol plant with capacity of 186,000MT/year and power station with 75MW$_{th}$ input heat capacity to be implemented in Dunaföldvár Industrial Park, on the real estates with top. lot Nos. 0111/26, 0109 and 0116/5:
I grant approval of our competent authority to the environmental impact study and integrated environment use permit application submitted by PROGRESSIO Mérnöki Iroda Kft. on assignment by Pannonia Ethanol Zrt. (1050 Budapest, Zrínyi u. 16. 3. em. 10.) in the subject-matter of the envisaged bioethanol plant with capacity of 186,000MT/year and power station with 75MW$_{th}$ input heat capacity to be implemented in Dunaföldvár Industrial Park, on the real estates with top. lot Nos. 0111/26, 0109 and 0116/5, under the following conditions:

1. *Should the implementation require requisition of forest areas, Licensee is bound to initiate requisition permit application procedure for temporary/final utilization of forest areas preventing their normal use of the forest areas concerned at my office, within 15 working days upon taking effect of the resolution closing down the licensing procedure;*
2. *Any felling may exclusively be performed based on reporting of forest management activity following amendment of the forest management plan.*
3. *During the implementation, forest areas may not be used for other purposes (preparatory work, storage, transport etc.); no construction materials, backfilling material or stockpiles may be deposited in the forest and no backfilling material may be extracted from the adjacent forest lands;*
4. *Motor vehicle traffic, material transport or transit is only allowed on the existing forest access roads, upon permit granted by the forest*

manager, and within the forest areas permitted during the requisition licensing procedure.

No independent legal remedy lies against my position; it may be contested within the framework of the legal remedy procedure instituted against the resolution or the order stopping the proceedings.

18.4 According to the position as competent authority of the **South Great Plain Regional Public Administration Office** No. K01/0652-5/2010:
Upon request of the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management (8000 Székesfehérvár, Hosszúsétatér 1.) of the above-mentioned reference number, I hereby provide our position as competent authority as follows to the environmental impact study and integrated environment use permit procedure related to the envisaged bioethanol plant with capacity of 186,000MT/year and power station with 75MW$_{th}$ input heat capacity to be implemented in Dunaföldvár Industrial Park, on the real estates with top. lot Nos. 0111/26, 0109 and 0116/5:

Approval of the competent authority is granted to the issuance of the integrated environment use permit, with the following stipulations:

During the implementation the emission limit values of the air polluting sources have to be established in a manner that the air load generated, in itself does not cause overstepping of the air pollution limit values within the administrative areas of Dunaegyháza community and of the city of Solt.

No costs requiring my order emerged during the proceedings of the competent authority.

No independent appeal against the competent authority's position lies; client may exercise its related legal remedy rights within the framework of the legal remedy procedure instituted against the resolution or the order stopping the proceedings.

18.5 According to the declaration of acceptance No. 01943-0003 of the **Directorate of Environmental Protection and Water Management of the Central Danube Valley:**

1. *Submission to us, as managers of the Danube bed concerned, of the plans, together with the pertaining calculations, concerning the rain-pipe and purification facilities to be implemented within the bioethanol plant is required for expressing opinion.*
2. *Similarly, submission of the plan documentation of the Danube inlet provided with operation permit No. KDT KTVF: 6419/2007, as well as of the pertaining drift, oil and debris trap is also required, for having full information on the water discharge system.*
3. *The acceptance declaration of CARGILL Magyarország Kereskedelmi Zrt. does not include the process waters and waters generated in case of contingency that need to be discharged; please submit this declaration within 30 days upon reception, by way of supplying the deficiency.*

4. *The plan documentation regarding final disposal of the communal waste waters should also be submitted.*
5. *Exclusively waste and rain waters of quality complying with the provisions of Govt. Decree 220/2004. (VII. 20.) and of Decree 28/2004. (XII. 25.) of the Ministry of Environment and Water Management may be discharged into the Danube.*
6. *Measurement results of the self-control to be performed every three months have to be sent also to the Directorate.*

19 Provisions on the emerged procedural costs and on the legal consequences of failed spontaneous fulfillment of the stipulated obligations

19.1 The administrative service fees have been paid up.

19.2 In the event of failure to voluntarily comply with the obligations included in this Resolution, the Inspectorate will take the necessary measures through enforcement procedure.

20 Publication of the Resolution

20.1 The town clerk of the Municipality of the community concerned by the activities will be informed on this Resolution, with the request to care for promulgation of this Resolution within 5 working days upon its reception, by indicating the date of appending on and that of removal from the bulletin-board and by sending the relevant notification to the Inspectorate.

20.2 It is ordered that the person responsible for the information of clients cares immediately upon issuance of the Resolution for appending it on the Inspectorate's bulletin-board, as well as for its publication on the Inspectorate's internet home-pate and within the central system.

20 Legal remedy

An appeal – subject to administrative service fee and addressed to the National Inspectorate for Environment, Nature and Water – but submitted to my office in two copies lies against my Resolution. The National Inspectorate for Environment, Nature and Water will decide on the appeal. The Inspectorate may approve, amend or annul this Resolution, or may order new proceedings in the matter, while abolishing it.

RATIONALE

In its Resolution No. 8407/10, issued to Pannonia Ethanol Zrt. (1050 Budapest, Zrínyi u. 16. 3. em. 10., referred to hereinafter as Licensee), by way of closing the preliminary assessment procedure performed by the Directorate of Environmental Protection and Water Management of the Central Danube Valley (hereinafter: the Inspectorate) under file number 23898/2009, the Inspectorate has established that from the performance of the bioethanol production and combustion equipment operation activities envisaged in the bioethanol plant of 200,000MT/year capacity and power station with $75MW_{th}$ input heat capacity to be implemented in 7020 Dunaföldvár Industrial Park on the properties of top. lot numbers 0111/26, 0109 and 0116/5 may derive remarkable environmental impacts, therefore their implementation is subject to environmental impact study and integrated environment use permit.

In order to obtain the integrated environment use permit for the above-described activities, the Inspectorate ordered to Licensee to submit an application for the integrated environment use

permit. The Resolution referred to above established that the procedures of the environmental impact study and that relating to the integrated environment use permit may be consolidated. The mentioned Resolution became final and effective on 10 March 2010.

Upon assignment by Licensee, PROGRESSIO Mérnöki Iroda Kft. (1125 Budapest, Galgóczy köz 6/C., fsz. 3.), in its application received on 31 March 2010, initiated performance of a consolidated environmental impact study and integrated environment use permit procedure in the subject-matter of the implementation of a bioethanol plant of 186,000MT/year capacity and power station with $75MW_{th}$ input heat capacity to be implemented in 7020 Dunaföldvár Industrial Park on the properties of top. lot numbers 0111/26, 0109 and 0116/5 (hereinafter: Site), with regard to the fact that the annual material flow of the technology has been corrected against the basic data stated in the preliminary survey documentation, amending the ethanol manufacturing capacity from 200,000MT/y to 186,000MT/y.

PROGRESSIO Mérnöki Iroda Kft. has prepared the environmental impact study and integrated environment use permit documentation entitled "Bioethanol plant and power station, Dunaföldvár (HRSZ.: 0111/26, 0109 and 0116/5)" and the comprehensible summary of the same title.

The Inspectorate has initiated the requested consolidated environmental impact study and integrated environment use permit procedure under reference number 11400/2010.

The envisaged activities concerned are subject to Article 1.1 (Combustion equipment with input heat capacity exceeding $50MW_{th}$) and 4.1 b) (Industrial chemistry establishments, production of basic chemicals, namely oxygen-containing hydrocarbons, namely alcohols, aldehydes, ketones, organic acids, esters, acetates, ethers, peroxides, epoxy compounds) of Annex 2, and to Article 37 (Production of chemicals (except for peroxides) in quantity exceeding 20,000 tons/year of finished product (if not subject to Annex 1)) and Article 78 (Equipment generating heat energy (producing steam and hot water) with output capacity from 50MW (if not subject to Annex 1)) of Annex 3 of Government Decree 314/2005. (XII. 25.) *on the environmental impact study and integrated environmental permit procedure* (hereinafter: **Govt. Decree**).

In virtue of Article 1, Section (1) of Govt. Decree 15/2010. (II. 5.) on qualifying the *public administration procedural issues relating to the major investment to be implemented within the administrative area of the city of Dunaföldvár through the bioethanol production plant project by Pannonia Ethanol Zrt. as issues of particular importance* (hereinafter: **Kiem.r.**), the Government pronounced the establishments connected with the "Pannonia Ethanol Zrt. bioethanol production plant" to be matters of particular importance, therefore the Inspectorate has performed the procedural acts during the licensing proceedings in compliance with the provisions of the **Kiem.r.**

Upon receipt of the application, in its Resolution under file number 33605/10, the Inspectorate called upon Licensee to supply deficiencies.

Part of the deficiencies have been supplied, while, on request, modification of the time-limit (extension until 26 May 2010) occurred in Resolution 40104/10 with regard to Articles 2.01 and 2.03.

Following compliance with the demand for supplying deficiencies – concerning stipulations not concerned by prolongation – the Inspectorate made an announcement published on the bulletin-board, on its home-page and within the central system, in compliance with the legal regulations. The communication has been sent as attachment to its letter filed under No.

36926/10 to the clerks of Dunaföldvár City, Dunaegyháza Community and Solt City, for being promulgated on public areas and locally in the usual manner, based on the provisions of Article 29, Section (6) of Act CXL of 2004 on the *general rules of the public administration procedures and services* (hereinafter: **Ket.**) and of Article 8 of the **Govt. Decree**.

Through its announcements published in the issue of 22 April 2010 of Tolnai Népújság, the Inspectorate has informed the public concerned on initiation of the proceedings, as provided for by the legal regulations.

The Inspectorate has informed the social organizations included in the database maintained by the Central Office for Administrative and Electronic Public Services through electronically forwarding the announcement, proceeding in compliance with provisions of Article 2, Section (2) of Govt. Decree 187/2009. (IX. 10.) *on implementation and maintenance of an electronic database for the sake of the notifications on initiation of public administration procedures and on making notification through such database.*

With regard to provisions of Article 29, Section (3), paragraph b) of the **Ket.**, the Inspectorate has notified the National Society of Conservationists in its letter filed under no. 40102/10 and the Inspectorate of Environmental Protection and Water Management of the Central Danube Valley in its letter filed under No. 40103/10.

Nobody has made observations in respect of the announcement on initiating the procedure, nor in respect of the content of the permit application documentation.

In compliance with Article 2, Section (1), paragraph b) of Act LIII of 2006 *on accelerating and simplifying the implementation of projects having particular importance for the national economy* (hereinafter: **Ntv.**), the authority designated by the Government will proceed as authority of first instance in matters of particular importance, respectively, in lack of such designation, the authority having second instance competence according to the special procedural rules relating to that type of issue.

In virtue of Article 1, Section (3) of the **Kiem.r.**, in the events when the legal rule relating to the types of issue specified in Annex 1 of the **Kiem.r.** orders intervention of the competent authorities in the matter concerned, the Government designates the authorities specified in Annex 2 of the **Kiem.r.** as competent authorities proceeding in the public administration matters specified in Annex 1 of the **Kiem.r.**

According to Article 32/A, Section (1) of Govt. Decree 347/2006. (XII. 23.) *on designation of the organizations providing environmental, nature protection and water management public administration tasks* (hereinafter: **Kr.**), the Inspectorate involves into the environmental impact study and integrated environment use permit procedure – under subsistence of the conditions and in the special issues specified in Annex 4 of the **Kr.** – the authorities specified therein as competent authorities.

The Inspectorate has called upon the competent authorities with regard to the above-described provisions – in compliance with Article 44, Section (1) of the **Ket.** – to provide their positions covering the special issues falling under their competence in compliance with the legal regulations.

The competent authorities asked for opinion have provided their positions as follows:

Article 18.1 of this Resolution includes the stipulations made by the **South-Transdanubia Branch of the National Office of Cultural Heritage** in its competent authority position No. 440/1726/001/2010. The rationale of the competent authority position gave the following reasons:

"The Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management has called upon my Office to provide our position as competent authority in the matter of the consolidated environmental impact study and integrated environment use permit procedure of the bioethanol plant to be implemented in Dunaföldvár, Industrial Park, on ground-plots of top. lot numbers 0111/26, 0109 and 0116/5.

On the basis of the attached application, I have established that the properties concerned by the project are located on a registered archeological site (KÖH ID: 71913, denomination: Dunaföldvár-Felső-rév).

During my proceedings as competent authority I have examined the professional issues listed in Article A of Annex 2 of Government Decree 308/2006. (XII. 23.) on the National Office of Cultural Heritage (hereinafter: Govt. Decree).

Within the area concerned a prehistoric and Roman archeology site named "Dunaföldvár-Felső-rév" is located, being a generally protected area according to the archeological regulations. The site has been identified in 2009 archeological research is in course therein.

My stipulations included in the purview have been determined on the basis of the content of the cultural heritage protection impact study prepared by Mr. Máté Stribrányi in 2009.

My stipulations are intended for the sake of the exact determination of the extent of archeological concerns and for the protection of the archeological sites.

According to the planning documentation, a bioethanol plant of 186,000MT/year capacity and a power station of 75MW_{th} input capacity will be implemented on the site.

I have established that the envisaged project qualified as a major investment, therefore contract on performance of the special archeological tasks with the Field Service for Cultural Heritage (1036 Budapest, Dugovics Titusz tér 13-17.) in compliance with Article 1, paragraph f. and Article 14/D, Section (1) of Decree 18/2001. (X. 18.) of the Ministry of National Cultural Heritage (NKÖM) on the detailed rules of uncovering archeological sites and of pecuniary rewards granted to finders of archeological sites and finds (referred to hereinafter as ***NKÖM.r****). I have taken into account that, in case of major investments, Article 14/C of the same Decree provides that archeological monitoring had to be granted covering the entire extension of the changes requiring earth work both during the preparatory works and during construction.*

Based on the available data I have established that the project complied with the requirements established in the legal rule relating to the protection of the cultural heritage according to the content of the application, under fulfillment of the conditions provided for in the operative part.

My competent authority position is based on Articles 44-45/A of Act CXL of 2004 on the general rules of administrative proceedings and services (hereinafter: Ket.), Articles 7-11 and 19-27 of the Kövtv. on the NKÖM Decree and on Article A of Annex 2 of the Govt. Decree.

The scope of authority and competence of my Office is established by Article 2, Section (1), paragraph b) of Act LIII of 2006 on accelerating and simplifying the

implementation of projects having particular importance for the national economy (hereinafter: Ngt.) and by Article 1, Section (3) and Annex 2 of the Govt. Decree.

My competent authority position has been given within the procedural deadline of 10 workdays established in Article 5, Section (1) of the Ngt.

Legal remedy is granted in compliance with Article 44, Section (9) of the Ket."

The **National Public Health and Medical Officer Service's Regional Institute of the South-Transdanubia** has granted approval with no conditions imposed in its competent authority position issued under No. 2272-3/2010, making the following declaration in its position as competent authority:

"From public health aspects, approval is granted on the basis of the consolidated environmental impact study and integrated environment use permit application documentation to the implementation of the envisaged bioethanol plant and power station by Pannonia Ethanol Zrt. (seat: 1050 Budapest, Zrínyi u. 16. III. 10.) in Dunaföldvár Industrial Park.

It is hereby stated that public health approval is granted to the development of individual air protection zone of 300m as specified in the documentation.

No independent appeal lies against this competent authority position.

RATIONALE:

"The Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management has called upon the NPHMOS' Regional Institute of the South-Transdanubia on 26.04.2010 for issuing competent authority position in the subject-matter of the bioethanol plant and power station to be implemented in Dunaföldvár Industrial Park.

Based on the consolidated environmental impact study and integrated environment use permit application documentation, I have established that there were no public health-related obstacles for issuing the competent authority's approval.

My resolution has been made on the basis of Article 32/A, Section (1) and of the provisions included in Annex 4 of Government Decree 347/2006. (XII. 23.) on designation of the organs responsible for public administration tasks related to environmental protection, nature protection and water management.

In the above matter the date of expiry of the deadline is 07.05.2010, thus it is maintained.

Please be informed that, in virtue of Article 33/A, Section (1)of the Ket.,, the authority has to repay an amount equaling the duty or fee paid by client for conducting the procedure if the authority overpasses the deadline applicable to such authority for reasons not imputable to client or to other participant of the procedures, or, if the duration of the procedures exceeds the double of the applicable term of procedure, the double of the duty or fee amount paid up by the client submitting application for initiating the procedure of first instance. The authority concerned has to care for the reimbursement within five workdays upon the date when the decision establishing the payment obligation became final.

The right of independent appeal has been excluded on the basis of Article 44, Section (9) of the Ket. According to its provisions, a decision may only be contested in an appeal against the resolution or, in lack thereof, against the decision annulling the procedure, except for the cases specified in Article 98, Sections (3) and (4) of the Ket.

The scope of authority and the competence of my Office has been established by Article 1, Section (3) and Annex 2 of Govt. Decree 15/2010. (II. 5.) on qualifying the public administration procedural issues relating to the major investment to be implemented within the administrative area of the city of Dunaföldvár through the bioethanol production plant project by Pannonia Ethanol Zrt. as issues of particular importance .”

The stipulations of the competent authority position of file number 26.2/533/2-TAL/2010 of the **Tolna County Agricultural Office Directorate of Plant and Soil Protection** are included in Article 18.2 of this Resolution. In the rationale of the competent authority position, the following reasons are exposed:

In the public administration procedure of first instance initiated upon your request of the above- specified file number, and upon review of the documentation entitled “Environmental impact study and Integrated environment use permit documentation of the bioethanol plant and Power Station, Dunaföldvár (hrsz.: 0111/26, 0109, 0116/5)”, (prepared by Progressio Mérnöki Iroda Kft., 8000 Székesfehérvár, Távirda u. 2/A.), I hereby give our competent authority position, as soil protection authority of first instance having power of collaboration and competence in the matter concerned:

As regards the soil protection aspects, environmental permit may be granted to the envisaged activity implemented and operated as described in the attached documentation.

The competent authority position remains effective until withdrawal or until the term specified in the environmental permit.

This competent authority position may not be used in other licensing procedures; no separate appeal lies against it; client may exercise its relevant legal remedy right within the framework of an appeal instituted against the Resolution.

No duty or administrative fee is applicable for the competent authority procedures.

RATIONALE

The following documents were available to me for judging the request:

Environmental impact study and Integrated environment use permit documentation of the bioethanol plant and Power Station, Dunaföldvár (hrsz.: 0111/26, 0109, 0116/5)”, (prepared by Progressio Mérnöki Iroda Kft., 8000 Székesfehérvár, Távirda u. 2/A., prepared in 2010, job number: -).

I have established on the basis of the available documentation:

Implementation of the bioethanol plant is envisaged in an uncultivated area.

The by-products generated during operation are intended for being sold, thus, no utilization concerning agricultural lands will occur.

The waste materials will be recirculated as far as possible; therefore no cultivated lands will be concerned by disposal of the residual wastes.

The volume of the earthworks required for the construction of the bioethanol plant does not make necessary implementation of any soil extraction sites or deposits, as a balance in soil volumes is strived for within the site.

The project operated in compliance with the provisions of my competent authority position will not injure any soil protection interests.

I have made my declaration as competent authority on the basis of authorization granted by Article 44 of Act CXL of 2004 on the general rules of administrative proceedings and services, of Article 32/A, Section (1) of Government Decree 347/2006. (XII. 23.) and Article 7, Section (1) of Government Decree 274/2006. (XII. 23.) on the establishment and operation of the Agricultural Office, under consideration of the provisions of Article 43, Section (1) of Act CXXIX of 2007 on the protection of agricultural lands.

Client may exercise its right of appeal against the competent authority position within the framework of appeal against the Resolution in the merits.

Stipulations included in the position 11.3/3042/1/2010 of **Baranya County Central Agricultural Office, Directorate of Forestry** as competent authority are contained in Article 18.3 of this Resolution. The competent authority position has given the following reasons:

"The Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management (8000 Székesfehérvár, Hosszúsétatér 1.) has called upon my Office to provide our position as competent authority in the matter of the environmental impact study and integrated environment use permit procedure of the bioethanol plant of 186,000MT/y capacity and of the power station of 75MW$_{th}$ input heat capacity to be implemented in Dunaföldvár, Industrial Park, on the ground-plots of top. lot Nos. 0111/26, 0109 and 0116/5, applied for by PROGRESSIO Mérnöki Iroda Kft. under assignment by Pannonia Ethanol Zrt. (1050 Budapest, Zrínyi u. 16. 3. em. 10.), in virtue of Article 4, Sections (1) and (2) of Act XCL of 2004 on general rules of the public administration procedures and services (Ket.), on the basis of Article 32/A, Section (1) and Annex 4 of Govt. Decree 347/2006. (XII. 23.) on designation of the organizations providing environmental, nature protection and water management public administration tasks.

In the matter concerned, based on the documentation sent to me, I have established that the project does not directly concern any forest area. Should the implementation require requisition of forest areas on temporary/final basis preventing their normal use, please observe, during submission of the application, the provisions of Articles 77 through 85 of Act XXXVII of 2009 on forests, forest protection and forest management and of Articles 54 to 60 of the Decree 153/2009. (XI. 13.) of the Ministry of Agriculture and Rural Development on its enforcement. In such case, the Baranya County Central Agricultural Office, Directorate of Forestry will proceed as authority.

In my view, neither the implementation, nor the operation have remarkable impacts to the forests, if the legal provisions and regulations are observed and the Best Available Techniques are applied.

With regard to the above facts, I have decided as explained in the purview.

My decision has been taken on the basis of the legal regulation(s) referred to here. The right of independent appeal has been excluded on the basis of Article 44, Section (9) of Act CXL of 2007 (hereinafter: ket.) and I have given information on the possibilities of legal remedy with reference to this regulation.

The scope of authority and competence of my office is established by Govt. Decree 274/2006. (XII. 23.)."

In its position as competent authority of file number 10183/2/2010, the **Paks District Land Office** has granted its approval to the issuance of the integrated environment use permit without imposing conditions, making in the position the following statement:

"In the public administration procedure of first instance initiated on request of the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management (8002 Székesfehérvár, Pf.: 137) of the above-cited file number, upon review of the documentation sent to me, hereby grant competent authority approval of my office as competent authority having power of collaboration and competence of first instance to the implementation of the bioethanol plant and power station envisaged in Dunaföldvár, on the real estates of top. lot Nos. 0111/26, 0109, 0116/5.

This competent authority position may not be used in other licensing procedures; no separate appeal lies against it; client may exercise its relevant legal remedy right within the framework of an appeal instituted against the Resolution.

RATIONALE

Following documents were available to me for judging the request:

- Request No. 11400/2010 of the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management (8002 Székesfehérvár, Pf.: 137);

- Permit application documentation and the attached maps.

My office has examined the permit application documentation received in the matter of the implementation of bioethanol plant and power station envisaged in Dunaföldvár, on the real estates of top. lot Nos. 0111/26, 0109, 0116/5, from the aspects of the protection of cultivable lands. The land portions having topographical lot numbers as cited above, are designated as public road and industrial plant according to the land register, therefore, they are not subject to the provisions of Act CXXIX of 2007 (on protection of cultivable lands).

Based on the available documentation, considering the issues falling into my competence, I have established that the envisaged project is not objectionable from land protection aspects and thus it does not injure any land protection interests.

The competent authority position has been issued in virtue of Article 1, Section (1) of Govt. Decree 15/2010. (II. 5.).

In compliance with Article 44, Section (9) of the Ket., client may exercise its right of appeal against the competent authority position within the framework of appeal against the Resolution in the merits."

In its competent authority position No. 23-475-15/2010, the **Regional Public Administration Office of the South-Transdanubia** has granted approval without stipulations, and has stated in its position:

"My competent authority position No. 23-475-4/2010, date 3 May 2010 issued on request of the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management (8000 Székesfehérvár, Hosszúsétatér 1.) in the consolidated environmental impact study and integrated environment use permit procedure concerning the implementation of bioethanol plant of 186,000MT/y capacity and power station of 75MW$_{th}$ heat input capacity envisaged in Dunaföldvár Industrial Park on the real estates of top. lot Nos. 0111/26, 0109 and 0116/5 is hereby amended as follows:

I grant approval without imposing conditions to the issuance of the integrated environment use permit in respect of the protection of the local environment and of the nature.

No independent appeal lies against this competent authority position. Client may exercise its relevant right of appeal within the framework of appeal against the Resolution in the merits.

No procedural fees emerged during the competent authority procedures.

RATIONALE

Based on the environmental impact study and integrated environment use permit application documentation attached to the request, I have established as follows:

The envisaged project does not concern any nature protection area of local importance, no environmental elements are concerned, protection of which falls under competence of the town clerk, and no environmental pollution is expected, protection against which is referred to the sphere of responsibilities and competences of the town clerk by the legislation.

Upon the repeated request by the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management received on 12 May 2010, my competent authority position No. 23-485-4/2010 had to be modified, because at the time of issuing my competent authority position I have provided such position in the field of construction matters in compliance with Article 2 of Annex 2 of Govt. Decree 15/2010. (II. 5.) on qualifying the public administration procedural issues relating to the major investment to be implemented within the administrative area of the city of Dunaföldvár through the bioethanol production plant project by Pannonia Ethanol Zrt. as issues of particular importance (hereinafter: Kiem.r.).

In compliance with Article 4 of Annex 4 of Govt. Decree 347/2006. (XII. 23.) on designation of the organizations providing environmental, nature protection and water management public administration tasks in the environmental impact study and integrated environment use permit procedure (hereinafter: ***Govt. Decree****), the town clerk of the Municipality of the settlement concerned is the competent authority of first instance in matters covering protection of the local environment and nature conservation and the Government's regional public administration organ having general competences is the second instance competent authority. The Govt. Decree does not designate any competent authority collaborating in construction matters.*

According to Article 2, Section (1), paragraph b) of Act LIII of 2006 on accelerating and simplifying the implementation of projects having particular importance for the national economy (hereinafter: Tv.) the authority designated by the Government will proceed as authority of first instance in matters of particular importance, respectively, in lack of such designation, the authority having second instance competence according to the special procedural rules relating to that type of issue.

Annex 2 of the Kiem.r. does not designate any collaborating competent authority covering issues of protection of the local environment and nature conservation, therefore, in virtue of Article 2, Section (1), paragraph b) of the Tv. and Article 4 of Annex 4 of the Govt. Decree., my Office had to proceed as competent authority of first instance.

My scope of authority is established by the legal rules referred to above and my competence by Article 1, Section (2), paragraph d) of Govt. Decree 318/2008. (XII.

23.) on the Government's regional public administration organ having general competences.

Date of expiry of the time-limit for proceeding in competent authority matters is 26 May 2010.

During amending my competent authority position I have proceeded in compliance with Article 44, Section (1) and (7) of Act CXL of 2004 on the general rules of the public administration procedures and services (hereinafter: Ket.).

Information on the possibilities of legal remedy has been given in compliance with Article 44, Section (9) of the Ket.

Article 18.4 of this Resolution contains the stipulations mad in the competent authority position No. K01/0652-5/2010 of the **South Great Plain Regional Public Administration Office**. In the rationale of the competent authority position, the following has been expounded:

"Based on the environmental impact study and integrated environment use permit documentation attached to the request, I have established the following:

The combined impact area of the bioethanol plant and power centre, in respect of the air as environmental element regarding transmission of the polluting substances, affects the administrative area of Dunaegyháza community and of Solt city in the project implementation phase.

As regards the administrative area of Dunaegyháza community, Chapter IV of the local building regulations passed by Decree 1/2004. (II. 1.) Kt. of the body of representatives (hereinafter: HÉSZ), while in respect of the administrative area of Solt city, Chapter III of Decree 6/2002. (V. 02.) Kt. of the body of representatives on environmental protection (hereinafter: Rend.) include provisions concerning air purity protection.

The areas concerned in Dunaegyháza belong to the protected forest zone marked "EV", while those in Solt to the flood-plain forest zone marked V-3" and to the flood-plain agricultural zone marked "V-4".

The HÉSZ and the Rend. do not contain any special air protection provision, diverging from the general provision, in respect of the zones specified above.

The condition specified in the purview has been imposed for the sake of compliance with provision of Article 5, Section (4) of Govt. Decree 21/2001. (II. 14.) on certain rules concerning air protection within the administrative areas of Dunaegyháza community and Solt city, and for the sake of protecting the flood-plain forests.

Competence of the South Great Plain Regional Public Administration Office in the matter is established by Annex 2 of Govt. Decree 15/2010. (II. 5.) on qualifying the public administration procedural issues relating to the major investment to be implemented within the administrative area of the city of Dunaföldvár through the bioethanol production plant project by Pannonia Ethanol Zrt. as issues of particular importance and by Article 4 of Annex 4 of Govt. Decree 347/2006. (XII. 23.), with regard to Article 2, Section (1), paragraph b) of Act LIII of 2006 on accelerating and simplifying the implementation of projects having particular importance for the national economy, while its jurisdiction by Article 1, Section (2), paragraph g) of Govt. Decree 318/2008. (XII. 23.) on the Government's regional public administration organ having general competences.

Date of expiry of the time-limit for proceeding in competent authority matters is 28 May 2010.

Information on the possibilities of legal remedy has been given in compliance with Article 44, Section (9) of Act CXL of 2004 on the general rules of the public administration procedures and services.

In his letter No. NFGM/3/2010, the **State Secretary for Regional Development and Construction of the Ministry for National Development and Economy** has sent the following statement:

"In connection with the consolidated environmental impact study and integrated environment use permit procedure initiated on request of Pannonia Ethanol Zrt. (1050 Budapest, Zrínyi u. 16. III/10.) concerning the implementation of the envisaged bioethanol plant of 186,000MT/y capacity and power centre of 75MW$_{th}$ heat input capacity in 7020 Dunaföldvár, Industrial Park, on the properties of top. lot Nos. 0111/26, 0109 and 0116/5 – upon request N. 43534/2010 of the Central-Transdanubian Inspectorate for Environmental and Nature Protection and Water Management – I hereby inform you as follows:

My powers as competent authority covers the examination of compliance with the regional development plants of certain technical infrastructure networks and individual establishments specified in Govt. Decree 218/2009. (X. 6.) on the content requirements of the regional development concept, the regional development program and country planning plan and on the detailed rules of their compliance, elaboration, discussion, approval and publication (hereinafter: Govt. Decree)..

The bioethanol plant and the pertaining power station – as its input heat capacity serves the operation of the bioethanol plant and is not connected to the elements of the electric power transmission line network, furthermore the electric energy production capacity (1,5MW$_{th}$) does not attain the capacity value qualified as small power plant by the Govt. Decree – is not included in the Govt. Decree among the technical infrastructure networks and individual constructions listed as content requirements of the country planning plan.

Consequently, the envisaged power station does not qualify as individual construction included in the country planning plans, thus its compliance with the country planning plans cannot be examined and no competent authority opinion can be provided in the country planning matter.

Through application of Article 22, Section (1) of Act CXL of 2004 on the general rules of the public administration procedures and services, taking into account the above explanation, I have established that the Minister for National Development and Economy has no competent authority power in respect of the envisaged project.

Please take note of my information."

In virtue of Article 63, Section (1), paragraph a) of the **Ket.**, providing that the authority has to held public consultation if required by the legislation, the Inspectorate has appointed 26 May 2010, 04:00 p.m., for the public consultation to be held in the Mayor's Office of Dunaföldvár City, 7020 Dunaföldvár, Kossuth Lajos u. 2. Information on the date and site of the public consultation was disclosed as follows:

- In its letter filed under No. 37313/10, on the subject-matter "*Notice on Public Consultation*", the Inspectorate invited the competent authorities and the Municipalities interested in the matter, Licensee and its representative, as well

as the Inspectorate of Environmental and Nature Protection and Water Management of the Central Danube Valley. In virtue of Article 27/G of Act LIX of 1993 on the Parliamentary Commissioner for Civil Rights, also the Parliamentary Commissioner for Future Generations received invitation for the public consultation.

- The announcement on the public consultation was published on the Inspectorate's bulletin-board, on its home-page and through the central system, and town clerks of Dunaföldvár city, Dunaegyháza community and Solt city were called upon to append the announcement on their bulletin-boards in letter No. 37310/10.
- The public concerned was informed on the public consultation by an announcement published in the issue of 26 April 2010 of Tolnai Népújság, in compliance with the legal rules.
- The National Society of Conservationists was informed in letter filed under No. 40102/10 and the Minister for National Development and Economy in letter filed under No. 43531/10.

Minutes were drawn on the public consultation under file No. 48554/10.

With respect to provisions included in Annex 9 of the **Govt. Decree**, the Inspectorate had to hold professional consultation with the environment user for establishing the Best Available Technique that was held on 26 May 2010, in the premises of the Mayor's Office of Dunaföldvár city, connected with the public consultation. Minutes were drawn on the professional consultation under file No. 48556/10.

With regard to the modification of term included in resolution filed under 40104/10, the supplement of deficiencies has occurred.

In its declaration on acceptance, the Directorate of Environmental Protection and Water Management of the Central Transdanubia No. 01943-0003, sent by PROGRESSIO Mérnöki Iroda Kft. to the Inspectorate, made the following provision:

> *"Based on the "Environmental impact study and integrated environment use permit application documentation of the bioethanol plant and power centre in Dunaföldvár", submitted to our Directorate, it has been established that the envisaged project affects the Danube river under Natura 2000 protection, constituting property of the Hungarian State and managed by KDV-KÖVIZIG, top. lot No. 0127/1 of Dunaföldvár, for which the acceptance declaration is hereby granted.*
>
> *The envisaged project:*
>
> - *communal water requirement: 10.9m^3/d, covered by water drawn from deep wells;*
> - *communal waste water: 9m^3/d, either collected in closed reservoir and removed by specialized contractors or discharged through sewage system to be constructed to the backbone line along main road 6;*
> - *process water demand: 3,000m^3/d, covered by water drawn from deep wells: implementation of 2 well-pairs in envisaged, for water withdrawal of 600l/min*

for each well, covering also the social water requirement. Drinking-water quality water will be extracted from the deep aquifers.

Water treatment technologies:

- *boiler operation, cooling circuit and process water:* *- preparation*
  - disinfection
  - deironing
- *salt-free water production:* *- desalinization (reverse osmosis)*
  - removal of residual hardness (softening)
  - feed water conditioning (with chemicals)

Capacity requirements:

- *Cooling circuit make-up water:*
  - from filtered sewage: *81.6m^3/h*
  - from RO permeate: *6.0m^3/h*
- *Process water:* *21.6m^3/h*
- *Boiler make-up water:* *16.8m^3/h*

Generated waters:

- *<u>process waste water:</u> only the high salinity waters generated in the power plant are discharged into the Danube. Its quantity amounts to about 780 to 1,000m^3/day, for which threshold values concerning salt content of 7,000mg/l, temperature of 30°C and pH value of 6-9.5 degree are proposed, as to Table 32, making reference to the high diluting power of the Danube. The remaining process waters (cooling waters etc.) are gathered in the boiling water tank and recycled into the technology;*
- *<u>clean rainwater:</u> roof waters may be discharged without processing on the green surfaces; non-desiccated precipitation waters are gathered in the rainwater pipe through the gullies located at the area's deep-lying points;*
- *<u>contaminated rainwater:</u> water from the parking sites, factory roads etc. may be outlet to the Danube only after proper treatment - letting through oil and drift traps – through the run-off system provided already with water rights operation permit (KDT-KTVF: 6419/2007) of CARGILL Magyarország Kereskedelmi Zrt., based in its declaration of acceptance;*
- *In case of emergency, the contaminated rainwater gathered in the containment basin of the ethanol tank park may be pumped through the rainwater run-off system upon proper treatment and laboratory tests;*
- *<u>Maintenance building:</u> the oil-containing waste water is gathered in a closed reservoir and removed by a specialized company.*

Remark by the Inspectorate: Article 18.5 of this Resolution contains the provisions listed here of the acceptance declaration issued by the Directorate of Environmental Protection and Water Management of the Central Danube Valley.

We have no information on where the loading of bioethanol – 80% of which will be transported on barges – would occur; that is, the site of the envisaged port is unknown to us.

In this connection, we wish to note that preliminary opinion had been provided for the outline planning application for port prepared and submitted by MÉLYÉPTERV-MÉVIT KFT. According to the outline plan, the port would be implemented in the 1563+405-1563+525rkm section of the Danube river, through backfilling of the guide bank on the right shore and its back land. Our Directorate gave negative opinion on this plan and on the technical solution included therein. All the same it is to be mentioned that the technical solution taking shape during the preliminary discussions in the matter conducted thereafter, implying implementation of the project's port through extension of the existing port(s), is evaluated in a considerably more favorable manner.

With regard to the fact that the river-bank section in front of the envisaged plant is rented by LUKOIL and Cargill from our Directorate, and that these companies operate ports, discussions and, if necessary, agreement with them is considered as indispensable.

Based on the data available to the Inspectorate and on the licensing documentation submitted under this procedure, the following establishments could be made:

Purpose of the implementation of the technology implies production of bioethanol additive to be mixed as engine fuel in an annual quantity of 186,000MT by utilization of agricultural products available in high quantities, for the sake of (partially) substituting the petroleum fractions. The secondary objective of the activity consists in selling the DDGS generated as by-product (195,000MT/year) for animal feed purposes. Grain corn constitutes feedstock of the production process.

Data of the primary and secondary materials used in the bioethanol plant (material balance) are included in Table 1, while Articles 3.1 through 3.5 specify the most important features of the production technology and of the point sources to be implemented and the general data of the plant and of the permitted activities.

Upon examining the impacts of the activities performed to the environmental elements on the basis of the documentation submitted to the Inspectorate, the following could be established:

As regards air purity protection:

The project area of the bioethanol plant and power station to be implemented within the administrative area of Dunaföldvár belongs to air pollution zone No. 10 in compliance with Annex 1 of Decree 4/2002. (X. 7.) of the Ministry of Environment and Water *on designation of agglomerations and zones of air pollution*.

Licensee intends to implement a bioethanol plant and a power station characterized by the technical parameters specified in Article 3.1 of this Resolution within the Site. Article 3.2 includes description of the technology to be implemented on the Site, Article 3.3 the data related to the power generation and Article 3.5 specifies the location of the point sources marked P1 to P6 to be implemented.

Air pollutant emissions mainly derive from the exhaust gases from the internal combustion engines of the work machines and transport vehicles operating on or arriving to the site during the implementation period of the bioethanol plant. During the construction work performed within the area, solid matters (dust) get into the environment's air. The air pollution from the motor vehicles moving within the area

during the implementation does not change in a detectable manner the background pollution.

A power station will be implemented within the site for satisfying the steam demand of the bioethanol plant. Main elements of the energy production include:

- Natural gas-fuelled boiler of 43MW_{th} input heat capacity for the steam supply of the technology (and, in a smaller part, for the plant's electricity supply, with steam turbine)
- Natural gas-fuelled boiler of 2×16MW_{th} input heat capacity for drying of the DDGS.
- Data of the areas concerned by the protection zone to be developed are included in Annex 2.
- From the documentation submitted to the Inspectorate, I have established the through the point sources P1 to P5 pertaining to the bioethanol production technology, solid, non-toxic dust and organic matters as to Article 3/C of Annex 5 of the joint Decree 14/2001. (V. 9.) of the Ministries of Environment, Health and Agriculture and Rural Development *on the air pollution threshold values and on the emission limit values of the stationary air polluting point sources* (hereinafter: **Er.**) are getting into the atmosphere. On this basis, I have established the technological emission limit values (solid, non-toxic dust) of the point sources P1 through P4 in compliance with Article 1/O of Annex 5 of the **Er**. and those of point source P5 (gas washer) (organic matters) in compliance with Article 3/C of Annex 5.
- From the documentation submitted to the Inspectorate, I have established that, though the aggregate input heat capacity of the combustion equipment to be implemented within the plant exceeds 50MW_{th}, no point source will be constructed with connected boilers of input heat capacity over 50MW_{th}, because each combustion equipment will be provided with independent point source. Therefore the technological emission limit values of the combustion equipment have been established in compliance with Annex 3 (gaseous state fuel) of Decree 23/2001. (XI. 23.) of the Ministry of Environment *on technological emission limit values of air polluting substances by combustion equipment with nominal heat input over 140kW_{th} but remaining below 50MW_{th}* (hereinafter: **KöM.r.**).
- With regard to the above, in compliance with the content of Article 9.1, the technological emission limit values of the point sources marked P1 to P6 to be implemented are specified in Annex 1.
- According to Articles A/1.1 and A/4.4/b of Annex 2 of Government Decree 21/2001. (II. 14.) *on certain rules connected with air protection* (hereinafter: **Lev.r**), a protection zone of a radius between 500 and 1,000 meters has to be designated for any large combustion equipment with input heat capacity over 50MW_{th} and for certain chemical establishments producing organic substances.
- In compliance with Article 6, Section (6) of the **Lev.r.**, the environmental protection authority may also define a distance below

500m, however the radius of the protection zone to be established may not be less than 300m.

- In the documentation submitted to the Inspectorate, Licensee has requested the Inspectorate (page 63, Article 6.3.1.7) to establish the size of the protection zone on the basis of the presented basic condition evaluation and diffusion modeling in 300m instead of 500 meters.
- Article 32/A, Section (3) of the **Kr.**, designates the institute of small region of the National Public Health and Medical Officer Service as competent authority in the first instance procedure and the regional institute of the National Public Health and Medical Officer Service in the second instance procedure concerning assessment of the health hazards and any effects of the air pollution and of the health effects of any stationary air polluting sources that cause dangerous air pollution.
- In matters of particular importance as to Article 2, Section (1), paragraph b) of the **Ntv.**, the authority designated by the Government in a Decree proceeds as competent authority in the first instance, or, in lack thereof, the authority designated as second instance authority according to the special rules related to that type of issue.
- With regard to the above, and taking into account provisions of Article 32/A, Section (3) of the **Kr.** and of Article 6, Section (6) of the **Lev.r.**, the Inspectorate has called upon the South-Transdanubia Regional Institute of the National Public Health and Medical Officer Service in its letter of file No.36925/2010, and the latter has granted approval from public health aspects to the establishment of a 300m "individual air protection zone" in its letter registered under file No. 2272-3/2010.
- Based on my powers granted in Article 9, Section (1) of the **Lev.r.**, I have given permit to the implementation of the point sources P1 to P6 in Article 2.2.1 of my Resolution. Permit to the operation of the point sources will be granted by the Inspectorate through amendment of the integrated environment use permit, on the basis of the LAL change report to be submitted within 60 days upon putting into operation. In this respect, I have made a stipulation in Article 9.1 of this Resolution. In compliance with provisions included in Article 2.3.1 of this Resolution, the operation permit of the point sources P1 to P6 is not to be deemed as granted.
- On the basis of Govt. Decree 213/2006. (X. 22.), the National Inspectorate for Environment, Nature and Water establishes the allowable quantity to be emitted of greenhouse gases, and I have ordered its observation in Article 9.2 of this Resolution.
- The stipulation included in Article 3.2 of the Resolution concerning operation of the point sources, has been provided for on the basis of Article 8, Section (1) and Section (2), paragraph b/.
- The emission measurement obligation following putting into operation imposed in Article 9.4 of the Resolution has been provided for in compliance with Article 9, Section (9) of the **Lev.r.**

- Article 27, Section (6) of the **Lev.r.** provides legal foundation for the imposition of data supply obligation under Article 9.5.
- In compliance with Article 9, Section (9), the environmental protection authority may oblige operators of the stationary air polluting point sources for controlling the emission in a resolution, making provisions on the frequency and method of the controls, as well as on the content and methods of the compulsory data supply. In Articles 9.6 and 9.7 I have made general provisions as regards the emission control obligation. Detailed rules concerning emission controls of the point sources P1 to P6 to be implemented will be included in the operation permit to be issued following the implementation.
- The rules included in Articles 9.8 and 9.10 concerning the periodic emission measurements are based on Article 7, Section (3), Article 11 and Article 13, Section (1) of Decree 17/2001. (VII. 3.) of the Ministry for Environment *on air pollution and on the rules of testing, controlling and evaluating emissions of the stationary air polluting sources* (hereinafter: **Kver.**).
- I have made provisions on the documentation of the control of the emission sources in Articles 9.11 to 9.13, in compliance with Articles 16 and 17 of the **Kver.**
- Special rules concerning improper operation of the equipment are included in Annex 4.2 of the **Lev.r.,** and I have made the relevant stipulation s in Article 9.14.
- In Article 9.15, I have made stipulations concerning the legal consequences of the failure to comply with the reporting and measuring obligations, under consideration of the provisions included in Article 72, Section (1), paragraph d4).
- As provided for above, a protection zone of 300m has to be established around the new point sources. Legal basis for designating the size of the protection zone is included in Article 6, Section (6) of the **Lev.r.** In Articles 9.16 to 9.19 I have made stipulations relating to the development of the protection zone on the basis of Article 6, Sections (8) and (10) to (12) of the **Lev.r.**
- As regards waste management:
- During **implementation** of the bioethanol plant, generation of inert, communal and hazardous wastes is to be expected. The inert wastes derive from construction or adventitiously from demolition residues. Wastes generated during the construction will be selected and, as far as possible, reused in other areas. The extent of recycling depends on the quality of the refuse and on the needs of the constructor; the quantity of the wastes is estimated in 1,400m^3. This quantity of waste will be disposed by constructor through involvement of a duly licensed forwarding company, in compliance with the legal regulations.
- Maintenance of the construction machinery will be made at the plant of the construction company. No dangerous waste will be generated within the project site from the operation of the machines. Small

quantities of dangerous waste may be generated from envelops and packing of construction materials and paints. Any hazardous waste generated during the demolishing and construction work will be collected in local refuse collection containers and removed within the shortest possible time.

- Presence of up to 30 construction workers is expected within the site; the quantity of communal waste generated by them may be estimated in 80l/d. Two receptacles of 1100l capacity each will be disposed within the site by constructor.
- The receptacles will be emptied once a week by a duly licensed specialized contractor.
- During **operation** of the bioethanol plant, no process wastes will be generated. The corn dust generated from the milling and dust separation will be recycled. No dressing residues will be generated from the technology, because the grain corn will be supplied in a quality containing no residues. DDGS (by-product) generated during the production process will be sold as animal feed.
- Typical wastes from maintenance include: spent oil, oily rags, oily condensates, accumulators, residues and packing of paints, used air filter cartridges, oil filters, old light tubes, dry batteries, metal scraps and communal wastes.
- An in-plant collection site will be developed for gathering the hazardous wastes.
- The in-plant hazardous waste collection site will be implemented with the technical content as provided for in Govt. Decree 98/2001. (VI. 15.) *on the conditions of performing activities connected with hazardous wastes* (hereinafter: **Vhr.**).
- Mowing waste generated on the green surfaces will be chopped if necessary on-site and composted through digging into the soil.
- During demolition works implied by **abandonment**, large quantities of tearing waste may be generated. Further treatment of the wastes generated during demolishing has to be performed in compliance with the then prevailing legal regulations. Contingencies may occur in case of improper waste treatment or in the event of operating troubles.
- In virtue of Article 13, Section (1) of Act XLIII of 2000 *on waste management* (hereinafter: **Hgt.**), producers and owners of wastes are bound to collect and care for utilization or disposal of any wastes generated or getting into their possession in any other manner. In this respect I have made stipulation in Article 10.1.
- The stipulations imposed in Articles 10.2 and 10.3 have been made on the basis of Article 15, Section (1) of the **Hgt.**
- The stipulation included in Article 10.4 has been made with regard to the provisions of the **Vhr.**

- The stipulation included in Article 10.4 is based on Article 12, Section (1) of Govt. Decree 126/2003. (VII. 15.) *on the detailed content requirements of the waste management plans.*
- The stipulation as to Article 10.6 has been imposed in compliance with Article 13, Section (2), paragraph b) and Article 14, Sections (1) and (2).
- The stipulation of Article 10.7 is based on the proximity principle, established by Article 4, paragraph h) of the **Hgt.**
- The stipulation of Article 10.8 has been made in the basis of Govt. Decree 164/2003. (X. 18.) *on registration and data supply obligations related to wastes*.
- Provisions of Article 10.9 are based on Article 5, Section (4) of the **Hgt.**
-
- As regards noise and vibration protection:
- To its application for establishing noise emission limit values, Licensee has submitted the integrated environment use permit documentation on the project site's noise assessment prepared by Progressio Mérnöki Iroda Kft.
- According to the documentation, and in compliance with the attached abstract of the regulation plan of Dunaföldvár community approved by Municipality Decree 18/2006. (XII. 5.), the area of the envisaged project is located in the outskirts of Dunaföldvár. The adjacent areas belong to commercial/industrial, agricultural and residential zones. The Napsugár Home of the Elderly under Hunyadi tér 5. and the residential houses of Hunyadi tér, located in a mixed zone of urban character, as well as the residential buildings of Felsőfok utca, located in commercial zone and in mixed zone of urban character are the closest buildings to be protected.

The expectable duration of the construction will presumably exceed one year. Upon comparing the calculation results with the threshold values, it may be established that the limit values are maintained during daytime in the construction stage. In nighttime the limit values are not exceeded even if the construction period would be longer than 1 year, because in this stage, already building and assembly works, implying lower noise output levels will be performed.

Taking into account the construction volume, no transport traffic in excess of 40-50 heavy trucks/day is probable. The transport traffic implemented on the service road and on main road No. 6 does not influence the background load of the residential areas. The increment value of the noise load along main road No. 6 amounts to 0.1-0.4dB.

The documentation has stated the main indicator figures characterizing the operation of the bioethanol plant. On the basis thereof, the expectable noise load during the production activity will not exceed the limit values at the buildings to be protected; the noise protection requirements are complied with.

According to the calculations included in the Chapter on noise and vibration protection and to the conditions of the location it may be however stated that establishments to be protected are found within the impact area.

In compliance with Annex 1 of joint Decree 27/2008. (XII. 3.) of the Ministry of Environment and Water Management and of the Ministry of Health *on the establishment of environmental noise and vibration load limit values* (hereinafter: **KvVM-EüM joint Decree**), noise protection rating of the areas to be protected is as follows:

Areas rated as "Vt"

"Residential area (built-up in urban-like manner), **mixed area**"

Allowed noise load in these areas:

In daytime (06:00 a.m. to 10:00 p.m.): 55dB(A)

- In nighttime (10:00 p.m. to 06:00 a.m.): 45dB(A)
-
- Areas rated as "Gksz", **"Commercial areas"**

Allowed noise load in these areas:

In daytime (06:00 a.m. to 10:00 p.m.): 60dB(A)

- In nighttime (10:00 p.m. to 06:00 a.m.): 50dB(A)
- Establishments and areas located within the noise protection impact zone of the plant site:
- Dunaföldvár, Hunyadi tér 4., top. lot No. 5003/1 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Hunyadi tér 3., top. lot No. 5003/2 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Hunyadi tér 2., top. lot No. 5003/3 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Hunyadi tér 5., top. lot No. 5003/51 residential building – rating as to the list of constructions: 1130, Communal residential buildings
- Dunaföldvár, Hunyadi tér 3., top. lot No. 5003/9 residential building – rating as to the list of constructions: 1163, Schools, universities and research institutes
- Dunaföldvár, Hunyadi tér 4., top. lot No. 5003/8 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Felsőfok utca 7., top. lot No. 0123/12 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings

- Dunaföldvár, Felsőfok utca 9., top. lot No. 0123/10 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Felsőfok utca 1., top. lot No. 6101 residential building – rating as to the list of constructions: 1110, Single-dwelling residential buildings
- Dunaföldvár, Felsőfok utca 2., top. lot No. 6130 residential building – rating as to the list of constructions: 1110, Single-dwelling residential buildings
- Dunaföldvár, Felsőfok utca 3., top. lot No. 0123/18 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Felsőfok utca 5., top. lot No. 0123/17 residential building – rating as to the list of constructions: 1110, Single-dwelling residential buildings
- Dunaföldvár, Felsőfok utca 4., top. lot No. 0123/11 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Dunaföldvár, Felsőfok utca 3., top. lot No. 0123/11 residential building – rating as to the list of constructions: 1122, Residential buildings with three or more dwellings
- Application of correction factor is not justified when establishing noise emission limit value for the residential buildings of topographical lot Nos. 5003/1, 5003/2, 5003/3, 5003/50, 5003/9, 5003/8, 0123/12, 0123/10, 6101, 6130, 0123/18, 0123/17 and 0123/11.
- In Article 2.2.2 and in Annex 3 of this Resolution, I have ordered the establishment of noise emission limit value, determining its term for fulfillment on the basis of the application.
- I have established the noise emission limit values specified in Annex 3 in compliance with Article 10, Section (4) and Article 11, Section 2 of Govt. Decree 284/2007. (X. 29.) *on certain rules of protection against environmental noise and vibration* (hereinafter: **ZajR.**), Article 1 and Annex 1 of Decree 93/2007. (XII. 18.) of the Ministry of Environment and Water Management *on the methods for establishing noise emission limit values and of controlling noise and vibration emissions* and with Article 2, Section (1) and Annex 1 of the **KvVM-EÜM joint Decree.**
-
- As regards protection of surface waters:
- Dunaföldvár Industrial Park, located in the North inner zone of Dunaföldvár is the project's implementation site. The Nagykarácsony stream emptying into the Danube flows on the southern border of the project area. The project site is located in the 1563rkm section of the Danube.

The construction area lies between 97 and 112mBf. The Danube's design flood, according to preliminary information provided by the Directorate of Environmental Protection and Water Management of the Central Transdanubia, is of 98.23mBf in this region, thus part of the site is located within the Danube's high-water riverbed. According to Article 5, Section (1) of Government Decree 21/2006. (I. 31.) on the use and utilization of high-water beds, littoral zones, wetlands and areas endangered by underseepage and on the procedures related to devaluation of the areas protected by summer dykes, the higher of the design flood level or the level of the highest flood level occurred until now in the area concerned marks out the high-water bed. The floor levels of the buildings are planned at 103.9 and 104.2mBf, thus the Danube flood does not endanger the buildings.

Daily water requirement of the workers during implementation (3m^3/day), will be granted through transportation to the site. No technological water requirement emerges during construction. Mobile toilets will be installed, to be replaced on weekly basis.

The communal water demand during operation will amount to 10.9m^3/day. According to the statement of Dunavíz Kft., operator of the Dunaföldvár public utility water network of Dunaföldvár, the communal water demand can be granted.

The water demand of the production technology and of the power station (3,000m^3/day) will be covered through implementing deep groundwater wells (4 pc) within the plant.

Water demand of the plant includes water requirements of the boiler, the cooling circuit and of the ethanol production process (cooling circuit make-up water supply from filtered sewage: 81.6m^3/h; cooling circuit make-up water from RO permeates: 6.0m^3/h; process water: 21.6m^3/h; boiler make-up water: 16.8m^3/h).

Catalytic deferrization and demanganization, desalination by reverse osmosis and ion-exchange after-softening is applied during water treatment. The used filter and blow-down waters generated during deferrization and demanganization are treated together with the communal waste waters. The concentrate generated during desalination is forwarded into the sewage.

Closed circuit cooling water system is used in the technology, equipped with a mechanical algae prevention device.

No sewer network is at present built out in the vicinity of the project area. A closed, insulated concrete tank will be implemented within the plant for collecting the communal waste waters (9m^3/day), or the sewer network will be constructed up to the trunk line along public road No. 6. Contract will be concluded with the specialized local Településtisztasági Kft. for the periodical removal of the waste water. Paksi Vízmű Kft., managing the Madocsa sewage treatment plant has granted approval for accepting the communal waste waters.

Practically no technological waste water will be generated in the plant, as the contaminated waters generated in the different stages of the ethanol production process will be recirculated into the technology at other processes. Process waste waters from the ethanol production will not be let into the surface waters.

30% of the daily 3,000m^3 water demand exits from the system as used water, being high salt containing blow-down water deriving from the power plant's cooling circuit. This will be inlet into the Danube river on the shore, through the rainwater run-off system of the adjacent Cargill plant.

Declaration of acceptance No. 01943-0003 of the Directorate of Environmental Protection and Water Management of the Central Danube Valley dated 31 May 2010 is available for discharging the used waters into the Danube.

In compliance with the documentation, the environmental impact of the water discharged is not sensible at the Danube's stream flow (2,000,000 to 28,000,000m^3/h). The degree of dilution is of 2,400 fold.

Treatment and discharge of the escaped waters:

- Escapages gathered from the floor surfaces of the factory buildings, cleanup waters, leakages and rainwater accumulated in the containment areas of the open air tanks are recirculated in full into the technological process (boiling kettle).
- Any technology leakages generated at the ethanol loading site are discharged into the tank farm's containment area through the sink-hole (and than through an oil and sediment trap).
- Any leakages (generated only in case of accident!) and rainwater from the tank farm's containment area are recirculated into the technological process (or evaporated in the event of smaller quantities).
- All tanks for storing feedstock (e.g. sulphuric acid) have independent waterproof containment trays of concrete. Any escaped waters or accumulated rainwater generated here are recirculated into the technology, or, if necessary, removed and treated as dangerous substances.
- Oil-containing escaped waters generated in the maintenance building are gathered in a closed containment tank and disposed as dangerous material.
- Waste waters of the CIP (Clean In Place) systems of the different equipment units are mixed in to the DDGS and evaporated during desiccation.

If the washing water deriving from the washing of the gas turbines' blades (2-3m^3 8 to 12 times in a year) contains substances constituting danger to the environment (e.g. heavy metals), it will be treated as hazardous waste. Otherwise it will be discharged through an oil separator.

Boiler water emptied during maintenance (desalinated water conditioned by chemicals, 100-200m^3/y) and blow-down drum water (1-1.5MT/h) are discharged into the surface water.

The chemicals used for regeneration or to cleaning of the equipment in the desalting plants have to be first neutralized in the neutralization basin and may be outlet into the public sewer only thereafter.

High salinity regenerates are produced during regeneration of the ion exchangers, therefore they may only be discharged into the surface waters only after proper dilution, even upon neutralization.

Other waste waters deriving from the plant (floor cleaning water) are outlet into the communal waste water system.

Clean precipitation waters falling on the roof surfaces of the buildings, the road pavements and green surfaces are partly evaporating on site or discharged into the Danube through a closed sewer pipe.

Precipitation waters that can be contaminated by petroleum derivates collected from the parking (50 park places) and loading areas are led through a dirt and oil trap device

into the previously developed and properly dimensioned rainwater run-off system of the adjacent CARGILL plant that discharges the waters into the Danube.

Cargill Magyarország Kereskedelmi Zrt. (hereinafter: Cargill Zrt.) has granted approval as proprietor of the system to discharge rain waters of the bioethanol plant into its own run-off system.

The rainwater run-off system a Cargill Zrt. is operated in compliance with water rights operation issued under file No. 52322/07 and amended under file No. 9713/10.

In case of a contingency, contaminations getting onto the pavement may be washed away together with the rain waters into the system. However, the sand and oil trap facility implemented at the border of the industrial area prevents getting of the contaminating substances into the surface waters.

In Articles 12.1 – 12.2 I have made stipulations for the protection of the surface waters in compliances with the genera water protection provisions of Act LIII of 1995 *on environment protection* (hereinafter: **Kvt.**) and of Govt. Decree 220/2004. (VII. 21.) *on the rules concerning protection of the surface waters' quality* (hereinafter: **FvR.**).

Article 14, Section (1), paragraphs a), b) and c) constitutes the legal basis for the provisions included in Article 12.3.

The stipulation included in Article 12.4 has been made on the basis of Article 20, Section (1) of the **Hgt.**, according to which owner, occupant or user of a real estate is bound to collect any communal liquid wastes generated on the property, deriving from the facilities serving for temporary storage (substituting public utilities) and not discharged into the public utility sewage network or otherwise into a recipient or a sewage treatment plant, as well as the communal solid wastes in a manner as provided for in a separate legal rule and to consign such wastes to the waste treatment companies authorized for their collection.

The provision included in Article 12.5 has been made in compliance with the general rules concerning protection of the surface waters' quality of the **Kvt.** and the **FvR.**

The stipulation concerning water rights implementation and operation permit under Article 12.6 is included in Article 3, Section (12) of Govt. Decree 72/1996. (V. 22.) *on exercising official powers concerning water management***,** providing that the Inspectorate's permission is required for the implementation, putting into use and operation of any facilities serving for the purification, pre-treatment and disposal of the waste waters and rain waters, except for waste water treatment facilities provided with technical building permit or CE compliance mark under a separate legal regulation. Content requirements of the application for water rights permit are specified in Decree 18/1996. (VI. 13.) of the Ministry of Transport, Communication and Water Management *on the application required for the water rights permit procedure and its attachments,* Article 2, Section (1), paragraph c) of which provides that the licensing plan documentation has to be submitted in eight copies.

If the equipment to be applied has a technical building permit (ÉME permit), the implementation and operation of the establishment are not activities subject to water rights permit. In such cases, in compliance with the general regulations concerning waste water discharge of the **FvR.**, the Inspectorate establishes the environmental protection requirements in its resolution granting permit to the waste water discharge

and establishing the waste water discharge limit values – amending this integrated environment use permit. Provision as to Article 12.7 has been made accordingly.

The provision in Article 12.8 has been made on the basis of the general provisions of the **FvR.** applicable to emitters, in order to grant controllability of the emission limit values concerning quality of used waters discharged into surface recipients in compliance with the legislation relating to the protection of surface waters.

The monitoring system required for monitoring the quantity and quality of the used waters discharged into the Danube from the above-ground establishments of the bioethanol plant has been determined in Article 12.10 in compliance with Article 10, Section (4), paragraph ba) of the **Govt. Decree.**

The self-control obligation provided for in Article 12.9 is to be performed in compliance with Articles 27 and 28 of the **FvR.** Detailed regulation concerning self-control is included in Decree 27/2005. (XII. 6.) of the Ministry of Environment and Water Management *on detailed rules concerning controlling of the discharges of used and waste waters.* Licensee will be called upon to in a separate procedure (water rights permit procedure concerning the plant's water establishments) for the submission of the self-control plan. Frequency of the waste water quality tests and of the data supply will also be defined in a separate procedure.

The Inspectorate will determine the sampling points for measuring quantity and quality of the used waters discharged from the site and the frequency of sampling during procedure for granting water rights permit.

Within the framework of the water rights operation permit procedure I will establish the allowed quantity of used waters to be discharged into the Danube river, which is indispensable for the control.

The data supply obligation included in Article 12.10 has been imposed in virtue of Article 30 of the **FvR.**

Maintenance of the provision made in Article 12.11 will occur in compliance with the regional limit values established for the recipients of general protection category according to Annex 2 of Decree 28/2004. (XII. 25.) of the Ministry of Environment and Water Management *on limit values and certain rules of their application related to discharges of water polluting substances* (hereinafter: **HatR.**). Itemized prescriptions concerning the typical components characterizing the rain waters and waste waters discharged from the plant into the recipient will be made in the water rights procedure.

With regard to the fact that no process waters will be discharged from the ethanol production technology, establishment of process-specific emission limit values relating to used waters discharged into surface recipients, as to Annex 1, Part III of the **HatR.** is not justified.

In virtue of Article 6, Section (1) of Govt. Decree 90/2007. (IV. 26.) *on the order of preventing and controlling environmental damages* (hereinafter: **Kár.Rend.**), damage control has to be granted on the basis of in-plant and regional plans. In virtue of Article 6, Section (3) and Annex 2, Articles 1.1 and 4.1.b) of the **Kár.Rend.**, operator of a bioethanol plant with the capacity specified herein is bound to prepare an in-plant plan that has to be submitted to the Inspectorate for approval. I have made the relevant stipulation in Article 17.2. Content requirements of the in-plant plan are specified in Annex 1 of the **Kár.Rend.**

As regards protection of subsurface waters

Technological water demand of the envisaged activity amounts to 3,000m^3/day, obtained from deep groundwater wells to be implemented within the plant. Drinking water quality is required.

Water acquisition can be granted from 4 wells, always two of them bored down into identical depth ranges. The two pairs of wells are able to grant the required water quantity. It is reasonable to locate the well pairs on the opposite sides of the ground-plot, near its borders. According to the simplified model calculation included in the documentation, depression near the wells will be of 14m, and of 0.5m at a distance of 1150m. According to the possible well implementation versions, 2 wells each of 100 and 150m depth, or 2 wells each of 150 and 200m bottom depth will be implemented. Decision on the version to be actually implemented will be taken on the basis of the 200m deep exploratory boring and that of the geophysical profiling performed therein.

According to the water acquisition expertise prepared on water withdrawal, the effects of the water withdrawal from aquifers do not exclude feasibility of the water withdrawal; no establishments, areas or water uses are to be found within the forecasted zone of the impacts that would *ab ovo* exclude the feasibility.

The Inspectorate has issued a preliminary water rights permit in respect of the water withdrawal under ref. No. 27651/2009 and file No. 1663/10. During the licensing procedure, the Directorate of Environmental Protection and Water Management of the Central Transdanubia has not made objections against water extraction of 3,000m^3/d. Whether the water withdrawal may be implemented, can only be determined upon detailed analysis. For the sake of monitoring the effects of water withdrawal, the Inspectorate has stipulated the implementation of a monitoring network in the preliminary water rights permit, the necessity of which is also confirmed by the documentation.

For the implementation of the exploratory well indispensable for the detailed analysis of the effects of the water withdrawal, water rights implementation permit has been issued by the Inspectorate under ref. No. 5374/2010 and file No. 35414/10.

The region is rich in subsurface waters; ground water is found everywhere above the top aquiclude layer, its depth varying between 2 and 4m, depending on the precipitation quantity and on the Danube's water level. Water supply of the city is granted by wells implemented onto the Pannonian strata. According to the model calculations prepared, operation of the envisaged wells will not have any impact to the city's water supply, falling beyond the impact area.

Contamination sensitivity classification of the area: according to sensitivity map of 1:100,000 scale under Article 7, Section (4) of Government Decree 219/2004. (VII. 21.) *on the protection of the subsurface waters* (hereinafter: **faviR.**), the area is qualified as sensitive as regards condition of the subsurface waters.

The project site does not concern any water base protection zone.

In compliance with boring tests performed within the project sit and with the test results of the analyzed soil and groundwater samples – for TPH, BTEX, halogenated aliphatic hydrocarbons, halogenated aromatic hydrocarbons, toxic metals and full water chemistry analyzes – none of the parameters exceeds the contamination

threshold value “B”. The flow direction of the groundwater is South – South-East, towards the Nagykarácsony stream and the Danube.

On the surface of the area, there are fine-grained soils: argillaceous and sandy silt and fine-grained sands and fluvial sediments are to be found. Typical depth of the sod layer amounts to 0.5m.

There is no process water demand during the implementation period. Mobile toilets will be installed for satisfying the needs of the workers. The top soil will be removed where the constructions will be located, deposited and later used for terrain correction. Remarkable quantity of earth will be moved.

Possible consequences of the deep groundwater withdrawal following the implementation: a deeper operational level than the actual one may be expected at the water uses already existing, depression of the groundwater level is expectable; through operation of the monitoring system, the actual water level depressions will be traceable.

Operation of the technology implies minimal environmental hazards, due to the design of the establishments; the monitoring well will supply proper information on any environmental pollutions.

The competent Measuring and Technical Safety Office of the Hungarian Trade Licensing Office will conduct the licensing procedure for the installation, implementation and putting into use of the containers serving for the collection of the contaminating materials.

The Inspectorate will issue permit for disposal of the contaminating substances in compliance with **faviR.** – through amendment of this integrated environment use permit – in respect of the containers, following approval of the datasheets submitted together with the application for issuing permit of putting into use, by way of data supply. With regard thereto, permit for disposal of the contaminating substances as to Article 2.3.2 of this Resolution is not deemed as granted. I have made stipulation on the above in Article 13.5 of this Resolution.

Abandonment of the establishment does not imply load to the subsurface waters.

The stipulation included in Article 13.1 has been made with regard to Decree 18/1996. (VI. 13.) of the Ministry of Transport, Communication and Water Management *on the application required for the water rights permit procedure and its attachments.*

Based on the general water protection provisions of the **faviR.**, I have ordered the development of a monitoring system.

Analysis of the subsurface water and of the geologic-geographic medium has to be performed through the standard measurement method specified in joint Decree 6/2009. (IV. 14.) of the Ministries of Environment and Water Management, Health and Agriculture and Rural Development *on limit values and measuring of contaminations for the sake of protection against pollution of the geologic-geographic medium and subsurface water* for pollution limit value “B”, on which I have made provisions in Articles 13.3 and 13.4 of this Resolution.

<u>As regards landscape and nature protection</u>

- The project area of the bioethanol plant is located in the periphery of Dunaföldvár city; it does not affect any nature protection or Natura 2000 area, or nature importance area.

- The nearest areas of nature protection value are located to the East at about 170m distance, and to the South-West at about 430m, the Tolna-Duna Natura 2000 area of code No. HUDD 20023. The Natura 2000 area located at 430m distance to the SW constitutes at the same time part of the Dunaföldvár Fish Pond Nature Protection Area of local importance. To the East, at 18km distance, the Kiskunság National Park, the nearest area of national importance, to the West, at 11km distance the protected natural area of national importance of the Dél-Mezőföldi Landscape Protection Area are located.
- No protected or unique plant species are found within the project area. Within and around the plant mainly cultivated plants and weeds are to be found, the role of the species denoting natural conditions is inferior. The fauna of the area is characterized by the presence of the most frequent species that tolerate well the human disturbance.

Taking into account the impact area of the single impact factors and the combined impact area, the investment has no damaging effects to the nearby NATURA 2000 areas and to their flora and fauna; no natural values will suffer damages through implementation of the project.

In compliance with Article 7, Section (2), paragraph a) of Act LIII of 1996 *on nature protection*, care has be taken during placement of buildings, constructions and line-drawn installations in the outer areas for their adaptation to the landscape through functional and aesthetic co-ordination of the natural values and functions of the man-made environment. Through implementation of the envisaged buildings and constructions within the project site, a highly built-in plant will be developed; plantation of trees and bushes in compliance with the attached plantation plan may be suitable for granting its insertion into the landscape. Consequently, I have made the provisions as to Article 14.1 of this Resolution.

Checking compliance with the Best Available Techniques

No Reference Document on BAT has been prepared specially for the bioethanol production technology by the competent EU Commission, thus compliance with the Best Available Techniques has been examined by the Inspectorate on the basis of the following documents:

- Draft BAT Guidance Note on Best Available Techniques for the Brewing, Malting & Distilling Sector
- Reference Document on Best Available Techniques in the Food, Drink and Milk Industries

The competent EU Commission has issued the following guidance for conducting licensing procedures of environmental protection character on large combustion plants:

- Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for Large Combustion Plants

The operation criteria are established in the above-listed documents, and reference thereto has been made in Articles 5.1 and 5.2 of this Resolution.

On the basis of the statements included in the documentation and made during the professional consultation, as well as of Article 5.1 of this Resolution, it may be established that the operation of the envisaged bioethanol manufacturing technology and of the power plant satisfies the provisions related to the Best Available Techniques. Based on Article 17, Section (2) and Annex 9 of the **Govt. Decree** and on the statements made during the professional consultation, I have made stipulations as to Articles 5.2 to 5.4 of this Resolution.

The best available technology will be implemented during the investment, therefore the emission control techniques and the frequency of checking air polluting emissions grant compliance with the limit values established for the environmental air quality and with the technological emission limit values provided for in the prevailing legislation.

As regards waste management, the Best Available Techniques are granted by the fact that hazardous wastes are generated only during maintenance operations and the DDGS produced will be used for feeding animals. Operation of the feeding system is optimized and storage is made in closed-system silos for preventing dust generation.

As regards noise and vibration protection, the content of the documentation allows establishing that the technological buildings and installations of the envisaged project have been designed in compliance with the Best Available Techniques.

Concerning protection of the surface and subsurface waters: The water consumption is optimized. The public utility system is regularly maintained; overfilling and overflowing of the liquid material storage tanks is prevented through the application of proper storage, treatment and feeding technologies. Overfill protection is applied in the case of the bulk storage tanks, too. The bottom and side walls of the sewage containers are insulated. The quantity of the sewage to be generated is minimized.

Based on the content of the permit application documentation, on the positions of the competent authorities submitted and on the data available to the Inspectorate, I have accepted the application of Licensee and I have issued an integrated environment use permit in compliance with Article 71, Section (1), paragraph c) of the Kvt. and Article 24, Section (9), paragraph a) of the Govt. Decree, for the following installations to be implemented under observation of the provisions included in the purview:

- **Chemical installations for industrial scale production of basic organic substances, namely oxygen-containing hydrocarbons, namely alcohols, chemical substances, from manufacturing capacity of 20,000MT/year final product,**
- **Combustion equipment with input heat capacity over 50MW$_{th}$, installation of a heat energy generating equipment (for producing steam and hot water) with output capacity over 50MW$_{th}$ on the project site concerned.**

In virtue of Article 20, Section (8) of the **Govt. Decree,** integrated environment use permits may be issued for determined periods, but for at least five years. The requirements and stipulations included in the integrated environment use permit have

to be revised at least every five years. With regard thereto, in Article 2.4, the validity term of this Resolution has been established in 30 June 2020. 31 January 2015 is the term for submitting the revision documentation, on the basis of the above legal regulation.

The Inspectorate has examined the basic activity to be performed within the plant and has established that it is ranked under TEÁOR 20.59 (manufacturing of other chemicals n.e.c.) and the activity conducted in the power plant under TEÁOR 35.30 (steam supply).

With regard to the fact that activities of thermal plant operation and manufacturing of organic chemical substances will be performed within the project site, I have ordered compulsory employment of an environmental protection agent in compliance with Govt. Decree 93/1996. (VII. 4.) *on environment uses subject to employment of an environmental protection agent*. Stipulations concerning the person to be employed are included in Decree 11/1996. (VII. 4.) of the Ministry of Environmental Protection and Rural Development *on employment and qualification criteria of environmental protection agents.*

Administrative service fees of the procedure concerned: in compliance with Decree 33/2005. (XII. 27.) of the Ministry of Environment and Water Management *on administrative service fees of the official procedures concerning environmental protection, nature protection and water management* (hereinafter: **Iszd.r.**): Annex 1, Part III, Article 1.1: HUF 2,100,000 (Combustion plants with input heat capacity over $50MW_{th}$) and Article 6: HUF 2,100,000 (Chemical industry); as well as Annex 1, Part IV, Article 7: HUF 1,650,000 (Chemical industry) and Article 10.1: HUF 1,500,000 (heat energy production installation over 50MW output capacity); 75% of the administrative service fee established in Part III, according to Part V of Annex 1 (consolidated procedure) (2,100,00 + 2,100,000+1,650,000+1,500,000) × 0.75 = HUF 5,512,500.

In compliance with Article 18, Section (1) of Act CXXIX of 2007 *on protection of cultivable lands*, a fee amounting to HUF 15,000 is payable for land protection procedures initiated in first instance, including fee payable to the authority responsible for real estates for its collaboration as competent authority for asserting quantitative protection of the cultivable lands. Based on the data available to me I have established that Licensee had confirmed in its letter filed under 30383/10 payment of the administrative service fee due to the Land Office for its collaboration during the procedure initiated at the Inspectorate.

Licensee has confirmed payment of the fee payable for the competent authority procedure amounting to HUF 29,700 in compliance with Annex 1, Article XI.16 of Decree 1/2009. (I. 30.) of the Ministry of Health *on fees payable for certain public administration procedures and services of administrative character granted by the National Public Health and Medical Officer Service* in letter filed under 30383/10.

Licensee has paid up the administrative service fee provided for in Article 19.1 of this Resolution in compliance with Article 72, Section (1) paragraphs dd) and de) and Article 153, Section (2), Subsection 2.

In Article 19.2 of this Resolution I have made stipulations concerning legal consequences of failure to comply with the obligations stipulated on the basis of Article 72, Section (1), paragraph df) of the **Ket.**

I have granted possibility of appeal against my Resolution in compliance with Article 98, Section (1) and Article 99, Section (1) of the **Ket.** Article 21 has made provisions concerning possibility of appeal according to Article (72), section (1), paragraph dg) of the **Ket.**

With regard to Article 21, Section (8) of the **Govt. Decree**, in Article 20.1 of my Resolution I have made provision that the town clerk of the community concerned has to care for the publication of the Resolution within 5 working days upon its reception, by indicating the date of displaying and that of removing the Resolution and sending the relevant notification to the Inspectorate.

In virtue of Article 80, Section (4) of the **Ket.**, in Article 20.2 of the Resolution, I have ordered display of the Resolution on the Inspectorate's bulletin board, as well as its publication on the Inspectorate's home-page.

Legal ground for publication of the decision is contained in Annex 80, Section (3) of the **Ket.** The purview of the Resolution includes the subject-matter and file number of the decision, description of the proceeding authority and the impact area concerned by the activity.

Attention of the clients is called to the fact that a decision published by way of announcement is to bee deemed as conveyed on the 15th day following the date of display; therefore appeals may be submitted within 10 working days upon this date in compliance with Article 99, Section (1) of the **Ket.**

The town clerk concerned is requested to inform the Inspectorate on the date of conveyance, that is, on the date of removal of the announcement.

For clients receiving information on the Inspectorate's Resolution in mail, a period of 10 working days upon conveyance, that is, upon reception of the relevant letter, is available for the submission of legal remedy applications.

The fee payable for the legal remedy procedure amounts to 50% of the fee established here above, with regard to the provisions of Article 2, Section (4) of the **Iszd.r.**, that is in this concrete case to 0.5 × 5,512,500 = HUF 2,756,250.

According to Article 2, Section (7) of the **Iszd.r.**, the fee payable for the legal remedy procedure instituted by social organizations, if the licensing procedure had not been initiated on the request of such social organization, amounts to 1% of the fee established in the **Iszd.r.**, being in this case: 5,512,500 × 0.01 = HUF 55,125.

This Resolution, if no appeal is submitted against it, will become effective without separate notification on the day following the 10th working day upon its conveyance, as provided for in Article 128, Section (1) of the **Ket.**

In virtue of Article 32/A, Section (1) of the **Kr.**, the competent County Directorate of Disaster Management has to be informed on the Resolution taken in the procedure, therefore this Resolution is sent to the Tolna County Directorate of Disaster Management.

The date of expiry of the procedural time-limit: 14 September 2010.

By mailing this Resolution, the procedure has been closed down by the Inspectorate, therefore the procedural time-limit is deemed as maintained.

Annex 1, Article 4 of the **Kiem.r.** established the scope of authority and competence of the Inspectorate.

In compliance with Decree 7/2000. (V. 18.) of the Ministry of Environment and Water Management, I have taken measures for official registration of the present Resolution.

Székesfehérvár, 04 June 2010

Dr. István Kling m.p.

Director

This is a true copy:

Mrs. József Flórián

Administrator of the Licensing Office

Addressees:

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20.

Upon taking effect:

21.

22.

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25.

Annex 1

Emission limit values of air polluting substances

Technological emission limit values of the point sources P1 through P5 pertaining to the bioethanol manufacturing technology

Description of the point source	Point source No.	Air polluting substance	Limit value mg/m^3
Corn reception in store	**P1**	Solid matters	50
Mill	**P2**		
DDGS cooling	**P3**		
DDGS loading	**P4**	Solid matters	150
Gas washer	**P5**	Organic matters, class C	150

Technological emission limit values of air polluting substances for natural gas fuelled combustion plants of nominal heat input capacity over 140kW$_{th}$ but less than 50MW$_{th}$

Technological emission limit values of the air polluting substances exhausted through the point source marked **P6** pertaining to one natural gas fuelled boiler with input heat capacity of 43MW$_{th}$ supplying the steam demand of the technology, and two natural gas fuelled boilers of 16MW$_{th}$ input heat capacity granting the heat required for the DDGS desiccation, in case of combined fuelling by natural gas and biogas:

Point source No.	Air polluting substance	Limit value mg/m^3
P6	Solid matter	5
	Carbon monoxide (CO)	100
	Nitrogen oxides (expressed in NO_2)	350
	Sulphur dioxide and sulphur trioxide (expressed in SO_2)	35

The concentrations expressed in mg/m^3 refer to dry (anhydrous) **flue gas with 3% oxygen content** and 273°K temperature and 101kPa pressure.

Annex 2

Data of the ground-plots concerned by the 300m protection zone

	Name and address of proprietor
0107/8	Holl István 7020 Dunaföldvár, Béke tér 8. ½.
0107/9	Cargill Magyarország Kereskedelmi Zrt. 1134 Budapest, Váci u. 37.
010710	
0107/11	
0107/12	
0107/13	
0107/14	
0107/15	
0111/5	
0111/6	
0111/7	
0111/8	
0111/9	
0111/11	
0111/13	
0111/14	
0111/18	
0111/25	
0111/26	
0113/1	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L u. 2.
0113/5	
0113/6	
0113/7	

HRSZ	Name and address of proprietor
0113/8	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L u. 2.
0113/16	
0114/1	
0115/9	Kovács Imre 1112 Budapest, Beregszászi u. 56/b.
0115/10	Hungarian State, National Land Fund
0116/5	Cargill Magyarország Kereskedelmi Zrt. 1134 Budapest, Váci u. 37.
0116/7	Lukoil Magyarország Kft. 1145 Budapest, Újvilág u. 50-52.
0116/8	Master Vase Kereskedelmi Kft. 2112 Veresegyháza, Szentkorona u. 4.
0117	Hung.State MoA, Tolna County FMH, Szekszárd, Augusz Imre u. 7.
0118/3	Hung. State, National Land Fund
0118/4	Kovács Imre 7000 Sárbogárd, Táncsics M. u. 33. Nagy Antal 6136 Harkakötöny, Kötöny u. 3.
0109	Municipality of Dunaföldvár 7020 Dunaföldvár, Kossuth L u. 2.
0119	Hungarian State
0110/4	ADUVIÉP 6500 Baja, Déri Frigyes sétány 13.
0127/1	Hungarian State

Annex 3

Noise emission limit values

Noise emission limit values established for the bioethanol plant and power centre located on properties of top. lot Nos. 0111/26, 0109 and 0116/5 in Dunaföldvár

- at 2m before the fronts to be protected of the residential building No. 5003/1 at Dunaföldvár, Hunyadi tér 4.
- at 2m before the fronts to be protected of the residential building No. 5003/2 at Dunaföldvár, Hunyadi tér 3.
- at 2m before the fronts to be protected of the residential building No. 5003/3 at Dunaföldvár, Hunyadi tér 2.
- at 2m before the fronts to be protected of the residential building No. 5003/51 at Dunaföldvár, Hunyadi tér 5.
- at 2m before the fronts to be protected of the residential building No. 5003/9 at Dunaföldvár, Hunyadi tér 3.
- at 2m before the fronts to be protected of the residential building No. 5003/8 at Dunaföldvár, Hunyadi tér 4.
- at 2m before the fronts to be protected of the residential building No. 0123/12 at Dunaföldvár, Felsőfok utca 7.
- at 2m before the fronts to be protected of the residential building No. 0123/10 at Dunaföldvár, Felsőfok utca 9.

in daytime (06:00 a.m. to 10:00 p.m.)	55dB(A)
in nighttime (10:00 p.m. to 06:00 a.m.)	45dB(A)

- at 2m before the fronts to be protected of the residential building No. 6101 at Dunaföldvár, Felsőfok utca 1.
- at 2m before the fronts to be protected of the residential building No. 6130 at Dunaföldvár, Felsőfok utca 2.
- at 2m before the fronts to be protected of the residential building No. 0123/18 at Dunaföldvár, Felsőfok utca 3.
- at 2m before the fronts to be protected of the residential building No. 0123/17 at Dunaföldvár, Felsőfok utca 5.
- at 2m before the fronts to be protected of the residential building No. 0123/11 at Dunaföldvár, Felsőfok utca 4.
- at 2m before the fronts to be protected of the residential building No. 0123/11 at Dunaföldvár, Felsőfok utca 3.

in daytime (06:00 a.m. to 10:00 p.m.)	60dB(A)
in nighttime (10:00 p.m. to 06:00 a.m.)	50dB(A)

ECOFYS

Greenhouse Gas Assessment

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Greenhouse Gas Assessment

Greenhouse Gas Assessment
of Pannonia Ethanol Zrt. (Dunafoldvar Facility)

Steven Wonink

Willem Hettinga

Carlo Hamelinck

First version November 2009

Update June 2010

PEGENL084694 / PSUPNL101420 / © Ecofys 2010

by order of:

Pannonia Ethanol Zrt.

ECOFYS INTERNATIONAL BV, A PRIVATE LIMITED LIABILITY COMPANY INCORPORATED UNDER THE LAWS OF THE NETHERLANDS HAVING ITS OFFICIAL SEAT AT UTRECHT AND REGISTERED WITH THE TRADE REGISTER OF THE CHAMBER OF COMMERCE IN UTRECHT UNDER FILE NUMBER 24343898

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Statement

Ecofys International BV (Ecofys) has been mandated by Pannonia Ethanol Zrt. (Pannonia) to assess the greenhouse gas (GHG) performance of a planned corn ethanol production facility (including the full supply chain) to be located in Dunafoldvar, Hungary (the Facility) and owned by Pannonia.

Ecofys is an international consultancy specialising in energy saving and renewable energy solutions. Ecofys was involved in the development of the Renewable Energy Directive and currently advises the European Commission in developing the biofuels sustainability scheme and greenhouse gas reporting guidelines.

This study has been guided by (i) assumed technical performance parameters for the Facility as provided by Pannonia (the Technical Assumptions), (ii) an assessment methodology for biofuels greenhouse gas balances promulgated by the European Commission (the Methodology), and (iii) our own skills and experience.

Please note that the Methodology is not currently complete and will be updated and refined in coming months and years. We have made certain assumptions with respect to Methodology omissions and uncertainties in order to complete this greenhouse gas assessment (this Report), which assumptions are, in our opinion, reasonable and objective. However, we note that the Methodology is a policy instrument and, as such, anticipated updates and refinements to the Methodology (as well as any future changes in law) will be driven not only by scientific and technical concerns. Furthermore, some future methodology updates may have a considerable effect on the assessment of all biofuel supply chains. Accordingly, we make no representation or warranty about the final form of the Methodology. This Report is based solely on the Methodology in its current form and our technical interpretation of existing European Union laws and regulations impacting ethanol production.

Please note that the Technical Assumptions have been provided by Pannonia and have been represented to us as being consistent with the performance standards that will be contractually guaranteed by Fagen, Inc. (or an affiliate thereof). The Technical Assumptions are included in Appendix C. Also included in Appendix C are performance standards expected by Fagen, Inc. to be achieved by the Facility based upon the performance of recent Fagen facilities similar to the Facility (the Technical Expectations). We make no representation or warranty with respect to the actual performance of the Facility but have based this report solely on the Technical Assumptions and (where expressly identified) the Technical Expectations.

Technical summary

Pannonia is planning to build a plant in Hungary to produce ethanol from corn produced in the region. Sales of the ethanol as biofuel on the European market, require that the ethanol meets certain sustainability requirements defined by the European Directive 2009/28/EC, known as the Renewable Energy Directive (the RED).

For any biofuel used to meet the requirements of the RED, in 2010, a minimum greenhouse gas performance of 35% emission reduction (GHG savings) needs to be achieved in comparison with fossil fuels. In 2017, this threshold is increased to 50%. The Facility is expected to enter commercial operation in 2011 and will thus first need to meet the 35% GHG savings threshold and from 2017 onwards the 50% threshold.

Based on the information supplied by Pannonia, Ecofys has calculated that the corn ethanol to be produced in the Facility, should be able to reach even the 2017 threshold with considerable margin. This is shown in the first bar in the figure below. The figure also shows that the expected performance is better than default performances according to various sources including the RED default.

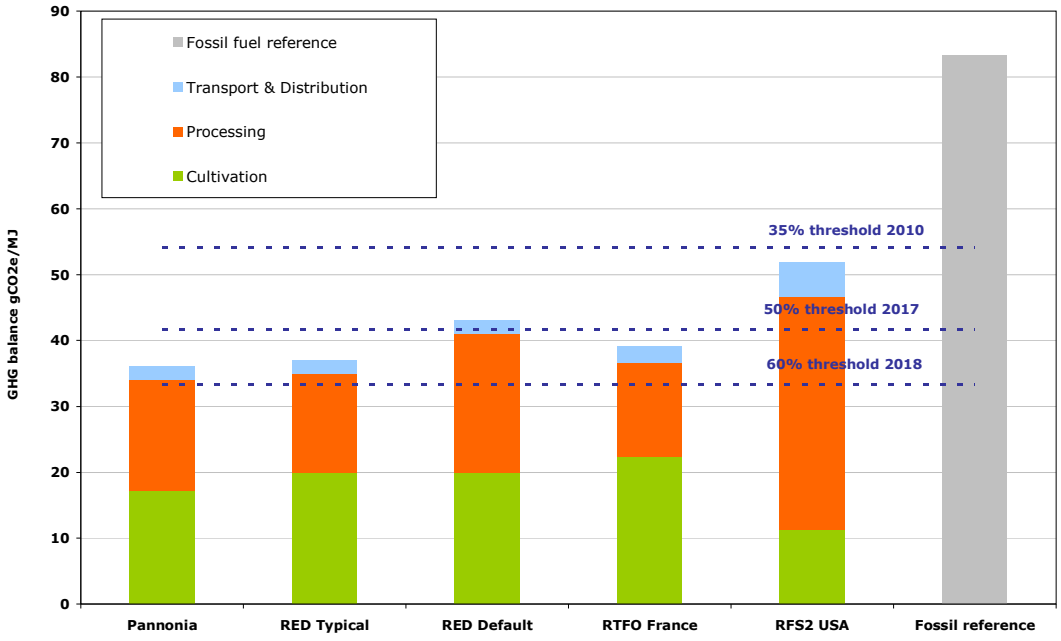

Figure S1. The expected GHG performance of corn ethanol (57.0% emission savings), calculated for the Facility, and compared to default performances quoted in different sources.

Based on the Technical Assumptions (guaranteed plant performance), we estimate that Facility ethanol will represent GHG savings of 53.8%; if the product is to be shipped by rail transport, the savings will slightly increase to 54.2%. Based on the Technical Expectations (expected plant performance as observed in similar plants), we estimate that Facility ethanol will even represent GHG savings of 57.0%.

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1 Introduction

The EU's GHG emissions reduction target for 2020 can not be reached without a considerable reduction in the GHG emissions of the transport sector. All Member States are therefore, by way of the EU Renewable Energy Directive (the RED), required to achieve a 10% renewable energy supply to the transport sector by 2020. In addition, the recently amended Fuel Quality Directive (the FQD) requires fuel suppliers to reduce the carbon intensity of their transport fuel by 6% by 2020. In both cases, biofuels are the primary source of GHG emissions reduction.

These targets promise to create a substantial EU market for biofuels. However, concerns that biofuels could emit more GHGs than fossil fuels have led to the introduction in the RED of a minimum GHG performance threshold. The FQD also rewards savings that go beyond this threshold.

1.1 RED GHG Overview

The RED requires that three sustainability criteria are met in order for Member States to count biofuels towards the 10% target. These are:

- A minimum GHG emission reduction;
- No feedstock cultivation in areas of high biodiversity; and
- No feedstock cultivation in areas of high carbon stocks.

The initial mandatory minimum GHG saving compared to fossil fuel has been set at 35% beginning in 2011 for new facilities and beginning in 2013 for facilities in operation in January 2008. In 2017, the minimum GHG emission saving compared to fossil fuel increases to 60% (for new facilities) and 50% (for facilities in operation before 2017).

1.2 FQD GHG Overview

The FQD requires fuel suppliers to reduce the GHG emissions of the fuels they sell and employs the same sustainability criteria and Methodology as the RED. The FQD sets a 6% mandatory reduction in GHG emissions from fuels by 2020. This is calculated from well to wheel over the entire value chain of the fuels supplied to the market, in comparison to 2010. Intermediate targets are formulated as follows:

- First 2% by December 2015
- Another 2% by December 2017
- Last 2% by 2020

The 6% emission reduction can either be achieved by reducing emissions from fossil fuel delivery (exploration, transport, refining and distribution) or by replacing fossil fuels by alternatives that have lower well-to-wheel emissions. It is very difficult to reduce upstream emissions. Current refineries are already quite efficient, and as exploration becomes even more difficult, fossil fuels will likely require more energy to recover and thus lead to higher GHG emissions. Therefore, the easiest way to achieve the 6% emission reduction is probably by introducing biofuels.

There is an important difference between the RED and the FQD. Whereas under the RED a biofuel either qualifies or not, under the FQD the actual GHG savings will also be important. As a result, under the FQD, biofuels with higher GHG reductions should be able to command a premium in the market over biofuels that demonstrate only the minimum GHG reductions.

1.3 Methodology Options

Article 19.1 of the RED outlines three options to calculate biofuels GHG performance

1. by using a default value for a specific biofuel or bioliquid production process listed in an annex to the RED (in which case, the Facility would yield 49% GHG savings);
2. by using an actual value calculated in accordance with the Methodology; or
3. by using a value calculated as the sum of the factors of a formula, with default values for some factors, and actual values, calculated in accordance with the Methodology, for all other factors.

In this Report, we focus on options 2 and 3.

1.4 Report Structure

Section 2 discusses the Methodology. It also specifies where the Methodology is unclear and the resulting uncertainties.

Section 3 outlines our conclusions and describes the impact of the Methodology's uncertainties.

2 The Methodology

*This section describes the method that is used to calculate GHG performance for biofuels. We also highlight in **bold** the choices that have been made in relation to the RED methodology. The final section of this chapter lists the uncertainties that still exist surrounding the interpretation of the RED methodology.*

2.1 The Life Cycle

In general a biofuel's GHG performance is calculated through a life cycle analysis (LCA), which takes into account all GHG emissions throughout the biofuel supply chain, i.e. from the farm to the fuel pump (Well-to-Tank). This is also the case for the RED Methodology. The GHG performance is either expressed as the GHG intensity (in gCO_2eq/MJ) or GHG savings compared to fossil fuel (%). **The RED Methodology does not distinguish between diesel and gasoline, but employs an average fossil fuel value of 83.8 gCO_2eq/MJ.**

The biofuel supply chain includes all transport and conversion steps during the production and distribution process. Figure 1 shows a typical biofuel supply chain.

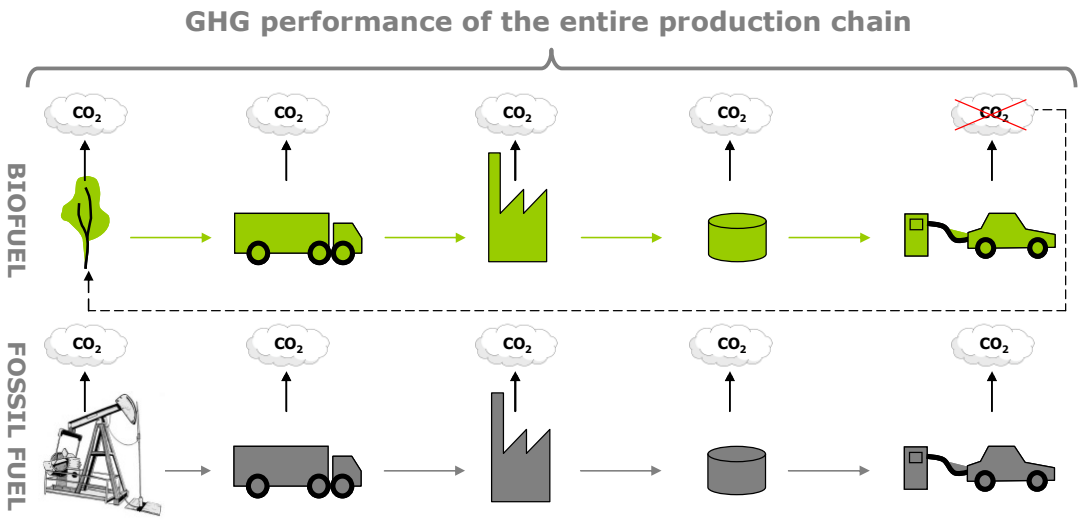

Figure 1: Two typical supply chains: all GHG emissions are added up in the LCA calculation, both for biofuels and for fossil fuels. Major difference is that for the combustion of biofuels no emissions are allocated to the end-use phase since the emission in that phase equals the CO_2 uptake by growing biomass.

The different steps include:

- *Crop establishment and cultivation:* Onsite emissions include CO_2 emissions from fossil fuel use by farm machinery and N_2O emissions from fertiliser application. Land use change (LUC) for the establishment of the farm could lead to losses in carbon stock and resulting GHG emissions. Offsite emissions include emissions from fertiliser production.

- *Harvesting:* Onsite emissions occur mostly from fossil fuel use for machinery. Harvested co-products can improve the GHG performance of the biofuel.
- *Transport:* Fossil fuel use for transportation leads to CO_2 emissions.
- *Storage / pre-treatment:* Some harvested products are dried which results in CO_2 emissions from heating. Oilseeds and palm oil first need oil extraction and sometimes oil refining, which would lead to additional CO_2 emissions for electricity and fossil fuel use. CO_2 emissions in this phase also result from hauling and milling. **It is unclear whether the RED Methodology includes drying of corn in the production process of corn ethanol.**
- *Conversion:* Fossil fuel use results in CO_2 emissions, and often additives (such as methanol for biodiesel production) are applied that result in offsite emissions from the production of these additives. In this phase co-products (such as animal feed) typically take a share in the total GHG burden which is beneficial for the GHG performance of the biofuel.
- *Distribution & end use:* Emissions from distribution are often not taken into account in comparing biofuel with fossil fuel as these are the same for both fuels. Emissions from end use combustion for biofuels are not taken into account (as the emitted $C0_2$ was recently absorbed by the biofuel feedstock), whereas for fossil fuels these are included. **The RED Methodology includes distribution, for both biofuels and fossil fuels.**

In general, biofuel performance is the sum of the emissions described above. **However, the RED Methodology divides emissions into categories, which, lumped together, give a biofuel's GHG performance.** Box 1 sets out these categories.

Box 1: RED Methodology GHG formula

$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee}$ (1)

E = total emissions from the use of the fuel;

e_{ec} = emissions from the extraction or cultivation of raw materials;

e_l = annualised emissions from carbon stock changes caused by land-use change;

e_p = emissions from processing;

e_{td} = emissions from transport and distribution;

e_u = emissions from the fuel in use;

e_{sca} = emission saving from soil carbon accumulation via improved agricultural management;

e_{ccs} = emission saving from carbon capture and geological storage;

e_{ccr} = emission saving from carbon capture and replacement;

e_{ee} = emission saving from excess electricity from cogeneration.

Relevant emission categories for biofuels are: extraction and cultivation (e_{ec}), processing (e_p), transport and distribution (e_{td}) and when applicable carbon stock change (e_l)

In general all CO_2, N_2O and CH_4 emissions are taken into account in each step in the production chain. These three GHGs have different global warming potentials. CH_4 has a 23 times higher impact than CO_2; N_2O has a 296 times higher impact.

Which emissions are included in the different steps of the biofuels chain depends on the choice of system boundaries. Also relevant are the definitions of and methodology to deal with co-products and residues. Public schemes, such as the UK RTFO scheme, the RED Methodology, and private standards differ in their approaches on the above items. This can lead to a single supply chain having different GHG performance under different schemes and standards. Since Pannonia intends to sell ethanol only into EU markets, only the RED Methodology is relevant to this Report.

2.2 System Boundaries

The system boundary specifies which processes are included and which processes are excluded in a GHG performance calculation. Boundaries are set depending on the level of detail and the type of emissions sources considered. Boundaries have to be set on:

- Off-site emissions associated with inputs: GHG emissions associated with the production and/or transportation of inputs are typically included. Example:
    - Emissions from the production and transportation of fertiliser;
    - Emissions from the production of electricity that is used on site;
- Capital goods: GHG emissions that result from the manufacturing of capital goods, such as trucks and factories, are usually excluded because they have a negligible impact;
- On-site emissions: All emissions generated on site are typically taken into account; this includes:
    - Emissions from energy carriers such as coal, natural gas and oil derivatives;
    - Emissions from fertiliser application;
    - Emissions from residue streams such as methane emissions from palm oil mill effluent;
- Emissions from Land Use Change (LUC): If a new farm for biofuel crops is established, LUC occurs. This could lead to large changes in carbon stocks, as above and below ground biomass and soil carbon may be removed or added. The resulting GHG emissions should be attributed to the biofuels produced from this land. Most often the associated GHG emissions from LUC are depreciated over 20 years according to IPCC methods. The RED Methodology requires inclusion of LUCs if it occurred after January 2008;
- Emissions from Indirect Land Use Change (ILUC): ILUC could occur when the production of biomass displaces certain activities to other areas where this may cause negative land use change (see Appendix A). Although recognised as an important factor in determining biofuel GHG performance, no consensus currently exists on how to deal with this. In Appendix A we explain the mechanisms behind ILUC. **The European Commission (EC) is expected to formulate an ILUC**

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proposal in 2010. Regardless of the outcome, it will affect biofuels facilities that become operational before 2013 only beginning in 2018.

2.3 Co-Products and Residues

Within GHG methodologies, co-products and residues play a special role as these are often beneficial to the GHG performance of a biofuel. The distinction between a co-product and a residue is generally based on the value for further application. Their definitions and the methodologies used to deal with co-products and residues are therefore often of crucial importance for biofuel GHG performance. **The RED Methodology is not consistent in distinguishing between co-products and residues.**

Co-products

Usually more products are produced in a biofuel supply chain than fuel alone. For instance, dried distillers' grains (DDGS) are co-products of a corn to ethanol chain and rapeseed meal is a co-product of a rapeseed to biodiesel chain. GHG emissions are attributed to co-products as well. Three methodologies are widely used to calculate GHG emissions associated with co-products:

- Substitution: Co-products displace other products and thereby avoid the emissions associated with production of those other products. In a substitution approach the foregone GHG emissions, by preventing the production of the substituted product, are subtracted from the emissions of the biofuel chain.
- Allocation by market value: The GHG emissions are distributed over the various products, based on their relative economic value. Thereby, the most valuable products are held responsible for most of the GHG burden of the chain.
- Allocation by energy value: the GHG burden is divided over the products based on their relative energy content. This is used mostly for pragmatic reasons as energy content is relatively easy to determine and constant over time.

The RED Methodology allocates by energy value (lower heating value). GHG emissions of corn ethanol are for example divided between DDGS and ethanol on the basis of energy content. Energy content depends on moisture content and it is unclear how the RED Methodology will deal with this (see Section 2.6).

Residues

Residues (as feedstock) are often favoured because they are not produced specifically for biofuels, reducing the environmental burden. However, residues may have other purposes than being used for biofuels.

If a biofuel feedstock is considered a residue product, it is allocated zero emissions at the point where it originates. Therefore, whether a product is considered a residue or not can have a significant impact on biofuel GHG performance. Definitions of residues differ among countries and standards. **The RED Methodology describes residues as waste and agricultural crop residues, gives no further criteria, and provides examples, such as straw, bagasse and crude glycerine.**

2.4 Default Values

Accurate assessment of GHG performance depends upon accurate information. Often, detailed information on GHG emissions in a specific supply chain is unavailable or difficult to obtain. Reporting and calculations can then be made on the basis of predefined default values. These default values are based on common emission figures from a total production chain or specific parts of a chain, for example corn cultivation and harvesting. Defaults are typically set conservatively to avoid free riding and to stimulate producers to report actual values.

Default values can be defined at several levels of detail. A default may exist on the fuel (e.g. ethanol), but may be further specified per feedstock (corn ethanol), up to where disaggregated defaults are presented for the various stages in the chain (e.g. corn cultivation). Figure 2 illustrates the different levels of reporting default values in the UK RTFO scheme. It gives a good overview of the different levels and their correspondence with data requirements and conservative or actual outcomes.

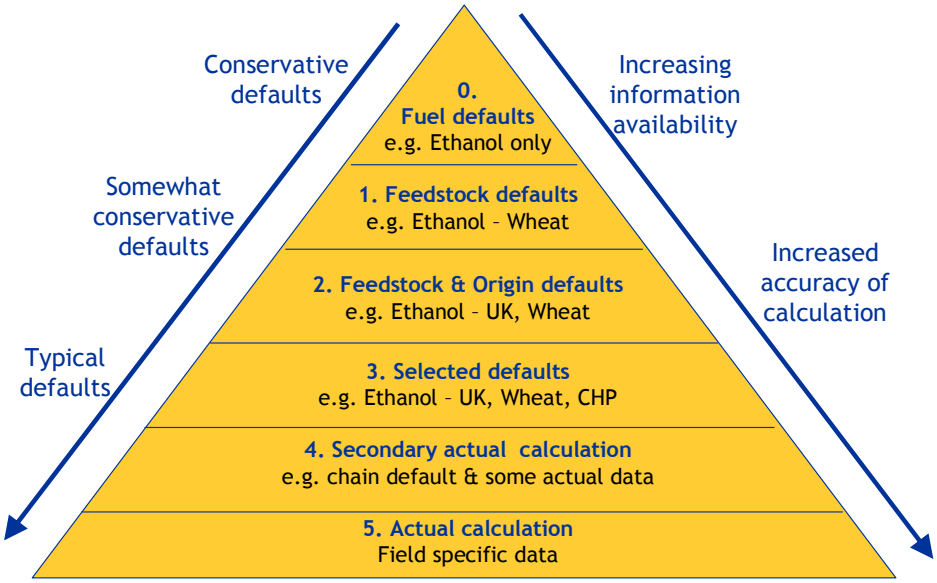

Figure 2: The RTFO presents six levels of reporting on default values, with increasing levels of detail and accuracy of the calculation.

Values become less conservative when they are more detailed (less aggregated), until the level where actual values are used.

The RED Methodology allows default value full or partial results for every level below Fuel defaults (0). It specifies default values on the feedstock level (1) as well as for parts of the chain (4). **The EC has not yet provided detailed guidance on how to use defaults.**

2.5 RED Methodology Default Values

For a range of feedstock-fuel combinations the RED includes default GHG emission values. These default values have been derived from so called "typical values", which are based on calculations by the EC Joint Research Centre in Ispra, Italy (the JRC).

Figure 3 gives some example default emissions. Corn ethanol meets the 2011 threshold of 35%, but it falls short by 1% of the 2017 target of 50%. There is also a 60% threshold from 2018 onwards for facilities that started production after 2016; this threshold is not applicable for Pannonia. Of course, many different process outlines exist for corn ethanol production, but the RED only includes one default value. This is different for wheat ethanol. The graph shows that ethanol from wheat does not automatically comply with the initial GHG requirements. If the plant uses lignite as a fuel, the emission saving is assumed to be only 16% (default); if natural gas is used in a conventional boiler, the emission saving is assumed to be only 34% which is still not sufficient; if natural gas is used for energy production in a CHP the emission saving is 47%, which is sufficient for the 2010 target, but not for the 2017 target); and if straw (or other residue) is used for energy generation, the emission saving becomes 69% by default, which is sufficient until 2020.

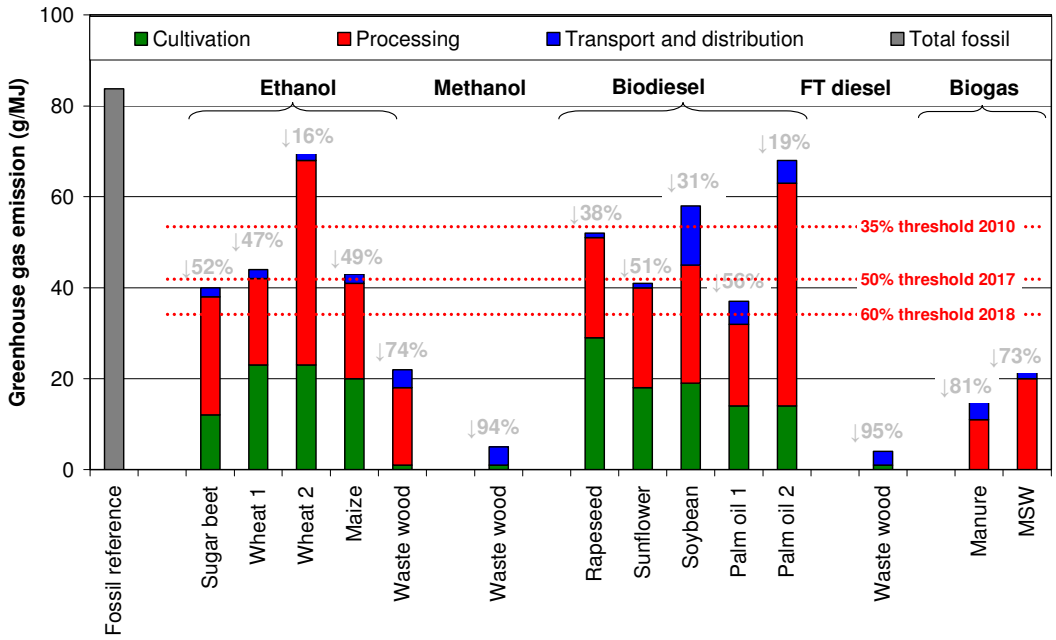

Figure 3: Selection of RED default emissions for a range of crop-fuel combinations.

The RED excludes the use of default values under certain conditions. Aggregate default values (level 1 in Figure 2) may not be used when:

- Land use change takes place after January 2008, since the aggregated default does not include emissions from LUC. Actual values need to be used unless further guidance on how to calculate LUC emissions is provided.

Disaggregated default values (level 4 in Figure 2) for the cultivation phase may not be used when:

- Emissions from cultivation of raw agricultural materials exceed the RED disaggregated default value for cultivation. Member States should identify areas where this is the case (see next Section).

2.6 RED Methodology uncertainties

The RED does not give clarity on all issues that are required to make an exact GHG performance calculation for biofuels. Consequently, each calculation that is made on the basis of the RED Methodology has to be treated with some care. The RED Methodology will be clarified going forward, although further clarifications were initially expected by the EC before the end of 2009 but are still postponed. In this section, we list the Methodology's key current uncertainties.

What is a consignment?

A consignment is a batch of biofuels with the same sustainability characteristics. The RED requires the use of a mass balance system to supply sustainability information through the production chain. This means that feedstock/biofuels that meet the sustainability requirements can be mixed with feedstock/biofuels that do not meet the criteria. On an administrative level these batches have to be kept separated and it has to be ensured that the amount of sustainable feedstock/biofuels that goes into a mixture equals the amount that goes out of the mixture. RED Article 18.1b requires that information about the sustainability characteristics and sizes of the consignments remains assigned to the mixture. However, what a consignment exactly is, is not clear at the moment.

This is currently relevant for Pannonia because its suppliers and buyers may be located in different locations. This means that transport distances are different for the corn supplied to the plant (ranging from 0 km to 50 km), as well as the distance to ethanol buyers. In the future other differences may become relevant, for example at the cultivation phase. At the moment it is unclear whether factory averages are allowed or whether GHG performance has to be calculated separately for each consignment. If the latter is the case, it will increase the administrative burden on Pannonia and may change the GHG performance of different consignments. Although the impact of transport is relatively small (see section 3.3), it may have a large impact if actual values for GHG emission are used for the cultivation phase, which may differ significantly between batches of corn.

Where is the point of allocation in the production process?

Allocation of GHG emissions between the main product and co-products plays an important role in biofuel GHG performance. For corn ethanol, this division generally takes place between the ethanol and DDGS. RED Annex V.C.17 states that when multiple products are produced, they all carry part of the upstream GHG emissions according to the principle of energy allocation. What is still unclear is where this allocation between the main product and the co-products should take place. Picking a different location where a co-product is defined can lead to a different GHG score for the main product, the biofuel. This is because the ratio between the energy content of

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the main product and the co-product may change during the production process. We give two examples for corn ethanol to show what impact this has on the final outcome.

In the dry milling process used by Pannonia, the distillation unit produces ethanol and co-produced "whole stillage". Whole stillage is a mix of 85-90% water and 10-15% solids (protein, fat and fibre). It is usually converted to DDGS through a drying process and sold as feed.

- If we apply allocation at the exact point where co-products emerge, this will be at the exit of the distillation unit. GHG burden should then be divided between the whole stillage and the ethanol in proportion to their energy content. Since whole stillage contains 85-90% water we estimate that the lower heating value is zero. This means that all of the GHG burden collected up to that point, will be allocated to the ethanol;
- If we regard the complete process as a black box, DDGS is co-produced with ethanol. In this case the drier gives a considerable extra GHG burden. However, the total burden is divided more equally over the two products.

Depending on the amount of GHG burden resulting from the drier on the one hand and from the upstream supply chain on the other hand, the first or the second allocation option will yield a lower total GHG emission for the ethanol.

What combination of defaults and actual values is allowed?

The RED specifies defaults at two levels of detail, on the biofuel based on the type of feedstock and on a disaggregated level for different parts of the biofuel chain (see Section 2.4). For the latter option, no information has been supplied on what combinations of disaggregated defaults and actual values are allowed. For example, it is unclear whether GHG emissions from the cultivation phase may be calculated by combining actual data with FAO data and RED assumptions. This is relevant because fertilizer and yield are closely related. Another example is whether it is allowed to use an actual calculated value for cultivation, but a default value for transport and distribution. If actual values are known, then it should be expected that the transport distance is also known.

What source of information may be used for actual data, and what proof should be given?

Related to the previous point is uncertainty about what information sources may be used as proof when using actual data or alternative disaggregated default values. For example, is it allowed to use FAO data on Hungary? What information has to be supplied as proof for the conversion efficiency of corn to ethanol used in calculations?

What NUTS region GHG average is applicable for Hungary?

The RED requires all EU Member States to make an inventory of GHG emissions from the cultivation phase on a NUTS 2 level. A NUTS region is an EU administrative region; level 2 is generally a province. The disaggregated emission values for cultivation in the RED may not be used for the calculation of GHG performance when the NUTS 2 level emissions exceed this. To our knowledge, the Hungarian government has not yet

published this data. Depending on the outcome, it may change the emissions from the cultivation phase of the corn produced in Hungary.

What happens to Indirect Land Use Change (ILUC)?

GHG emissions from ILUC are currently not included in the RED Methodology. Before the end of 2010 the EC is expected to develop a proposal on how to deal with this. It is currently considering several options to deal with ILUC (published in a public consultation document). Box 2 lists the options specified in the consultation document.

Box 2: Proposed option in EC public consultation document

- Extend to other commodities/countries the restrictions on land use change that will be imposed on biofuels consumed in the European Union
- International agreements on protecting carbon-rich habitats
- Do nothing
- Increase the minimum required level of GHG savings
- Extend the use of bonuses
- Additional sustainability requirements for biofuels from crops/areas whose production is liable to lead to a high level of damaging land use change
- Include an indirect land use change factor in GHG calculations for biofuels
- Other policy elements that respondents may wish to raise.

Responses from Member States show that no agreement currently exists on how to deal with this. There seems to be an equal split for and against the inclusion of an ILUC in the RED Methodology. The inclusion of a factor in the RED Methodology can dramatically alter the outcome of the GHG performance of all biofuels produced from food and energy crops. At the moment it is not possible to say how large this impact will be. However, so long as the Facility enters commercial operation prior to 2013, due to a grandfathering provision in the regulations, the impact will be felt on the Facility only after 2017.

3 GHG performance of corn ethanol

This section presents Pannonia's estimated GHG performance based on inputs provided by Pannonia. Section 3.1 gives general conclusions. Section 3.2 explains our calculation. Section 3.3 discusses risks and uncertainties.

3.1 Pannonia GHG Performance

We have developed (and delivered with this Report) an Excel-based calculation tool to calculate Pannonia's expected GHG performance. Although the tool allows any number of different combinations of variables, in this section we present our base-case combination, which we believe to be the most reasonable. This means the use of actual values when available and default values applicable to Hungary where possible.

Pannonia's calculated GHG performance shows a reduction of **54.2%** compared to fossil fuels based on the Technical Assumptions (guaranteed plant performance) and assuming 950 km rail transport of the final product. Based on the Technical Expectations (expected plant performance as observed in similar plants) and assuming 850 km barge transport of the final product this reduction would increase to **57.0%.** This compares favourably with the 49% RED default value for corn ethanol and is similar to the 56% typical value the RED would expect for corn ethanol using actual values (see Figure 4).

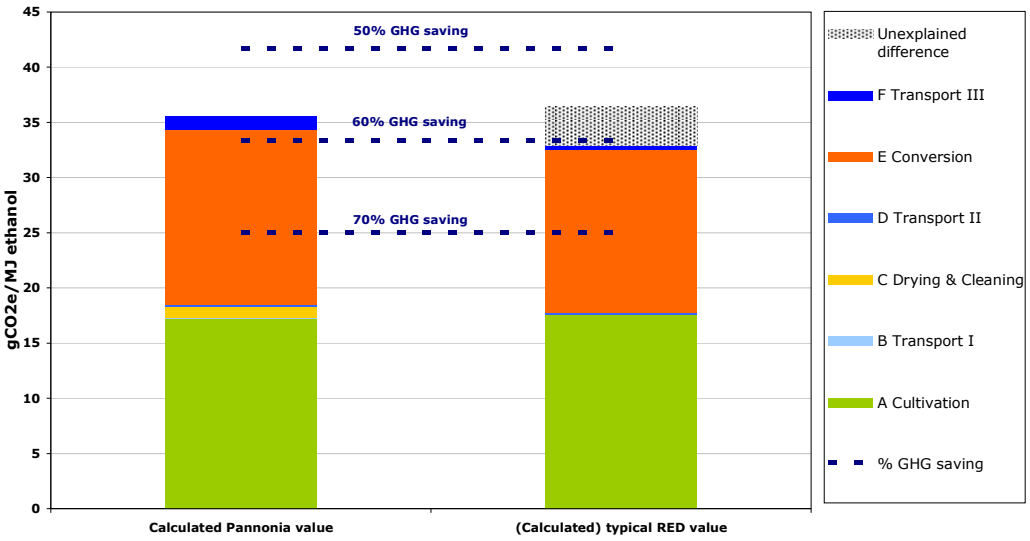

Figure 4: The model output (based on weighted corn supply, expected ethanol plant performance and weighted ethanol distribution) versus the calculated typical RED value, which is 37 gCO2e/MJ ethanol.

In Figure 5 we have also plotted some other default values that are used. It shows that Pannonia's corn ethanol scores similar to all standard / default values for corn

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ethanol presented in legislation. Country specific default values that are used in the UK under the RTFO scheme for France and the USA are both worse.

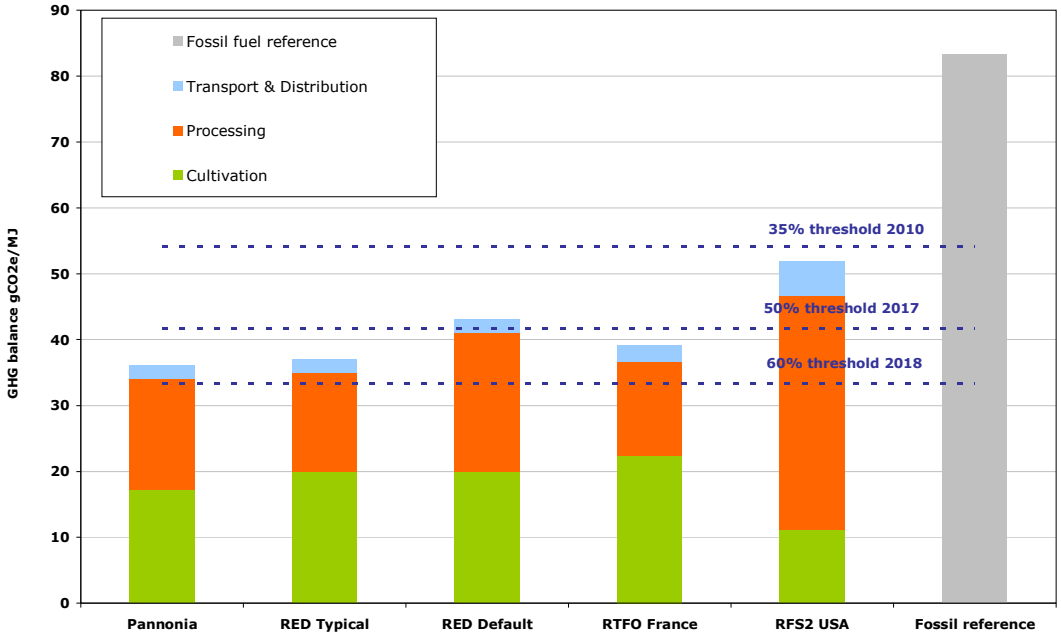

Figure 5: The GHG performance of corn ethanol, quoted in different sources/methodologies.

3.2 Background and Key Assumptions

Inputs for the GHG calculation are partly based on information supplied by Pannonia, and partly based on best guesses of what the supply chain will look like in the future, since not everything has been outlined yet. If no best guesses exist, we used RED assumptions. Figure 6 shows the data sources that were used to make the calculations. Per phase multiple data sources are indicated, the highlighted sources have been used for the base case calculation.

	Phase	Options for data input			
A	Cultivation	Typical value (RED)	Assumption (Pannonia)	Assumption (FAO)	
B	Transport I	Typical value (RED)	Actual		
C	Drying & Cleaning	Typical value (RED)	Actual		
D	Transport II	Typical value (RED)	Actual		
E	Conversion	Typical value (RED)	Actual (observed)	Actual (guaranteed)	
F	Transport III	Typical value (RED)	Actual (Lukoil)	Actual (others)	Actual (weighted)
G	Ethanol depot and filling station	Typical value (RED)			

Data input for base case

Figure 6: The various options for data sources per phase.

The calculations are consistent with the RED methodology and use parameters that have been extracted from spreadsheets used in the RED policy making process, such as, for example, by the JRC. More information can be found in Appendix B.

Make your choice		Choose data input	GHG value	% saving
	Phase		gCO2e/MJ ethanol	
A	Cultivation	Assumption (Pannonia)	17.19	
B	Transport I	Actual	0.09	
C	Drying & Cleaning	Actual	1.00	
D	Transport II	Actual	0.20	
E	Conversion	Actual (observed)	15.85	
F	Transport III	Actual (others)	1.19	
G	Ethanol depot & filling station	Typical value (RED)	0.55	
	Total		**36.07**	**57.0%**

Figure 7: Screenshot from the model showing data used for calculations in various phases.

Key assumptions behind the calculation are:

- **Information on the cultivation phase (A).** Multiannual information on yield, fertiliser use and pesticides has been supplied by Pannonia (and found to be consistent with what would be expected on basis of FAO databases for Hungary specific). For yield results, a five year rolling average has been used. Emission factors associated with material and energy use are taken from assumptions used in the UK RTFO and USA GREET model. As described in Section 2.6, the EC is likely to provide additional guidance soon, on which data sources can be used by economic operators in their actual calculations. Furthermore, Member States were required to submit a report by March 2010 on regional specific cultivation conditions, which might eliminate the possibility of using a cultivation default value or could lead to a better insight into Hungary-specific conditions. Until now, these reports have either not been submitted, or not been published (for none of the Member States).
- **Information on transport distances and means (B, D & F)** is provided by Pannonia, and distances are weighted over the different suppliers/off takers. The corn supply is expected to come from an average distance of 50 km by truck (15 km before drying, 35 km after drying). For the ethanol product, it is assumed that 100% will be transported either 850 km by barge, or 950 km by train.
- **Drying and cleaning (C)** data stems from the inputs provided by Pannonia. Technical Assumptions represent the guaranteed plant performance, Technical Expectations represent the observed plant performance in similar plants built by Fagen.
- **Data for the conversion (E)** are based on inputs provided by Pannonia, that represent expected plant performance. The expected plant performance is derived from observations at similar production facilities. In addition, data input based on guaranteed plant performance can be selected. The most important parameters are natural gas input and electricity requirements. No excess electricity generation occurs, and all DDGS is dried, which makes the calculation reasonably straightforward. As for Step C, both Technical Assumptions (guaranteed performance) and Technical Expectations (observed performance) are used.
- Typical RED values are taken for emissions from the **ethanol depot and filling station (G).**

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3.3 Risks and Uncertainties

Our conclusions are based on several information sources and our current knowledge of the RED Methodology. This implies two areas of uncertainty: 1) the accuracy of information; 2) the correct application of a methodology that is not fully clarified by policymakers. Two input categories are particularly vulnerable to uncertainties:

- Cultivation: Given limited information about the corn cultivation phase, actual data on the corn yield and nitrogen fertiliser application of the actual suppliers may impact Pannonia's results. Moreover, yield and fertiliser inputs are closely related and should not be changed independently.
- Transport: Generally this has a very low impact on GHG performance. Only for long distance transport by truck (e.g. in Brazil) or intercontinental shipping is its contribution material. However, a merchant producer has little influence on who buys its product and how far the buyer transports the product.

Figure 8 shows the sensitivity on actual GHG performance when input parameters are changed within a representative range. It should be noted that nitrogen fertiliser rates and corn yields are not independent variables. However, in this graph we have varied these variables separately as little information exists on the relationship between fertiliser use and corn yields in Hungary. When actual data becomes available, it may show that this ratio to be different. If all best case parameters are chosen, GHG savings increase to 66.0%; compared to 39.4% GHG saving if all worst case parameters are chosen.

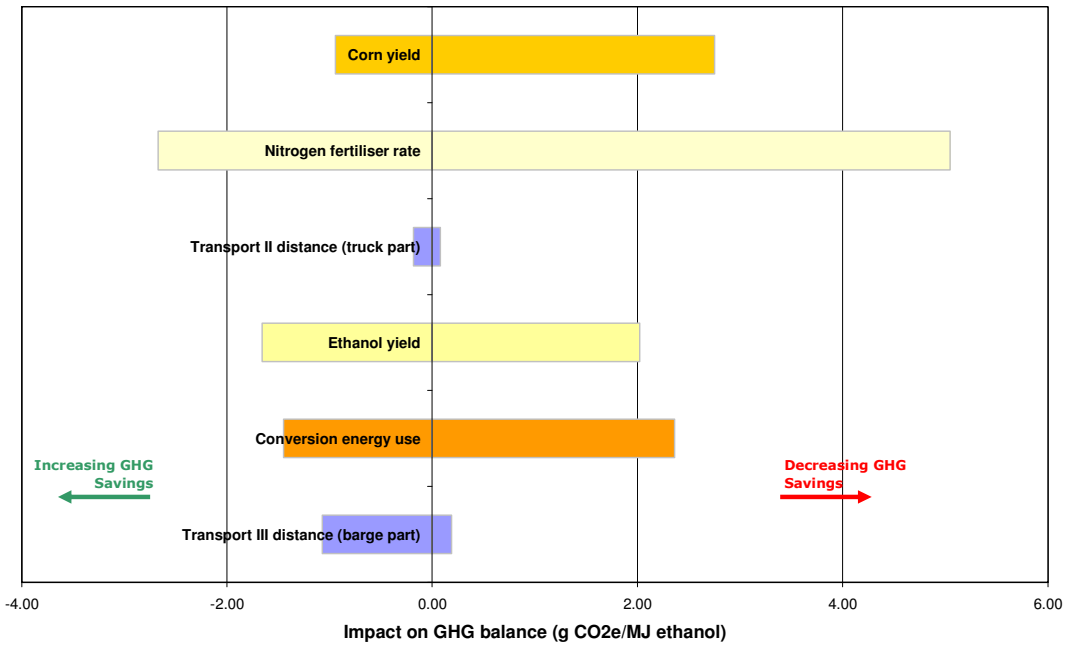

Figure 8: Visual representation of the sensitivities in the GHG calculation. The ranges of the parameter input can be found in Appendix D, as well as the resulting GHG performance.

Depending on how the definition of consignments (see Section 2.6) are interpreted, Pannonia may have to report separate greenhouse gas scores for each distinguishable supply chain. Since, all the corn is assumed to origin from Hungary and the conversion process is constant, the only difference between Pannonia's supply chains is in the transport steps.

- Pannonia may source corn from Cargill ("over the fence"), but this supply chain is not expected to be significantly different than direct sourcing from other suppliers, since on average the corn will be transported over the same distance.
- Pannonia may sell part of the ethanol to Lukoil ("over the fence"), which requires no transport distance in Transport step III. In that case, the emission reduction improves to 58.4%. This value will be applicable to a maximum of 10% of its consignment of ethanol.

The difference of 1.4% points between the transport by barge and the short pipeline to Lukoil is still small and may not be significant given the larger uncertainties in other parts of the biofuels chain. Differences in consignments do become more important when, for example, differences in fertiliser use have to remain attached to the consignment of feedstock, instead of being averaged over the total feedstock input.

Finally, we have indentified additional uncertainties, with respect to the Methodology in Section 2. For these uncertainties it is complex to quantitatively assess the implications on GHG saving. In general, it can be said that changes in the Methodology will affect all biofuel producers. This especially holds for including a carbon factor to deal with indirect land use change effects. In theory it could also lead to significant differences between corn ethanol producers. This is especially the case when it concerns DDGS production, as whether the grains are sold wet or dry.

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Appendix A ILUC

A 1 Understanding indirect effects of biofuel production

Indirect effects (or 'displacement' or 'leakage' effects) form one of the main and most complex threats to the sustainability of biomass production for biofuels. Options provided to prevent indirect effects will generally also be beneficial in preventing unwanted competition with food.

Indirect effects can occur when the production of biomass displaces certain activities to other areas where this may cause negative land use change. These land use changes are a treat to sustainability issues, such as:

- Biodiversity: areas that have high biodiversity value (e.g. tropical rainforests) may be converted;
- Land rights: the displaced activity may relocate elsewhere, where it may lead to conflicts with local communities over land rights;
- Carbon stocks: large carbon stocks may be destroyed, such as dense forests or by draining peat soils - these lead to large GHG emissions;

Textbox 1- An example of how indirect effects work in practise

> If production from an existing plantation, e.g. palm oil, is used for supplying the biodiesel market, but was previously used for food purposes, displacement effects can occur. Because palm oil is now supplied to the biodiesel sector, the food sector is confronted with a shortage in supply. In the short term this could lead to higher prices as supply is slow to adapt. However, on the longer term this demand will require additional plantations. Where these plantations will be located is uncertain, and more importantly, is out of control of the biofuel industry.

If demand from the biofuel sector is met by feedstock from existing plantations, displacement of previous production (e.g. for food purposes) might occur since total demand still has to be met by sufficient supply (or consumption in other sectors has to decrease which could negatively impact food security); this could cause an indirect land use change. One of the ways to prevent indirect effects is to produce biofuel feedstock on land that was previously not in production for any purpose, so-called idle land[1]. Figure 9 illustrates both direct and indirect effects.

[1] Also referred to as degraded lands or marginal land.

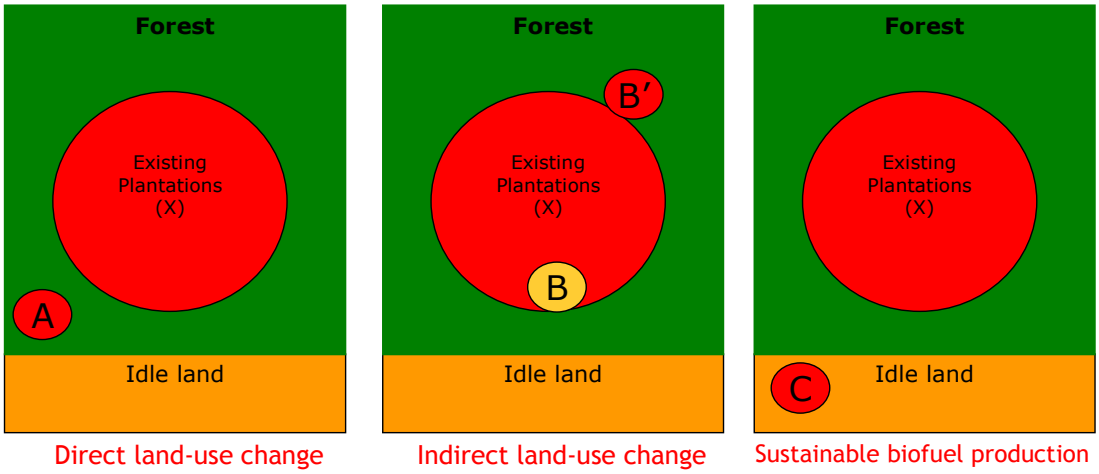

Figure 9- Illustration of direct and indirect land use change. 'A' is new demand from the biofuel sector on new plantations leading to a direct LUC. 'B' is demand from the biofuel sector from existing plantations, leading to displacement of existing production to new plantations ('B`': indirect LUC). 'C' is one of the options to avoid indirect LUC, by expanding production of energy crops on 'idle land'.

A 2 How to cope with indirect effects

In coping with the challenges of indirect effects, it is important to note that commodity markets are global markets and displacement effects act across borders. Having effective *national* land use planning in place will not avoid all indirect effects. For example country X shifts palm oil exports to domestic biodiesel production, the displaced exports may lead to increased production in country Y to compensate for this decrease in exports.

Another complicating factor in managing displacement effects is that these effects act across different crops and other land uses. An often cited example is where the expansion of soy replaces cattle ranges and small farmers. Thereby, the expansion of soy does not replace the forest directly, but indirectly, by pushing cattle ranges and small farmers into the forest.

Options to prevent indirect effects

To prevent indirect effects, the 'additional' biomass consumption for biofuels must be supplied from 'additional' production which does not displace other (agricultural) activities. There are basically, three ways to achieve this:

- Additional production on idle land (in line with sustainability criteria);
- Additional production through intensification. The key aspect here is that the introduction of energy crop cultivation should not displace current agricultural production. This can be achieved by:
    - Increasing yields of existing energy crops;
    - Integration of energy cropping with other agricultural functions whereby the introduction of energy crops leads to in increased productivity of the original agricultural functions. E.g. combined sugar cane plantations and

cattle farms in which excess bagasse is used as animal feed – reducing the land requirements for cattle grazing.

- Biofuels produced from waste products and residues.

Possibilities to include indirect effects in a standard (e.g. RED)

Summarising the possibilities to include indirect effects in a standard are:

- Distinguish between biofuels that may cause indirect LUC and those that do not. This requires a better understanding of concepts that can prevent indirect LUC, such as idle land and sustainable intensification. Currently such concepts are still poorly defined.
- Once the distinction can be made, policy measures can provide specific incentives for biofuels that do not cause indirect LUC. These incentives can be created in at least two ways:
    - Introduction of a split biofuel target, in which an increasing amount of biofuels need to come from feedstocks that do not cause indirect LUC
    - Provision of additional support to biofuels that do not cause indirect LUC.
- Include indirect effects in the GHG methodology of the standard by including a 'GHG-penalty' to those biofuels than come from existing agricultural land. The use of a standard bonus for biofuels from degraded land is not recommended. A proper GHG methodology that takes direct LUC into account will automatically reward biofuels produced from energy crops that increase carbon stocks.

Note that even with a GHG-penalty for indirect LUC, there will still be a need to distinguish between biofuels that cause indirect LUC and those that do not, see above.

A 3 Summarising

Preventing indirect land use change is not yet included as minimum requirements in either the RED or the RTFO. However, ILUC is the most contentious issue around biofuel sustainability today and companies will take an interest in biofuels that can be demonstrated not to cause ILUC. From around 2012 it is also expected that ILUC will be included in the sustainability criteria or GHG-methodology of the RED.

- Work on preventing ILUC is still in its infancy. Three options to prevent ILUC include:
    - Use of residues and wastes
    - Expanding production on previously unused land if available and in line with other sustainability criteria on biodiversity, carbon stocks, land rights, etc.
    - Sustainable increase in agricultural productivity that would "free-up" arable land.

Appendix B The Excel Model

We have used the following colour coding throughout the worksheets

input by Pannonia
fixed value
calculated value
not applicable

The Excel Model consists of two Worksheets:

- **Overview**: this sheet shows the results
- **Inputs & Calculations**: in this sheet the inputs and parameters are given and the calculations are made.

In **Overview** we distinguish:

- **Remarks**: general remarks about the calculation are made (these have also been included in the report).
- **Results**: in this section for each phase the type of data input needs to be specified. The results table shows the disaggregated GHG emissions per phase. Under 'Total' one can show the calculated GHG performance, but one could also show the Typical RED value.
- **Graphical outcome**: The selected values from the results table are plotted in the left diagram. The Typical RED value is shown on the right (please note that there is a difference between the *calculated* typical RED value, and the value as *presented* in the RED: this is corrected for by the grey area).
- **Sensitivity analysis**: the impact of various fluctuated parameters on the GHG performance is graphically shown.
- **Benchmark**: in this graph the selected values from the results table are plotted against other default/standard values used in legislation.

In **Inputs & Calculations** we distinguish:

- **Parameters**: These are similar parameters as have been used in the calculation of values presented in the RED. Parameters are standardised and there is no need to change these.
- **Inputs**: Five columns are shown that each represent a set of data input, e.g. Actual values or RED typical values. These values could be changed if other information becomes available.
- **GHG calculation**: In this part the parameter values and the inputs values are used to do the actual GHG calculation. The results are shown in the same five columns as the inputs. There is no need to adapt these calculations.
- **Sensitivity analysis**: In this part the values of the fluctuated parameters are given and the sensitivity calculation has been executed. If changes are needed, these need to be added in the grey table.

Appendix C Inputs used in the calculation

Stage / Parameter		Excel name	Value					Unit	Remark
A Cultivation			Typical value (RED)	Assumption (Pannonia)	Assumption (FAO)				
Corn yield		Corn_yield_X	3.5	6.57	5.56			ton corn/ ha	Data provided by Ethanol Europe May 2010
N fertiliser			51.7	92.66	115			kg nutrient / ha	Data provided by Ethanol Europe May 2010
P fertiliser			34.5	1.78	20			kg nutrient / ha	Data provided by Ethanol Europe May 2010
K fertiliser			25.9	5.455	24			kg nutrient / ha	Data provided by Ethanol Europe May 2010
NPK fertiliser				40.155					Data provided by Ethanol Europe May 2010
Pesticide			2.4	4.51	4			kg nutrient / ha	Assumed RED ratio
Diesel			3600	4697	4697			MJ diesel/ha	Diesel use for France (RTFO quoting GREET Model) for assumption case
B Transport I	**Plantation to drying facility**		Typical value (RED)	Actual					
Distance				15				km	
Modus				Tractor					
C Drying & Cleaning			Typical value (RED)	Actual					
Fossil fuel type				Natural Gas				MJ/ton corn	
Fossil fuel use				209					
Electricity use				0				kWh/ton corn	
D Transport II	**Drying facility to biofuel plant**		Typical value (RED)	Actual (Cargill)	Actual (others)	Actual (weighted)			
Distance			50	0	35	31.5		km	
Modus			Truck	Conveyor belt	Truck	Truck			
E Conversion			Typical value (RED)	Actual (observed)	Actual (guaranteed)				
Ethanol yield		Ethanol_yield_X	0.304	0.314	0.314			ton ethanol / ton corn	
DDGS yield			1.390	1.021	1.021			ton DDGS/ton ethanol	1.305 kg/L ethanol according to EE input, is this too high (should this be 1.305 kg/kg ethanol)?
Ethanol allocation factor		Allocation_X	52%	59%	59%				
Fossil fuel type			Natural gas	Natural gas	Natural gas				
Fossil fuel use			24290	9661	11234			MJ fuel / ton ethanol	
Electricity use			0	130	158			kWh/ton ethanol	
F Transport III	**Biofuel plant to ethanol depot**		Typical value (RED)	Actual (Lukoil)	Actual (others)	Actual (weighted)			
Distance			150	0	850	765		km	
Modus			Truck	(Pipeline)	Barge	Barge			
G Ethanol depot and filling station			Typical value (RED)						
Electrictiy use ethanol depot			22.51					MJ elec/ton ethanol	
Electricity use filling station			91.12					MJ elec/ton ethanol	
Cogeneration credit (only in RED Default cases)			Typical value RED						
Excess electricity production			-7197.81					MJ elec/ton ethanol	
Reference emission factor			0.12309214					kgCO2e/MJ fuel	1.82 MJ fuel / MJ elec & 0.07 kgCO2/MJ for Natural Gas

Appendix D Sensitivity Analysis

Parameter	Reason for variation	Base case	Low value	High value		Remark
Corn yield	Uncertainty	6.57	5.26	7.17	ton corn / ha	Proposed variation by Pannonia. Fertiliser kept at same value.
		100%	*80%*	*109%*		
Nitrogen fertiliser rate		92.66	51.7	170	kg N / ha	High fertiliser number is for France, low value comes from RED typical calculation
		100%	*56%*	*183%*		
Transport II distance		35	0	50	km	
		100%	*0%*	*143%*		
Ethanol yield		0.314	0.283	0.345	ton ethanol / ton corn	10% up and down. Co-product yield, allocation, energy use is kept at same value. This adaptation does impact GHG of preceeding phases
		100%	*90%*	*110%*		
Conversion energy use		9661	8695	11234	MJ / ton ethanol	Variation between guaranteed value and 15% less energy use (when no DDGS drying)
		100%	*90%*	*116%*		
Transport III distance		850	0	1000	km	
		100%	*0%*	*118%*		

Parameter	Low GHG value	High GHG value	(g CO2e/MJ ethanol)	
Corn yield	34.81	38.50		
Nitrogen fertiliser rate	33.08	40.79		
Transport II distance (truck part)	35.75	35.75		
Ethanol yield	34.11	37.75		
Conversion energy use	34.30	38.11		
Transport III distance (barge part)	34.68	35.94		

Appendix E Gross emissions for base case

	GHG value	Guaranteed Per unit ethanol	200 m l/a plant	Observed Per unit ethanol	240 m l/a plant	Fossil reference Per unit fossil fuel	(Ethanol equivalent) 200 m l/a plant	(Ethanol equivalent) 240 m l/a plant
	Phase	gCO2e/MJ ethanol	thousand tonne CO2	gCO2e/MJ ethanol	thousand tonne CO2	gCO2e/MJ fossil fuel	thousand tonne CO2	thousand tonne CO2
A	Cultivation	17.2	73.2	17.2	87.8			
B	Transport I	0.1	0.4	0.1	0.4			
C	Drying & Cleaning	1.0	4.3	1.0	5.1			
D	Transport II	0.2	0.9	0.2	1.0			
E	Conversion	18.5	78.7	15.9	81.0			
F	Transport III	1.2	5.1	1.2	6.1			
G	Ethanol depot & filling station	0.5	2.3	0.5	2.8			
	Fossil reference					83.8	356.6	428.0
	Total	**38.72**	**164.8**	**36.07**	**184.2**	**83.8**	**356.6**	**428.0**
	Total savings	**45.08**	**191.8**	**47.73**	**243.7**			

Pannonia Ethanol: Feedstock and Market Report

Final report for

NordKap Bank AG

by

Agra CEAS Consulting in conjunction with F.O. Licht

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Unit conversions

1 hectolitre	100 litres
1 m^3 / cubic metre	1,000 litres
EU€/m^3	EU€ cents/litre or EU€/1,000 litres
US$/$m^3$	US$ cents/litre or US$/1,000 litres
1 barrel (oil)	158.98 litres
1 ton (ethanol)	1,266 litres

Executive Conclusions

Nordkap Bank AG has mandated Agra CEAS Consulting to prepare this report in relation to anticipated senior debt financing of an approximately 200 million litre capacity maize ethanol production facility in Dunaföldvár, Hungary (the "Project").

Agra CEAS Consulting is a joint venture between Agra Informa and Imperial College (UK) delivering policy and economic research and consultancy to the agri food and biofuel chain through analysis and evaluation. Agra Informa is a leading information specialist on soft commodities, agriculture and food policy, markets and trade. F.O. Licht – part of the Agra Informa group – is considered the leading source in Europe for information on the global biofuel market.

The market for biofuel is (in the main) politically driven, meaning that policy developments ultimately drive demand for bio-ethanol and hence the structure and development of the bio–ethanol industry.

The EU's energy policy goals are to increase the demand and use of biofuel in road transport fuels. Biofuel policies at the EU level have been driven by:

- the desire within the EU for energy security;
- the wish to diversify and support EU agricultural incomes; and
- the need to reduce carbon emissions to meet EU environmental targets.

EU biofuel policy has evolved rapidly this decade and has included non-binding targets of 2% biofuel content in transport fuels by 2005 and 5.75% biofuel content in transport fuels by 2010. In contrast to the United States, where biofuel now constitute more than 10% of transport fuels, the European Union biofuel industry is not in a position to meet its 2010 goals. The EU anticipates only 4% biofuel use in 2010, and the 2005 actual number was 1.4%.

There is currently no expectation that the European Union will be able to meet biofuel goals purely from domestic sources in the short or medium term, and EU Commission reports suggest that the EU will have to import around 20% of its biofuel requirements despite imposing high tariffs on imported ethanol, as well as on imported grains.

Current EU policy calls for 10% of all transport fuels (by energy content; by volume the number would be higher) to be from renewable sources by 2020. This 10% target is an aggregate target for 2020; however individual member states are likely to have differing national plans for achieving this target (which must be submitted by 30th June 2010).

In order to be eligible for meeting these binding targets, biofuel must meet certain sustainability criteria including greenhouse gas efficiency criteria. The sustainability criteria include qualitative factors related to land use, social issues and broad environmental issues. The greenhouse gas efficiency criteria set forth minimum standards (35% net greenhouse gas reductions) for the period

to 2017, and 50% thereafter for facilities that enter commercial operation before 2017. More efficient biofuel production facilities, especially facilities using combined heat and power approaches, will, accordingly have an advantage going forward. Likewise, imports from tropical or otherwise forested countries may not find it possible to meet these sustainability criteria due to restrictions against any nexus between eligible biofuel and the loss of tropical or otherwise biodiverse environments.

Maize is the most important crop in Hungary, covering 38% of arable land, and Hungarian production costs are among the lowest in the EU. Until recently, the EU operated an intervention scheme to ensure minimum prices for maize. With the discontinuance of this scheme in 2009, maize prices have fallen dramatically. Because of the importance of maize to the Hungarian economy and the low level of productivity of Hungarian maize farming, Hungary, which currently exports around two-thirds of its maize crop (67% in 2007; 79% in 2008; up from 25% between 2004-2006) can be expected to be able to substantially expand maize production in coming years with appropriate price signals. Hungarian maize producers currently produce only approximately two-thirds of the yield per hectare obtained by their Western European counterparts.

The EU is the fourth largest maize producer in the world, with Hungary producing approximately 10% of EU maize. Maize production is expected to expand EU-wide in the next decade. Even taking into account biofuel production targets, the EU does not anticipate biofuel using more than 7% of the maize crop in 2015.

Agra CEAS considers it unlikely that the 10% mandate will be achieved, but assumes in its forecasting that the non-binding 5.75% EU biofuel blending target will be met by 2020. This equates to approximately 11.3 billion litres of ethanol demand. We estimate 2009 year-end EU ethanol production to be approximately 6.0 billion litres, up 1.7 billion litres from 2008. However, it should be noted that approximately 2.2 billion litres of this amount is for non-fuel use (i.e. for beverage, pharmaceutical and other industrial use). The EU imported approximately 1.7 billion litres of ethanol in 2008, and we anticipate imports of 1.1 billion litres in 2009. Almost half of all imports are from Brazil.

Relatively few EU bio-ethanol production facilities are currently under construction (or expansion), and, to the best of our knowledge, no new projects have broken ground in 2009. We note that there is no guarantee that projects under construction will be completed or operate at full capacity (and we note that several new projects due to come on line in 2008 and 2009 have been stopped due to design and construction issues). However, even assuming that all existing and under-construction fuel ethanol facilities operate at full capacity, there would still be a domestic supply shortfall of approximately 4.2 billion litres to meet the EU target.

Based upon our own research and information provided by Ethanol Europe, it is our opinion that:

- the Project appears to meet EU sustainability requirements because maize produced in Hungary is reasonably certain to be produced from lands that have historically been used for farming.
- The Project would appear to meet both the current EU minimum 35% greenhouse gas efficiency standard and the 50% standard for 2017 onwards as set out in EU Directive 2009/30, assuming the Project is fully operational by 2017. The Directive assumes typical GHG savings from EU maize-based facilities with combined heat and power (as is the case for this Project) of 56%.
- It is not considered likely that the Project would face any barriers to maize procurement, and it is reasonable to assume that all of the Project's maize will come from Hungary.
- Agra CEAS forecast an average base case (US$60/bbl oil) maize price of EU€ 128/ton and a stress case (US$40/bbl oil) maize price of EU€ 119/ton for the period through 2020.
- There is significant potential for Project ethanol sales and it is reasonable to assume that all of the Project's ethanol will be sold via the Danube to refiners and blenders in Croatia, Hungary, Austria and Germany.
- Agra CEAS forecast an average base case (US$60/bbl oil) ethanol price of EU€ 0.51/litre (delivered Rotterdam ex Brazil) and a stress case (US$40/bbl oil) ethanol price of EU€ 0.53/litre for the period through 2020.
- Project ethanol sold in Vienna would be competitive *with ethanol imported from Brazil and transported from Rotterdam to Vienna* at a price below EU€ 0.53/litre; i.e. the forecast average base case (US$60/bbl oil) ethanol price of EU€ 0.51/litre (delivered Rotterdam ex-Brazil price) plus EU€ 0.02/litre transport from Vienna to Rotterdam.
- Although the European market for distillers' grains is relatively undeveloped, it is considered likely that the market price for this commodity would remain closely associated with the price for maize and other commodities used for animal feed. On the basis of observed historic price associations and forecast world maize and oilmeal prices, the world DDGS price is estimated at US$ 127/ton (range US$ 110-139/ton), i.e. 80% of world maize price (US fob Gulf) in the period to 2018/19.
- In Hungary, based on historic *ad hoc* price relationships observed over the past 5-years in the EU and the average base case (US$ 60/bbl) forecast maize price in Hungary (EU€ 128/ton), the DDGS price is estimated at approximately EU€ 147/ton for the period to 2020.

Executive Summary

S1. Background to the study

This study has been conducted as part of the market due diligence for a plant to be built in Hungary by Ethanol Europe Ltd / Pannonia Ethanol Zrt for the potential lenders Nordkap Bank AG. The analysis has been conducted primarily on the basis of desk research drawing on Agra CEAS' and F.O. Licht's extensive sector experience, in-house data and Agra CEAS' econometric model of the world ethanol market. It is understood that Ethanol Europe/ Pannonia Ethanol intends to construct a fuel ethanol plant located just north of the town of Dunaföldvár in Hungary using maize feedstock and producing Distillers' Dried Grain with Solubles (DDGS) and/or Wet Distillers Grain with Solubles (WDGS) as well as CO_2.

S2. Feedstock market analysis

EU maize production is forecast to rise by 5.4% from 60.9 million tons in 2009 to some 64.2 million tons in 2015 according to recent estimates from the European Commission. Maize consumption is forecast to increase by 9.5% from 60.0 million tons in 2009 to 65.7 million tons in 2015. Maize imports are expected to rise by 20% from 3.0 million tons to 3.6 million tons over the period, while maize use for biofuel production is forecast to expand substantially by 228% from 2.5 million tons in 2009 to 8.2 million tons by 2015 (12.5% of total EU domestic maize use). There would be sufficient scope to expand EU cereal production to meet expected biofuel demand, for example by bringing some 5 million hectares of uncultivated fallow land into production in addition to expected increases in maize crop yields over time. However, European Commission estimates suggest that this would not be necessary as biofuel use is expected to reach just 7% of total cereals consumption in 2015 and the EU cereals market is forecast to remain relatively balanced throughout the period.

Hungary is a net exporter of maize, with net exports amounting to some 3.1 million tons in 2008. Over the period since EU accession, the average market price in Hungary (delivered Budapest) was EU€ 122/ton (US$ 164/ton) compared to EU€ 151/ton (US$ 199/ton) in Germany (delivered Hamburg). Maize prices for the period 2009-2020 were forecast using the Agra CEAS world biofuel and feedstock model under three different (constant) crude oil price scenarios. Under the baseline (US$60/bbl) scenario, Hungarian maize prices are forecast to fall from EU€ 152/ton (US$224/t) in 2008 to EU€ 126/ton (US$183/t) in 2020; compared to EU€ 111/ton (US$161/t) under a lower oil price (US$40/barrel) scenario and EU€ 135/ton (US$195/t) under a higher oil price (US$80/barrel) scenario.

S3. Co-product market analysis

EU-27 DDGS output as a co-product of ethanol production (from maize and wheat) is expected to rise from around 3.01 million tons in 2008, to some 4.99 million tons in 2020, based on forecast ethanol output under the baseline US$60/bbl oil price scenario using the Agra CEAS biofuel forecasting model and generalising assumptions relating to the proportion of ethanol likely to be derived from cereal grains.

The EU is approximately 23% self sufficient in the production of proteins and therefore, in the context of an EU compound feed market of some 150.6 million tons in 2008 (FEFAC data), the volume of EU DDGS production foreseen in the medium-term is not expected to cause any oversupply in the EU animal feed sector. Hungarian production of compound feeds totalled some 4.1 million tons in 2008. It is estimated that the Hungarian livestock sector alone could potentially absorb some 1.035 million tons of DDGS annually, with any surplus output exportable.

The market for DDGS in the EU is relatively undeveloped and therefore there is no consistent price history. By comparison, in the US market (the largest world DDGS market) DDGS prices have historically tracked maize and soybean meal prices closely. Based on an analysis of historic price spreads between DDGS, maize and soybean meal, the US$ denominated world DDGS price is estimated at US$ 127/ton (range US$110-139/ton) over the period to 2018, i.e. at around 80% of the forecast world (fob US Gulf) maize price.

In the EU, oilseed meals are increasingly available in the EU as a result of increased cultivation and demand for biodiesel production. However, given that the EU is a net importer of protein crop products used for livestock feed and considering that the feeding value of DDGS is higher than that of straight maize (whole crop) due to the nutrient concentrations, *ad hoc* market quotes for DDGS in the EU market have typically been priced at premium of around 15% over feed ingredients. On this basis, the DDGS price in Hungary over the period is estimated at approximately EU€ 147/ton in the period to 2020, based on the average base case (US$60/bbl oil) maize price of EU€ 128/ton.

S4. Ethanol market analysis

EU ethanol production is forecast to rise under the baseline (US$60/bbl oil) scenario from 5.0 million m^3 (5.0 billion litres) in 2008 to 7.3 million m^3 (7.3 billion litres) in 2020. Over the same period, EU consumption is forecast to increase from 6.7 million m^3 (6.7 billion litres) to 9.9 million m^3 (9.9 billion litres). This is expected to lead to an increase in EU net imports over the period of just under 1.0 million m^3 (1.0 billion litres), from 1.7 million m^3 (1.7 billion litres) to 2.6 million m^3 (2.6 billion litres).

These forecasts are based on the assumption that by 2020 the 10% mandate for biofuel to account for 10% of total transport fuel would <u>not</u> be met and that the 5.75% target (as originally set out under Directive 2003/30/EC for 2010) will only be met by 2020. This is because it is considered that the markets and technologies will not have had sufficient time to be put in place to achieve the 10% target. However, should a higher percentage fulfilment of the EU's target be achieved, then this

would be beneficial to Pannonia in the sense that it would imply a larger overall market. This therefore represents a conservative and cautious view of the likely size of the EU market.

S5. Factors that impact EU ethanol demand and supply

The demand for ethanol in the EU is largely policy driven. EU energy policy essentially aims at increasing the demand and use of biofuel in road transport fuels through the 2020 blending mandate introduced in 2009 under the Renewable Energy Directive (Directive 2009/28/EC) and by tax incentives under the Directive on the Taxation of Energy Products (Directive 2003/96/EC).

However, the future demand for ethanol is largely determined by the comittmentv of politicians to ensure that the targets and mandates are met by the industry. The European Commission confirmed that the EU was also unlikely to achieve its 5.75% target by 2010, however by 2013 the Commission now believes an incorporation rate of 5.5% could be reached if Member States stringently aim at meeting the 10% mandate set for 2020 although as is indicated above this is considered unrealistic.

The extent to which EU ethanol production will increase to meet domestic demand is in large part determined by the competitiveness of EU production with imports from third countries both under tariff restrictions (as is the case with Brazil) and from countries with preferential access to the EU market such as African, Caribbean and Pacific (ACP) countries under the Everything but Arms agreement (EBA). As the model forecasts show, it is likely that EU domestic production will rise, but the supply deficit will continue to grow to 2020 and would have to be met by increased imports, assuming that the demand for fuel ethanol rises as forecast. This indicates clearly that there will be a more than adequate market for ethanol produced by Pannonia in Hungary.

In the medium term, either as part of a multilateral WTO outcome or a bilateral EU-Brazil arrangement, improved access for Brazilian exports is to be expected; however, in the medium to long term this access is likely to be limited and should therefore not pose a significant threat to EU ethanol producers.

S6. Ethanol price analysis

EU ethanol prices have typically ranged between EU€ 500/m^3 and EU€ 600/m^3 (EU€ 0.50-0.60/litre) over the last decade, peaking at around EU€ 665/m^3 (EU€ 0.67/litre) when oil prices surged in 2008.

Biofuel prices for the period 2009-2020 were forecast using the Agra CEAS world biofuel and feedstock model under three different (constant) crude oil price scenarios (US$40/bbl, US$60/bbl and US$80/bbl). Under the baseline (US$60/bbl) scenario, the average EU ethanol price in the period to 2020 is forecast at EU€ 505/m^3 (EU€ 0.51/litre); falling from EU€ 561/m^3 (EU€ 0.56/litre) in 2008 (year average) to EU€ 467/m^3 (EU€ 0.47/litre) over the period. Under a lower oil price (US$40/barrel) scenario the average EU ethanol price is forecast at EU€ 476/m^3 (EU€ 0.48/litre) compared to EU€ 530/m^3 (EU€ 0.53/litre) under a higher oil price (US$80/barrel) scenario.

S7. Factors that affect price of ethanol

Econometric analysis suggests that biofuel prices are determined by the crude oil price irrespective of feedstock. The price of biofuel going forward will continue to be driven by the future evolution of, and volatility in oil prices. Furthermore, as energy markets absorb a greater share of harvested crops, feedstock prices are expected to move more in line with developments in energy (crude oil) prices.

The EU ethanol price is determined at the world level, i.e. at import parity. This represents the ceiling price for EU domestic production, above which ethanol could be imported into the EU at a lower cost than domestic production. EU ethanol prices are driven by the Brazilian (export) price with the price spread determined by a function of transport, insurance, tariffs and other transaction costs (including exchange rate movements). Between 2002 and mid-2009, the price differential between EU ethanol and Brazilian ethanol has averaged at US$ 296/m^3 (EU€ 0.24/litre). According to the *law of one price*, this price differential over the long run should equal the cost of transport to the importing country (i.e. from Brazil to EU) plus any transaction costs. The EU import tariff for fuel ethanol is EU€ 192/m^3 (EU€ 0.19/litre) and an indicative freight cost for shipping ethanol from Brazil to the EU is in the region of EU€ 43/m^3 (EU€ 0.04/litre). Assuming other transaction costs of EU€ 8.0/m^3 (EU€ 0.01/litre), this would suggest that the law of one price holds, with the price for ethanol in the EU being set at import parity.

S8. Competitiveness analysis

Based on the production cost data provided by Pannonia, ethanol from the proposed plant in Hungary would be competitive with other EU ethanol production using wheat and sugar beet feedstock, with an expected net production cost of EU€ 326/m^3 (EU€ 0.33/litre) (subject *inter alia* to assumptions for feedstock and co-product prices) compared to wheat ethanol net costs of EU€ 429/m^3 (EU€ 0.43/litre) and sugar beet ethanol costs of EU€ 340/m^3 (EU€ 0.34/litre) (indicative average net production costs between 2004/05 and 2008/09). Brazil remains the most cost competitive ethanol producer with net production costs of around EU€ 199/m^3 (EU€ 0.20/litre).

In the context of EU ethanol imports from Brazil, ethanol produced by Pannonia at Dunaföldvár would be competitive on a delivered Rotterdam basis, due to the impact of ocean freight costs and tariff protection (subject inter alia to feedstock and co-product price assumptions). Based on the production costs provided by Pannonia, the cost of ethanol delivered to Rotterdam including freight via inland waterway (Danube/Rhine) is estimated at EU€ 353/m^3 (EU€ 0.35/litre) compared to a delivered Rotterdam cost of EU€ 434/m^3 (EU€ 0.43/litre) for imported ethanol ex-Brazil. On the basis of the forecast average base case (US$60/bbl oil) ethanol price of EU€ 505/m^3 (EU€ 0.51/litre) (delivered Rotterdam ex-Brazil price) plus EU€ 24.0/m^3 (EU€ 0.02/litre) transport from Vienna to Rotterdam, ethanol produced by Pannonia at Dunaföldvár and sold in Vienna would be competitive with ethanol imported from Brazil and transported from Rotterdam to Vienna at a price below EU€ 529/m^3 (EU€ 0.53/litre).

1. Introduction

1.1. Background of the study

This study has been conducted as part of the market due diligence for a plant to be built in Hungary by Ethanol Europe Ltd / Pannonia Ethanol Zrt for the potential lenders Nordkap Bank AG. The analysis has been conducted primarily on the basis of desk research drawing on Agra CEAS' and F.O. Licht's extensive sector experience, in-house data and Agra CEAS' econometric model of the world ethanol market.

1.2. Report objectives

The scope of our due diligence report for Ethanol Europe's proposed plant will focus geographically on the European region and more specifically on Hungary. That said, it is important to acknowledge that the ethanol sector, and its interrelationship with the agricultural sector, is truly global in nature at both the feedstock and biofuel market level. As such, although the study will provide a particular geographical focus on Hungary and the wider European region from an investment perspective, the rationale for investing in Hungary has to be seen within the wider context of the European and global biofuel and agricultural markets. Therefore, our due diligence process will not be limited solely to the Hungarian and wider European feedstock and biofuel markets.

1.3. Methodology

This analysis has been undertaken on the basis of desk research drawing on our extensive sector experience, our in-house data and econometric model of the world ethanol market, a structured internal brainstorming process, where necessary telephone interviews with relevant parties and reviewing relevant literature.

2. Feedstock market analysis

2.1. Choice of feedstock

Ethanol can be produced from a variety of different feedstock, which can be divided into two main groups: renewable (agricultural/fermentation) and non-renewable (synthetic). Both products are chemically identical. Nevertheless, synthetic ethanol may not be used in the preparation of foods and beverages in most countries.

First-generation agricultural/fermentation ethanol technologies rely on the fermentation of sugars. Processors can ferment high-sugar feedstock such as sugarcane or sugar beet directly, but for starchy feedstock such as maize and wheat, they must first convert the starch to sugar using enzymes. Wine can also be distilled to concentrate the ethanol content. The most important feedstock worldwide is grain accounting for 53% of the world ethanol production, with maize playing a dominant role. Roughly 44% of world ethanol production is from sugary feedstock such as cane and beet. Synthetic alcohol may be derived from crude oil, gas or coal. On a global scale, synthetic feedstock plays a minor role (less than 5%).

2.1.1. Feedstock suitability – technical drivers

As feedstock costs account for about 65%-90% of total ethanol production cost, it is the feedstock cost that crucially determines the profitability of fuel ethanol production. If the productivity of different raw materials is compared, maize appears to be the feedstock with the highest ethanol yield per ton (Table 2.1). By comparison, sugar cane has lower productivity than sugar beet. If the yield from a hectare of land is compared, EU wheat appears to have the lowest yields. The Brazilian cane estimate is an overall Brazilian average. Cane ethanol yields per hectare of land in the Centre/South region in Brazil are relatively high at 6.4 m^3/hectare (6,400 litres/ha) according to the 2007/08 CONAB (National Supply Company) estimates.

Table 2.1: Ethanol yields from different feedstock

	USA maize	Brazil sugar cane	EU (France) sugar beet	EU wheat
Ethanol yields (m^3/t)	0.39	0.086	0.1	0.37
Ethanol yields (m^3/ha)	3.4	6.1	7.3	2.3

Source: F.O. Licht

While cane sugar is the feedstock of choice in Brazil, producing ethanol from sugar beet in the EU is not an economically viable proposition following the reform of the sugar regime introduced in 2006 which restructured the sector to reduce European Union sugar production to sustainable levels. As part of the restructuring process, some sugar refiners were able to develop ethanol production as a means keeping plants in operation, maintaining beet throughput and thus ensuring the profitability of the plants. However, this is not a viable option for new sugar beet ethanol facilities.

From a purely technical perspective, of the grains available within the EU maize would be the most attractive feedstock in that it has a slightly (1-2% on average) higher starch content than wheat but it has generally not been economically attractive because of the consistent premium of some EU€ 15-20/ton payable on this grain in the EU market. One plant in France has chosen maize as feedstock. It is understood that this is entirely due to the fact that the plant will be located in an area with an abundance of maize, where wheat is relatively more expensive. However, in the specific case of Hungary, which has a high proportion of arable land cultivated with maize and in recent years sold significant quantities into EU intervention (precipitating the reform and subsequent closure of the EU maize intervention system) and prior to this maize was fed directly to livestock (mainly pigs), maize is considered an attractive and economically viable option.

Looking at the other alternatives of barley and rye we would note that:

- the starch content tends to be slightly lower than wheat;
- a major problem with both these crops is that they produce a greater volume of DDGS/ton of ethanol requiring higher drying costs;
- the higher volume of gluten generated during processing tends to create considerable technical problems within the plants;
- where plants have been set up using such grains as a feedstock they have always been located in regions where there has tended to be a surplus of production due to the fact that there is little alternative use for the land i.e. rye on the sandy soils of eastern Germany;
- given the cuts in market support for this crop there must also be some doubts about the continuation of this surplus of supply;
- looking at the experience of existing plants using rye as a feedstock, it is understood these tend to have capacity utilisation problems mainly due an absence of dryers and the production of larger amounts of DDGS that then have to be disposed of wet. This ultimately makes the costs of production higher despite the rye price initially being lower than the wheat price;
- in Spain barley is used as feedstock in a mixture with wheat and other grains. Spain does not, however, have a sufficient domestic supply of grains in general. It is therefore a net importer of all types of grain and plants will have higher grain transport costs

2.2. Policy

Cereals have always been at the heart of the EU's Common Agricultural Policy (CAP). This is because cereals are the most widely grown arable crop in Europe covering some 59 million ha or 32% of the farmland used in the EU-27 and also because these crops are the mainstay of the agricultural economy both directly and indirectly in that cereal prices strongly affect the profitability of livestock and particularly intensive livestock production.

In the 1990s, the EU substantially reduced intervention and market price support for grains, although this was partially compensated for by a system of direct income payments to farmers. Originally linked specifically to production, since 2006 these payments have been largely decoupled, i.e. not

specifically linked to production. The payments are termed the Single Farm Payment (SFP) in most of the EU-15 Member States or the Single Area Payment Scheme (SAPS) in most of the new Member States which acceded from 1 January 2004 onwards. The total budgetary cost of these payments in the EU amounted to some EU€ 41 billion in 2009. In Hungary the amount allocated was EU€ 947 million in 2009 and is expected to rise to EU€ 1.319 billion by 2013[1].

In recent years, significant changes to the cereals price support system were introduced, most notably the abolition of the intervention buying system for rye in 2004, maize in July 2009 and will also be removed for barley from July 2010. As far as Hungary is concerned, the abolition of maize intervention of which the country was the main beneficiary removed the main market price support mechanism for maize production in Hungary. The removal of this 'floor' to the EU market, even though the volumes had already been reduced to 1.5 million tons in the 2007/2008 marketing year and 700,000 t in the 2008/2009 marketing year and the time periods for intervention purchasing were in any case restricted, will therefore tend to pressure Hungarian and wider EU prices .

The only additional feature of relevance for the purpose of this study is to note that since the 2008 Health Check reforms of the CAP the provisions and mechanism requiring a proportion of arable land to be set-aside or taken out of production are formally no longer in force and this has meant that in the EU as a whole[2] a higher area of land is now available for cultivation.

It appears unlikely there will be further significant reforms to the EU cereals regime in the foreseeable future. Major reforms were undertaken to make the regime compatible with the mid-1990s Uruguay Round WTO reforms and the EU does not consider its decoupled direct income payments to farmers to be subject to any reduction commitment that may be necessary to revive the stalled Doha Round of WTO trade talks. More generally, while an agreement in the Doha Round would likely involve increased access to the EU market for third country cereals, this is seen as a benefit rather than a risk for grain using sectors in the EU.

2.3. Feedstock availability

2.3.1. Maize feedstock availability

In 2007, global maize production was 766 million tons, having increased by some 25% over the last 5 years. Most of this production increase has been due to demand growth in Asia; demand is expected to continue to grow over the coming decade, mainly driven by biofuel production increase in the USA and EU-27. The EU-27 is the world's fourth largest maize producer, after the USA, China and Brazil but represents no more than 6% of the world production. With extra-EU imports of less than 5 million tons in recent years, the EU-27 does not play a key role in global maize trade. Some economists consider that maize areas have reached a plateau in most EU Member States, although some further expansion in maize areas is likely in some Northern and Eastern parts of Europe, including Hungary. However, there is still considerable scope for productivity increases with.

[1] It should be noted that Member States are entitled to re-direct up to 10% of this total to rural development measures if they wish.
[2] This effectively only applied in the old EU-15 Member States

Table 2.2: Global maize production (million tons)

	2002	2003	2004	2005	2006	2007
World	605.1	625.1	713.2	694.7	698.1	766.0
USA	227.8	256.3	299.9	282.3	267.6	332.1
China	121.3	115.8	130.3	139.4	145.5	145.0
Brazil	47.6	42.0	35.0	42.5	51.4	53.5
EU-27	39.9	40.3	53.7	50.2	55.2	47.7

Source: FAO

In the EU-27, maize is cultivated on 13.9 million ha of land representing almost 13% of the EU arable land area (Table 2.3). Five Member States account for some 70% of the total maize area in the EU, with Hungary having the fifth largest maize area accounting for 9.4% of EU-27 maize area. Furthermore, Hungary uses 38% of its arable area for maize production (the third largest in the EU-27).

Unlike other Member States, Hungary has a comparatively lower area of maize under monoculture cropping (i.e. maize grown year after year on the same land) at 13.5%. This compares to an EU-27 average of 20.8%. Monoculture of maize (i.e. with no crop rotation) provides ideal conditions for an increase in Diabrotica population size over time, if not properly managed. Diabrotica virgifera (Western Corn Rootworm) is a harmful organism of maize which has been a particular problem affecting maize production in Hungary. To control this harmful organism, Hungary adopted a Decree in 2001 enacting obligatory crop rotation in areas infested with the larvae of this pest. Consequently, the proportion of maize produced under monoculture cropping in Hungary has decreased considerably in recent few years.

Table 2.3: EU maize production, by Member State (2007)

	Arable land ('000 ha)	Conventional maize cultivated area ('000 ha)	% maize area on arable land	% area with monoculture on maize cultivated area
France	18,330.9	3,127.6	17.1%	30.7%
Romania	6,626.5	2,819.6	42.6%	41.4%
Germany	11,897.1	1,738.9	14.6%	18.7%
Italy	6,891.3	1,411.7	20.5%	43.4%
Hungary	3,445.5	1,308.5	38.0%	13.5%
Poland	10,290.5	656.7	6.4%	30.0%
Spain	11,855.4	507.4	4.3%	29.0%
Bulgaria	2,369.0	380.9	16.1%	35.0%
Czech. Rep.	2,634.2	281.3	10.7%	10.9%
Austria	1,383.8	252.5	18.2%	21.1%
Netherlands	1,117.0	249.1	22.3%	65.5%
Slovakia	1,300.0	245.1	18.9%	11.0%
Belgium	844.9	215.0	25.4%	31.7%
Greece	2,027.6	200.0	9.9%	29.0%
Portugal	1,171.6	162.0	13.8%	29.0%
UK	5,979.9	140.0	2.3%	20.0%
Denmark	2,398.4	138.0	5.8%	n.a.
Slovenia	169.2	70.5	41.7%	9.5%
Lithuania	1,680.2	22.5	1.3%	0.0%
Ireland	1,142.4	15.0	1.3%	n.a.
Luxemburg	59.9	10.0	16.7%	29.0%
Sweden	2,616.4	8.5	0.3%	n.a.
Cyprus	105.2	0.1	0.0%	n.a.
Estonia	562.5	1.0	0.0%	n.a.
Finland	2,231.2	0.2	0.0%	n.a.
Latvia	916.8	3.0	0.0%	n.a.
Malta	7.0	0.0	0.0%	0.0%
Total	**100,054.4**	**13,960.8**	**n.a.**	**n.a.**
Average	n.a.	n.a.	12.9%	20.8%

Source: European Commission

Four different types of maize is produced in the EU, namely grain maize, silage maize, sweet maize and seed maize. Table 2.4 presents the number of hectares for the different types of conventional maize and the proportion of grain and silage maize in the countries production. Grain and silage maize are the two most important maize production systems, representing around 65% (9 million ha) and 34% (4.7 million ha) of total EU maize area respectively. Traditionally, grain maize production is concentrated in the Southern Member States (including Hungary) where over 80% of the area is cultivated with grain maize, whereas silage maize for feeding livestock is concentrated in the northern Member States where over 74% of the area is cultivated with silage maize. The area cultivated with seed and sweet maize is much smaller.

Table 2.4: EU maize production, by type and Member State (2007)

	Conventional maize area ('000 ha)	Grain		Silage		Sweet	Seed
		'000 ha	%	'000 ha	%	'000 ha	'000 ha
France	3,127.6	1,639.6	52.4%	1,414.4	45.2%	26.2	47.3
Romania	2,819.6	2,774.0	98.4%	33.2	1.2%	0.0	12.4
Germany	1,738.9	434.5	25.0%	1,300.1	74.8%	1.3	2.9
Italy	1,411.7	1,128.2	79.9%	274.7	19.5%	4.5	4.4
Hungary	1,308.5	1,139.5	87.1%	111.3	8.5%	32.0	25.7
Poland	656.7	334.5	50.9%	315.5	48.1%	4.5	2.2
Spain	507.4	414.5	81.7%	89.5	17.6%	2.9	0.5
Bulgaria	380.9	350.0	91.9%	30.0	7.9%	n.a.	0.9
Czech. Rep.	281.3	97.5	34.7%	182.5	64.9%	n.a.	1.3
Austria	252.5	167.5	66.3%	80.0	31.7%	n.a.	2.5
Netherlands	249.1	21.3	8.6%	227.5	91.3%	0.3	0.0
Slovakia	245.1	157.5	64.3%	82.5	33.7%	2.0	3.1
Belgium	215.0	55.0	25.6%	160.0	74.4%	n.a.	n.a.
Greece	200.0	195.0	97.5%	5.0	2.5%	n.a.	n.a.
Portugal	162.0	107.5	66.4%	54.5	33.6%	n.a.	n.a.
UK	140.0	2.0	1.4%	138.0	98.6%	n.a.	n.a.
Denmark	138.0	0.0	0.0%	138.0	100.0%	n.a.	n.a.
Slovenia	70.5	42.6	60.5%	27.7	39.3%	0.0	0.2
Lithuania	22.5	4.5	20.0%	18.0	80.0%	n.a.	n.a.
Ireland	15.0	0.0	0.0%	15.0	100.0%	n.a.	n.a.
Luxemburg	10.0	0.0	0.0%	10.0	100.0%	n.a.	n.a.
Sweden	8.5	0.0	0.0%	8.5	100.0%	n.a.	n.a.
Total	**13,960.8**	**9,065.2**	**64.9%**	**4,715.9**	**33.8%**	**73.6**	**105.9**

European Commission

Table 2.5 summarises available data on yields, production costs, market values and profit margins for each type of maize for 9 key maize producing Member States. It should be noted that there is considerable inter-country variability in yields. While in general yields, production costs and profit margins are lowest in the new Member States, following accession in 2004 the yield gap between the new Member States and the Member States in the EU-15 has narrowed as farmers respond to market and policy signals using Western European crop production practices.

Table 2.5: EU-27 maize yields, production costs, market value and profit margin by Member State and type of maize (average 2003-2007)

		Grain	Silage	Sweet	Seed
France	Yield (100kg/ha)	94.0	388.2	186.4	29.4
	Production cost (EU€/ha)	1,004.5	n.a.	681.7	1,346.0
	Market value (EU€/ton)	131.1	46.7	75.0	n.a.
	Profit margin (EU€/ha)	220.3	n.a.	731.3	1,000-1,300
Romania	Yield (100kg/ha)	34.7	207.8	n.a.	13.6
	Production cost (EU€/ha)	547.9	653.0	n.a.	830
	Market value (EU€/ton)	161.2	54.7	n.a.	1,473.00
	Profit margin (EU€/ha)	87.0	223.0	n.a.	1,046.00
Germany	Yield (100kg/ha)	86.3	427.3	n.a.	27.6
	Production cost (EU€/ha)	886.0	937.0	n.a.	n.a.
	Market value (EU€/ton)	131.8	24.5	n.a.	n.a.
	Profit margin (EU€/ha)	245.0	n.a.	n.a.	n.a.
Italy	Yield (100kg/ha)	103.0	511.3	n.a.	25.0-27.0
	Production cost (EU€/ha)	783.3	n.a.	n.a.	n.a.
	Market value (EU€/ton)	143.5	46.1	n.a.	n.a.
	Profit margin (EU€/ha)	618.3	n.a.	n.a.	n.a.
Poland	Yield (100kg/ha)	62.5	401.8	n.a.	24.0
	Production cost (EU€/ha)	432.7	n.a.	n.a.	n.a.
	Market value (EU€/ton)	105.7	10.4	n.a.	n.a.
	Profit margin (EU€/ha)	233.3	255.0	n.a.	n.a.
Hungary	Yield (100kg/ha)	62.7	247.5	145.6	26.5
	Production cost (EU€/ha)	603.3	n.a.	n.a.	n.a.
	Market value (EU€/ton)	102.2	20.1	120.0	n.a.
	Profit margin (EU€/ha)	189.4	n.a.	n.a.	n.a.
Spain	Yield (100kg/ha)	109.2	441.6	n.a.	30.0
	Production cost (EU€/ha)	734.0	0.0	n.a.	n.a.
	Market value (EU€/ton)	135.3	23.0	n.a.	n.a.
	Profit margin (EU€/ha)	780.8	0.0	n.a.	n.a.
Netherlands	Yield (100kg/ha)	81.1	141.7	65.0	n.a.
	Production cost (EU€/ha)	909.0	664.0	n.a.	n.a.
	Market value (EU€/ton)	101.9	25.5	n.a.	n.a.
	Profit margin (EU€/ha)	821.0	978.0	n.a.	n.a.
Slovenia	Yield (100kg/ha)	71.2	407.2	n.a.	13.0
	Production cost (EU€/ha)	n.a.	n.a.	n.a.	n.a.
	Market value (EU€/ton)	1,27.5	37.7	n.a.	n.a.
	Profit margin (EU€/ha)	n.a.	n.a.	n.a.	n.a.

European Commission

There is also considerable intra-country variability in yields. In Hungary, yields are at their highest in Dél-Dunántúl in the south of the country (14.4% above the average between 1995 and 2007) where Ethanol Europe's proposed ethanol plant is to be located, and at their lowest in Észak-Magyarország in the north of the country (15.8% below the average between 1995 and 2007) (Table 2.6). Dél-Dunántúl accounts for a quarter of the area of maize grown on average (1995-2007) each year in Hungary (Table 2.7).

Table 2.6: Hungarian grain maize yields, by region, 1995-2007 (100kg per ha)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Közép-Magyarország	40.8	57.1	53.2	43.1	64.7	33.8	52.4	37.3	26.7	61.0	68.5	67.4	27.3
Közép-Magyarország	40.8	57.1	53.2	43.1	64.7	33.8	52.4	37.3	26.7	61.0	68.5	67.4	27.3
Dunántúl	53.9	59.8	68.1	64.8	67.6	44.5	61.2	60.6	43.8	72.4	82.5	72.4	36.6
Közép-Dunántúl	46.4	58.6	64.5	60.7	66.9	40.7	58.1	51.7	39.6	69.4	84.2	71.2	32.3
Nyugat-Dunántúl	49.6	53.2	62.1	61.0	62.2	40.0	38.0	49.7	43.4	65.8	74.1	63.4	44.4
Dél-Dunántúl	59.4	63.2	72.2	68.2	70.2	48.1	72.1	68.4	45.9	76.5	85.1	76.6	35.5
Alföld és Észak	37.9	54.1	62.4	57.1	60.9	40.0	64.5	42.9	36.8	68.5	69.4	64.0	39.2
Észak-Magyarország	36.0	43.1	54.1	50.7	51.4	33.4	55.8	37.0	38.9	62.3	64.4	54.3	36.0
Észak-Alföld	36.8	50.5	56.9	55.5	58.7	43.4	65.2	42.3	41.5	70.6	67.7	63.1	38.8
Dél-Alföld	39.2	59.6	68.6	59.4	64.4	37.8	65.4	44.6	31.2	67.6	72.2	66.9	40.4
Hungary	45.3	56.9	64.5	60.1	64.1	41.8	62.5	50.8	39.6	70.0	75.6	68.2	37.3

Source: European Commission

Table 2.7: Hungarian grain maize area, by region, 1995-2007 ('000 ha)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Közép-Magyarország	65	51	57	52	54	56	59	55	49	49	50	57	50
Közép-Magyarország	65	51	57	52	54	56	59	55	49	49	50	57	50
Dunántúl	467	481	481	485	508	557	568	554	534	554	570	578	543
Közép-Dunántúl	127	116	123	120	123	140	141	134	133	132	144	142	132
Nyugat-Dunántúl	92	110	103	103	115	119	123	112	118	125	124	126	115
Dél-Dunántúl	248	256	256	262	271	298	304	308	283	297	302	310	297
Alföld és Észak	502	521	521	486	553	580	631	597	562	588	578	580	486
Észak-Magyarország	47	49	55	44	49	48	53	51	56	56	60	55	48
Észak-Alföld	218	226	208	186	233	260	290	273	262	279	263	262	223
Dél-Alföld	237	246	259	257	271	271	288	273	244	252	256	263	214
Hungary	1,033	1,053	1,059	1,023	1,115	1,193	1,258	1,206	1,145	1,190	1,198	1,215	1,079

Source: European Commission

At EU level, 47 million tons of maize (grain or silage) is used as feed for animals, compared to some 5.3 million tons for human consumption (including the starch and meal industry). EU-wide use of grain maize for ethanol production amounts to 800,000 tons. The use of maize as a biogas feedstock is quite limited (mainly in Germany).

In Hungary, only 4% of maize production is currently being used as a feedstock for ethanol production. This compares to 11%, 14% and 17% in the Netherlands, France and Germany respectively. The majority (90%) is currently used for animal feed (Table 2.8).

Table 2.8: Use of grain maize in key EU Member States

	Food	Feed	Industrial		
			Ethanol	Starch	Other
France	4.0%	82.0%	14.0%		
Romania	5-10.0%	90-95%	0%		
Germany	23.0%	60.0%	17.0%		
Italy	7.4%	89.7%	0.0%	0.0%	2.9%%
Hungary	0.0%	90.0%	4.0%	6.0%	0.0%
Netherlands	7.0%	82.0%	11.0%		

Source: European Commission

2.3.2. Prospects for feedstock availability in the EU

Table 2.9 shows that in 2008 cereals were grown on some 60.2 million hectares (73%) out of some 82.0 million hectares of arable cropping land in the EU-27. In addition to this there were 4.4 million hectares of arable land left uncultivated[3] (fallow). Currently, maize is grown on some 9.0 million hectares but the European Commission expects this area to increase to 9.7 million hectares by 2015.

Table 2.9: Area under arable crops in the EU (million hectares)

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cereals		**57.2**	**56.6**	**60.2**	**59.6**	**59.3**	**59.4**	**59.5**	**59.5**	**59.6**	**59.5**
of which	*EU-15*	*34.9*	*34.7*	*37.2*	*37.0*	*35.6*	*35.6*	*35.7*	*35.8*	*35.8*	*35.8*
	EU-10	*15.6*	*15.5*	*16.0*	*15.6*	*15.9*	*15.9*	*15.9*	*15.9*	*15.9*	*15.8*
	EU-2	*6.7*	*6.4*	*7.0*	*6.9*	*7.8*	*7.8*	*7.8*	*7.9*	*7.9*	*7.8*
Soft wheat		21.9	22.0	23.5	23.2	23.5	23.6	23.7	23.7	23.7	23.7
Durum wheat		3.0	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Barley		13.6	13.6	14.4	14.3	13.3	13.2	13.1	13.1	13.1	13.0
Maize		8.5	8.0	9.0	8.8	9.5	9.5	9.6	9.6	9.7	9.7
Rye		2.6	2.6	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8
Other cereals		7.5	7.5	7.7	7.6	7.3	7.3	7.3	7.3	7.3	7.3
Oilseeds		**9.5**	**10.2**	**10.4**	**10.4**	**10.3**	**10.2**	**10.1**	**10.2**	**10.2**	**10.2**
of which	*EU-15*	*5.4*	*5.7*	*5.8*	*5.9*	*5.8*	*5.8*	*5.8*	*5.8*	*5.9*	*5.8*
	EU-10	*2.1*	*2.5*	*2.6*	*2.5*	*2.5*	*2.5*	*2.4*	*2.5*	*2.5*	*2.5*
	EU-2	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*1.9*	*1.9*	*1.9*	*1.9*	*1.9*
Rapeseed		5.1	6.4	6.3	6.3	6.3	6.2	6.2	6.3	6.4	6.3
Sunflower seed		3.9	3.4	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6
Soyabeans		0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Sugar beet		1.7	1.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Protein crops		1.2	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.6
Flax and Hemp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Silage (1)		4.5	4.4	4.4	4.5	4.5	4.5	4.4	4.4	4.4	4.4
Sub-total		**74.2**	**74.2**	**77.6**	**77.0**	**76.6**	**76.6**	**76.6**	**76.7**	**76.6**	**76.3**
Uncultivated land (2)		7.0	6.9	4.4	5.1	5.1	5.0	5.0	5.0	5.0	5.0
Total		**81.2**	**81.1**	**82.0**	**82.0**	**81.7**	**81.7**	**81.7**	**81.7**	**81.6**	**81.3**

Notes: (1) excluding grass silage; (2) includes land on set-aside until 2007.

Source: European Commission

In this context it should be noted that there is also scope for further improvements in yields in all EU Member States, with the greatest yield improvements expected in Bulgaria and Romania (where yields are comparatively low) and throughout the major cereal producing regions in the new Member States including Hungary which acceded in 2004. Clearly it will take time for such yield increases to occur as production structures in many of the acceding countries are relatively fragmented and infrastructure is poor. According to the Food and Agricultural Policy Research Institute of the University of Iowa (FAPRI) which also provides long-term production forecasts to 2018/19, EU maize yields are expected to increase from 6.83t/ha to 7.11t/ha in the EU as a whole and from 4.38t/ha to 5.21t/ha in the New Member States.

EU cereals production is projected to reach just over 300 million tons by 2015 (see Table 2.10), with soft wheat and barley output expected to decline to 135.4 million tons and 60.9 million tons respectively. In contrast, maize output is set to rise by 6.65.4% from 60.9 million tons to 64.2 million

[3] Prior to 2007 there was a requirement to leave some land uncultivated under the EU set-aside policy as a production control mechanism.

tons. Domestic consumption of cereals is also projected to keep growing over the medium term, mainly driven by the rapid growth in bio-ethanol use.

Table 2.10: Total cereal and maize market projections for the EU (million tons)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cereals										
Usable production	**267.1**	**257.7**	**311.9**	**293.0**	**287.7**	**291.0**	**293.6**	**296.2**	**299.0**	**302.0**
of which EU-15	*195.7*	*194.0*	*225.9*	*213.3*	*206.7*	*209.1*	*210.4*	*211.7*	*213.1*	*214.6*
EU-10	*50.2*	*52.7*	*62.2*	*58.3*	*58.1*	*58.8*	*59.5*	*60.4*	*61.3*	*62.3*
EU-2	*21.3*	*11.0*	*23.7*	*21.4*	*22.8*	*23.2*	*23.6*	*24.1*	*24.6*	*25.1*
Consumption	**266.0**	**267.9**	**270.9**	**271.8**	**272.1**	**273.1**	**275.9**	**279.5**	**283.2**	**288.0**
of which food & Industrial	*84.7*	*84.6*	*84.9*	*85.3*	*85.4*	*85.6*	*85.9*	*86.1*	*86.4*	*86.6*
of which livestock feed	*167.9*	*170.0*	*168.8*	*168.0*	*167.7*	*167.7*	*168.4*	*168.6*	*169.4*	*170.3*
of which Bio energy	*2.8*	*2.5*	*6.5*	*7.8*	*8.3*	*9.1*	*10.9*	*14.1*	*16.9*	*20.4*
EU-15	*211.5*	*211.9*	*214.9*	*216.4*	*216.7*	*217.6*	*219.9*	*222.6*	*225.7*	*229.7*
EU-10	*35.1*	*36.3*	*37.3*	*36.4*	*36.4*	*36.4*	*36.6*	*36.9*	*37.2*	*37.5*
EU-2	*19.5*	*19.7*	*18.7*	*19.0*	*19.0*	*19.1*	*19.4*	*20.0*	*20.4*	*20.8*
Imports	**10.1**	**26.7**	**9.4**	**8.4**	**11.3**	**9.2**	**9.6**	**9.6**	**10.4**	**10.5**
Exports	**26.5**	**22.4**	**30.5**	**29.9**	**27.4**	**27.2**	**26.3**	**27.7**	**25.6**	**25.3**
Beginning stocks	69.2	53.9	48.0	67.8	67.5	66.9	66.9	67.9	66.5	67.0
Ending stocks	**53.9**	**48.0**	**67.8**	**67.5**	**66.9**	**66.9**	**67.9**	**66.5**	**67.0**	**66.2**
Of which Intervention	*2.6*	*0.0*	*1.5*	*1.6*	*1.6*	*0.5*	*0.0*	*0.0*	*0.0*	*0.0*
EU-15	*0.0*	*0.0*	*0.0*	*0.0*	*0.7*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
EU-10	*2.6*	*0.0*	*1.6*	*1.6*	*0.9*	*0.5*	*0.0*	*0.0*	*0.0*	*0.0*
EU-2	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Maize										
Usable production	**55.5**	**48.2**	**61.8**	**60.9**	**60.2**	**61.0**	**61.8**	**62.7**	**63.5**	**64.2**
of which EU-15	33.6	36.6	40.4	38.6	36.9	37.2	37.6	38.0	38.2	38.5
EU-10	11.3	7.5	12.6	12.0	11.8	12.0	12.2	12.4	12.6	12.8
EU-2	10.6	4.2	8.8	10.3	11.5	11.8	12.1	12.4	12.7	12.9
Consumption	**59.3**	**63.1**	**59.1**	**60.0**	**60.8**	**61.4**	**62.8**	**64.2**	**65.0**	**65.7**
of which food & Industrial	*8.7*	*8.7*	*8.8*	*8.8*	*8.8*	*8.8*	*8.9*	*8.9*	*8.9*	*8.9*
of which livestock feed	*49.9*	*53.5*	*48.0*	*48.3*	*48.9*	*49.0*	*49.1*	*48.9*	*48.6*	*48.2*
of which Bio energy	*0.3*	*0.4*	*1.9*	*2.5*	*2.7*	*3.2*	*4.4*	*6.0*	*7.0*	*8.2*
EU-15	*39.5*	*42.6*	*40.1*	*41.3*	*41.8*	*42.4*	*43.6*	*44.6*	*45.2*	*45.9*
EU-10	*7.8*	*8.8*	*8.3*	*8.1*	*8.2*	*8.2*	*8.2*	*8.3*	*8.3*	*8.3*
EU-2	*11.9*	*11.6*	*10.7*	*10.7*	*10.8*	*10.8*	*11.0*	*11.3*	*11.4*	*11.6*
Imports	**4.4**	**4.3**	**3.2**	**3.0**	**3.3**	**2.6**	**2.9**	**2.8**	**3.6**	**3.6**
Exports	**1.7**	**1.4**	**2.4**	**3.9**	**2.4**	**2.3**	**2.2**	**2.3**	**2.2**	**2.3**
Beginning stocks	16.7	15.6	13.7	17.1	17.1	17.3	17.2	16.9	16.0	15.9
Ending stocks	**15.6**	**13.7**	**17.1**	**17.1**	**17.3**	**17.2**	**16.9**	**16.0**	**15.9**	**15.8**
Of which Intervention	*2.2*	*0.0*	*0.7*	*0.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
EU-15	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
EU-10	*2.2*	*0.0*	*0.7*	*0.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
EU-2	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Source: European Commission

These projections suggest that there is sufficient scope to expand EU cereal production if this were to be necessary to meet expected biofuel demand, not least by bringing some 5 million hectares of uncultivated (set-aside) land into production. However, despite a substantial increase in biofuel output, current Commission estimates suggest that such an additional expansion of cereals production would in fact not be necessary as biofuel use is estimated at just 7% of total cereals

consumption in 2015 (12.5% of EU maize use) and overall the EU cereals market is forecast to remain relatively balanced throughout the period.

2.4. Historic price analysis and outlook

2.4.1. Historical price analysis

Like all grain markets, the market for maize is considered to be global as maize is a commodity (i.e. largely undifferentiated) and can be easily traded. As such, the economic *law of one price* holds which suggests that any difference between prices in two separate markets is a function of transport and transaction costs (including import tariffs). Therefore, prices in any market are fundamentally determined at the world level and respond to the supply and demand conditions on the world market. This is clearly shown in Figure 2.1, where maize prices throughout the world can be seen to trend in concordance with each other over time.

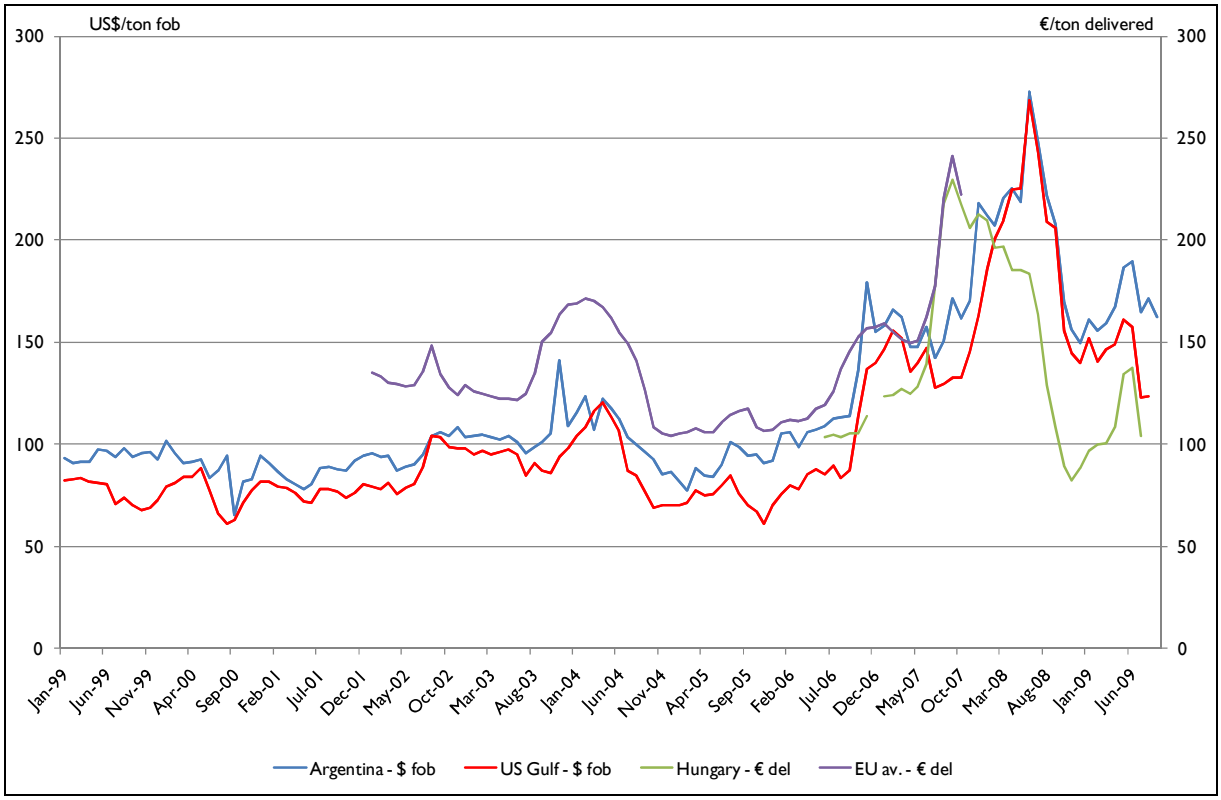

Figure 2.1: World maize prices, 1999-2009 (US$/t fob and EU€/t delivered)

Source: Agra CEAS Consulting and HGCA

Hungary is a net exporter of maize (see Table 2.11), with net exports amounting to some 3.1 million tons in 2008. It is this tonnage that sets the domestic maize value *vis-à-vis* imported maize prices. In other words, Hungarian maize prices are set by *'export parity'*.

Table 2.11: Hungary maize supply balance, 2004-2008 ('000 tons)

	2004	2005	2006	2007	2008
Usable production	4,532	8,332	9,050	8,282	4,027
Imports	26	24	38	63	61
Intra-EU	*:*	*17*	*34*	*53*	*52*
Exports	1,234	1,916	2,300	5,544	3,187
Intra-EU	*:*	*1,726*	*2,237*	*4,960*	*2,982*
Net-exports	**1,208**	**1,892**	**2,262**	**5,481**	**3,126**
Total domestic use	4,258	3,883	4,302	4,481	3,981

Source: Eurostat

Export and import parity are two of the key price-setters in grain markets. According to the *law of one price*, grain prices range between export and import parity depending on the availability of the domestic crop. In general:

- **Export parity**. If a country is in surplus, or has more grain than domestic buyers can use, grain must be priced competitively enough to attract export demand.

- **Import parity**. If a country is in deficit, or does not have enough grain to meet domestic demand, then the market will be operating at import parity and domestic production is priced to encourage imports to make up for the domestic production shortfall.

Thus, as Hungary is in surplus it operates at export parity, meaning that Hungarian prices are lower than they would be if Hungary were to operate at import parity. Over the period since EU accession, the average market price in Hungary (delivered Budapest) was EU€ 122/ton or US$ 164/ton. By comparison the average market price in Germany (delivered Hamburg) was EU€ 151/ton or US$ 199/ton, as illustrated in Figure 2.2.

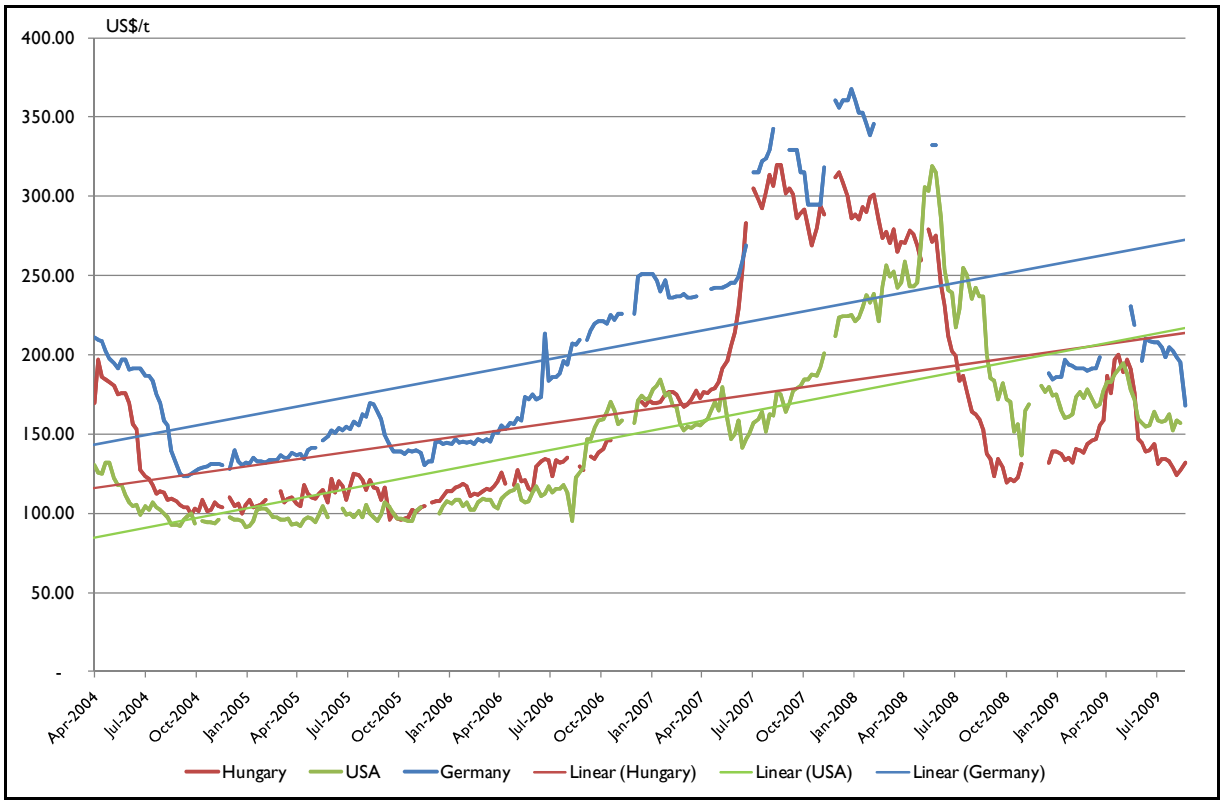

Figure 2.2: Evolution of maize prices since EU-accession in Hungary, compared to prices in Germany and the USA, April 2004 to September 2009 (US$/ton)

Source: Agra CEAS Consulting and HGCA

2.4.2. Outlook for feedstock prices to 2020

This Section presents feedstock price forecasts generated by Agra CEAS Consulting for this study using our proprietary world biofuel and feedstock econometric model. A brief description of the model and the assumptions behind the forecasts presented are summarised in the box below. More detail on the specifications of the model and the economic and policy assumptions used to generate the forecasts are set out in Appendix 1 and 2.

Box 2.1: Summary of the Agra CEAS Consulting world biofuel and feedstock econometric model

The model uses a dynamic partial equilibrium framework to examine how the global market for biofuel and crops might evolve given identified econometric interactions between policies, biofuel, feedstock and crude oil prices. The model employs a set of behavioural equations covering biofuel consumption, production, inventory holding and trade in biofuel, for countries with major energy crop programmes together with a 'Rest of World' aggregate. All price forecasts are nominal based on a constant oil price. The base year of 2008 represents actual data, on which forecasts have been generated to 2020.

The Agra CEAS model uses a variety of external data to generate these forecasts. Biofuel data (quantities and prices) are taken from the F.O. Licht and feedstock data (quantities and prices) are from the FAO. Macroeconomic data are sourced from the World Bank. The general assumptions on which the forecasts are based include:

- all present and future mandated ethanol programmes are assumed to be fulfilled, except for the EU-27 where it is assumed that only the 5.75% target will be met by 2020 (not the 10% mandate) (see Annex A2.2.3.3);
- indicative programmes and targets are used to condition the projections;
- domestic support where notified to continue; and,
- market access provisions to remain.

International ethanol feedstock price forecasts for the period 2009-2020 under the baseline US$60/bbl (constant) crude oil price scenario are presented in Table 2.12. International grain prices are expected to rise above their long-term historic trend as a result of the growth in biofuel capacities in both the EU and the US; a more competitive ethanol sector (i.e. as energy markets absorb a greater share of harvested crops) is expected to result in maize prices being bid-up to levels that reflect more the price of the energy yield from the crop, to the extent that we expect to see a greater correlation between maize prices with energy (crude oil and ethanol) prices going forward (see also section 4.7.2).

International wheat and maize prices which have historically tended to move together are expected to continue to do so over the projection horizon. Despite the fact that maize is likely to be affected more by energy fundamentals going forward, increasing wheat usage as a feedstock in EU bio-energy production and also being a close substitute for a feed ingredient, will all ensure that price paths for both crops will be closely linked. However, with the constant oil prices assumed in Table 2.12, feedstock price movements will tend to reflect changes in production costs, cost efficiencies and market fundamentals in the respective agricultural/food/feed sectors.

Table 2.12: Feedstock price forecasts to 2020 under various crude oil price (US$/bbl) assumptions (US$/ton and EU€/ton)

		2008*	2010	2012	2014	2016	2018	2020
Crude oil - Baseline (US$ 60/bbl)		**99.3**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**
World feedstock price								
US Maize No. 2	US$	218	166	167	171	175	168	167
US Wheat No.2 Soft	US$	340	211	212	208	208	204	204
Brazil Sugar Cane	US$	13.7	14.1	13.2	12.3	11.5	10.8	10.4
EU feedstock price								
Hungary maize	US$	224	182	183	187	191	184	183
	EU€	152	126	126	129	132	127	126
Germany maize	US$	327	236	237	241	245	238	237
	EU€	222	163	164	166	169	164	164
Crude oil – High (US$ 80/bbl)		**99.3**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**
World feedstock price								
US Maize No. 2	US$	218	169	172	177	183	177	178
US Wheat No.2 Soft	US$	340	211	224	223	226	225	228
Brazil Sugar Cane	US$	13.7	14.1	13.5	12.9	12.5	12.1	11.8
EU feedstock price								
Hungary maize	US$	224	185	189	194	200	194	195
	EU€	152	128	130	134	138	134	135
Germany maize	US$	327	240	243	248	254	248	249
	EU€	222	165	167	171	175	171	172
Crude oil – Low (US$ 40/bbl)		**99.3**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**
World feedstock price								
US Maize No. 2	US$	218	163	161	161	161	151	147
US Wheat No.2 Soft	US$	340	199	196	190	187	180	177
Brazil Sugar Cane	US$	13.7	13	11.9	11	10.3	9.7	9.3
EU feedstock price								
Hungary maize	US$	224	179	176	176	176	165	161
	EU€	152	123	122	121	121	114	111
Germany maize	US$	327	233	231	230	230	220	215
	EU€	222	161	159	159	159	151	148

Note: * Historic 2008 exchange rate US$/EU€ 0.68 (EU€/US$ 1.47);
Forecast 2010-2020 exchange rate US$/EU€ 0.69 (EU€/US$ 1.45).
Source: Agra CEAS

In the above table, the 2008 prices are the historical (Jan-Dec) averages. From 2010 the world feedstock prices are forecast by the Agra CEAS model at a forecast exchange rate US$/EU€ 0.69 (EU€/US$ 1.45). The EU German and maize price projections based on an analysis of the historical price spreads between the US, German and Hungarian maize price between 2006 and 2009. 2008 was a year of exceptional price volatility and notably while the German maize price remained at very high levels during the first half of 2008, the Hungarian price fell more rapidly and therefore the price spread increased in that year.

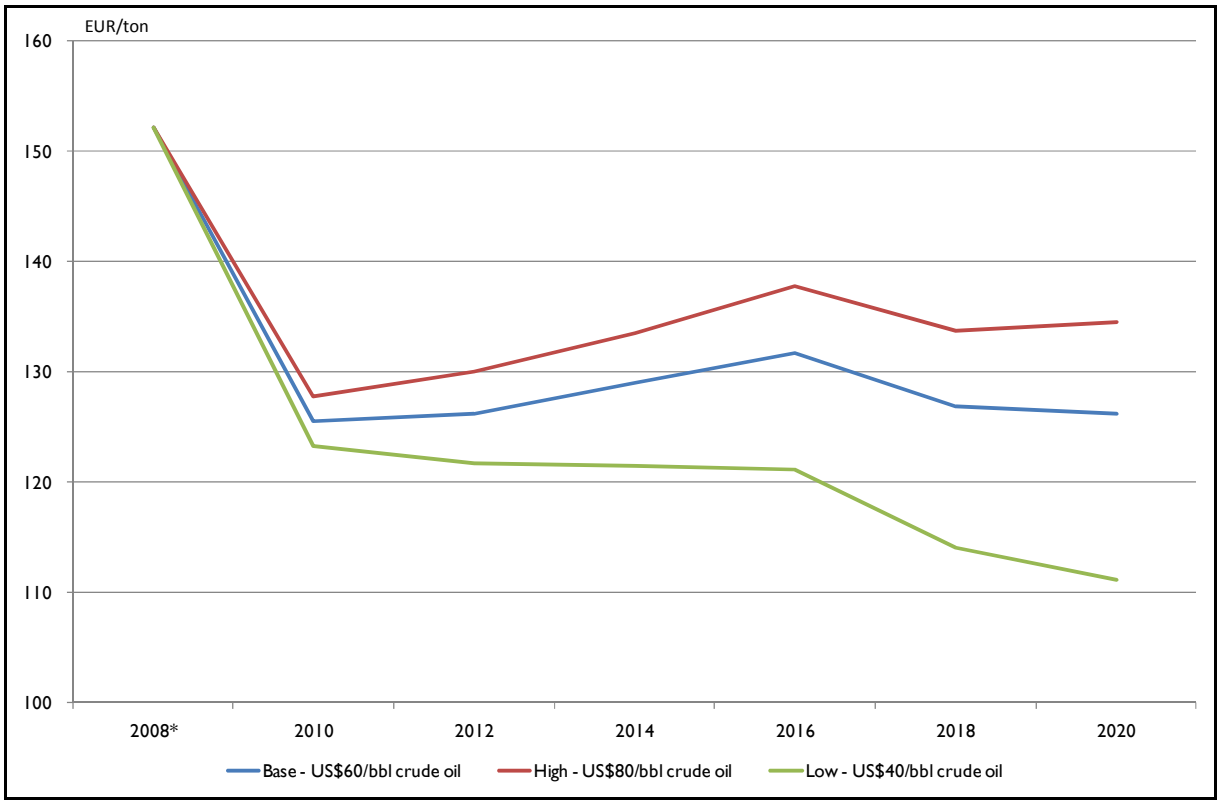

Figure 2.3: Hungary maize feedstock price forecast to 2020 under various crude oil price assumptions (EU€/ton)

Source: Agra CEAS Consulting and HGCA

3. Co-product market analysis

3.1. DDGS

The principal co-product of ethanol production from maize feedstock is DDGS, which is mainly used as a protein rich livestock feed component. DDGS is the term generally used for the dried residue that remains after the starch fraction of the grain has been fermented. After the fermentation process the alcohol is removed and the residues are dried. As DDGS has a relatively (albeit varying) high protein content, it is widely used in the livestock feeding industry in North America. In 2005 the EU-27 imported around 740,000 tons of DDGS from biofuel distilleries in the USA, although this volume had declined to 154,000 tons in 2008. In terms of planned capacities this is less than expected Hungarian production. The low import volume is because DDGS is difficult and expensive to transport, and thus bio-ethanol producers seek nearby markets. Furthermore, the volume of DDGS produced from non-GM corn in the US is relatively low and EU traceability legislation restricts the use of GM feed ingredients in livestock feed rations. A similar co-product also results when wheat is used as a feedstock for ethanol or beverage alcohol production which, as wheat is the predominant feedstock for ethanol production in the EU, is the main source of DDGS for the EU livestock sector and is generally known as wheat distillers' feed/pellets[4]. As ethanol production increases throughout Europe, DDGS (whether from maize or other grain feedstock) is expected to become an increasingly important livestock feedstuff in the future.

3.1.1. Supply outlook

EU-27 DDGS output as a co-product of ethanol production is expected to rise from around 3.01 million tons in 2008, to some 4.99 million tons in 2020 (see Figure 3.1), compared to total EU DDGS imports in 2008 of just 154,000 tons. This is based on the volume of ethanol output under the baseline US$60/bbl oil price scenario (see section 4.6.1) using the Agra CEAS biofuel forecasting model and the assumption that around 70% of forecast EU ethanol production would use grains (predominantly wheat, maize and barley) as a feedstock[5], rising to 75% in 2012 and 80% from 2015, with the remaining part derived from sugar beet feedstock. An additional 135,000 tons of wheat DDGS is currently produced as a co-product of the whisky and grain alcohol distilling industry, which is assumed to remain broadly constant over the period. From 2015 onwards, it is expected that the share of ethanol production from sugar beet feedstock would remain constant (after the recent EU sugar reforms have been fully implemented), but that the share of ethanol produced from grains would rise to around 80%, particularly as maize output in large landlocked new EU member states such as Hungary is expected to increase substantially, and to a lesser extent rye and barley.

[4] Since wheat DDGS has until recently been available only as a co-product of the whisky industry, it is generally referred to as 'wheat distillers pellets/feed', regardless of whether it is a co-product of ethanol or beverage alcohol production.

[5] This calculation is based on a conversion factor of 1 ton ethanol from grains (mainly wheat) feedstock yielding approximately 1.085 tons of DDGS co-product (0.935 tons for maize)

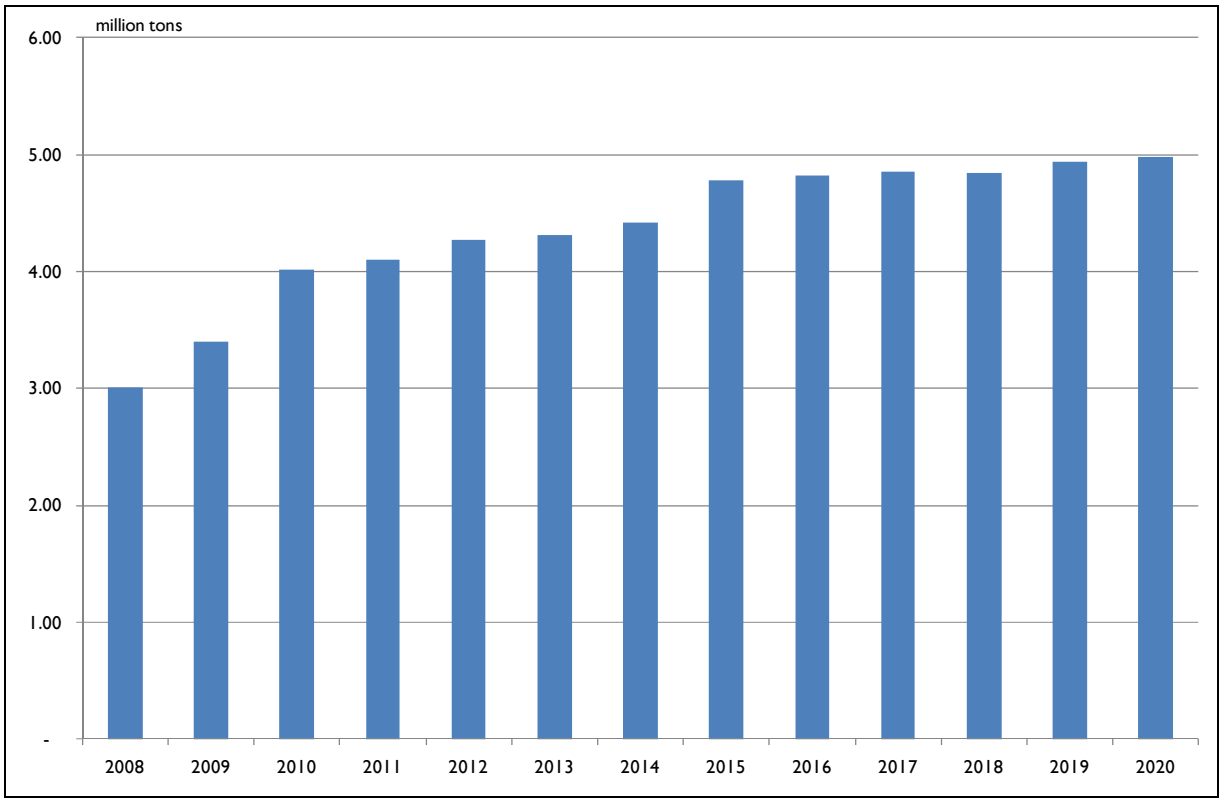

Figure 3.1: Forecast EU-27 DDGS production (baseline US$60/bbl oil price scenario), 2008-2020 (million tons)

Source: Agra CEAS Consulting

3.1.2. Demand outlook

The EU is approximately 23% self sufficient in the production of proteins and therefore, in the context of an EU compound feed market of some 150.6 million tons in 2008 (FEFAC data), the volume of DDGS production foreseen in the medium-term is not expected to cause any oversupply in the EU animal feed sector. By comparison, Hungarian production of compound feeds totalled some 4.1 million tons in 2008, of which 1.7 million tons consisted of poultry feed, 1.7 million tons of cattle feed and 0.5 million tons of pig feed.

As a livestock feed ingredient, DDGS competes with other protein sources, most notably maize gluten feed, soya protein and also rapeseed meal, and therefore demand is heavily influenced by the relative price and availability of competing products. The maximum inclusion levels of DDGS in livestock feed rations are shown in Table 3.1 below.

Table 3.1: Maximum inclusion levels of DDGS

Ruminants- % of Dry Matter		Pigs - % of Dry Matter		Poultry -% of total feeds	
Calf	10%	Nursery	25%	Chick	0%
Dairy	20%	Grower	20%	Broiler	10%
Beef - growing	10-40%	Finisher	20%	Breeder	5%
Beef - finishing	10-20%	Lactating sow	30%	Layer	15%
Sheep	0%-10%	Gestating sow	50%	Turkeys	10-15%

Source: National Corn Growers Association (USA)

In 2007, Hungary had around 705,000 cattle, of which 266,000 were dairy cows and 3.9 million pigs. The exact size of the Hungarian feed market is difficult to establish, particularly as historically, pig producers typically feed whole maize rations from domestic maize production, rather than purchasing compound feed. Nevertheless, with a pig compound feed market of some 1.7 million tons (as mentioned above), assuming a 20% inclusion rate, DDGS could be substituted for around 340,000 tons of compound feed. It is estimated that DDGS usage in the Hungarian livestock sector between 2000 and 2005 amounted to some 335,000 tons (Potori et al, 2006), of which dairy cows consumed 87,000 tons; beef cattle 87,000 tons; pork 56,000 tons; and poultry 105,000 tons thousand tons. In addition, it is estimated that some 700,000 tons of soybeans are used by the livestock sector. This would suggest that the Hungarian livestock sector alone could potentially absorb some 1.035 million tons of DDGS annually, with any additional output needing to be exported to other EU member states.

However, it should be noted that in the USA, where the DDGS market is well established, DDGS prices have averaged between US$ 26.48 to US$ 42.22 lower in the past 10 and 5 years respectively than maize (corn) prices (see section 3.1.3 below). As the market for DDGS in Europe and in particular Hungary becomes more established, assuming that a similar price relationship emerges, the availability of DDGS as a substitute for whole maize at a lower cost would be expected to stimulate demand.

It should also be noted that some DDGS, as well as maize gluten feed and soya protein have typically been imported cheaply into the EU, mainly from the USA. However from 2006 onwards, EU imports of US maize based feedstuffs fell sharply, for two important reasons:

- the US maize harvest has increasingly been mainly made up of genetically modified crop varieties that were not approved for import into the EU; and
- high domestic maize prices in the US effectively lowered the relative cost of corn gluten feed pellets, increasing domestic consumption and lowering total exports (despite increased output).

Consequently, many animal feed companies have begun to switch supplies from imported maize-based DDGS and gluten feed to domestic and EU produced feedstuffs that facilitate compliance with EU product traceability legislation.

3.1.3. Historical price analysis

In considering the outlook for DDGS prices it is important to state from the outset that due to the relatively small volumes of DDGS that have historically been produced and sold in the EU, there is no consistent price history. Livestock feed compounders that use DDGS are continually looking for combinations of ingredients based on a large number of competing protein sources (such as maize gluten feed, soya cake, rapeseed meal, etc.) in order to produce 'least cost' formulations that balance the energy, protein and fibre specifications required by livestock producers. Furthermore, as the exact size of the livestock feed markets is difficult to establish (as noted above), and as the supply of DDGS rises (in line with ethanol production), it is likely that changes in demand for DDGS could have a significant impact on the price. Consequently, the determination of the price outlook is highly complex and feed ingredient prices change on a daily/weekly basis.

By far the largest market for DDGS has historically been in the US, and therefore the relationship between the relationship between feedstock and co-product price in that market is significant when considering the outlook for DDGS prices, as is the relationship between DDGS and substitute protein sources for livestock feed rations such as soybean meal. In the US market, DDGS prices have historically tracked maize and soybean meal prices closely. In the past, the trend in DDGS price was generally slightly above that of maize, although due to historically very high maize prices (supported by strong demand for ethanol feedstock) since 2006/07 in more recent times, this trend has reversed (see Figure 3.2). Over the period between 1982 and 2009, DDGS has traded at an average US$1.71 (5%) premium over maize, although over the past 10 years this trend has reversed and DDGS has traded at a discount of up to 25% at times (see Table 3.2).

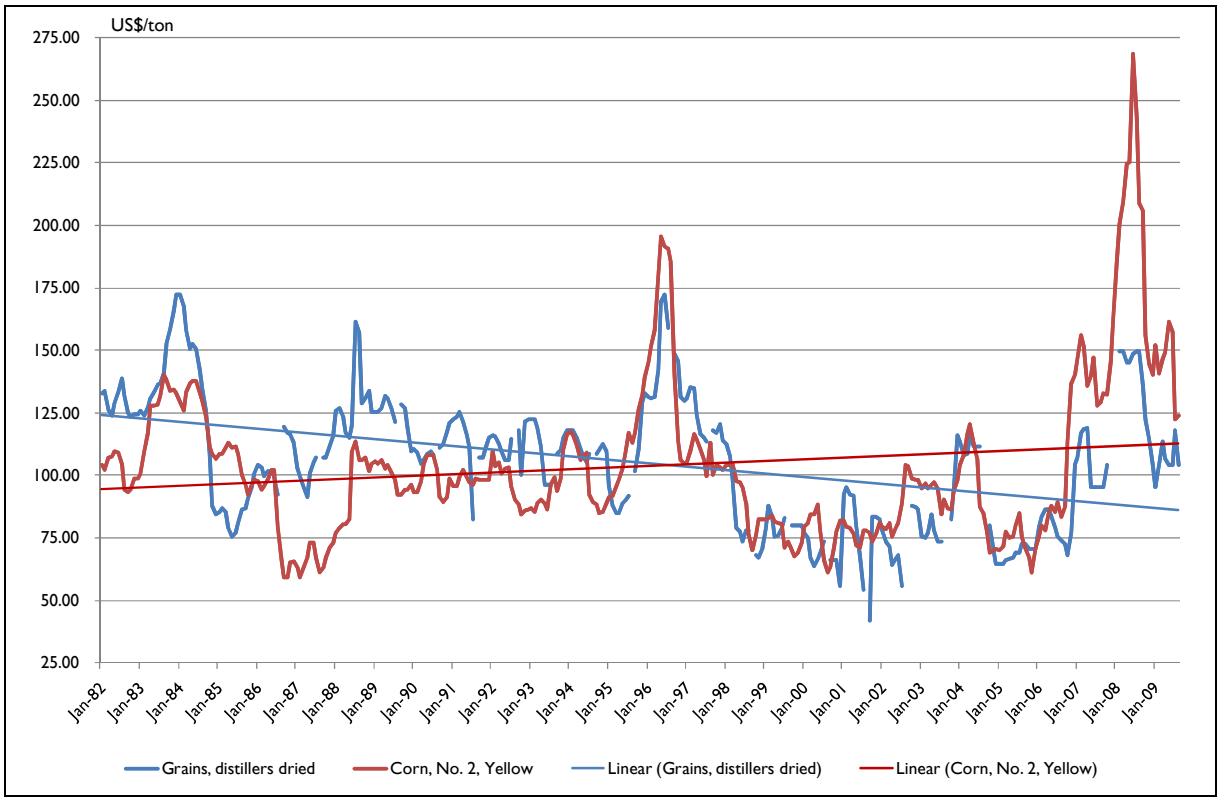

Figure 3.3: DDGS (Lawrenceburg, Indiana, wholesale price) and Yellow No2 corn (maize) (Kansas City, market price), January 1982 – August 2009 (US$/ton)

Source: USDA and Agra CEAS

The trend in DDGS prices has historically been below that of soybean meal, with the price spread increasing gradually over time as rising ethanol output increased demand for and production of maize, thereby reducing total soybean output, while as a consequence DDGS prices have fallen (until recently) due to increased supply (from higher ethanol output) (see Figure 3.4 below). Over the period between 1982 and 2009, DDGS has traded at an average US$ 79.60 (42%) discount compared to soybean meal, although this discount has increased to 62% in the past year (see Table 3.3).

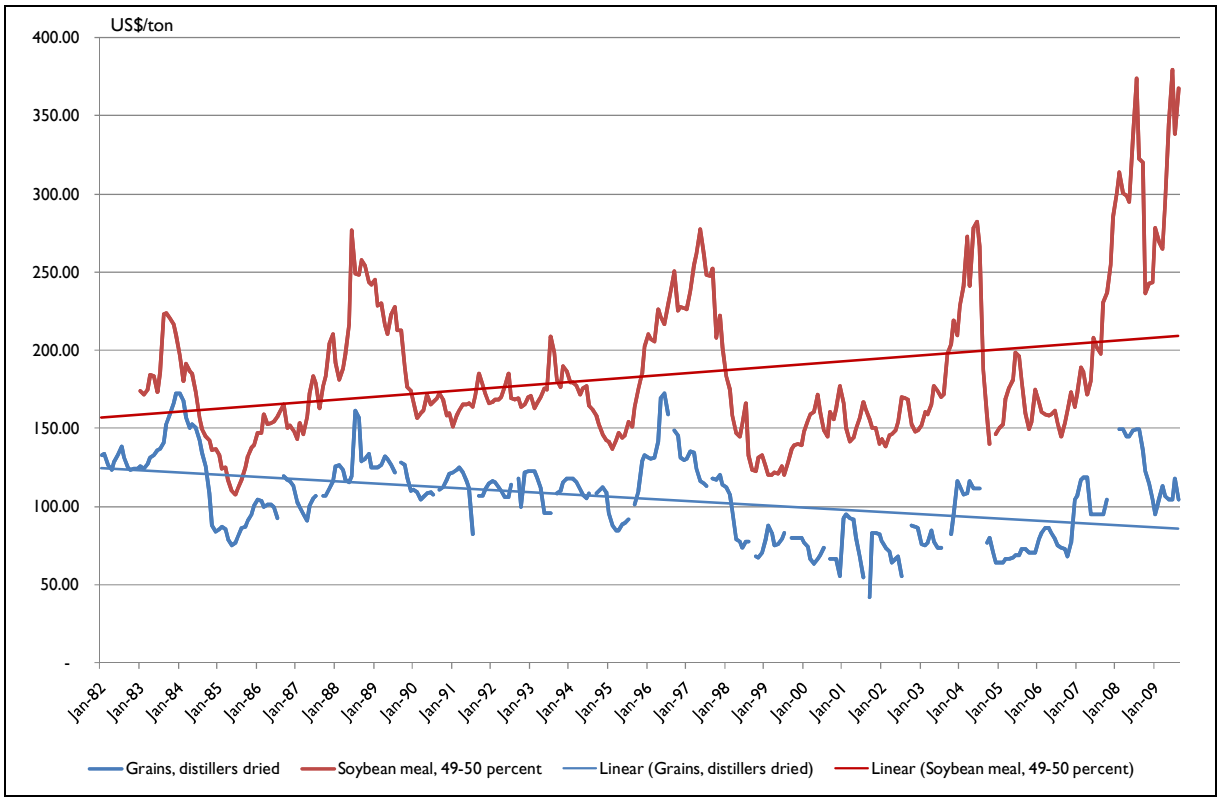

Figure 3.5: DDGS (Lawrenceburg, Indiana) and soybean meal (Illinois points), January 1982 – August 2009 (US$/ton, wholesale)

Source: USDA and Agra CEAS

As explained above, it is evident from the linear trend that the price spread between maize and DDGS has reversed in recent years due to historically high maize prices and a downward trend in the DDGS price. At the same time, however, (excluding the past year due to exceptional price volatility) the correlation between the two series has strengthened from a 59% for the whole period from 1982 to 2009, to 87% for the past decade and 92% for the past 5 years (see Table 3.4). There is also a strong correlation between the DDGS and soymeal price series at 74% to 77% for the past 5-10 years.

Table 3.4: Average DDGS-maize and DDGS-soymeal price spread (US$/ton) and price series correlation (%), 1982-2009

	Whole period	Past 10 years	past 5 years	past 1 year
DDGS-Corn Av. spread	1.71	-18.09	-34.04	-39.40
DDGS-Corn Av. spread %	5%	-12%	-20%	-25%
Correlation	59%	87%	92%	55%
DDGS-Soymeal Av. spread	-79.60	-110.00	-126.43	-187.73
DDGS-Soymeal Av. spread %	-42%	-54%	-53%	-62%
Correlation	54%	77%	74%	-10%

Source: USDA and Agra CEAS

What this means, in effect, is that while there may not be sufficient evidence to prove a direct causal relationship between variations in the maize price and the corresponding variations in DDGS price, there is clearly a very strong linear association between the two price series and therefore a direct causal relationship cannot be discounted either. Intuitively, it is reasonable to assume that DDGS prices are to a large extent dependent upon the underlying maize price because one is a by-product of the other. At the same time, demand for DDGS is also affected by the availability and price of competing products, such as soybean meal.

It is considered likely that in the EU, the association between the DDGS price would exhibit a similar association to the maize price and also the oilseed rape meal price, as oilseed rape plays a similar role to soyabean meal in the livestock feed sector and is the main oilseed crop cultivated in the EU, particularly Germany. Oilseed meal is increasingly available in the EU as a result of increased cultivation and demand for biodiesel production. However, given that the EU is a net importer of protein crop products used for livestock feed and considering that the feeding value of DDGS is higher than that of straight maize (whole crop) due to the nutrient concentrations, *ad hoc* market quotes for DDGS in the EU market have typically been priced at premium of around 15% over feed ingredients. Agra CEAS therefore considers it reasonable that the outlook for EU DDGS prices could develop in line with forecast maize and oilseed meal prices. On this basis, at the 5-year average (2004/5 to 2008/9) maize price in Hungary of EU€ 122/ton, the DDGS price in Hungary over the period is estimated at approximately EU€ 140/ton (the price used to determine the co-product credit in the net production cost analysis in Section 5).

3.1.1. Outlook for DDGS prices to 2020

On the basis of the historic 5-year average price spread between DDGS and both maize and oilseed meals, the world DDGS price is projected for the period to 2018/19 at an average discount to the world maize (US No 2 Yellow, fob Gulf) and oilseed meal (weighted average, delivered EU ports) price forecast by the OECD and FAO. Under this scenario, DDGS is seen trading at an average of US$ 127/ton (range US$110-139/ton) over this period, i.e. at around 78% of the forecast world (fob US Gulf) maize price (see Figure 3.6)

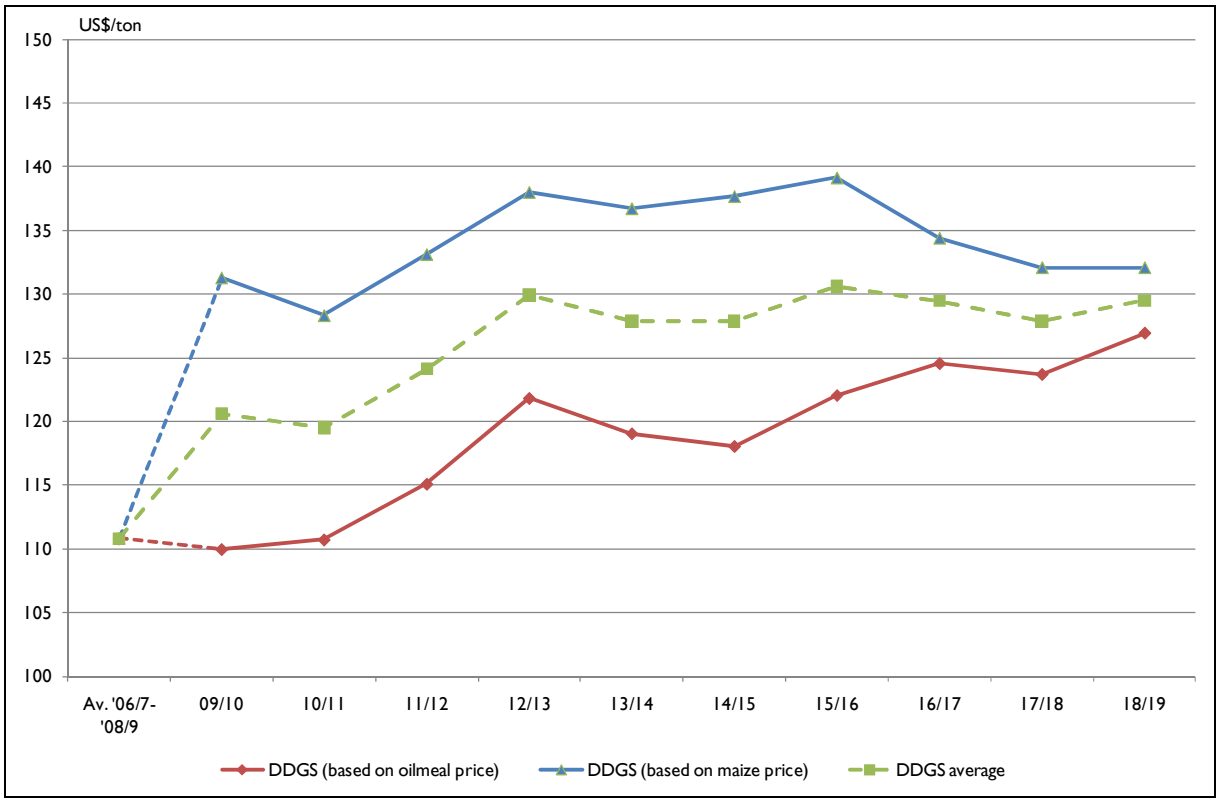

Figure 3.6: Projected world market DDGS price, 2009/10 - 2018/19 (US$/ton)

Source: OECD/FAO and Agra CEAS Consulting

It should be noted that as the EU is currently and is certain to remain a net importer of protein (particularly oilseeds), driven by the rising demand for oilseed meal and vegetable oils and constrained oilseed crushing capacity, economic theory (notably import parity) suggests and historical trends confirm that the EU domestic market price is and will continue be determined by world supply, demand and prices, with most of the variance explained by transport and tariff costs. In the EU market, it is likely that DDGS would continue to trade at a premium over feed maize and substitute products such as feed wheat, while being strongly influenced by substitute products such as oilseed meals. Furthermore, as Hungary is expected to remain a net exporter of maize, it is likely that with increased availability of DDGS that DDGS prices would be strongly influenced by the maize (export) price. Given these factors, it is reasonable to assume a lower bound estimate of DDGS prices going forward based on the historic trends observed in the US market, while at the same time it would also be reasonable to assume a higher bound estimate based on the net-import requirements of the EU that could see DDGS continuing to trade at a premium over the maize price. Assuming that this *ad hoc* price relationship were to continue, this would suggest that based on the average base case (US$ 60/bbl) forecast maize price in Hungary of EU€ 128/ton for the period to 2020, the DDGS price in Hungary would be approximately EU€ 147/ton.

3.2. Carbon Dioxide

In relation to the question on possible commercial applications for the CO_2 produced during the fermentation process experience of such practices in Europe are limited to date as few plants we have knowledge of have invested in their sales of CO_2. Some relevant experience in this respect can be derived from the US market experience, where ethanol producers sell CO_2 to the beverage or refrigeration industry.

Basically, CO_2 remaining from the ethanol production process is either sold directly in its raw form to specialised gas supplying companies such as Linde, Praxair or Air Liquide, or the ethanol producers can set up their own plant to process raw CO_2 to food/beverage grade. In processed form CO_2 can then be sold to the beverage industry.

As far as costs of these two options are concerned, the US experience suggests they vary largely depending on the location of the ethanol plant and the market for CO_2 in that region. Assuming the ethanol plant is in a CO_2 deficit area it is estimated the raw CO_2 can sell for anywhere between an estimated EU€ 12-24/ton[6]. If Ethanol Europe were to invest in its own plant and process the CO_2, the price would be a low multiple of the raw CO_2 price depending on the capital cost of the plant, the energy and other plant costs for the liquefaction process and the cost of shipping to the user(s). In this context it is worth noting that the estimated cost of the of 250,000 tons annual liquid capacity liquefaction plant Yara International ASA has established at the Ensus bio-ethanol plant site on Teesside in the UK is estimated at some EU€ 30 million. An important observation highlighted by this arrangement that for the CO_2 recovery and sale to be economically efficient, the ethanol plant should generally be situated within a short distance from the plant or company procuring the CO_2.

If additionally the intention is to obtain the benefit of carbon credits for the plant since March 2008 the average weekly value of such credits to September 7th 2009 came to EU€ 18.33/ton[7] with a range from EU€ 8.37/ton to EU€ 27.05/ton.

[6] It should be noted that this is a rough estimate as the procurement arm of a possible purchasing company regarded this information as commercially sensitive.

[7] Based on 71 weeks data from the Carbix exchange

4. Ethanol market analysis

4.1. Product characteristics and applications

There is a vast range of uses for ethanol, both direct and indirect. The main uses are for fuel, industrial and beverage use. Fuel ethanol is by far the largest market with a market share of 85% while the beverage sector accounts for about 8% and industrial use 7% (Figure 4.1).

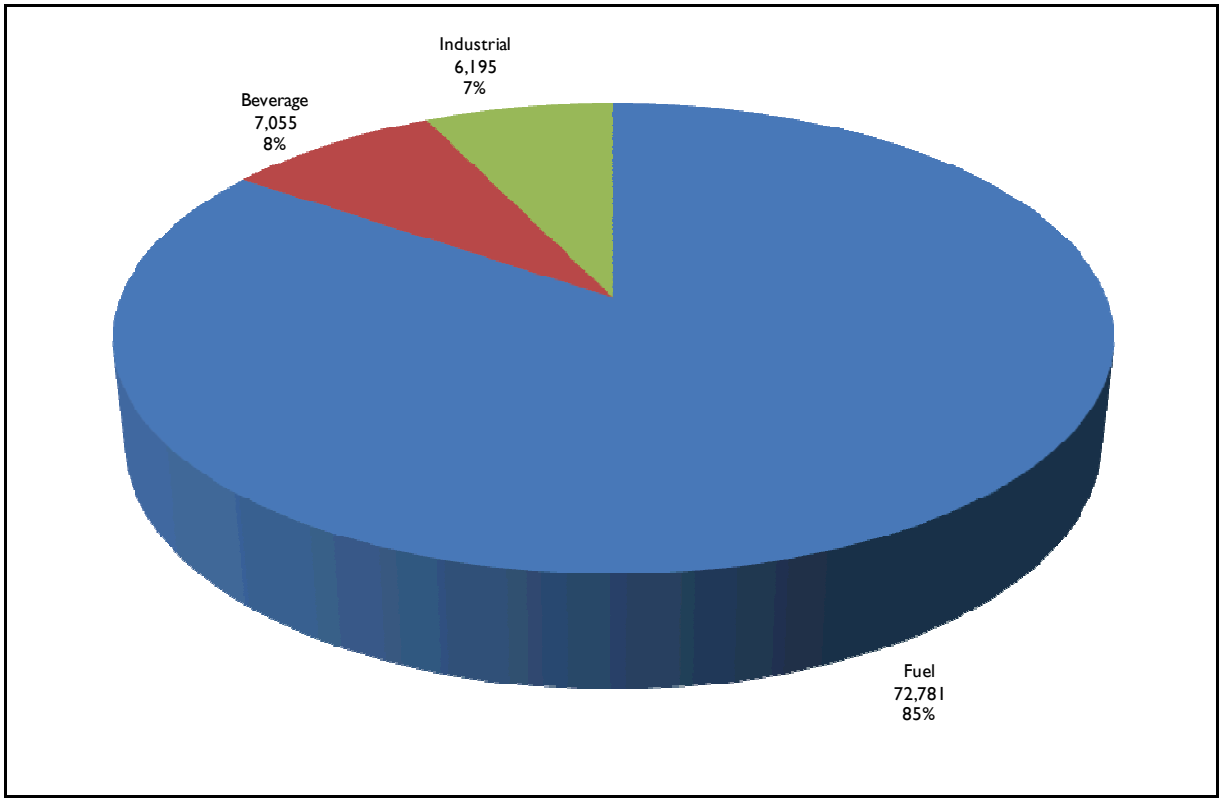

Figure 4.1: World ethanol consumption by sector, 2009* ('000m^3 / million litres)

Note: * Estimate
Source: F.O. Licht

4.2. EU biofuel policy and regulatory framework

The market for biofuel is (in the main) politically driven, meaning that policy developments ultimately drive the demand for bio-ethanol and hence the structure and development of the bio-ethanol industry. Given the importance of policy for the future development of the sector, this section provides an overview of the policy environment detailing the direct and indirect policies affecting bio-ethanol (and biofuel more generally) production at both the EU and Member State level.

4.2.1. Biofuel policy at the EU level

The EU's energy policy essentially aims at increasing the demand and use of biofuel in road transport fuels. Biofuel policies at the EU level have been driven by the: desire within the EU for energy security; the wish to diversify and support EU agricultural incomes; and, the need to reduce carbon emissions to meet EU environmental targets. The original drivers for both fuel ethanol and biodiesel production are two biofuel Directives from the European Commission adopted in 2003:

- The **Directive on the Taxation of Energy Products (Directive 2003/96/EC)**, in force since October 2003, allows Member States to exempt from taxation, in full or in part, products that contain renewable substances (such as biodiesel or bio-ethanol)[8].

- The '**Promotional' Directive (Directive 2003/30/EC)**, which entered into force in May 2003, sets indicative targets for the share of renewable fuels in the transport fuel market of at least 2% of EU transportation fuel from biofuel by the end of 2005 and 5.75% by the end of 2010. These are indicative targets based on the energy content of all petrol and diesel for transport purposes placed on the market. Under this Directive the EU's goal for biofuel use was not mandatory, and there is no penalty for non-compliance. In effect it has been left up to Member States to set their own targets for the use of biofuel and other renewable fuels and determine how these best be achieved.

More recently, in January 2007, the Commission adopted an energy and climate change package, calling on the Council and European Parliament to approve:

- An independent EU commitment to achieve a reduction of at least 20% in the emission of greenhouse gases by 2020 compared to 1990 levels and the objective of a 30% reduction by 2020, subject to the conclusion of a comprehensive international climate change agreement.

- A mandatory EU target of 20% renewable energy by 2020, including a 10% biofuel (equivalent to 13% by volume) inclusion in transport fuels. This implies the use of ethanol to replace petrol and biodiesel to replace diesel.

This strategy was endorsed both by the European Parliament and by EU Ministers at the March 2007 European Council. The European Council invited the Commission to come forward with concrete proposals, including how efforts could be shared among Member States to achieve these targets. It is important to note that the European Commission's strategy was designed to be strongly encouraging for alternative energy sources and encompasses all forms of energy consumption. Several studies evaluating the suitability of overall policy and the impact of the biofuel mandate on feedstock supplies and land resources and the environment were commissioned by and presented to the European Commission. The more relevant findings from these studies that are applicable to biofuel and of importance to the outlook for ethanol supply and demand in the EU include the following:

[8] A tax exemption/reduction existed prior to the EU-wide Directive in some Member States, including Spain, France and Sweden.

- A 10% biofuel policy is sustainable and achievable.
- The EU will probably have to import about 20% of its biofuel needs.
- Second generation biofuel technology will be needed to support the use of higher biofuel blends across the EU.
- Second-generation technology, such as biomass to liquid (BTL) and second-generation feedstock are vital to meeting the 10% target, particularly after 2014.
- The final European Commission proposal estimates that to achieve the 10% target, 30% of supply would be expected to come from second-generation technologies. Second generation biofuel can include the use of conventional agricultural feedstock.

The **Renewable Energy Directive (Directive 2009/28/EC)**) was adopted in June 2009 and sets a binding target (mandate) for 10% of energy used in the transport sector to be from renewable sources.

As part of the Renewable Energy Directive a set of sustainability criteria were also established in order for the biofuel to be counted as meeting the EU's 10% mandate by 2020. In other words, companies blending and distributing transport fuel have to ensure that the biofuel they use meet these criteria if they are to meet their obligations. It should be noted that no specific targets for second generation biofuel and renewable electricity were set in the RED. Nevertheless so-called second generation biofuel are encouraged by doubling the contribution they are counted as making toward the meeting of the 10% mandate. In addition renewable electricity for electric cars counts 2.5 times as much as first generation biofuel.

The criteria established by the Directive specify that in order for renewable fuels to count towards the EU's 2020 target, they must achieve minimum rates of greenhouse gas saving compared to using fossil fuels. This saving is set at 35% to start with, rising to 50% for existing installations and 60% for new installations in 2017. The issue of how to potentially factor in indirect land use change into the carbon footprint of biofuel has not been addressed as yet as to date there is no scientific consensus on how to measure this. Instead, there is a requirement for the Commission to produce a report on how the minimisation of indirect land use impacts change might be achieved by 2010 and to develop a methodology to measure the greenhouse gas emissions caused by indirect land use change.

While the GHG impact of indirect land use change has not been factored into the GHG saving targets the Directive nevertheless introduces comprehensive land use criteria within the sustainability criteria. These criteria apply to biofuel produced both inside and outside the European Community and the reference application date is January 2008. The aim of these land use criteria is to protect biodiversity and carbon stocks.

Specifically with respect to biodiversity, the criteria specify that biofuel may not be produced on:

- Primary forest and other wooded land where there are no clear indications of human activity and the ecological processes are not disturbed.

- Areas for natural protection purposes, either designated as such by the competent authority recognised as such by international agreements, or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature[9].

- Highly biodiverse land; either grassland which would remain as such in the absence of human intervention, or which would cease to be grassland in the absence of human intervention, and is species rich and not in a degraded condition[10].

Specifically with respect to the protection of land which is a source of carbon stocks, the criteria specify that biofuel may not be produced on:

- Wetlands (land covered in water either permanently or for a significant part of the year).

- Continuously forested areas (land spanning more than 1 hectare with trees higher than 5 metres and a canopy cover of more than 30%, or trees able to reach these thresholds in situ).

- Land spanning more than 1 hectare with trees higher than 5 metres and a canopy cover of between 10% and 30%, or trees able to reach these thresholds in situ.

The European Commission is required to report to Parliament and Council every two years on measures taken to respect these land use criteria. This report will be for both Member States and third countries, and the first report is due in 2012.

While no fixed social criteria are established in the Renewable Energy Directive, there is a requirement for the Commission to report on a variety of social criteria. The first report is also due in 2012, and subsequent reports are due every two years.

It is the responsibility of the operator (i.e. biofuel producer) to show compliance with the sustainability criteria, though it is up to the Member States to take measures to ensure that operators submit reliable information regarding the sustainability criteria. As is indicated above, the effects of not fulfilling the sustainability criteria are that: (a) the biofuel will not count towards the renewable energy obligation or the national targets; and (b) the biofuel will not be eligible for any financial support.

Finally it is important to note that the Community will try to conclude bilateral or multilateral agreements with third countries containing provisions on sustainability criteria corresponding to those outlined in the directive.

[9] Unless it is proven that production of the material does not interfere with the nature protection purposes

[10] Unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status

The **Fuel Quality Directive (Directive 2009/30/EC)** was also adopted in June 2009 and in effect sets the ceiling for bio-ethanol use in unmodified car engines at 5%. Other aspects of the Directive relevant to the EU biofuel sector include:

- the introduction of a binding target of a 6% reduction in the lifecycle greenhouse gases from transport fuel by 2020, with possibility of increasing this to 10% after a 2012 review. Additional interim targets of 2% by 31st December 2014 and 4% by 31st December 2017 could also be introduced in future.

- E10 will be phased in, with E5 petrol to be marketed until 2013 (and eventually beyond) to avoid damage to old vehicles.

- A waiver in respect of vapour pressure limits was introduced to make petrol blending easier. Member States can apply for the waiver to the Commission so they do not have to respect the vapour pressure limit for blending, in turn making blending more attractive. Whether or not a waiver is granted depends on socio-economic and environmental/health criteria. The FQD must be transposed into national law by 31 December, 2010.

4.2.2. Biofuel policy in Hungary

The regulatory framework for biofuel production in Hungary has been set out through the publication of a national biofuel strategy, the harmonisation of national laws with the EU Directives on biofuel and an amendment to the excise tax code[11]:

- Measures were taken to bring Hungary in line with the EU Directive that 0.4% of all vehicle fuel consumed had to be of biological origin in 2006, increasing to 4% by 2010.
- Since 1 July 2007, there has been a tax allowance of HUF 8.3 per litre for 4.4% biofuel blended into petrol. Since 1 January 2008, the same allowance applied to diesel oil. Since 1 July 2007 and 1 January 2008, respectively, fuels sold by the Hungarian Oil Company must contain 4.4% ethanol and biodiesel.
- For gasoline and diesel oil blended with at least 4.4% biofuel, a discounted excise tax for gasoline and diesel oil is applied of HUF103.5 per litre for gasoline and HUF85.0 per litre for diesel oil. Sales of petroleum fuel that contains no biofuel carries a tax penalty.
- For producers, the quantity produced is free from excise tax until 2010 if the whole quantity is blended in Hungary, transported from a Hungarian tax depot to a foreign tax depot, or sold to a registered distributor.
- For distributors, excise tax can be reclaimed if biodiesel is blended up to 5%.

[11] Some of the pertinent regulations in place in Hungary include: EU Directive 2003/30/EK, Government Decree 2233/2004 (IX.22), Government Decree 42/2005 (III.12) (income tax), and Parliamentary Order 63/2005 (VI.28).

4.2.3. EU trade policy affecting biofuel

It should be noted that in the EU a key difference between ethanol and biodiesel is the treatment of imports of both the feedstock and the biofuel. The EU ethanol sector operates with the benefit of protection both for the key feedstock (i.e. grains) and the end product in the form of ethanol on which a duty of EU€ 192/m^3 (EU€ 0.19/litre) is payable on undenatured ethanol and EU€ 102/m^3 (EU€ 0.10/litre) for denatured ethanol[12]. Similarly import duties are payable on grains which ensure that imports do not undercut domestically produced grains. By contrast biodiesel imports into the EU are subject to a much lower ad-valorem duty of 6.5% and import tariffs on vegetable oils tend to be either nil or very low. For ethanol therefore domestic production is encouraged, albeit allowing mainly Brazilian imports to set the ceiling on the market, whereas for biodiesel trade policy tends to encourage the import of feedstock rather than the biodiesel itself.

Although the EU ethanol sector is relatively protected from import competition, any further liberalisation of trade could have a sizable impact on the trade of ethanol in future. Although recent multilateral trade talks (WTO) have failed to reach agreement for further liberalising world trade, there are several bilateral, regional multilateral and preferential trade agreements that have entered into force recently or will do so in the near future. Since these involve key ethanol trading countries, they could have a sizable impact on world ethanol trade in the future. The agreements could also have an impact on the development of the ethanol market in the medium term. The major trade agreements are:

- ***Everything but Arms – the Preferential Trade Agreement with Least Developed Countries.*** In February 2001, the EU Council of Ministers adopted the so-called EBA (Everything But Arms) Regulation (Regulation (EC) 416/2001), granting duty-free access to imports of all products from all countries recognised and classified by the United Nations as least developed countries (LDCs) without any quantitative restrictions, except for arms and munitions as well as some agricultural commodities on a time limited basis. Imports of sugar, fresh bananas and rice were not fully liberalised immediately. Duties on these products are gradually reduced until duty free access is granted for sugar in July 2009 (amongst others). At present, 49 developing countries belong to the category of LDCs. The provisions of the EBA have been incorporated into the GSP (Generalised System of Preferences) Regulation (Council Regulation (EC) No 2501/2001) and came into force in 2002. Currently, countries covered by the EBA agreement include non-signatories of EPAs (see the section below) and 10 Asian countries.

- ***Preferential Trade Agreement with ACP countries***. Until recently, trade between African, Caribbean and Pacific (ACP) countries and the EU was mainly regulated by the ACP/EU Sugar Protocol and the Agreement on Special Preferential Sugar. Under these agreements, ACP preferential sugar imports amounted to approximately 1.3 million tons (1.6 billion litres) a year, the main sugar producers in this group being Mauritius (490,000 tons or 620 million litres), Fiji

[12] In this context it should be noted that the EU has resisted efforts from some quarters in the EU to allow a marginally modified form of fuel ethanol to enter the EU under a different tariff heading attracting a much lower rate of duty.

(204,000 tons or 258.2 million litres), Guyana (195,000 tons or 246.8 million litres), Swaziland (169,000 tons or 213.9 million litres) and Jamaica (150,000 tons or 189.9 million litres). However, in September 2007, the EU Council of Ministers took the decision to end the Sugar Protocol. With the denouncement of the Sugar Protocol, ACP sugar trade relations were incorporated in EPAs.

Under the Economic Partnership Agreements (EPA), market access conditions have improved for ACP signatories, with additional regional quotas amounting to 230,000 tons for the 2008/09 season. From 2009, ACP signatories have quota free, tariff free access with a specific dual safeguard mechanism (set at 3.5 million tons for the whole ACP, with separate secondary mechanisms for LDCs and developing countries), and from 2015 this safeguard will be loosened to the regular EPA safeguard adjusted for sugar. However, not all ACP countries have so far signed EPAs, although it is worth noting that the main ACP sugar-exporting countries listed above have signed. Non-signatory LDCs are covered under the EBA scheme, but the developing country non-signatories are covered by the GSP, although it is worth noting that there are no significant sugar exporters in this group. Trade relations with South Africa are governed by the Trade, Development and Cooperation Agreement (TDCA). The transitional period under the TDCA runs until 2012. However, sugar is currently excluded from the TDCA, though it is on the list of commodities that can be periodically reviewed.

- ***EU-India Free Trade Agreement***. Negotiations on an EU-India Free Trade Agreement (FTA) are underway. The talks were originally scheduled to be completed in 2009, but the pace of the talks slowed at the end of 2008, and the European Parliament is now pushing to have the FTA signed by the end of 2010. The EU-India FTA is expected to cover between 90 and 95% of goods, although it is not yet clear which goods categories will be tariff free, and which will maintain tariffs (therefore the statuses of sugar and ethanol are unknown). As a result of the FTA, it is estimated that Indian exports to the EU will increase by 20%. Sugar imports from India currently qualify for special preferential treatment.

- ***EU-ASEAN, Central America and the Andean community Free Trade Agreement***. The EU is currently negotiating FTAs with ASEAN, Central America and the Andean community, to add to the negotiations with the Gulf region, which have been ongoing for over a decade. There currently no expected date for the end of these negotiations.

- ***EU-Ukraine Free Trade Agreement***. Trade relations with the Ukraine are currently governed by the Partnership Co-operation Agreement (PCA), which is based on the MFN principle. Talks regarding the establishment of an FTA between the EU and the Ukraine began in February 2008, and are expected to finish in 2009. With three rounds of talks completed, it is not yet known whether ethanol will be included in the FTA. Despite this, in a 2007 sustainability impact assessment on the FTA commissioned by DG TRADE, it was noted that under an FTA, output in cereals is expected to increase, partly driven by the demand for ethanol. However, two

potential limitations to cereal exports were identified; export quotas by the Ukraine, and tariff rate quotas by the EU.

- ***EU-Mercosur Free Trade Agreement***. In the 2004, negotiations between the European Union and the Mercosur trade bloc (comprising Brazil, Argentina, Uruguay and Paraguay as full members, with Chile and Bolivia as associate members and Venezuela in the process of becoming a full member at the time of writing) for a bilateral trade agreement, the European Commission offered an import quota of 1 million tons of ethanol (1.26 billion litres) at a reduced duty. This offer was linked to certain conditions. The proposal was based on the so-called "single-pocket" principle, meaning that under the negotiations volumes would be split 60:40, into an immediate portion and a second share depending on the outcome of WTO Doha Round of trade talks. Under the scheme, any potential additions to the initial EU-Mercosur quota would reduce the available volume for preferential access in the latter negotiations.

  The last plan from the European Commission dated late September 2004 provided for an import quota of 60,000 tons (75.9 million litres) in the first year of the agreement which could be imported at a reduced tariff of a yet undefined level of between EU€ 5-10/hl (EU€ 0.05-0.10/litre). The preferential quota was set to rise to 120,000 tons (151.9 million litres) in the second year and by 60,000 tons (75.9 million litres) in each of the following years until 600,000 tons (759.6 million litres) were reached in year 10. The remaining 400,000 tons (506.4 million litres) of the total import quota of 1 million tons (1.3 billion litres) were to be allocated subject to the results of the Doha trade round.

  Several EU Member States, including France, Italy, Germany, Austria, Finland and the Netherlands, expressed serious misgivings relating to the bio-ethanol part of the proposal. These countries pointed out that allowing a volume equivalent to several times current EU production of ethanol into the Community could seriously threaten this emerging industry in the EU. Former German Minister for Consumer Protection, Food and Agriculture, Renate Künast, called for a transition period for bio-ethanol imports from the Mercosur countries in order to protect the recent investments in the German bio-ethanol industry.

  In addition, three European associations representing the trade in and processing of cereals and oilseeds raised strong objections to the Commission's offer. The EBB (European Biodiesel Board), COCERAL (Grain and Feed Trade Committee of the EEC) and Fediol (a federation that represents the vegetable oils and fats industry in the European Union) warned that the EU's policy for promoting indigenous biofuel could be put at risk due to potential high imports of low priced bio-ethanol, produced in Brazil. They also pointed out that the 1.25 billion litres duty-reduced import quota offered by the European Commission was more than three times the level of domestic bio-ethanol production then being generated in the EU. The European associations doubted whether EU Member States would want to continue offering tax relief for biofuel, which, in the final analysis, would benefit only non-EU producers. They criticised the inherent contradiction in this concession, as they argued it threatened to undermine the measures for

promoting domestic biofuel production the EU took in 2003, and they therefore urged the European Commission to reconsider this offer.

Former EU Trade Commissioner Peter Mandelson and current Agriculture Commissioner Mariann Fischer Boel have focused on multilateral trade negotiations and have therefore temporarily left bilateral issues aside. However, there seems to be political will to relaunch the negotiations, which may in turn lead to the re-opening of the Mercosur talks. In February 2009, the Spanish and Argentinean governments asked for a restart of the negotiations, in part driven by the respective countries' desire to increase co-operation in the field of renewable energy.

- ***EU-Brazilian trade negotiations***. Current imports of ethanol from Brazil do not qualify for preferential treatment. Sugar imports from Brazil are subject to an MFN tariff. Trade negotiations between the EU and Brazil have so far proceeded under the Doha Round of trade talks, and the EU-Mercosur bilateral negotiations. Negotiations have been complicated by the EU's agricultural subsidies and barriers to agricultural trade, which Brazil sees as disadvantageous for its exports.

  For ethanol in particular, there are signs that the EU is willing to lower tariffs for Brazilian exporters; the WTO wished for a 57% cut in the EU€ 192/m^3 (EU€ 0.19/litre) tariff in the Geneva negotiations held in summer 2008. The European Commission has proposed to cut tariffs on 1.4 million tons (1,772 million litres) of ethanol imports by 2020 which would be around 8% of the bloc's fuel ethanol demand based on the 10% biofuel target. Under the proposal, a 10% tariff would be levied on shipments within the import quota. Earlier, the EU had proposed to put ethanol on the list of sensitive products which then allows the introduction of import quotas. This move was strongly opposed by European ethanol producers.

  However, such a cut in tariffs would come at a price; the EU has hinted at two options. The first is placing ethanol on the sensitive products list, hence introducing quotas for EU imports of ethanol from Brazil. The second is better market access for unspecified EU exporters in return for reduced tariffs on ethanol.

  The change of the EU trade Commissioner and the absence of progress in the WTO Doha Round brought trade negotiations between the EU and Brazil temporarily back to life in December 2008. At the time the new Commissioner Catherine Ashton stated that she was in Brazil for negotiations with ethanol in particular on the agenda. While Brazilian diplomats were keen to keep the negotiations fairly secret due to the risk of damaging their negotiating position for the Doha Round, they admit to having received an offer for a quota to fill 6% of EU ethanol consumption. No further comments have been made since on the state of negotiations and as multilateral discussions are now once again the process of being re-launched very little progress is expected of a bilateral nature.

In summary, while in the medium term, either as part of a multilateral WTO outcome or a bilateral EU-Brazil arrangement, improved access for Brazilian exports is to be expected in the medium to long term this access is likely to be limited and should therefore not pose a significant threat to EU ethanol producers.

4.3. Industry structure and capacity

4.3.1. Structure of the EU ethanol sector

Table 4.1 provides a summary of existing and under construction fuel ethanol production capacities in the EU. There are currently some 72 ethanol plants in operation in Europe, with an annual capacity of some 6.2 million m^3 (6.2 billion litres). It is estimated that 31 of these plants, with an annual capacity of 4.7 million m^3 (4.7 billion litres), provide dedicated fuel ethanol capacity (Figure 4.2).

Table 4.1: EU-27 bio-ethanol production capacity ('000m^3 / million litres)

	Established		**Under construction**	
	number	capacity	number	Extra capacity
Bio ethanol plants	72	6,247		
Of which fuel bio-ethanol plants	*31*	*4,700*	*13*	*2,298*

Source: Agra CEAS Consulting based on information collected from F.O. Licht; eBIO and EU ethanol producers

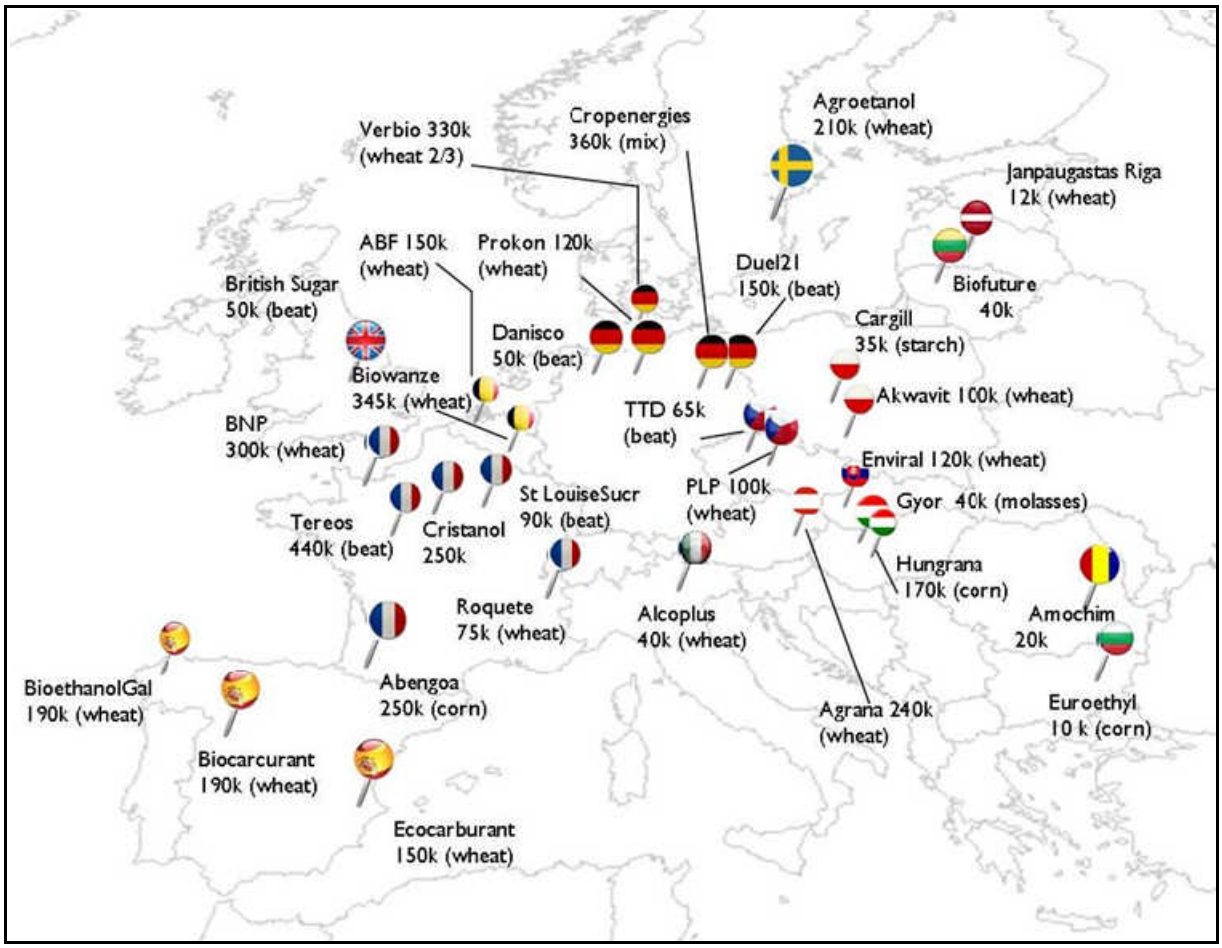

Figure 4.2: EU fuel ethanol plants

Source: Agra CEAS Consulting based on information collected from F.O. Licht; eBIO and EU ethanol producers

There are also an additional 13 plants reported to be under construction (although these are at various stages of completion, as progress on a number of these may have stalled), which are expected to be dedicated fuel ethanol capacity. These plants will add a further annual capacity of 2.3 million m^3 (2.3 billion litres). The most significant fuel ethanol plants that are currently under construction that are expected to be fully operational during 2010 are the Ensus plant in the UK (with an annual capacity of 400,000 m^3 (400 million litres)) and the Abengoa plant in the Netherlands (with an annual capacity of 500,000 m^3 (500 million litres)).

Over the last few years, at least 151 potential projects have been announced, most of which have since been abandoned. If these were projects were to have been realised, then they would add a further 17 million m^3 (17 billion litres) of annual capacity. A detailed list of existing and under construction ethanol capacity as well as various projects planned is provided in Appendix 3.

4.3.1. Structure of the Hungarian ethanol sector

There are currently two ethanol plants in operation in Hungary, Hungrana Kft. and Gyôri Szeszipari Rt., with an annual capacity of some 120,000 m^3 (120 million litres) (Table 4.2). Over the last few

years, at least 20 potential projects have been announced, although almost all have since been abandoned. If these projects were to be realised, then they would add a further 2.7 million m^3 (2.7 billion litres) of annual capacity. All these projects proposed using maize as a feedstock.

Table 4.2: Bio ethanol plants in operation and announced projects in Hungary

Ownership	Location	EtOH capacity (mln litres)	Processing capacity (tons)	Feedstock
Operational				
Hungrana (Agrana, Tate&Lyle/ADM)	Féjer	170	160,000	Maize
Györ Distillery	Györ	50	160,000	Molasses
Project				
First Hungarian Bioethanol Kft (Elsö Magyar Bioetanol Termelö Kft, Eastern Sugar)	Hajdun/aBihar	85	300,000	Maize
CSLM (US)/Bion/aTech Energie	Somogy	126	500,000	Maize
United Biofuel Holdings Europe AG/ Duna Fejlesztesi Holding Rt.	Baranya	100	300,000	Maize
United Biofuel Holdings Europe AG/ Duna Fejlesztesi Holding Rt.	Somogy	100	300,000	Maize
United Biofuel Holdings Europe AG	Békés	125	300,000	Maize
Svensk Etanolkemi AB (Sekab), BKZ Developments Beruhazasfejleszt Rt., EBP Europai Bioenergia Zrt	Gonyu/Györ, Marcali, Mohacs, Kaba	600	1,500,000	Maize
Svensk Etanolkemi AB (Sekab)	Southeast Hungary	150	300,000	
Rodeport Kft (Sirabel (CH) et al	Tolna	n/a	300,000	Maize
Bion/aTech Energie, CSLM (US)	Hajdun/aBihar	430	1,000,000	Maize
Amidonn Kft (Catelli Holding (I))	Borsodn/aAbaujn/aZemplen	n/a	n/a	n/a
US investor	Komáromn/a Esztergim	405	1,000,000	Maize
Magyar Bioenergetikai Zrt (Mabio)	Békés	125	350,000	Maize
Magyar Bioenergetikai Zrt (Mabio)	Bácsn/aKiskun	125	350,000	Maize
Bion/aMA Magyarorszag	n.a.	n/a	n/a	n/a
Bácsn/aBion/aEtabol Kft	Bácsn/aKiskun	83	n/a	Maize
Global Green One AS (NOR)	Békés	60	200,000	Maize
Global Green One AS (NOR)	Vas	n/a	n/a	Maize
Global Green One AS (NOR)	Bácsn/aK iskun	n/a	n/a	Maize
Global Green One AS (NOR)	Vas	n/a	n/a	Maize
Duna Development Ltd. (Regional Development Holding Corp. (44.45%), Silbergie AG (44.45%) (CH), Hungarian Investment and Trade Development Agency (ITDH) (1.92%, Tibor Ersek (9.1%)	Békés	100	280,000	Maize

Notes: 1 million litres = 1,000 m^3
Source: F.O. Licht

4.4. Supply and demand analysis

As discussed in Section 4.2 the main drivers of fuel ethanol production in the EU have been the European Commission's four biofuel directives which will continue to define the framework for the supply and demand of fuel ethanol beyond 2010. Table 4.3 presents the EU ethanol supply and demand balance for the period 2006-2009, which shows a: 77% increase in output; an 11% increase in imports; a 52% increase in consumption; and a 423% increase in exports (notably from a low base – total exports remain relatively low and substantially below import levels) over the period. The increase in consumption and trade is reflected in a 15% decrease in stocks over the period.

Table 4.3: EU ethanol supply balance, 2006-2009 ('000m^3 / million litres)

EU supply balance	2006	2007	2008	2009*
Opening stocks	**1,223.0**	**1,093.0**	**736.6**	**891.3**
Output	**3,402.0**	**3,587.0**	**4,315.0**	**6,032.0**
Fuel ethanol	*1,577.0*	*1,797.0*	*2,822.0*	*3,830.0*
Non-fuel ethanol	*1,825.0*	*1,790.0*	*1,493.0*	*2,202.0*
Imports	**943.9**	**1,415.5**	**1,651.2**	**1,050.0**
Consumption	**4,410.9**	**4,966.1**	**5,697.0**	**6,700.0**
Fuel ethanol	*2,110.9*	*2,666.1*	*3,597.0*	*4,400.0*
Non-fuel ethanol	*2,300.0*	*2,300.0*	*2,100.0*	*2,300.0*
Exports	**65.0**	**392.7**	**114.5**	**340.0**
Ending stocks	**1,093.0**	**736.6**	**891.3**	**933.3**

Note: * 2009 estimated.
Source: F.O. Licht

4.4.1. Historic analysis of EU ethanol production

The development of total ethanol (i.e. fuel, beverage and industrial) production in the EU is shown in Table 4.4. Based on F.O. Licht estimates, overall ethanol output in the EU is expected to rise to some 6 million m^3 (6 billion litres) in 2009, up by some 1.7 million m^3 (1.7 billion litres) on 2008 output of 4.3 million m^3 (4.3 billion litres). Most of the rise is due to the increase in the production of fuel ethanol, which is expected to account for almost two-thirds of the EU ethanol market.

Figure 4.3 and Table 4.5 look specifically at the development in fuel ethanol production in the EU. In 2009, it is estimated that 19 of the 27 EU Member States are producing fuel ethanol, up from just 8 in 2004 (Table 4.5). Based on F.O. Licht estimates, fuel ethanol output in the EU is expected to rise to some 3.8 million m^3 (3.8 billion litres) in 2009, an increase of 1 million m^3 (1 billion litres) on 2008 output of 2.8 million m^3 (2.8 billion litres). In Western Europe, considerable volumes of fuel ethanol are produced in France, Germany and Spain. In addition, Poland and Hungary are producing significant volumes of ethanol in Eastern Europe.

Table 4.4: EU ethanol production and outlook, 2000-2009 ('000m^3 / million litres)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Austria	8	9	9	8	7	7	12	25	89	180
Denmark	19	20	19	18	18	21	20	13	13	8
France	812	812	844	817	830	910	850	1,150	1,550	1,850
Germany	285	295	275	280	230	335	742	689	815	1,050
Hungary	43	43	43	47	54	58	86	99	93	192
Italy	206	207	200	149	150	161	180	118	100	115
Poland	173	181	210	220	195	241	279	208	190	400
Spain	145	225	258	292	334	379	478	438	417	590
Sweden	17	92	97	100	105	110	115	116	124	220
U.K	435	430	330	310	285	290	280	327	350	580
Other EU	317	313	274	266	283	299	360	404	574	847
EU	**2,460**	**2,627**	**2,559**	**2,507**	**2,491**	**2,811**	**3,402**	**3,587**	**4,315**	**6,032**
Of which fuel ethanol	7%	10%	12%	19%	24%	32%	46%	50%	65%	63%

* estimate
Source: F.O. Licht

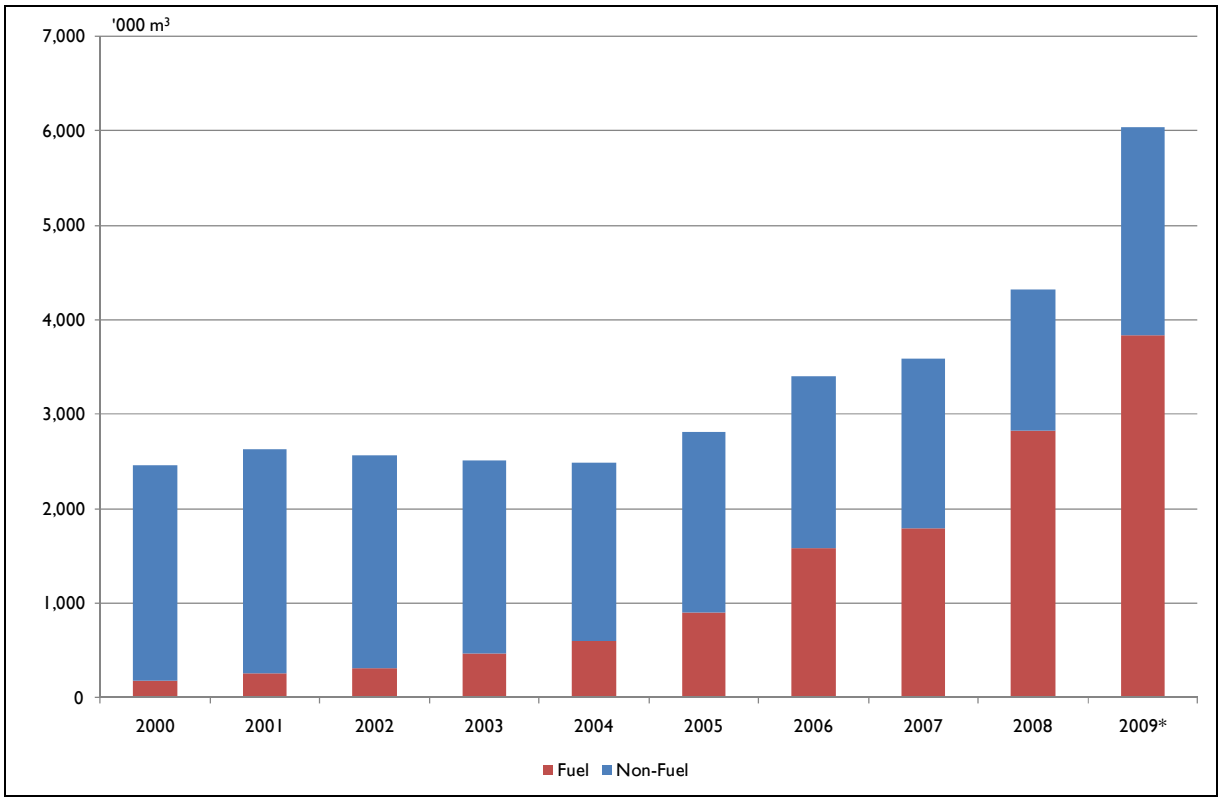

Figure 4.3: EU ethanol production, 2000-2009 ('000m³ / million litres)

Note: * 2009 estimated.
Source: F.O. Licht

Table 4.5: EU fuel ethanol production and outlook, 2004-2009 ('000m³ / million litres)

	2004	2005	2006	2007	2008	2009*
France	101	144	293	539	1,000	
Germany	25	165	431	394	568	
Spain	254	303	402	348	317	
Poland	48	64	120	155	200	
Sweden	71	153	140	120	78	
Italy	0	8	128	60	60	
Czech Republic	0	0	15	33	76	
Slovakia	0	0	0	30	94	
Austria	0	0	0	15	89	
Hungary	0	35	34	30	150	
Netherlands	14	8	15	14	9	
Lithuania	0	8	18	20	20	
UK	0	0	0	20	75	
Latvia	12	12	12	18	20	
Ireland	0	0	0	7	10	
Finland	3	13	0	0	50	
EU	**528**	**913**	**1,593**	**1,803**	**2,816**	**3,830**

* estimate
Source: eBIO, F.O. Licht

4.4.2. Historic analysis of EU ethanol demand

Given the relatively 'loose' EU biofuel and policy framework described in Section 4.2.1, implementation by EU Member States was initially slow. This was not surprising since not all Member States were supportive of the idea of producing biofuel. Thus, the EU only reached an overall 1.4% share of renewable fuels by the end of 2006, thereby missing the 2% target. Only seven of the 25 EU Member States met their stated biofuel consumption targets (Figure 4.4):

- Germany and Austria were the most successful, surpassing their biofuel targets by 4.3% and 0.9%, respectively.

- Latvia, Estonia and Greece missed their targets by the widest margins. While these markets had respective 2006 targets of 2.75%, 2% and 2.5%, biofuel represented less than 1% as a proportion of total road fuels in each of these countries in 2006.

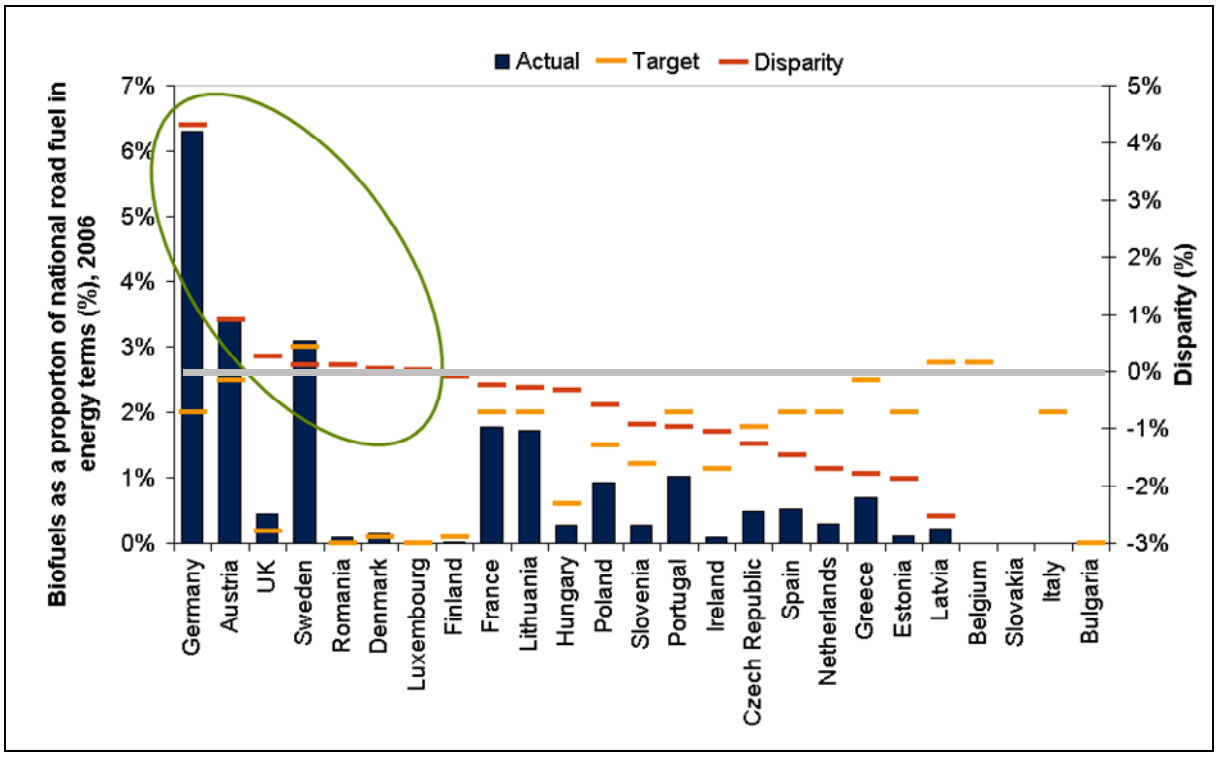

Figure 4.4: EU biofuel use as a proportion of national road fuel in energy terms, 2006

Source: Member State reports to the European Commission

Excise duty exemption and blending obligations are the main tools used by governments to encourage the use of biofuel (Table 4.6). While long-standing political support for biofuel has been the key driver in successful markets (such as Germany, Austria and Sweden), the main reasons for the poor performance in other countries (such as Latvia, Estonia and Greece) are the relatively recent adoption of targets and the lack of legislation obliging fuel retailers to blend a prescribed

proportion of biofuel into all of the fuel that they sell. This is because Member States have been allowed to deviate from the EU's 5.75% blending target due to:

- practical considerations such as the limited potential for biofuel production;
- the amount of resources already being allocated to the exploitation of biomass for energy uses other than transport and the specific technical or climatic characteristics of their national transport fuel markets; and,
- domestic policies allocating comparable resources to the production of other transport fuels based on renewable energy sources.

Furthermore, in accordance with Article 3 Paragraph 5 of Directive 2003/30/EC, the proportion of renewables in fuels can be up to 5% by volume without the product needing to be labelled. However, if the fuel ethanol share was to reach the 5.75% target by energy content, labelling would be required since the volumetric share for ethanol would be more than 8%.

Table 4.6: EU biofuel consumption, mandates, indicative targets (% of total fuel consumption by energy content) and tax exemptions

Country	2006 biofuel share	Mandate	Indicative target	Tax exemption / reduction
Austria	0.93	2008*: 4.3% 2010: 5.75%		Tax exemption for pure biofuel. Duty refund for certain blends.
Belgium	0.00		2008: 4.25% 2009: 5% 2010: 5.75%	Tax advantages for limited volumes (quotas).
Bulgaria	-	2008- : 5%	2010: 5.75%	Tax exemption for biofuel.
Cyprus	0.00	2008: 2% 2009: 2% 2010: 2%	2008: 2.5% 2009: 2.5% 2010: 2.5%	Tax exemption for biofuel until 2010.
Czech Republic	0.05	2008: (E) 2% 2009: (E) 3.5% 2010: (E) 5.75%		Tax exemption for high percentage biofuel.
Denmark	-	2010: 5.75%		CO2 tax exemption until 2010.
Estonia	0.00		2010: 5.75%	Tax exemption for certain biofuel until Apr 2011.
Finland	-	2008: 2% 2009: 4% 2010: 5.75%		
France	0.97		2008: 5.75% 2009: 6.25% 2010: 7%	2008: Tax exemption. 2009-12: tax reduction, falling in volume over the period.
Germany	3.75	2008: (E) 2% 2009: (E)2.4%, (T) 5.25% 2010: (E) 3.3%, (T) 6.25%		Tax exemption for E85 and 90%+ ethanol blends. Tax reduction for diesel, FAME, PPO.
Greece	-		2008: 1.47% 2010: 5.75%	Tax exemption for limited quantities (quotas) in blends above 5%.
Hungary	0.07		2010: 5.75%	Tax exemption for the bio component of E85. Favourable tax rates for certain blends.
Ireland	0.05		2010: 3%	Tax relief for limited volumes (quotas).
Italy	0.51		2008: 2.50%	Reduced tax rates on certain biofuel.

Country	2006 biofuel share	Mandate	Indicative target	Tax exemption / reduction
			2009: 3.75% 2010: 4%	
Latvia	0.33		2010: 5.75%	Reduced rates for certain blends.
Lithuania	0.72	Various; exact mandate depends on fuel type		Tax exemption for biofuel, calculated by volume.
Luxembourg	0.02	2007 onwards : 2%	2010: 5.75%	Tax exemption for pure biofuel.
Malta	0.52		2010: 1.25%	Tax exemption for biofuel, calculated by volume.
Netherlands	0.02	2008: 3.25% 2009: 3.75% 2010: 4%		None
Poland	0.48		2008: 3.45% 2009: 4.60% 2010: 5.75% 2011: 6.20% 2012: 6.65%	Tax exemption calculated by volume, subject to a minimum amount of excise.
Portugal	0.00	2009: 1.75% 2010: 4.25% 2011: 6.50% 2012: 10%	2008: 5.75% 2010: 10%	Partial exemption for a limited amount (quota) of biofuel.
Romania	-	Jul 2009: (E) 4%	2010: 5.75%	Tax exemption for biofuel.
Slovakia	-	2007: 2% 2010: 5.75%		Reduced excise for biofuel.
Slovenia	0.35	2008: 3%[13] 2009: 4% 2010: 5% 2011: 5.5% 2012: 6%	2008: 1.5% 2009: 2% 2010: 3% 2011: 4% 2012: 5%	Tax exemptions for blends up to 5%.
Spain	0.44	2009: 3.90% 2010: 5.83% 2011:7%		Tax reductions. Complete exemption for a limited amount (quota) of bio-ethanol.
Sweden	2.23		2010: 5.75%	Full tax exemption for biofuel.
U.K.	0.18	2008: 1.75% 2009: 2.45% 2010: 2.8% 2011: 3.15% 2012: 3.5%		20p per litre tax reduction until 2010.

Notes: Volume targets: A 10% volume target means that, out of 100,000 m^3 (100 million litres) of petrol and diesel, 10,000 m^3 (10 million litres) will be replaced with ethanol and biodiesel. Original UK targets are by volume, not by energy content. These have been converted to energy targets with the conversion rate of anhydrous ethanol (0.7). Energy content targets: Energy content targets are higher than volume targets because it takes more ethanol and biodiesel to get the same energy as from petrol and diesel. Anhydrous ethanol has 70% of the energy content of petrol, and biodiesel has 90% of the energy content of diesel. This means that, for petrol, at least 14,300 m^3 (14.3 million litres) of ethanol will be needed for every 100,000 m^3 (100 million litres) of fuel in order to meet a 10% energy content target. For diesel, at least 11,000 m^3 (11 million litres) of diesel will be needed for every 100,000 m^3 (100 million litres) of fuel to meet the same target. Targets are for all biofuel consumption, unless stated otherwise.

* October 2007-08

(E) indicates an ethanol-only target.

(T) indicates a total biofuel consumption target

[13] Slovenia has the possibility to reduce this mandate if the price of biofuel exceeds that of fossil fuels with duty included

4.4.3. Historic analysis of EU ethanol trade

The EU is a net importer of ethanol. In 2008, total ethanol imports amounted to some 1.6 million m^3 (1.6 billion litres), with imports of some 1.1 million m^3 (1.1 billion litres) expected in 2009 (see Figure 4.5). This has not always been the case, however, as the EU was a substantial net exporter of subsidised wine alcohol which was mostly shipped to the Caribbean. This alcohol was of lower quality than that produced by the traditional distilling sector. However, with the emergence of the fuel ethanol industry in the EU, policymakers decided to stop subsidising exports of wine alcohol and divert the quantities to the domestic market for fuel use. Subsequently, from 2001 the EU switched from being net exporter to net importer, taking advantage of lower world market prices, improved market access through preferential trade agreements and rising domestic requirements from the industrial and fuel sector. EU fuel ethanol net trade data is presented in Table 4.7.

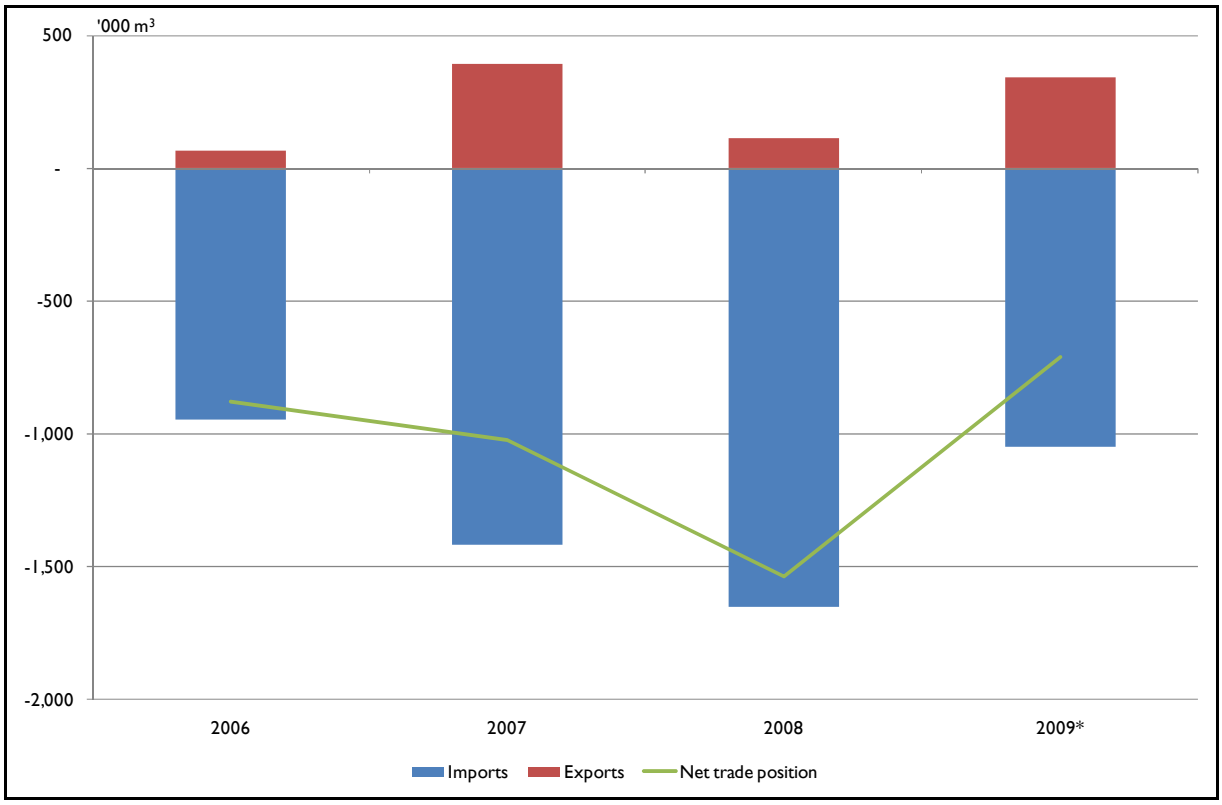

Figure 4.5: EU ethanol trade with third countries, 2006-2009 ('000m^3 / million litres)

Note: * 2009 estimated.
Source: F.O. Licht

Table 4.7: EU fuel ethanol net-trade, 2004-2008 ('000m^3 / million litres)

	2004	2005	2006	2007	2008
Imports	319	494	534	910	1,300
Exports	8	-	-	-	300
Net-trade	-311	-494	-534	-910	-1,000

Source: F.O. Licht

EU ethanol imports are categorised as either T1 (ethanol subject to duty) or T2 (ethanol of EU origin and counties with duty free access). T1 ethanol attracts a customs duty of EU€ 192/m^3 (EU€ 0.19/litre) for undenatured (i.e. suitable for beverage and/or industrial/fuel use) alcohol (HS 2207.10) and EU€ 102/m^3 (EU€ 0.10/litre) for denatured (rendered toxic for human consumption) (HS 2207.20). For T1 ethanol, tariffs do not have to be paid if the product is re-exported to third countries. Table 4.8 presents an import trade matrix for total EU ethanol (fuel, beverage and industrial) imports in 2008 by origin. Custom's codes do not distinguish between ethanol imports for fuel, beverage or industrial use. Brazil is the single largest ethanol exporter to the EU market, contributing some 47% of total EU imports in 2008, including 45% of all undenatured ethanol imports (which attract the highest EU€ 192/m^3 (EU€ 0.19/litre) tariff).

Table 4.8: EU ethanol trade with third countries: import trade matrix, total exports and net-trade position, 2008 (m^3 / '000 litres)

	Ethanol (a) HS 2207.10	Ethanol (b) HS 2207.20	Ethanol (c)	Ethanol blends HS 3814	Total	% share
Argentina	-	15,937	-	-	15,937	1.0%
Bolivia	-	51,314	-	-	51,314	3.1%
Brazil	118,162	592,849	-	58,327	769,338	46.6%
Congo (Dem Rep)	-	2,238	-	-	2,238	0.1%
Costa Rica	-	33,322	-	-	33,322	2.0%
Croatia	-	4,843	-	-	4,843	0.3%
Cuba	2,045	-	-	-	2,045	0.1%
Cuba	-	3,718	-	-	3,718	0.2%
Dubai	2,900	-	-	-	2,900	0.2%
Egypt	-	41,630	-	-	41,630	2.5%
El Salvador	-	38,318	-	-	38,318	2.3%
Ethiopia	-	1,610	-	-	1,610	0.1%
Guatemala	-	40,154	-	-	40,154	2.4%
Kazakhstan	1,297	-	-	-	1,297	0.1%
Malawi	-	1,479	-	-	1,479	0.1%
Mauritius	-	4,374	-	-	4,374	0.3%
Nicaragua	-	-	-	-	-	0.0%
Norway	-	13,307	-	-	13,307	0.8%
Pakistan	18,946	102,105	-	-	121,051	7.3%
Peru	-	39,337	-	-	39,337	2.4%
Russia	2,503	-	-	-	2,503	0.2%
Saudi Arabia	-	-	-	17,420	17,420	1.1%
Serbia	-	1,619	-	-	1,619	0.1%
South Africa	-	6,489	-	-	6,489	0.4%
Swaziland	-	19,594	-	-	19,594	1.2%
Turkey	-	4,969	-	-	4,969	0.3%
Ukraine	-	10,258	-	-	10,258	0.6%
USA	-	1,944	-	-	1,944	0.1%
Zimbabwe	-	7,436	-	-	7,436	0.5%
Other countries	1,969	285,385	98	103,256	390,708	23.7%
EU	**147,823**	**1,324,228**	**98**	**179,003**	**1,651,152**	100.0%
Exports	18,043	66,465	-	24,890	109,398	
Net-imports	129,780	1,257,763	98	154,113	1,541,754	

Notes: (a) Denatured, all strengths; (b) Undenatured >80 degrees strength; (c) Undenatured <80 degrees strength.
Source: F.O. Licht

It should be noted that due to the steep tariffs, there is some incentive for third countries without preferential access agreements to transform ethanol in such a way that it can be imported under customs headings other than 2207. Primarily this means importing blended ethanol under HS3814, which attracts a normal customs duty of around 6%. In 2008, some 179,000m^3 (179 million litres) of ethanol in blends were imported, surpassing imports of denatured ethanol. Ethanol can also be imported in the form of Ethyl Tertiary Butyl Ether (ETBE)[14], however, due to the high cost of constructing ETBE plants, the production of ETBE is realistically limited to countries with existing Methyl Tertiary Butyl Ether (MTBE)[15] plants that have been converted. Furthermore, ETBE is not considered a pure biofuel and therefore ETBE blends would not qualify towards meeting the EU biofuel blending mandate of 10% by 2020.

While the EU as a whole is a net importer of both fuel and non-fuel ethanol, not all individual EU Member States are net-importers. Figure 4.6 below presents ethanol net-trade data (including intra-EU trade (i.e. trade with other EU Member States). In 2008, France was a net-exporter of just under 0.5 million m^3 of ethanol and Spain's net-exports amounted to 55,000 m^3 (55 million litres). The three largest net importers of ethanol in 2008 were Germany at 0.7 million m^3, (700 million litres) the Netherlands at 0.4 million m^3 (400 million litres) and Sweden at 0.2 million m^3 (200 million litres).

[14] Ethyl Tertiary Butyl Ether (ETBE) is produced from ethanol and isobutylene in a catalytic reaction. Although ETBE can be produced from bioethanol, isobutylene is derived from fossil sources, so ETBE is not a pure biofuel.

[15] Methyl Tertiary Butyl Ether (MTBE) is manufactured via the chemical reaction of methanol and isobutylene. Methanol is derived from natural gas, and isobutylene is derived from fossil sources, thus MTBE is a fossil fuel. MTBE use as a gasoline additive has been phased out due to environmental concerns.

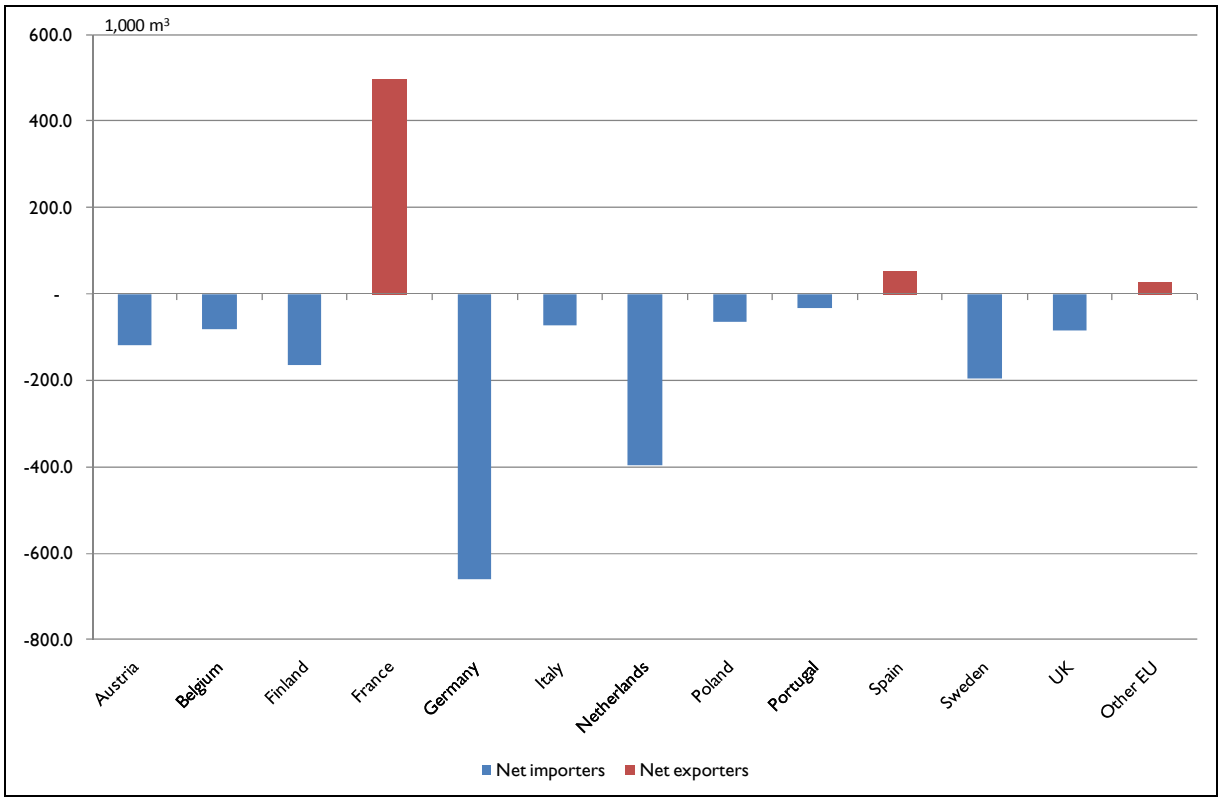

Figure 4.6: EU ethanol net-trade (including intra-EU trade), 2008 ('000m³ / million litres)

Source: F.O. Licht

It should be noted, however, that the location of large port facilities in the Netherlands (Amsterdam and Rotterdam) in particular may mean that the data may not accurately reflect all of the ethanol imported and then trans-shipped to other Member States by road or rail. Nevertheless, they key issue is that there is free movement of goods within the EU and so as long as ethanol can be shipped competitively to any of the major Northern European ports such as Amsterdam, Rotterdam, Antwerp, Ghent, or other European ports on the Mediterranean coast, the widest potential market can be accessed.

4.5. Outlook for EU fuel ethanol supply and demand to 2015

In 2007, the European Commission confirmed that the EU was unlikely to achieve its 5.75% target by 2010. According to the analysis undertaken by DG Transport and Energy (TREN) the current biofuel Directive (EC 2003/30) promoting 5.75% biofuel by 2010 would not be reached because the markets and technologies have not had sufficient time to be in place. With current policies and measures, the share is likely to be about 4% in 2010. However, by 2013 the Commission considers an incorporation rate of 5.5% could be reached if Member States stringently aim at meeting the 10% objective in 2020. While there has been no further analysis by DG TREN since the 2007 report, the estimation of a 4% incorporation rate of biofuel by 2010 appears to still be valid, particularly in light of the subsequent lowering of mandatory and indicative targets by several Member States during 2008.

However, these incorporation rates are for biofuel in general. Current blending of ethanol in petrol is far lower as biodiesel currently accounts for the majority of the blending targets. This is because the EU biodiesel sector is well developed, with the EU having the largest biodiesel market in the world. Based on the data presented in Table 4.9, it is estimated that domestically produced ethanol was blended at a rate of 0.74% in 2006, 0.86% in 2007 and 1.38% in 2008. If EU fuel ethanol production in 2009 were to reach 3.83 million m^3 (3.83 billion litres) (as estimated by F.O. Licht (Table 4.4)), then this would suggest that domestically produced ethanol would reach an incorporation rate of 1.91%. This is far less than the overall 5.75% blending target for biofuel and the expected overall blending rate of 4% for 2010 (Figure 4.7).

Going forward, the scope for domestic ethanol production to increase its share in the overall blending of biofuel in transport fuel, compared to biodiesel, is likely to increase as the ethanol sector develops. Furthermore, technical constraints to increased biodiesel blending above certain limits exist more for biodiesel than bio-ethanol, at least in the short to medium term. This is because existing engine technology currently limits biodiesel to a 5% blend, without engine modifications. In the short to medium term, the widespread use of biodiesel blends above 5% would require a substantial uptake of flex-fuel vehicles. In calculating the likely fuel ethanol supply and demand outlook to 2015 (Figure 4.7 and Table 4.9), it has been assumed that bio-ethanol will increase its share of the blending targets/mandates to 2015 (and an equal share of the blending targets/mandates under the policy demand scenario).

Based on the data contained in Figure 4.7 and Table 4.9, if the EU 2010 5.75% target and then the 2020 10% mandate were to be reached, EU fuel ethanol supply would need to rise to 11.3 million m^3 (11.3 billion litres) by 2010 and (assuming a linear increased to meet the 2020 mandate) 14 million m^3 (14.0 billion litres) by 2015. However, given that the EU is not expected to meet the 2010 target, assuming a linear blending trajectory from current blending levels to the 2020 10% mandate, EU fuel ethanol supply would need to rise to 11.2 million m^3 (11.2 billion litres) by 2015.

Assuming that all existing and under construction fuel ethanol plants operate at full capacity, Figure 4.7 and Table 4.9 suggest that additional capacity would be required if the EU is to meet all of its fuel ethanol requirements domestically. If the 2015 fuel ethanol requirement is 11.2 million m^3 (11.2 billion litres) (i.e. assuming a linear blending trajectory from current blending levels to the 2020 10% mandate), then there would be a shortfall in demand of 4.1 million m^3 (4.1 billion litres) (37%). This demand would either need to be met from imports or from additional domestic production from new plants.

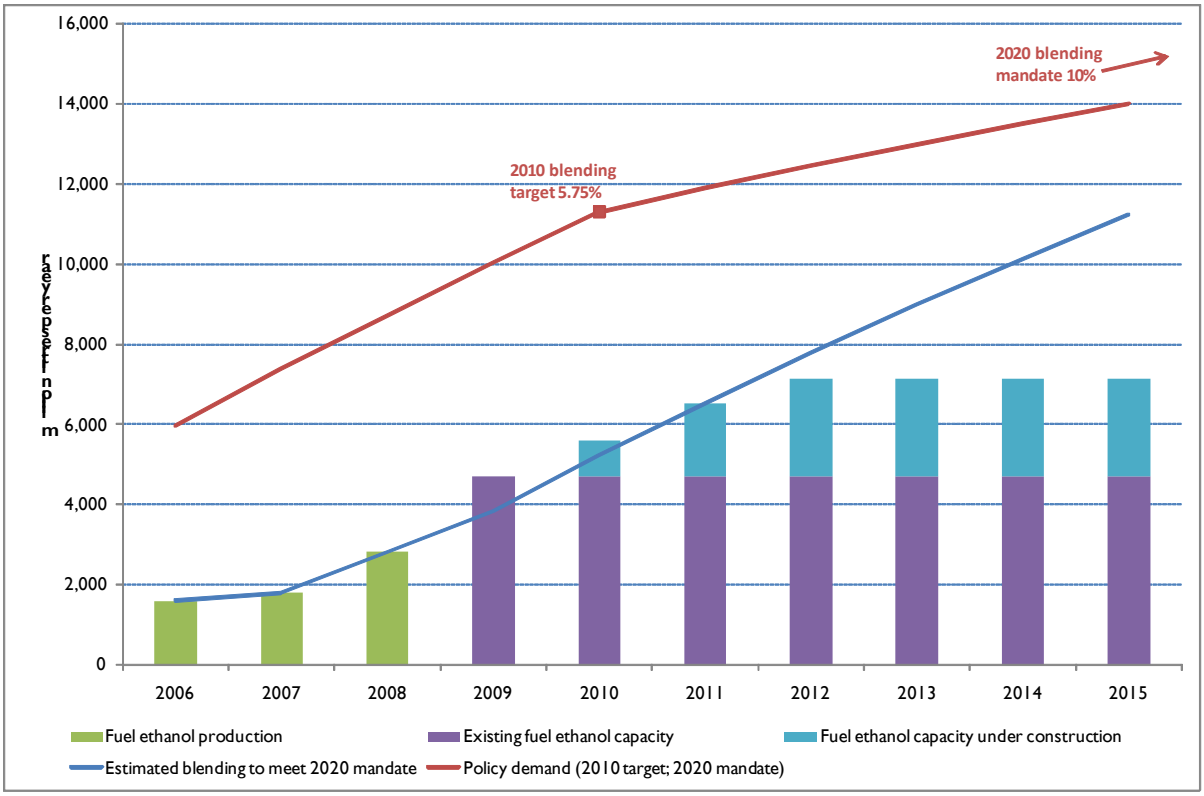

Figure 4.7: Fuel ethanol (domestic) supply and demand outlook to 2015 ('000m^3 / million litres)

Table 4.9: Fuel ethanol (domestic) supply and demand outlook to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Petrol ('000m^3 / million litres)										
EU demand	147,174	143,230	139,100	136,318	133,592	130,920	128,302	125,736	123,221	120,757
Blending rates (%)										
Estimated blending rate	0.74%	0.86%	1.38%	1.91%	2.65%	3.38%	4.12%	4.85%	5.59%	6.32%
EU blending rate (to meet 2010 target; 2020 mandate)	2.75%	3.50%	4.25%	5.00%	5.75%	6.18%	6.60%	7.03%	7.45%	7.88%
EU fuel ethanol production ('000m^3 / million litres)										
Historic and 2009 forecast	1,593	1,803	2,816	3,830						
Forecast production to meet 2020 mandate					5,198	6,510	7,768	8,973	10,126	11,229
Production to meet 2010 target & 2020 mandate	5,952	7,372	8,694	10,023	11,296	11,889	12,453	12,990	13,500	13,985
EU fuel ethanol capacity ('000m^3 / million litres)										
Existing (2009) fuel ethanol capacity				4,700	4,700	4,700	4,700	4,700	4,700	4,700
Fuel ethanol capacity currently (2009) under construction					900	1,810	2,424	2,424	2,424	2,424
EU domestic supply shortfall ('000m^3 / million litres)										
Forecast production shortfall to meet 2020 mandate					-402	0	644	1,849	3,002	4,105
Forecast production shortfall to meet 2010 target & 2020 mandate					5,696	5,379	5,329	5,866	6,376	6,861

Source: Agra CEAS Consulting based on OECD/European Commission petrol data; F.O. Licht ethanol production data; F.O. Licht and eBIO total bio-ethanol capacity data.

4.6. Outlook for world fuel ethanol supply, demand and net trade to 2020

This Section presents world and EU ethanol production and consumption forecasts generated by Agra CEAS Consulting using its proprietary world biofuel and feedstock econometric model. A brief description of the model and the assumptions behind the forecasts presented are summarised in Box 4.1. More detail on the specifications of the model and the economic and policy assumptions used to generate the forecasts are set out in Appendix 1 and 2.

Box 4.1: Summary of the model specifications and main assumptions

The model uses a dynamic partial equilibrium framework to examine how the global market for biofuel and crops might evolve given identified econometric interactions between policies, biofuel, feedstock and crude oil prices. The model employs a set of behavioural equations covering biofuel consumption, production, inventory holding and trade in biofuel, for countries with major energy crop programmes together with a 'Rest of World' aggregate. All price forecasts are nominal, based on a constant oil price. The base year of 2008 represents actual data, on which a forecasts have been generated to 2020.

The Agra CEAS model uses a variety of external data to generate these forecasts. Biofuel data (quantities and prices) are taken from the F.O. Licht and feedstock data (quantities and prices) are from the FAO. Macroeconomic data are sourced from the World Bank. The general assumptions on which the forecasts are based include:

- all present and future mandated ethanol programmes are assumed to be fulfilled, except for the EU-27 where it is assumed that only the 5.75% target will be met by 2020 (not the 10% mandate) (see Annex A2.2.3.3);
- indicative programmes and targets are used to condition the projections;
- domestic support where notified to continue; and,
- market access provisions to remain.

Ethanol production, consumption and net trade quantities for the period 2008-2020 under three different (constant) crude oil price scenarios (US$ 40/bbl, US$ 60/bbl and US$ 80/bbl) over the projection horizon are presented below.

4.6.1. Baseline supply, demand and trade forecasts (US$ 60/bbl crude oil scenario)

Table 4.10 presents biofuel supply, demand and net trade forecasts between 2009 and 2020, based on a crude oil price assumption of US$ 60/bbl.

Biofuel production

Global biofuel production is forecast to more or less double by 2020, when measured from the base year. Sheer volume growth in sugar and maize based ethanol production will underpin the ethanol sector, although world biodiesel production is forecast to witness a higher rate of increase.

The US is predicted to be the largest biofuel producing country with a global output share of around 39%, closely followed by Brazil with a share of 36%. Much of the production expansion in the US is set to be fuelled by the Energy Independence and Security Act of 2007, while for Brazil, higher

demand from the global market. In Brazil, the number of flex-fuel vehicles, are expected to dominate the transportation sector by 2020. Higher yields alongside a more efficient conversion of sugar-to-ethanol and maize-to-ethanol should alleviate to some extent the constraints on the large area expansion needed to meet higher production in both countries.

Strong policy-led demand and more competitive ethanol at-the-pump in the United States could see the country struggle to compete with international suppliers (notably Brazil), with substantial imports of biofuel displacing domestic production, despite high import tariffs. This is a result of high feedstock and energy costs in the production of biofuel, relative to those produced from other feedstock (notably sugar cane).

In the EU-27 biofuel output could double by 2020 to satisfy the (targeted) mandatory consumption requirement for Member States, with biodiesel set to be the mainstay of the biofuel sector (biofuel production in 2008 was approximately 39% ethanol to 61% biodiesel, see Table 4.10). There are several reasons to support this view:

- Firstly, there is projected profitability of rape-oil bio-diesel over wheat ethanol for much of the projection horizon, particularly when energy equivalence is considered.
- Secondly, the EU has far more existing biodiesel capacity than ethanol capacity, whereby extra capacity could be added, without having to incur the risks and high fixed costs of constructing new plants, in a volatile macroeconomic environment.
- Thirdly, the EU fleet is largely composed of diesel vehicles, which would provide a greater source of demand.
- Finally, owing to global food inflation reasons, the community will tend to support the use of largely industrial oil crops at the expense of staple food crops.

Elsewhere, strong production growth in ethanol production is expected in China, India, Canada and South Africa. These and the emergence of other producing countries could attain a 25% share of world ethanol production by 2020. Much of the growth is expected to be policy led, but foreign direct investment in many developing countries, particularly sugar cane fed ethanol distilleries will support competitive growth. This is somewhat in contrast to the biodiesel sector, where production growth will likely be fuelled by mandated demand in industrial countries. Countries in the Americas could emerge as large scale biodiesel producers, especially the US, Brazil and Argentina, given a certain comparative advantage in their soybean oil sectors. Several countries, notably Malaysia and to a lesser extent Indonesia, could gear their productive biodiesel sector towards lucrative developed markets.

Biofuel consumption

At the minimum, projections of biofuel consumption reflect levels that are mandated by governments, either through blending requirements or overall volume targets. Sustained oil prices in the region of US$ 60/bbl imply that biofuel will struggle to be competitive with fossil-fuels at the retail level, with the exception of sugar cane derived ethanol. This would be evident in Brazil, where

demand for biofuel is expected to be buoyant from flex-fuel vehicles. Also, the continuation of excise tax exemptions on biofuel and tax credits for fossil-based fuel blends would lower the bio - fossil fuel price relative in certain countries which could constitute an important source of biofuel consumption growth.

Consequently, the combination of market-driven and mandated consumption growth in many countries is projected to outpace biofuel production from domestic feedstock, giving rise to some dependence on international markets to meet needs.

For reasons stated above biodiesel demand is expected to outpace ethanol demand in the EU. Demand for diesel in Brazil and the US is expected to rise to meet the needs of the haulage sector, and is likely to be met from domestically produced soybean based biodiesel. However, much of the growth in biofuel consumption will likely originate from ethanol.

Biofuel net trade

A major highlight concerning the projections pertains to the growth in global trade:

- Brazil is set to become a large supplier of biofuel to the international market. The model is not spatial in nature, so it is difficult to ascertain precise trade flows. However, the United States would appear to be the main destination of Brazil's international shipments, since prices of Brazilian ethanol plus import duties and freight costs would still be competitive with United States domestic prices, particularly along coastal regions. This was the case in the last three years when the United States reported around 2 billion litres of ethanol imports (as much as 15% of its domestic market) from Brazil. According to official statistics from the USITC, US ethanol imports in the first 5 months of 2009 were 33% higher than in the corresponding period in 2008. Therefore, 2009 (and thereafter) could register strong increases in ethanol deliveries into the United States.

- Under the current CBI initiative, it is also predicted that Brazil would be able to supply the United States market, indirectly, through the CBI tariff rate quota.

- The EU is also set to be a large importer of biofuel along with Japan.

Table 4.10: Baseline biofuel supply, demand and net trade forecasts: 2009-2020 (US$ 60/bbl crude oil scenario)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
						Oil Prices (US$ Barrel)							
World Oil (Brent)	99.3	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
						Biofuel Production (million litres)							
United States Ethanol	34,463	39,780	44,550	46,459	46,972	49,417	52,597	54,081	54,369	55,641	54,509	54,863	54,910
Brazil Ethanol	22,239	26,145	27,618	29,445	31,514	33,763	36,159	38,685	41,334	43,660	46,052	48,546	50,966
Canada Ethanol	1,083	1,079	1,092	1,110	1,121	1,125	1,132	1,135	1,138	1,148	1,159	1,172	1,187
Japan Ethanol	110	110	110	110	110	110	110	110	110	110	110	110	110
China Ethanol	3,964	4,082	4,267	4,479	4,661	4,819	4,985	5,135	5,277	5,456	5,631	5,818	6,017
India Ethanol	1,725	1,960	2,221	2,516	2,849	3,225	3,648	4,120	4,643	5,217	5,843	6,546	7,332
EU-27 Ethanol	5,021	5,681	6,695	6,838	6,654	6,718	6,876	6,971	7,038	7,083	7,065	7,205	7,279
Russia Ethanol	932	985	1,018	1,041	1,062	1,085	1,112	1,142	1,177	1,215	1,259	1,314	1,375
Thailand Ethanol	615	700	795	903	1,028	1,171	1,334	1,521	1,734	1,974	2,244	2,552	2,902
South Africa Ethanol	16	21	28	38	50	65	85	109	140	180	229	292	371
ROW Ethanol	2,886	3,071	3,273	3,501	3,762	4,059	4,396	4,779	5,212	5,701	6,251	6,871	7,566
World Ethanol	73,055	83,613	91,666	96,440	99,782	105,557	112,434	117,789	122,172	127,386	130,353	135,290	140,017
EU-27 Bio-diesel	8,064	8,820	10,005	11,185	12,359	13,529	14,694	15,853	17,006	18,154	19,296	20,434	21,565
Brazil Bio-diesel	1,089	2,057	2,221	2,395	2,579	2,774	2,978	3,192	3,415	3,645	3,881	4,161	4,454
Argentina Bio-diesel	1,364	1,534	1,715	1,903	2,096	2,289	2,475	2,648	2,798	2,917	2,995	3,051	3,082
Canada Bio-diesel	100	1,461	2,144	2,826	3,508	3,636	3,768	3,905	4,047	4,195	4,348	4,506	4,670
United States Bio-diesel	2,709	2,908	3,119	3,341	3,576	3,822	4,082	4,354	4,640	4,938	5,250	5,576	5,919
Malaysia Bio-diesel	536	854	928	1,009	1,096	1,191	1,294	1,406	1,528	1,660	1,804	1,961	2,131
Indonesia Bio-diesel	356	566	607	649	692	737	781	825	867	906	941	993	1,045
China Bio-diesel	296	296	308	320	333	347	360	375	389	405	420	438	456
ROW Bio-diesel	1,218	1,535	1,541	1,548	1,554	1,562	1,569	1,577	1,585	1,593	1,602	1,605	1,607
World Bio-diesel	15,731	20,032	22,587	25,176	27,795	29,886	32,002	34,135	36,276	38,414	40,538	42,724	44,930
						Biofuel Consumption (million litres)							
United States Ethanol	36,069	40,773	45,455	47,727	50,000	52,273	54,545	56,818	56,818	56,818	56,818	56,818	56,818
Brazil Ethanol	17,846	21,922	23,148	24,556	26,080	27,683	29,346	31,064	32,835	33,824	34,806	35,845	36,809
Canada Ethanol	1,587	1,540	1,660	1,879	2,099	2,127	2,156	2,185	2,214	2,244	2,274	2,304	2,335
Japan Ethanol	1,066	1,077	1,087	1,098	1,109	1,120	1,132	1,143	1,155	1,167	1,179	1,191	1,204
China Ethanol	3,787	3,816	3,937	4,100	4,280	4,462	4,640	4,811	4,974	5,129	5,276	5,385	5,479
India Ethanol	1,991	1,960	2,221	2,516	2,849	3,225	3,648	4,120	4,643	5,217	5,843	6,546	7,332
EU-27 Ethanol	6,698	7,552	7,741	7,934	8,132	8,336	8,544	8,758	8,977	9,201	9,431	9,667	9,909
Russia Ethanol	932	985	1,018	1,041	1,062	1,085	1,112	1,142	1,177	1,215	1,259	1,314	1,375
Thailand Ethanol	694	630	715	813	925	1,054	1,201	1,369	1,560	1,776	2,020	2,297	2,611
South Africa Ethanol	16	21	28	38	50	65	85	109	140	180	229	292	371
ROW Ethanol	3,470	2,937	2,357	3,038	4,695	5,127	5,775	6,270	7,679	9,413	11,218	13,630	15,772
World Ethanol	74,157	83,213	89,366	94,740	101,282	106,557	112,184	117,789	122,172	126,186	130,353	135,290	140,017
EU-27 Bio-diesel	9,200	9,568	10,746	11,919	13,087	14,251	15,409	16,562	17,710	18,852	19,989	21,120	22,245
Brazil Bio-diesel	1,089	1,530	1,560	1,591	1,622	1,654	1,686	1,719	1,753	1,787	1,822	1,858	1,894
Argentina Bio-diesel	400	383	393	403	413	425	438	454	472	492	514	527	540
Canada Bio-diesel	100	1,674	2,482	3,290	4,098	4,290	4,487	4,689	4,897	5,111	5,331	5,557	5,789
United States Bio-diesel	1,383	2,182	2,202	2,223	2,243	2,263	2,283	2,303	2,323	2,343	2,362	2,385	2,408
Malaysia Bio-diesel	267	277	288	299	310	322	334	347	360	374	388	403	419
Indonesia Bio-diesel	220	245	248	251	254	257	260	263	266	270	273	276	280
China Bio-diesel	296	296	308	320	333	347	360	375	389	405	420	438	456
ROW Bio-diesel	1,813	2,930	3,295	3,689	4,113	4,629	5,174	5,649	6,052	6,482	6,937	7,469	8,143
World Bio-diesel	14,767	19,085	21,522	23,984	26,474	28,437	30,433	32,362	34,223	36,115	38,037	40,033	42,174
						Biofuel Net Trade (million litres)							
United States Ethanol	-1,605	-1,992	-2,905	-2,968	-3,028	-2,856	-2,949	-2,737	-2,449	-2,378	-2,309	-1,955	-1,908
Brazil Ethanol	4,393	4,222	4,470	4,889	5,434	6,081	6,813	7,621	8,499	9,836	11,245	12,701	14,157
Canada Ethanol	-504	-361	-568	-769	-979	-1,002	-1,024	-1,049	-1,076	-1,095	-1,115	-1,133	-1,148
China Ethanol	177	266	330	379	381	357	345	324	303	327	356	433	538
Japan Ethanol	-620	-967	-977	-988	-999	-1,010	-1,022	-1,033	-1,045	-1,057	-1,069	-1,081	-1,094
Thailand Ethanol	-79	70	79	90	103	117	133	152	173	197	224	255	290
EU-27 Ethanol	-1,677	-1,871	-1,045	-1,096	-1,479	-1,618	-1,668	-1,786	-1,938	-2,118	-2,366	-2,461	-2,629
ROW Ethanol	-584	133	916	464	-934	-1,069	-1,379	-1,491	-2,467	-3,713	-4,966	-6,759	-8,206
Brazil Bio-diesel	0	600	735	880	1,035	1,199	1,372	1,555	1,745	1,943	2,146	2,391	2,650
Malaysia Bio-diesel	268	577	640	710	786	869	960	1,059	1,168	1,286	1,416	1,558	1,713
Indonesia Bio-diesel	136	321	359	398	439	480	521	562	601	637	668	717	765
EU-27 Bio-diesel	-1,136	-748	-741	-734	-728	-722	-715	-709	-704	-698	-692	-686	-680
Canada Bio-diesel	0	-162	-238	-314	-390	-404	-419	-434	-450	-466	-483	-501	-519
USA Bio-diesel	1,326	807	998	1,201	1,417	1,645	1,886	2,040	2,107	2,187	2,281	2,386	2,607
ROW Bio-diesel	-594	-1395	-1754	-2141	-2559	-3067	-3605	-4072	-4467	-4889	-5334	-5865	-6536

Note: 1 million litres = 1,000 m^3

Source: Agra CEAS Consulting world biofuel econometric model

4.6.2. Supply, demand and trade forecasts (US$ 80/bbl crude oil scenario)

Table 4.11 presents biofuel supply, demand and net trade forecasts between 2009 and 2020, based on a crude oil price assumption of US$ 80/bbl.

Biofuel production

With oil at US$ 80/bbl, global ethanol production is set to rise by well over two-fold, and 13% more than the baseline projections by 2020. The global bio-diesel production response is not so dramatic at higher oil prices. This is because higher oil prices alter the biodiesel-ethanol cost relative, with ethanol gaining advantage. Where mandates are in place, such as the EU-27, the relative share of bio-ethanol (production and consumption) as a proportion of biofuel would thus increase with higher oil prices.

Production in Brazil relative to the world's leading biofuel producer, the United States, is set to increase. Higher demand in Brazil as well as from the global market, which translates to export-led growth, will underpin a large ethanol production expansion in the country. Biofuel output could rise markedly in all other countries, particularly China, India, Thailand and South Africa. Those countries which primarily use sugar crops in biofuel production stand to register the largest expansions, given the high returns from using this feedstock in ethanol production relative to other feedstock.

Biofuel consumption

Higher oil prices provide some stimulus for market-based growth in consumption. Higher oil prices raise the cost of biofuel and their market prices, however, on balance, biofuel becomes a more competitive substitute or additive to fossil-fuels. Were it not for the lack of widespread retail biofuel distribution and production plants, the rise in biofuel consumption would likely be greater. More importantly, biofuel will still be primarily blended in most countries (flex-fuel vehicles fleets are not expected to rise substantially except in Brazil) thus higher oil prices will attract higher blends, but given this complementarity, higher oil prices will ultimately temper fuel demand.

Biofuel net trade

Trade in biofuel is expected to rise substantially, with Brazil likely to be the world's major international supplier. Despite higher oil prices that could render ethanol production more competitive in the US relative to gasoline, much of the (competitive) consumption growth in the US could be met from the international market place rather than domestically. The US tariff and shipping costs will fail to bind, *vis-à-vis*, sugar cane ethanol, and ethanol deliveries could rise significantly by the end of the projection horizon. China and Thailand could emerge as moderately sized ethanol exporters.

High oil prices also leads to marked substitution from bio-diesel to ethanol production to meet EU mandated/targeted levels, since the cost structure between producing wheat-ethanol and rape oil–bio-diesel favours ethanol based biofuel production over much of the horizon, regardless of energy

yields. Notably ethanol imported by the EU is also expected to play a greater role in meeting consumption requirements.

Table 4.11: Biofuel supply, demand and net trade forecasts: 2009-2020 (Higher (US$ 80/bbl) crude oil price scenario)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
						Oil Prices (US$ Barrel)							
World Oil (Brent)	99.3	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
						Biofuel Production (million litres)							
United States Ethanol	34,463	39,914	42,349	47,970	48,630	51,296	54,739	56,401	56,707	58,056	56,875	57,231	57,283
Brazil Ethanol	22,239	35,923	37,203	38,909	40,857	42,953	45,145	47,409	49,732	51,323	52,890	54,484	55,788
Canada Ethanol	1,083	1,186	1,252	1,326	1,393	1,455	1,521	1,585	1,648	1,725	1,803	1,888	1,978
Japan Ethanol	110	110	110	110	110	110	110	110	110	110	110	110	110
China Ethanol	3,964	4,229	4,570	4,954	5,323	5,679	6,057	6,430	6,805	7,239	7,683	8,156	8,661
India Ethanol	1,725	2,016	2,349	2,732	3,173	3,680	4,259	4,918	5,661	6,495	7,424	8,483	9,685
EU-27 Ethanol	5,021	6,676	7,645	7,651	7,748	7,803	7,970	8,039	8,125	8,167	8,213	8,280	8,349
Russia Ethanol	932	990	1,035	1,076	1,116	1,160	1,207	1,259	1,315	1,377	1,444	1,527	1,618
Thailand Ethanol	615	719	840	980	1,143	1,333	1,554	1,810	2,104	2,443	2,832	3,280	3,795
South Africa Ethanol	16	23	34	50	72	104	148	210	295	415	579	807	1,123
ROW Ethanol	2,886	3,143	3,428	3,747	4,106	4,512	4,971	5,489	6,073	6,733	7,478	8,319	9,264
World Ethanol	73,055	94,930	100,814	109,504	113,672	120,085	127,682	133,658	138,577	144,085	147,331	152,563	157,655
EU-27 Bio-diesel	8,064	7,275	8,422	9,563	10,698	11,827	12,950	14,066	15,176	16,279	17,375	18,465	19,548
Brazil Bio-diesel	1,089	2,203	2,381	2,571	2,773	2,987	3,212	3,450	3,698	3,957	4,224	4,537	4,869
Argentina Bio-diesel	1,364	1,547	1,743	1,951	2,167	2,386	2,602	2,808	2,993	3,148	3,261	3,351	3,416
Canada Bio-diesel	100	1,551	2,324	3,096	3,868	4,086	4,308	4,535	4,767	5,005	5,248	5,496	5,750
United States Bio-diesel	2,709	2,932	3,170	3,424	3,694	3,982	4,287	4,610	4,953	5,315	5,696	6,101	6,529
Malaysia Bio-diesel	536	907	1,031	1,172	1,331	1,447	1,573	1,710	1,859	2,020	2,195	2,387	2,595
Indonesia Bio-diesel	356	572	642	750	874	930	988	1,044	1,100	1,152	1,198	1,267	1,335
China Bio-diesel	296	296	323	352	384	419	456	475	494	513	533	556	580
ROW Bio-diesel	1,218	1,725	1,731	1,738	1,745	1,752	1,760	1,767	1,776	1,784	1,793	1,796	1,798
World Bio-diesel	15,731	19,009	21,767	24,616	27,534	29,816	32,136	34,465	36,814	39,171	41,524	43,955	46,419
						Biofuel Consumption (million litres)							
United States Ethanol	36,069	44,810	48,605	51,050	53,521	56,022	58,557	61,131	61,478	61,877	62,336	62,864	63,471
Brazil Ethanol	17,846	26,261	27,557	29,005	30,548	32,157	33,820	35,532	37,293	38,162	39,021	39,932	40,752
Canada Ethanol	1,587	1,640	1,759	2,011	2,267	2,319	2,372	2,425	2,480	2,535	2,592	2,650	2,709
Japan Ethanol	1,066	1,077	1,093	1,104	1,115	1,126	1,137	1,149	1,161	1,173	1,185	1,197	1,210
China Ethanol	3,787	3,797	3,869	3,967	4,071	4,175	4,273	4,365	4,450	4,527	4,598	4,634	4,657
India Ethanol	1,991	2,016	2,349	2,732	3,173	3,680	4,259	4,918	5,661	6,495	7,424	8,483	9,685
EU-27 Ethanol	6,698	9,069	9,296	9,528	9,766	10,011	10,261	10,517	10,780	11,050	11,326	11,609	11,899
Russia Ethanol	932	990	1,035	1,076	1,116	1,160	1,207	1,259	1,315	1,377	1,444	1,527	1,618
Thailand Ethanol	694	647	756	882	1,029	1,200	1,399	1,629	1,894	2,199	2,548	2,952	3,416
South Africa Ethanol	16	23	34	50	72	104	148	210	295	415	579	807	1,123
ROW Ethanol	1,470	6,300	6,266	7,037	8,666	9,329	10,220	10,570	11,841	13,272	13,602	15,260	16,796
World Ethanol	72,157	96,630	102,619	108,441	115,346	121,282	127,653	133,704	138,648	143,082	146,655	151,915	157,335
EU-27 Bio-diesel	9,200	8,050	9,190	10,325	11,453	12,576	13,692	14,803	15,906	17,004	18,094	19,178	20,254
Brazil Bio-diesel	1,089	1,603	1,635	1,667	1,699	1,733	1,767	1,801	1,836	1,872	1,909	1,946	1,985
Argentina Bio-diesel	400	525	537	549	562	576	592	611	631	654	680	695	711
Canada Bio-diesel	100	1,724	2,582	3,440	4,298	4,540	4,787	5,039	5,297	5,561	5,831	6,107	6,389
United States Bio-diesel	1,383	2,247	2,268	2,290	2,311	2,331	2,352	2,372	2,393	2,413	2,433	2,456	2,480
Malaysia Bio-diesel	267	280	294	308	323	339	355	372	390	409	429	450	472
Indonesia Bio-diesel	220	250	254	258	262	267	271	276	280	285	290	294	299
China Bio-diesel	296	296	323	352	384	419	456	475	494	513	533	556	580
ROW Bio-diesel	1,813	3,111	3,561	4,091	4,683	5,252	5,860	6,406	6,889	7,409	7,964	8,614	9,419
World Bio-diesel	14,767	18,087	20,643	23,278	25,974	28,032	30,132	32,154	34,117	36,121	38,163	40,297	42,589
						Biofuel Net Trade (million litres)							
United States Ethanol	-3,605	-3,896	-4,255	-4,280	-4,891	-4,725	-4,818	-4,930	-4,971	-5,121	-6,461	-6,633	-6,888
Brazil Ethanol	4,393	9,662	9,645	9,904	10,310	10,796	11,326	11,877	12,438	13,162	13,869	14,552	15,036
Canada Ethanol	-504	-253	-408	-554	-706	-672	-635	-600	-566	-519	-470	-417	-357
China Ethanol	177	432	701	987	1,251	1,504	1,784	2,065	2,356	2,712	3,085	3,522	4,005
Japan Ethanol	-620	-967	-977	-988	-999	-1,010	-1,022	-1,033	-1,045	-1,057	-1,069	-1,081	-1,094
Thailand Ethanol	-79	72	84	98	114	133	155	181	210	244	283	328	380
EU-27 Ethanol	-1,677	-2,393	-1,651	-1,877	-2,018	-2,208	-2,290	-2,478	-2,655	-2,883	-3,113	-3,330	-3,550
ROW Ethanol	1,416	-3,156	-2,838	-3,290	-4,560	-4,817	-5,249	-5,081	-5,768	-6,538	-6,124	-6,941	-7,532
Brazil Bio-diesel	0	600	747	905	1,074	1,254	1,446	1,649	1,862	2,084	2,315	2,591	2,884
Malaysia Bio-diesel	268	627	737	864	1,008	1,109	1,218	1,338	1,468	1,611	1,766	1,937	2,124
Indonesia Bio-diesel	136	322	388	492	611	664	717	769	819	867	908	972	1,036
EU-27 Bio-diesel	-1,136	-775	-768	-762	-755	-749	-743	-737	-731	-725	-719	-713	-706
Canada Bio-diesel	0	-272	-358	-444	-530	-554	-579	-604	-630	-656	-683	-711	-739
USA Bio-diesel	1,326	884	1,084	1,298	1,529	1,776	2,041	2,223	2,324	2,444	2,584	2,742	3,023
ROW Bio-diesel	-594	-1386	-1829	-2353	-2938	-3500	-4100	-4638	-5113	-5625	-6171	-6818	-7621

Note: 1 million litres = 1,000 m^3

Source: Agra CEAS Consulting world biofuel econometric model

4.6.3. Supply, demand and trade forecasts (US$ 40/bbl crude oil scenario)

Table 4.12 presents biofuel supply, demand and net trade forecasts between 2009 and 2020, based on a crude oil price assumption of US$ 40/bbl.

Biofuel production and consumption

Under this low oil price scenario, contractions in production and consumption are forecast in many countries, beyond what is mandated or where biofuel are produced and consumed competitively. Ethanol production and consumption at the global level is expected to contract by 11-12% by 2020 compared to the baseline projections.

Biofuel net trade

At lower oil prices, the US ethanol sector is expected to regain an advantage over Brazil. Most notably, the US import tariff is expected to play a more important role in preventing ethanol imports into the country. Indeed, lower export supplies from Brazil as a result of the forecast reduction in the country's output, coupled with an effective tariff, is expected to result in much higher production in the US.

However, in the EU (and in Canada), biodiesel production is expected to rise markedly, to compensate for the decline in ethanol production in order to meet mandated requirements. The cost of biodiesel falls much more relative to wheat-ethanol, attracting more biodiesel production. Furthermore, at low oil prices, biodiesel will be seen as a more 'sustainable' biofuel from a food security perspective than wheat based ethanol.

Even with low oil prices, Brazil can still sustain its biofuel sector and export smaller but considerable quantities to countries where such oil prices have rendered biofuel production non-competitive.

Table 4.12: Biofuel supply, demand and net trade forecasts: 2009-2020 (Lower (US$ 40/bbl) crude oil price scenario)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
						Oil Prices (US$ Barrel)							
World Oil (Brent)	99.3	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
						Biofuel Production (million litres)							
United States Ethanol	34,463	40,598	43,923	46,740	47,159	49,636	52,875	54,340	54,635	55,940	54,741	55,146	55,189
Brazil Ethanol	22,239	22,101	23,570	25,108	26,695	28,596	30,641	32,599	34,765	36,782	38,862	41,284	43,854
Canada Ethanol	1,083	1,117	1,123	1,138	1,147	1,152	1,161	1,169	1,178	1,198	1,220	1,248	1,281
Japan Ethanol	110	110	110	110	110	110	110	110	110	110	110	110	110
China Ethanol	3,964	3,975	4,062	4,178	4,267	4,336	4,418	4,490	4,562	4,671	4,781	4,907	5,051
India Ethanol	1,725	1,942	2,198	2,502	2,832	3,194	3,590	4,010	4,454	4,912	5,374	5,868	6,397
EU-27 Ethanol	5,021	4,611	5,311	5,331	5,422	5,479	5,610	5,673	5,745	5,781	5,822	5,884	5,946
Russia Ethanol	932	924	909	895	928	952	977	1,014	1,049	1,090	1,137	1,184	1,234
Thailand Ethanol	615	662	717	782	849	920	996	1,073	1,152	1,231	1,307	1,386	1,466
South Africa Ethanol	16	19	23	28	33	39	47	55	64	75	87	101	118
ROW Ethanol	2,886	3,073	3,058	3,071	3,082	3,099	3,121	3,142	3,164	3,186	3,204	3,224	3,245
World Ethanol	73,055	79,130	85,003	89,883	92,522	97,512	103,543	107,673	110,878	114,975	116,645	120,342	123,891
EU-27 Bio-diesel	8,064	10,365	11,587	12,806	14,021	15,231	16,438	17,640	18,837	20,030	21,219	22,403	23,583
Brazil Bio-diesel	1,089	2,057	2,218	2,388	2,567	2,756	2,953	3,158	3,370	3,587	3,808	4,072	4,347
Argentina Bio-diesel	1,364	1,521	1,686	1,856	2,028	2,195	2,354	2,496	2,614	2,701	2,749	2,774	2,777
Canada Bio-diesel	100	1,299	1,905	2,512	3,118	3,232	3,349	3,471	3,598	3,729	3,865	4,005	4,151
United States Bio-diesel	2,709	2,884	3,068	3,259	3,460	3,668	3,885	4,110	4,343	4,584	4,834	5,092	5,360
Malaysia Bio-diesel	536	802	871	947	1,028	1,117	1,213	1,318	1,432	1,555	1,689	1,835	1,994
Indonesia Bio-diesel	356	503	539	576	614	653	691	729	765	798	827	871	914
China Bio-diesel	296	296	297	298	299	300	300	301	302	303	304	305	306
ROW Bio-diesel	1,218	1,502	1,508	1,515	1,523	1,531	1,539	1,547	1,556	1,566	1,575	1,578	1,581
World Bio-diesel	15,731	21,230	23,681	26,158	28,658	30,682	32,722	34,771	36,818	38,854	40,868	42,935	45,013
						Biofuel Consumption (million litres)							
United States Ethanol	36,069	39,773	45,455	47,727	50,000	52,273	54,545	56,818	56,818	56,818	56,818	56,818	56,818
Brazil Ethanol	17,846	18,486	19,998	21,625	22,784	24,136	25,561	26,922	28,396	29,162	29,907	30,826	31,726
Canada Ethanol	1,587	1,440	1,660	1,879	2,099	2,127	2,156	2,185	2,214	2,244	2,274	2,304	2,335
Japan Ethanol	1,066	1,077	1,087	1,098	1,109	1,120	1,132	1,143	1,155	1,167	1,179	1,191	1,204
China Ethanol	3,787	3,663	3,570	3,863	3,969	4,121	4,277	4,391	4,520	4,632	4,733	4,839	4,945
India Ethanol	1,991	1,942	2,198	2,502	2,832	3,194	3,590	4,010	4,454	4,912	5,374	5,868	6,397
EU-27 Ethanol	6,698	6,035	6,185	6,340	6,499	6,661	6,828	6,998	7,173	7,352	7,536	7,725	7,918
Russia Ethanol	932	924	909	895	928	952	977	1,014	1,049	1,090	1,137	1,184	1,234
Thailand Ethanol	694	595	645	703	764	828	896	966	1,037	1,108	1,176	1,247	1,320
South Africa Ethanol	16	19	23	28	33	39	47	55	64	75	87	101	118
ROW Ethanol	2,970	2,398	2,946	1,844	1,080	1,587	2,015	2,605	3,386	4,558	5,725	7,494	9,090
World Ethanol	73,657	76,351	84,675	88,506	92,097	97,040	102,023	107,106	110,265	113,118	115,945	119,598	123,105
EU-27 Bio-diesel	9,200	11,085	12,301	13,513	14,721	15,925	17,126	18,322	19,513	20,701	21,884	23,062	24,236
Brazil Bio-diesel	1,089	1,457	1,486	1,515	1,545	1,575	1,606	1,637	1,669	1,702	1,736	1,770	1,804
Argentina Bio-diesel	400	474	477	482	496	511	526	545	566	589	615	629	644
Canada Bio-diesel	100	1,624	2,382	3,140	3,898	4,040	4,187	4,339	4,497	4,661	4,831	5,007	5,189
United States Bio-diesel	1,383	2,101	2,120	2,140	2,159	2,177	2,196	2,215	2,233	2,251	2,269	2,290	2,312
Malaysia Bio-diesel	267	277	288	299	310	322	334	347	360	374	388	403	419
Indonesia Bio-diesel	220	239	242	245	248	251	254	257	260	263	267	270	273
China Bio-diesel	296	296	297	298	299	300	300	301	302	303	304	305	306
ROW Bio-diesel	1,813	2,548	2,796	3,069	3,366	3,811	4,279	4,768	5,277	5,805	6,349	6,960	7,602
World Bio-diesel	14,767	20,102	22,390	24,700	27,042	28,911	30,808	32,731	34,679	36,650	38,642	40,696	42,784
						Biofuel Net Trade (million litres)							
United States Ethanol	-1,605	-1,675	-1,532	-1,987	-2,841	-2,637	-2,671	-2,479	-2,183	-2,079	-2,077	-1,672	-1,629
Brazil Ethanol	4,393	3,614	3,572	3,483	3,910	4,460	5,080	5,676	6,369	7,620	8,956	10,458	12,128
Canada Ethanol	-504	-323	-536	-741	-952	-976	-995	-1,016	-1,036	-1,046	-1,053	-1,056	-1,054
China Ethanol	177	312	492	315	298	215	140	99	42	39	49	69	105
Japan Ethanol	-620	-967	-977	-988	-999	-1,010	-1,022	-1,033	-1,045	-1,057	-1,069	-1,081	-1,094
Thailand Ethanol	-79	66	72	78	85	92	100	107	115	123	131	139	147
EU-27 Ethanol	-1,677	-1,423	-875	-1,009	-1,077	-1,182	-1,218	-1,325	-1,428	-1,571	-1,714	-1,841	-1,972
ROW Ethanol	-84	396	-215	849	1,577	1,038	586	-30	-834	-2,029	-3,222	-5,014	-6,631
Brazil Bio-diesel	0	600	732	873	1,023	1,181	1,347	1,521	1,700	1,885	2,073	2,302	2,543
Malaysia Bio-diesel	268	525	583	648	718	795	879	971	1,071	1,181	1,300	1,432	1,575
Indonesia Bio-diesel	136	264	297	331	367	402	438	472	505	535	560	601	641
EU-27 Bio-diesel	-1,136	-720	-713	-707	-700	-694	-688	-682	-676	-671	-665	-659	-652
Canada Bio-diesel	0	-325	-476	-628	-780	-808	-837	-868	-899	-932	-966	-1,001	-1,038
USA Bio-diesel	1,326	742	918	1,105	1,304	1,513	1,735	1,877	1,938	2,012	2,098	2,195	2,398
ROW Bio-diesel	-594	-1046	-1288	-1554	-1843	-2280	-2740	-3220	-3721	-4240	-4773	-5382	-6021

Note: 1 million litres = 1,000 m^3

Source: Agra CEAS Consulting world biofuel econometric model

4.6.4. Summary

Global biofuel production could expand around twice-fold by 2020 when measured from the base year. Growth in sugar and maize based ethanol production will underpin ethanol production growth. Most of this growth is expected to be policy led in those countries with existing biofuel policies in place, but Foreign Direct Investment in many developing countries (particularly sugar-ethanol distilleries) may support competitive growth, particularly those with preferential trade agreements with developed countries.

In the ethanol sector, the US is predicted to remain the largest ethanol producer, closely followed by Brazil. In the EU-27, ethanol output could double by 2020 to satisfy the mandatory consumption requirements, but the EU-27 is expected to remain dependent on imports to meet these requirements.

In the biodiesel sector, the EU-27 is predicted to remain the largest biodiesel producer. Biodiesel is expected to be the mainstay of the sector due to: the profitability of rape-oil biodiesel over grain ethanol; the significant capacity development scope that exists; the fact that the EU fleet is dominated by diesel vehicles unlike most countries throughout the world; and food versus fuel issues.

At the minimum, biofuel consumption going forward will reflect mandates, either through blending requirements or overall volume targets. The combination of market-driven and mandated consumption growth in many countries is projected to outpace production from domestic feedstock, giving rise to dependence on international markets to meet needs.

Brazil is set to remain the most significant supplier of biofuel to the international market as none of the key northern hemisphere markets are expected to be able to meet mandated blending requirements fully from domestic production. The United States would appear likely to be the main destination of Brazil's international shipments, since prices of Brazilian ethanol plus import duties and freight costs would still generally be competitive with United States domestic prices, particularly along coastal regions. Under the current CBI initiative, it is also predicted that Brazil will be able to supply the United States market, indirectly, through the CBI tariff rate quota.

The EU is also set to be a large importer of biofuel along with Japan. Much of the EU's ethanol demand will likely come from Brazil. That said, although Africa is currently not forecast to be a major player in global biofuel trade, this does not exclude significant opportunity for exports from specific countries that have a comparative advantage in production and preferential trade access.

Risks to the projections

As with all modelling, the forecasts generated are only as good as the assumptions made and the econometric relationships specified in the model. The Agra CEAS Consulting model has proven predictive power. However, there are risks that the assumptions underlying the forecasts will change during the forecast period. Such risks include:

- Growth in non-food crops:

There could be considerable growth in non-food crops and non-food staples for the production of biofuel (e.g. jatropha for biodiesel and sweet sorghum and cassava for ethanol, particularly in countries like Africa). These commodities are difficult to model given the lack of data, perennial harvesting, etc., and are expected to play important roles in India, China, south-eastern Asia and sub-Saharan Africa. At sustained high oil prices these crops could play a greater role.

- Policy developments:

Policy developments have been frequent in recent years, and are expected to be even more frequent in the near future. Since policies underpin the global biofuel sector, changes in these will have a significant impact on supply, demand and trade. Since most policies in place provide a mandate for demand, the forecasts presented effectively set a minimum level of supply/demand necessary to meet this demand. As additional countries start to implement policies on biofuel, future supply, demand and trade will likely increase. Looking forward, it is clear that in all major northern hemisphere markets at least, biofuel have firmly anchored mandated legislative targets for at least the next decade, creating some assurance at least that the supportive legislative framework for biofuel will remain in place in the medium term.

- Trade developments:

Trade developments could also have a significant impact on the extent and direction of ethanol trade. One development concerns the success of the Brazilian proposal to have the WTO designation of biofuel changed from agriculture to energy. If this is so, import tariffs on biofuel could be eliminated but the risk here is considered low given the balance of interests in terms of retaining tariffs.

In this connection, the potential for the United States to import significant quantities of biofuel could trigger a change in the United State's stance on trade barriers. The tariff could be raised (if compatible with the WTO) or imports could be restricted via Technical Barriers to Trade (TBT), as has emerged in the EU. There is already momentum building in the US to close the loophole allowing Brazil to export to the country *via* the CBI initiative.

In the case of the EU ethanol market, there are two potential trade policy concerns for EU bio-ethanol producers, namely the future of import tariffs and importing denatured ethanol (which has a lower tariff rate than undenatured) for fuel use:

- **Future of import tariffs**. If the EU were to reduce overall tariff levels, and if such reductions were to be applied to ethanol, this process would be unlikely to be immediate as hitherto virtually all multilateral agreements in the WTO or bilateral agreements e.g. between the EU and the Mercosur group of South American countries which includes Brazil have phased in trade concessions such as tariff reductions over a period of at least five years.

  Likelihood of bio-ethanol being imported in denatured form. Currently, bio-ethanol can be imported into the EU as either undenatured or denatured. Undenatured ethanol attracts an import tariff of EU€ 192/m^3 (EU€ 0.19/litre) compared to an import tariff of EU€

102/m^3 (EU€ 0.10/litre) for denatured ethanol. The majority of ethanol imports to the EU are in the form of undenatured ethanol. In some Member States (e.g. Germany and Sweden) this is because national biofuel law specifies that only undenatured ethanol can be used in mixtures with gasoline to qualify for tax reductions/mandates. The reason for this is that such countries are trying to protect domestic producers.

That said, in other Member States (e.g. the UK, Netherlands and Italy) denatured ethanol can also be used. In the UK and the Netherlands, for example, this is because the domestic oil industry has a relatively stronger bargaining position and the national governments are more "free market" oriented. Thus, the governments are more willing to provide better access to cheaper ethanol. That said, these governments are also more particular with respect to the formulation requirements of the denatured ethanol and have thus established so-called 'denaturing rules' which specify how the alcohol is to be denatured in order to be marketable in their domestic markets. These rules vary between countries, but in effect create an additional impediment to trade. Thus, while such imports benefit from a lower import tariff, the 'denaturing rules' add additional cost and risk for exporters thereby to a large extent mitigating the additional benefit of importing ethanol at a lower import tariff.

In conclusion while it is clear that cost competitive supplies of third country ethanol production would in theory pose a significant threat to the EU biofuel sector as well as preferential importers from third countries if import tariffs are reduced, this is unlikely to occur at least in the short term. This argument is reinforced by the point that a major market opening for ethanol would be seen to undermine the direction of EU's Common Agricultural Policy which is using biofuel as an effective mechanism to reduce overproduction and improve rural incomes. In addition it would tend to erode the value of any preferential access granted to least developed countries under the EBA ('Everything But Arms') agreement and any other countries which have preferential access to the EU market.

A summary of the outlook for EU import duties on ethanol are set out in Box 4.2.

Box 4.2: Summary of the outlook for import duties on ethanol

- As part of the failed WTO Doha Round negotiation, had cuts in ethanol import duties been agreed, it is highly likely that they would have been be phased in slowly e.g. over a six year period and therefore the threat to EU output would be limited. It would not make economic or political sense to introduce such a cut more speedily and substantially as capacity does not exist in third countries to service all the biofuel needs of the northern hemisphere.

- Given the failed global negotiation in the WTO, it is likely there will be a renewal of discussions on a bilateral basis with specific trading partners such as EU-Mercosur of which Brazil is a member. When these negotiations were suspended there had been an offer on the table of a reduced duty access quota for Mercosur (Brazil) and we would expect some such arrangement (or an arrangement which allows in a fixed percentage of EU domestic ethanol consumption as in the CBI arrangement with the US) to re-emerge should these negotiations be resumed.

- On denatured versus undenatured imports, non-tariff barriers effectively limit imports of lower tariff denatured ethanol.

- There is pressure from 'free traders' within the EU to allow in ethanol under another tariff heading at a lower duty rate. This issue is currently under review but given that providing access under this heading would seriously undermine the thrust of current EU policy which is supported by the farm lobby, those seeking greater energy self sufficiency, by Everything But Arms (EBA) countries which could potentially benefit from duty free access as well as the nascent bio-ethanol sector it seems unlikely this will be allowed.

All in all, the projections are simply a guide to what may happen in the future, given what we know today. Looking forward, the arrival of second-generation biofuel could cause considerable upheaval in traditional feedstock biofuel sectors. The US has mandated 80 million m^3 (80 billion litres) of cellulosic biofuel by 2022. However, it is difficult to assess at this stage the cost structure of producing energy from cellulosic crops/biomass *vis-à-vis* conventional feedstock, and thus the real potential for this fuel at the global level.

4.7. Ethanol price analysis

This Section provides a historic overview and analysis of how the price for ethanol in the EU has evolved over time (Section 4.7.1), commenting on the economic and industry specific drivers for price development (Section 4.7.2). Medium-term ethanol price forecasts to 2020 are presented (under various oil price scenarios) using the Agra CEAS Consulting world biofuel model (Section 4.7.3).

4.7.1. Historical ethanol price development

EU ethanol prices have typically ranged between EU€ 500/m^3 and EU€ 600/m^3 (EU€ 0.50-0.60/litre) over the last decade (Figure 4.8). Between 2005 and 2008, ethanol prices averaged nearer to €600/m^3 (EU€ 0.60/litre) as a result of increased demand as a significant number of Member States introduced blending mandates and against a background of rising crude oil prices. However, as crude oil prices started to fall at the end of 2008 and into 2009, EU ethanol prices fell to new lows.

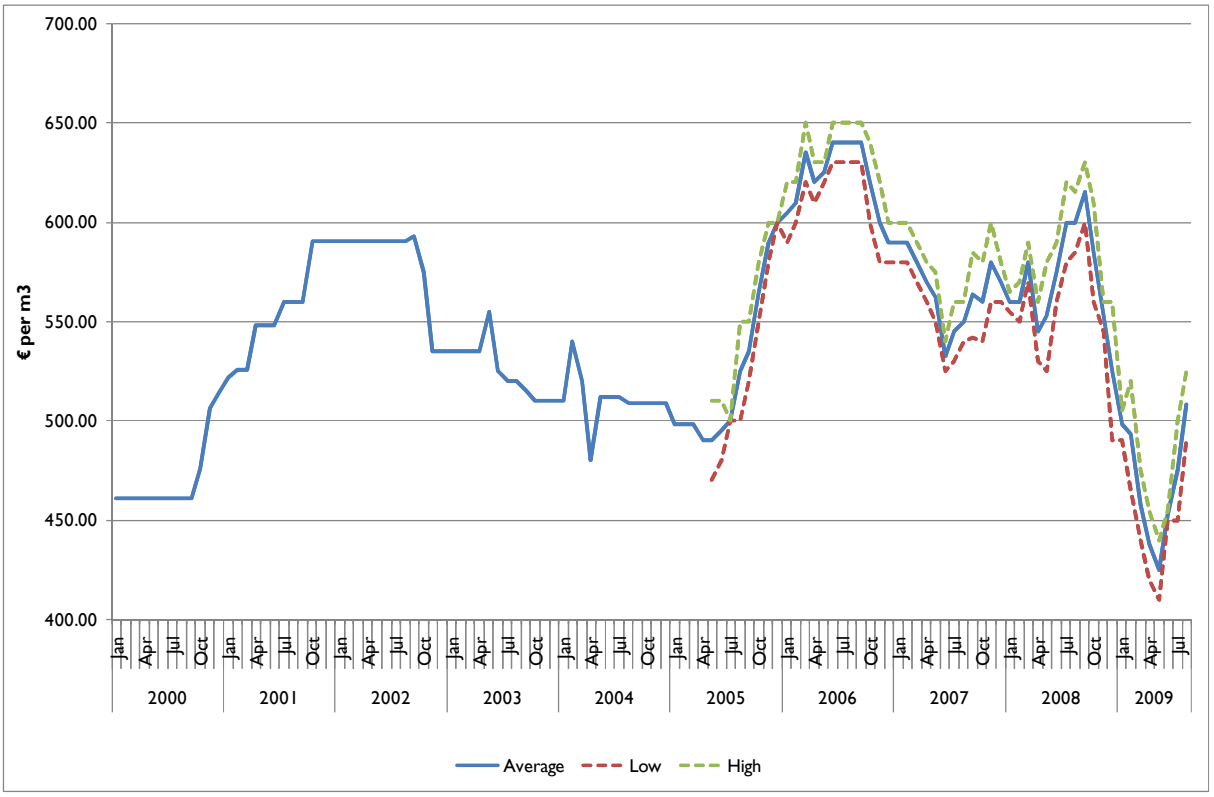

Figure 4.8: EU ethanol price, 2000-2009 (Rotterdam T2 fob EU€/m^3 (EU€ cents/litre))

Source: F.O. Licht

When converted into US dollars, the extent to which price developments in the EU and Brazilian ethanol markets have mirrored those in the crude oil sector can be clearly seen (Figure 4.9). As crude oil prices have increased in recent years, the value of ethanol as a substitute for, or blending component in, petrol-based gasoline has also increased. When oil prices peaked in 2008, EU ethanol prices reached US946^{/m3}$. Brazilian prices for anhydrous ethanol trend fairly closely with the crude oil price on a per litre basis.

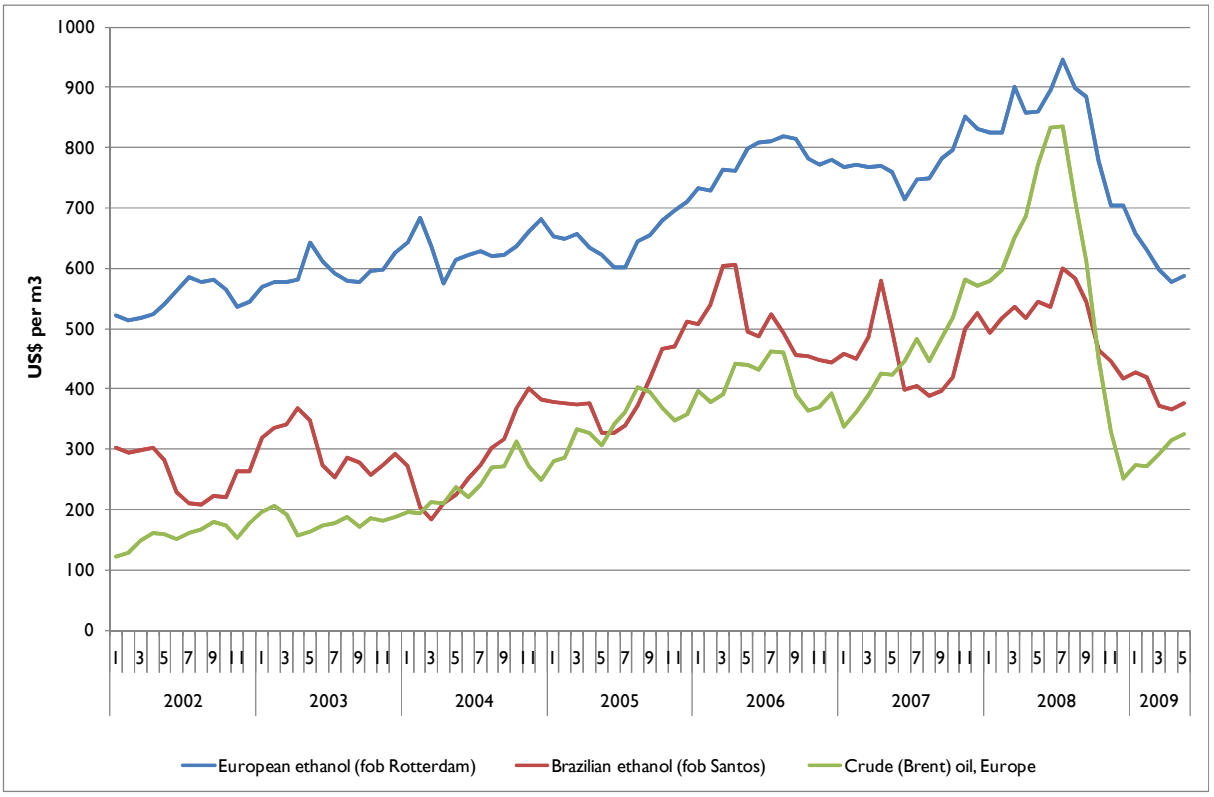

Figure 4.9: Historic EU and Brazilian ethanol and crude oil prices (US$/m^3 (US$ cents/litre))

Source: F.O. Licht and EIA

The market for ethanol is considered to be global as ethanol is a commodity product that can be easily traded (i.e. it is largely undifferentiated). Prices in any geographical market are fundamentally determined at the world level, thereby responding to the supply and demand conditions on the world market. This is clearly shown in Figure 4.10, where the trends in ethanol prices in Brazil, US and the EU are seen to move in concordance with each other in the medium to long-term.

Ethanol prices in the US and the EU are substantially higher than the Brazilian ethanol price due to higher domestic production costs, the cost of freight and border protection. Short-term price fluctuations between geographical markets are due to regional supply and demand conditions as well as changes in domestic biofuel policies that affect the relative cost competitiveness of regions. For example, the strong increase in US ethanol prices in mid-2006 resulted following the accelerated phase-out of MTBE and the subsequent drop in prices in 2007 was caused by large additional production capacities coming on-stream. In addition the cost of feedstock, given their relative importance as a proportion of total production costs, affects the price of ethanol; falling sugar prices in mid-2007 and rising sugar prices at the end of 2007 are reflected in ethanol price developments in Brazil.

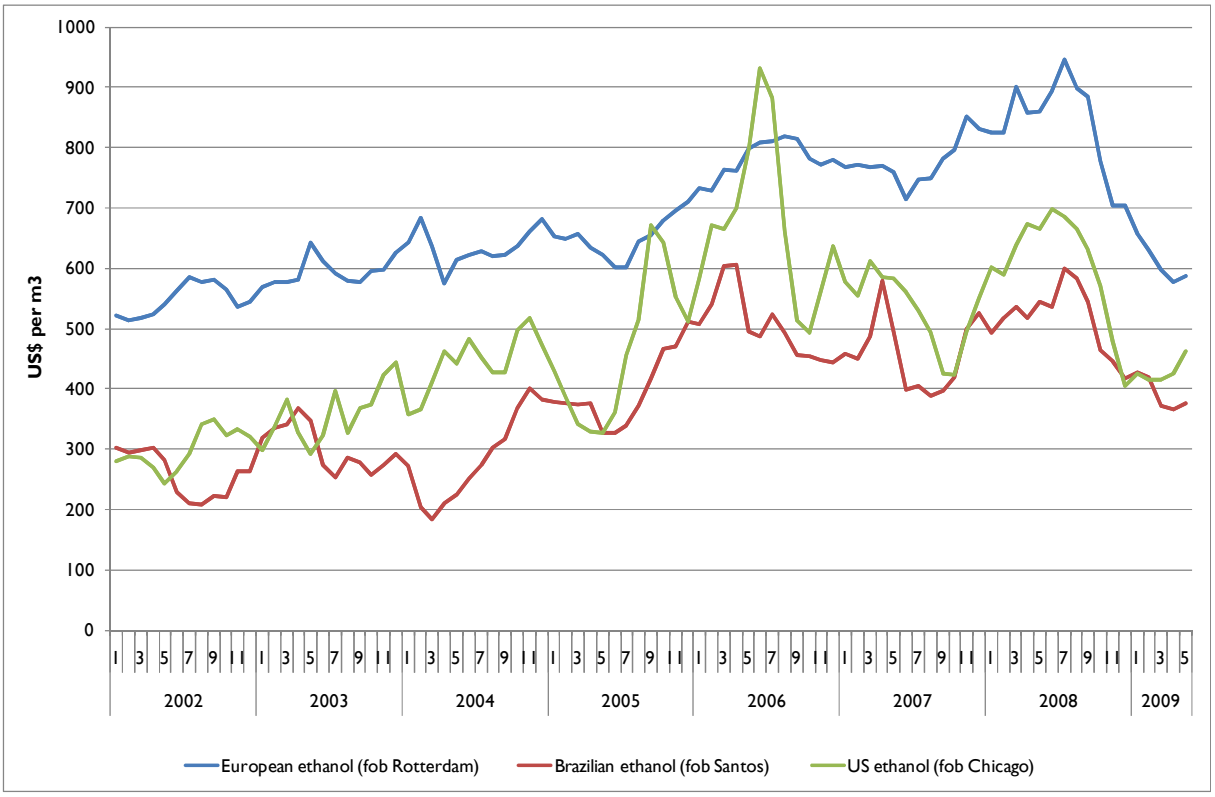

Figure 4.10: Historic EU, Brazilian and US ethanol prices (US$/m^3 (US$ cents/litre))

Source: F.O. Licht

From an economic perspective, this suggests that the 'law of one price' holds and the difference between ethanol prices in separate markets can be attributed to the cost of transport and the associated transaction costs (including tariffs and exchange rate movements). According to the 'law of one price', *export parity* and *import parity* are two of the key price-setters in such markets, with prices between geographic markets ranging between export and import parity depending on the availability of the domestic biofuel. In general:

- If a country is in surplus, or has more biofuel than domestic buyers can use (i.e. Brazil), biofuel must be priced competitively enough to attract export demand, i.e. they are priced at *export parity*.

- If a country is in deficit, or does not have enough biofuel to meet domestic demand (i.e. the EU and the US), then the market will be operating at *import parity* and domestic production is priced to encourage imports to make up for the domestic production shortfall.

4.7.2. Ethanol pricing fundamentals

Traditionally, price linkages between energy markets and agricultural crops were restricted to the impacts of fossil-fuel prices on agricultural production costs (e.g. fertiliser, pesticides and diesel).

However, with the onset of increasing fossil-fuel prices and improved bio-energy technologies, demand for agricultural crops as energy feedstock is rising, setting the scene for much closer price linkages between the agricultural and energy sectors.

Since the contribution of the bio-energy sector to total global energy supplies is still fractional, feedstock prices can be considered as endogenous to (i.e. arising from) changes in fossil-fuel prices. Consequently, there are several ways in which price changes in energy markets can be transmitted to agricultural markets:

- On the supply side, as long as the feedstock's net production costs (including any subsidies) are lower than the price of fuel, and the marginal (i.e. additional) value in the biofuel market exceeds that in the agricultural market, the crop will be diverted to the production of biofuel. When larger quantities of feedstock are absorbed by the energy sector, price determination will tend to mirror that in the energy sector and an 'energy floor price' effect will be created. As energy crops compete for other agricultural resources, a greater cultivation intensity of energy crops could lead to shortages in the supply of other agricultural commodities, thus pushing up their prices.

  Given the substitutability of agricultural commodities between the food, animal feed and biofuel feedstock sectors, the extent to which feedstock prices will fall under a scenario of falling oil prices/biofuel prices will be limited with the price for alternative uses setting a floor to the market. However, if excess supply results, exerting downward pressure on this floor price, then this will affect farmers' planting decisions for the following production season.

- On the demand side, the high degree of substitutability by which biofuel can be blended in large proportions with their fossil-fuel counterparts (e.g. B80 and E85 biofuel), ensures that biofuel and petroleum prices do not depart significantly from one another. With biofuel competitive at the pump and large quantities of feedstock subsumed by the energy sector, consumers ensure equilibrium between prices of petroleum and biofuel, and producers ensure equilibrium between prices of biofuel and the feedstock.

The evolution of, and relationship between, different agricultural feedstock, biofuel and crude oil price indices between 2001 and 2008 (namely: Brazilian sugar-ethanol-crude oil and US grain-ethanol-crude oil[16]) are presented in Figure 4.11 and Figure 4.12. Graphically, it would seem that international feedstock, biofuel and crude oil prices have trended in the same direction; following recent increases in crude oil prices, the prices for both biofuel and feedstock have also trended upwards. This would suggest that apart from short-term fluctuations, international prices for crude oil, biofuel and feedstock have a long-run relationship.

[16] The choice of feedstock and biofuels was governed by their importance in international trade and thus for the prospect of price shocks originating from them to be passed on to importing countries and also for the potential for shocks to be transmitted to other related commodities. In addition, pricing relationships for EU feedstocks-ethanol-crude oil were not modelled because the ethanol sector is not as developed as in the case of Brazil and the US, so the prospect of price shocks being transmitted between ethanol, feedstock and oil markets is more limited.

Figure 4.11: Evolution in Brazilian sugar, ethanol and crude oil prices, 2001-2008 (% change)

Source: F.O. Licht

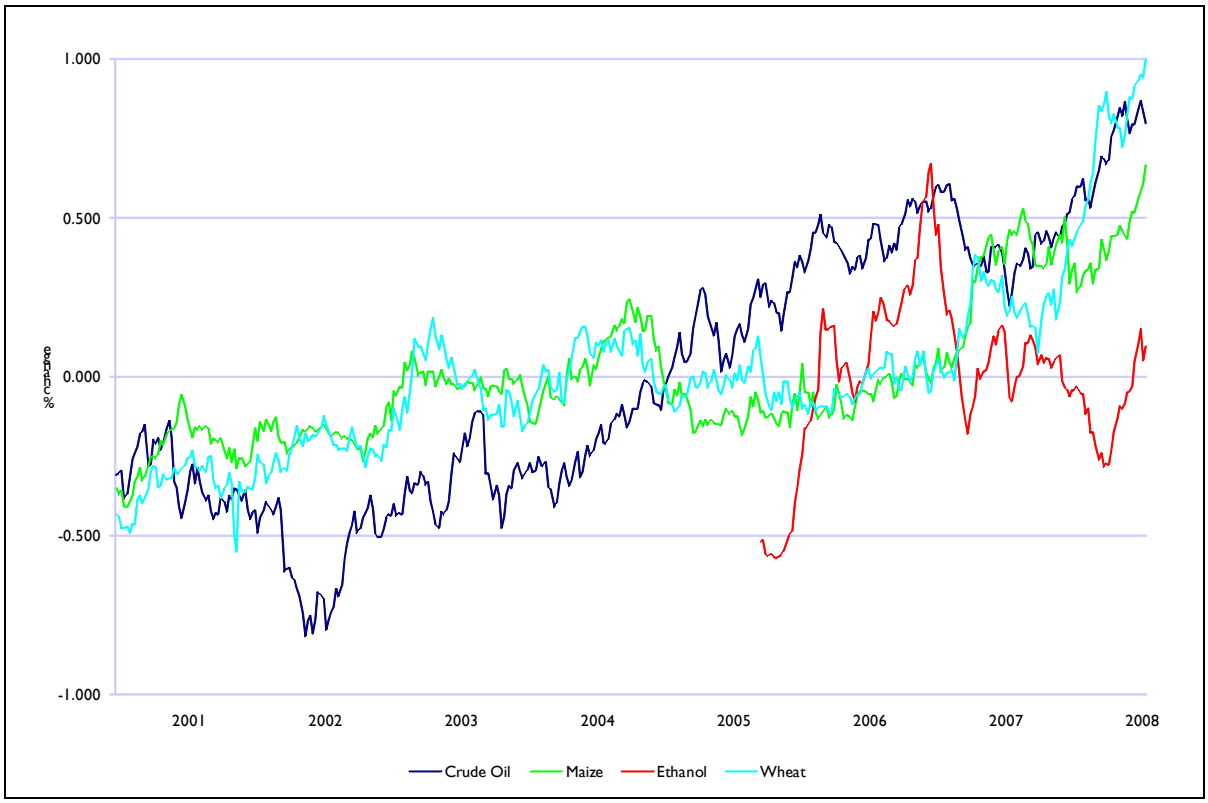

Figure 4.12: Evolution in US grain, ethanol and crude oil prices, 2001-2008 (% change)

Source: F.O. Licht

Econometric analysis[17], carried out to identify the nature and extent of any pricing relationship between the agricultural feedstock, biofuel and crude oil prices presented in Figure 4.11 and Figure 4.12 found that:

- **Brazil sugar-ethanol-crude oil**. Crude oil prices determine the long run price equilibria of both sugar and ethanol in Brazil, with the sugar price constituting an important source of price discovery for ethanol. Threshold effects (i.e. price corrections as a result of radical change) were also found in adjustment between sugar and crude oil prices and ethanol and crude oil prices. In non-econometric terms, this suggests that long term equilibrium prices are subject to changes in the relative competitiveness in sugar conversion (i.e. efficiency) and the volume of ethanol production.

- **US grain-ethanol-crude oil**. Interesting, changes in the maize price were found to be 'independent' of changes in energy prices in the econometric analysis of US grain-ethanol-crude oil prices. In essence, energy prices do not appear to feature in the equilibrium between grain markets, nor does the price of maize affect the determination of ethanol prices despite the price of the feedstock being the dominant component in ethanol's cost schedule. The evidence

[17] Specifically, regressions (cointegrating and threshold cointegrating) were conducted on each pricing relationship combination to ascertain whether energy prices play a role in determining feedstock prices.

suggests that over the time series, other 'fundamentals' in grain markets were more important in the evolution of the grain prices.

These results are illustrated pictorially in Figure 4.13.

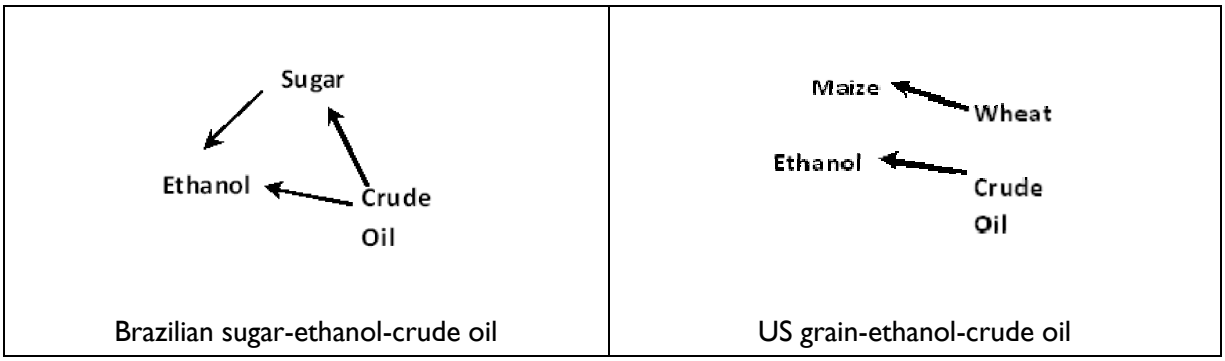

Figure 4.13: Relationship between the crude oil price, ethanol prices and feedstock prices in Brazil and the US

Notes: Solid lines refer to significance at the 5% level. The arrow signifies the direction of causality (i.e. the direction of any pricing relationship between feedstock, biofuel and crude oil).
Source: Agra CEAS Consulting

It would be statistically difficult to extend this analysis to the European situation because compared to Brazil and the US, demand for agricultural crops as energy feedstock for ethanol production in Europe is still relatively insignificant. Thus, *a priori* we would not expect to see a direct price linkage between the EU agricultural and energy sectors. However, trying to statistically prove this becomes difficult because of data limitations – the EU ethanol sector is still in an early stage of development and hence we do not have a long enough historic time series on which to carry out credible statistical analysis.

However, we would expect that the nature and extent of any pricing relationship between the agricultural feedstock, biofuel and crude oil prices in the EU to be similar to that in the US (although this has not been proven econometrically for the reasons noted in footnote 16). In other words, there would be independence between feedstock prices and the oil-ethanol price relationship. This would likely be the case given that the EU ethanol sector accounts for a relatively small proportion of EU grain production; other users of grain in the EU, notably the food and animal feed sectors, are larger users. Accordingly, we would expect that other price 'fundamentals' affecting the EU grain markets would be more important in determining the evolution of grain prices. In essence, we would expect that EU ethanol prices would continue to respond to developments in the crude oil price. As noted in the case of the US, we would also expect that EU grain type feedstock prices going forward will be less exposed to future evolution of, and volatility in, oil prices.

In summary, the findings of the econometric analysis suggest that:

- There is a strong relationship between the oil price and ethanol prices irrespective of feedstock, meaning that ethanol prices are determined by the crude oil price. Therefore, it holds that the price of ethanol going forward will continue to be driven by the future evolution of, and volatility in, oil prices.

- In Brazil, where sugar is used as a feedstock, a strong relationship exists between the oil price, feedstock price and ethanol price. Both sugar and ethanol prices are determined by the crude oil price; and the ethanol price responds to some extent to the sugar price, given that the sugar price is responding to the crude oil price. Therefore, it holds that the sugar feedstock prices going forward will continue to be driven by the future evolution of, and volatility in, oil prices.

- In the US, where grains are used as the main feedstock, there is independence between feedstock prices and the oil-ethanol price relationship. This is mainly because of the relative importance of grains for other uses in the US, although this may change with the introduction of flex fuel cars. However, currently neither wheat nor maize prices are directly determined by the crude oil price. Ethanol prices respond in the main only to developments in the crude oil price. Therefore, it is likely that grain type feedstock prices going forward will be less exposed to future evolution of, and volatility in, oil prices. That said, the introduction of flex fuel cars in the US to a significant degree will likely change the pricing dynamics between the oil price, feedstock price and ethanol price.

Going forward, as energy markets absorb a greater share of harvested crops, feedstock prices are expected to move more in line with developments in energy (crude oil) prices. In addition to the oil price and the usual supply and demand factors, a variety of other factors will impact on feedstock prices. These include:

- buoyant commodity exchanges which are drawing the attention of speculators as a way of spreading their risk and seeking more lucrative returns;
- soaring petroleum prices which raise input costs (e.g. fertiliser prices, processing costs, transportation costs) on the one hand, and boost demand for agricultural crops used as feedstock in the production of alternative energy sources on the other; and,
- increasing freight rates as a result of increasing fuel costs, stretched shipping capacity, port congestion and longer trade routes; and exchange rate volatility.

4.7.3. Outlook for biofuel prices to 2020

This Section presents ethanol price forecasts generated by Agra CEAS Consulting for this study using our proprietary world biofuel and feedstock econometric model. A brief description of the model and the assumptions behind the forecasts presented are summarised in Box 4.3. More detail on the specifications of the model and the economic and policy assumptions used to generate the forecasts are set out in Appendix 1 and 2.

Box 4.3: Summary of the Agra CEAS Consulting world biofuel and feedstock econometric model

The model uses a dynamic partial equilibrium framework to examine how the global market for biofuel and crops might evolve given identified econometric interactions between policies, biofuel, feedstock and crude oil prices. The model employs a set of behavioural equations covering biofuel consumption, production, inventory holding and trade in biofuel, for countries with major energy crop programmes together with a 'Rest of World' aggregate. All price forecasts are nominal, based on a constant oil price. The base year of 2008 represents actual data, on which a forecasts have been generated to 2020.

The Agra CEAS model uses a variety of external data to generate these forecasts. Biofuel data (quantities and prices) are taken from the F.O. Licht and feedstock data (quantities and prices) are from the FAO. Macroeconomic data are sourced from the World Bank. The general assumptions on which the forecasts are based include:

- all present and future mandated ethanol programmes are assumed to be fulfilled, except for the EU-27 where it is assumed that only the 5.75% target will be met by 2020 (not the 10% mandate) (see Annex A2.2.3.3);
- indicative programmes and targets are used to condition the projections;
- domestic support where notified to continue; and,
- market access provisions to remain.

In determining the future price of biofuel, the Agra CEAS model assumes that biofuel prices in each country are determined by the counterpart fossil-fuel (crude oil) price and an endogenous 'margin' between the two prices. Consequently, it is the crude oil price that drives the price of biofuel directly and indirectly through the feedstock prices; going forward we expect that feedstock prices will also (increasingly) move in line with crude oil price movements and in this respect we expect feedstock prices and biofuel prices to move in concordance with one another. The price of feedstock (such as sugar cane in Brazil, maize in the US and grains and oilseeds in the EU) is driven by the demand from the biofuel, feed and food sectors.

The EU is a net importer of ethanol (mainly from Brazil) and as such the EU price for ethanol is determined at the world level, i.e. the EU ethanol price is an *import parity price*. This represents the ceiling price, above which ethanol could be imported into the EU at a lower cost than the cost of domestic production. The difference between the world (Brazilian) ethanol price and the EU ethanol price is therefore a function of the costs associated with transport, insurance, tariffs and other transaction costs (including exchange rate movements).

Figure 4.14 would tend to confirm this, as EU and Brazilian ethanol prices have clearly moved in concordance with each other over time. Linear regression equations for each price data series in Figure 4.14 reveal the extent to which both the EU and Brazilian ethanol price have been trending in the same direction, with a β-value difference of just 0.0673; in terms of correlation, the *r*-value is 0.84 and the r^2 is 0.71.

Figure 4.14 suggests that between 2002 and mid-2009, the price differential between EU ethanol and Brazilian ethanol has averaged at US$296/m^3 (US$ 0.296/litre). At an average exchange rate of US$/EU€ 0.82 over the period, the average price differential in Euro terms is EU€ 243/m^3 (EU€

0.24/litre). According to the 'law of one price', this price differential over the long run should equal the cost of transport to the importing country (i.e. from Brazil to EU) plus any transaction costs. The EU import tariff for fuel ethanol is EU€ 192/m^3 (EU€ 0.19/litre) and an indicative freight cost for shipping ethanol from Brazil to the EU is in the region of EU€ 43/m^3 (EU€ 0.04/litre) (although this varies considerably depending on the size of vessel used), suggesting that the cost of exporting ethanol from Brazil to the EU is EU€ 235/m^3 (EU€ 0.24/litre) plus transaction costs of approximately EU€ 8.00/m^3 (EU€ 0.01/litre), this would suggest that the law of one price holds, with the price for ethanol in the EU being set at import parity.. This would suggest that the 'law of one price' holds, with the price for ethanol in the EU being set at *import parity*.

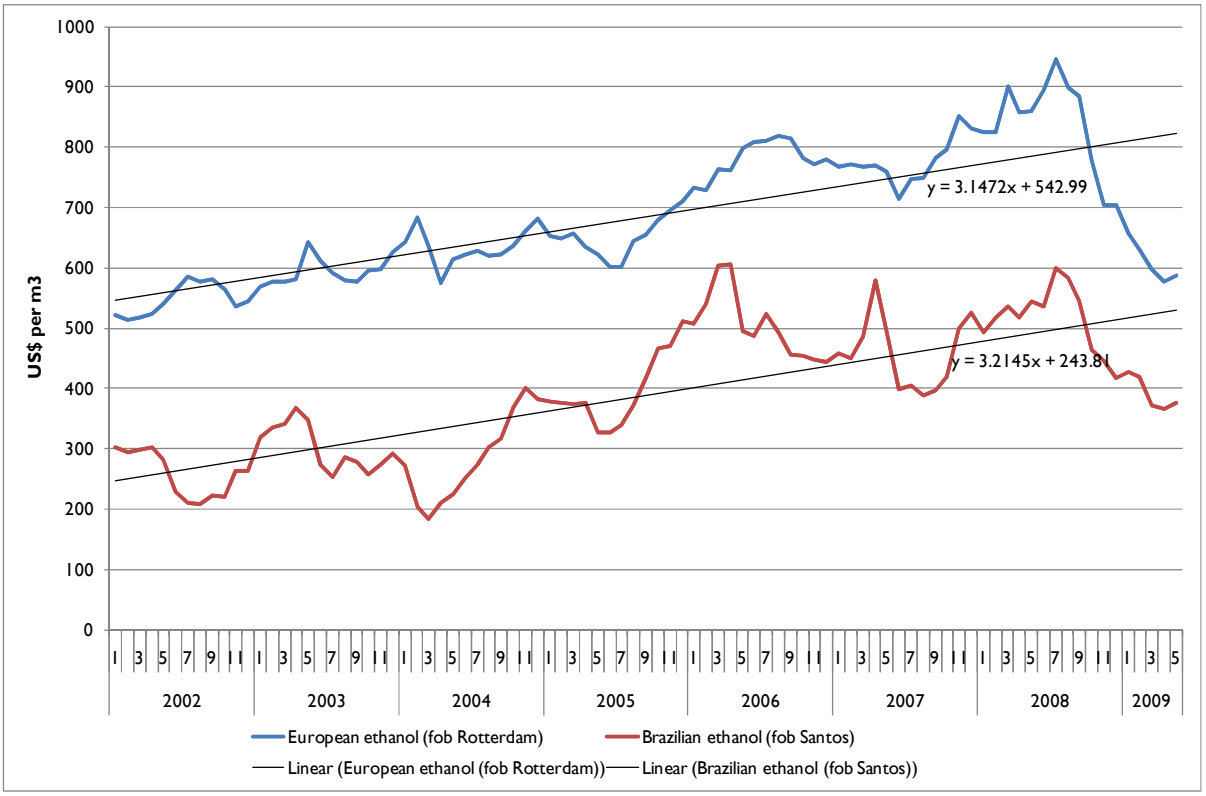

Figure 4.14: Historic EU and Brazilian ethanol prices (US$/m^3 (US$ cents/litre))

Source: F.O. Licht

Brazilian and EU ethanol price forecasts for the period 2009-2020 under three different (constant) crude oil price scenarios (US$ 40/bbl, US$ 60/bbl and US$ 80/bbl) are presented in Table 4.13. The complete set of forecasts for the three scenarios is presented in full in Appendix 3. Ethanol prices are forecast to evolve in concordance with projected oil price movements; the relationship between crude oil prices and ethanol prices will continue to strengthen as ethanol is increasingly blended with fossil-fuels coupled with growing numbers of flex-fuel cars that comprise vehicle fleets. That said, expected increased production of ethanol in Brazil over the period is likely to put some pressure on prices, the effect of which will be transmitted to the EU market given that the EU is expected to remain a net importer and as such prices on the EU market will continue to be set at import parity.

Table 4.13: Ethanol price forecasts to 2020 under three different crude oil price scenarios (US$/m³ (US$ cents/litre) and EU€/m³ (EU€ cents/litre))

US$/m³ or US$ cents/litre	2008	2010	2012	2014	2016	2018	2020
Crude oil (Brent) – US$/bbl	**99.3**	**40**	**40**	**40**	**40**	**40**	**40**
Brazil Ethanol (ex-factory)	479	412	371	344	325	311	297
Brazil Ethanol (fob Santos)	484	417	376	349	330	316	302
EU Ethanol (fob Rotterdam)	825	758	717	690	671	657	643
Crude oil (Brent) – US$/bbl	**993**	**60**	**60**	**60**	**60**	**60**	**60**
Brazil Ethanol (ex-factory)	479	461	424	391	365	344	331
Brazil Ethanol (fob Santos)	484	466	429	396	370	349	336
EU Ethanol (fob Rotterdam)	825	807	770	737	711	690	677
Crude oil (Brent) – US$/bbl	**993**	**80**	**80**	**80**	**80**	**80**	**80**
Brazil Ethanol (ex-factory)	479	469	446	425	408	395	390
Brazil Ethanol (fob Santos)	484	474	451	430	413	400	395
EU Ethanol (fob Rotterdam)	825	815	792	771	754	741	736

EU€/m³ or EU€ cents/litre	2008	2010	2012	2014	2016	2018	2020
$:€	0.68	0.69	0.69	0.69	0.69	0.69	0.69
Crude oil (Brent) – US$/bbl	**99.3**	**40**	**40**	**40**	**40**	**40**	**40**
Brazil Ethanol (ex-factory)	326	284	256	237	224	215	205
Brazil Ethanol (fob Santos)	329	288	259	241	228	218	208
EU Ethanol (fob Rotterdam)	561	523	495	476	463	453	444
Crude oil (Brent) – US$/bbl	**99.3**	**60**	**60**	**60**	**60**	**60**	**60**
Brazil Ethanol (ex-factory)	326	318	293	270	252	237	228
Brazil Ethanol (fob Santos)	329	322	296	273	255	241	232
EU Ethanol (fob Rotterdam)	561	557	531	509	491	476	467
Crude oil (Brent) – US$/bbl	**99.3**	**80**	**80**	**80**	**80**	**80**	**80**
Brazil Ethanol (ex-factory)	326	324	308	293	282	273	269
Brazil Ethanol (fob Santos)	329	327	311	297	285	276	273
EU Ethanol (fob Rotterdam)	561	562	546	532	520	511	508

Note: * Historic 2008 exchange rate US$/EU€ 0.68 (EU€/US$ 1.47);
Forecast 2010-2020 exchange rate US$/EU€ 0.69 (EU€/US$ 1.45).
Source: Agra CEAS

4.8. Technological developments

4.8.1. Flex-fuel vehicles

FFVs first appeared on the European market in 2001, when Ford introduced the FFV version of their Focus model. Saab and Volvo entered the market in 2005, increasing the range of models to five. In 2007, Renault, Skoda, Citroen, Peugeot and VW all entered the market, and the number of FFV models increased to 14. Opel entered the market in 2008, and there are currently approximately 20 FFV models available in the EU. Sweden was the first market for FFVs, and remains the largest market, though FFVs are now available in 18 EU countries. European flex-fuel vehicles are optimized to run on a maximum blend of 15% gasoline with 85% anhydrous ethanol (called E85 fuel).

Statistics on the size of the current EU FFV fleet are not readily available, however, based on data from BEST (Bio-Ethanol for Sustainable Transport), Agra CEAS estimates that in 2008: the Swedish fleet totalled around 115,000 vehicles; the Dutch fleet totalled around 3,000; the German fleet totalled around 2,000; and the Spanish fleet totalled around 4,000. Data from Roulons-Propre shows that nearly 70,000 FFVs were sold in Europe in 2008, a 65% increase on 2007, of which nearly 58,000 (82%) were sold in Sweden. However, as a proportion of the total EU vehicle fleet of some 230

million passenger vehicles (approximately 30% diesel; with diesel also accounting for 53% of all new passenger vehicle sales), the number of flex-fuel vehicles remains extremely low (at around 0.03%). There have not been any specific policy initiatives aimed at promoting the adoption of flex-fuel cars in the EU.

4.8.2. Second generation biofuel technologies

Second generation biofuel technologies are currently expensive and there is a need for significant cost reduction to compete with conventional fossil fuels and 1st generation biofuel. However, this is likely to be dependent upon the future cost of competing fuels and the level of public support for new technologies based on their greenhouse gas savings potential (estimated to be significantly greater than that of most 1st generation biofuel) and other potential benefits, such as energy security.

Further investment in 2nd generation biofuel is likely to rely on the recognition of their relative environmental and socio-political benefits compared to other fuels. In addition, the technical and economic viability of large scale 2nd generation biofuel plants needs to be proven and in this context, the availability of comparatively low-cost and sustainable feedstock is likely to be a key factor.

4.8.2.1. Ligno-cellulosic ethanol

Ethanol can be produced from ligno-cellulosic biomass; that is from any organic matter that contains a combination of lignin, cellulose and hemicelluloses. This includes agricultural wastes, forestry products and wastes, energy crops and the biological component of municipal solid waste. Ethanol is produced by first breaking down the cellulose and hemicelluloses into sugars, which can then be fermented. Ligno-cellulosic materials are more complex to break down than starch, and therefore require more advanced pre-treatment and conversion processes than those used in the production of first generation ethanol.

Currently, ligno-cellulosic ethanol production technology is still at the demonstration stage. However, it is regarded as the 2nd generation technology that is at the most advanced stage of development and deployment. Some individual stages involved in the process are already commercial (e.g. dilute acid pre-treatment, acid hydrolysis, fermentation and distillation). However, in order for the technology to become a competitive alternative, technological advances are still needed in several process stages (e.g. enzymatic hydrolysis, fermentation of C5 sugars).

Most current research and development work into ligno-cellulosic ethanol is taking place in the US, although there is also considerable interest in northern Europe (due to the extensive forestry resources in this region), and in Brazil (where sugar cane bagasse could be used as a direct feedstock, rather than for electricity generation for the ethanol plants). It is considered likely that commercial scale ligno-cellulosic ethanol plants will come on stream over the next decade.

4.8.2.2. Algae

Microalgae are microscopic aquatic plants with the potential to produce large quantities of lipids (fats and oils). Microalgae are of interest because of their high growth rates and tolerance to varying environmental conditions, and because the oils (lipids) they produce can be extracted and converted to biofuel, such as biodiesel (Brown, 1990).

Microalgae can be grown in ponds created in arid and semi-arid regions. Saline water from aquifers or the ocean that has few competing uses can also be used. According to Neenan et al. (1986) microalgae are projected to be grown in those areas where ligno-cellulosics or oilseed crops will not grow well and the yield of biomass per hectare from microalgae is 3-5 times greater than the equivalent yields from a typical crop plant.

According to Christi (2007), several commercial companies are attempting to commercialise micro algal biodiesel, however, producing micro-algal biomass is generally more expensive than growing crops and due to the temperatures required (20-30^{0}C) to minimize expense, bio-diesel production must rely on freely available sunlight.

Studies have shown that economic fuel production will require the microalgae to be grown in intensive culture in large outdoor ponds (Weissman and Tillett, 1992). Carbon dioxide (perhaps in the form of power plant stack gases) and other nutrients are injected into the culture to optimize algal growth and oil production. Lipid accumulation is generally triggered by environmental stress, such as depletion of a key nutrient. Current research is directed at a better understanding of ways to trigger lipid accumulation. Research and development is also underway to increase price competitiveness of algae oil production for biodiesel, in particular because there appears to be a trade-off between the oil content of algae and their growth rates.

4.8.2.3. Biomass to liquids (BTL) technology

Biomass feedstock can also be converted into a range of liquid and gaseous transport fuels, such as synthetic diesel and gasoline, methanol, ethanol, dimethylether (DME), methane, and hydrogen. There are two types of technical process used to create these liquid fuels, namely gasification and pyrolysis. Biomass gasification technology and the catalytic upgrading of the syngas to a liquid fuel (e.g. Fischer-Tropsch process) have been extensively researched in both the EU and USA. The technology is attractive because of the quality and range of low greenhouse gas emission synthetic biofuel (synfuels) that can be produced from syngas. Both biomass gasification and the Fischer-Tropsch processes involve mature technologies, already being used at commercial scale. However, there is very limited experience in integrating biomass gasification with downstream processes for the production of liquid or gaseous transport fuels. One particular challenge for this technology is that each type of biomass feedstock generally requires a specifically designed system with precise physical and chemical property ranges, which little inter-changeability.

Further research and development work is therefore needed into the optimal plant size and configurations that will be technically and economically viable based on a variety of feedstock.

According to the National Non-Food Crops Centre in the UK, technologies for the production of methanol from gasified mixed feedstock and for the production of green diesel (also known as syndiesel) from forest residue and waste wood are currently, being demonstrated in Germany. Demonstration plants for ethanol production via gasification are being built in the US. Successful demonstration of these plants could lead to the deployment of commercial scale plants over the next decade.

However, a key uncertainty for biomass to liquids technology is whether it will be possible to procure enough sustainable biomass to feed a plant at the scale needed for it to be economically viable. With current technologies, it is expected that economical BTL plants will need to be very large, requiring in the region of 1 million tons of dry biomass a year. Therefore the challenge is whether this process can be made to work technically and economically at a smaller scale, which would enable a wider distribution of synfuel production, i.e. due to reduced feedstock procurement needs and reduced transport costs.

Pyrolysis technology, on the other hand could be applied at a smaller scale compared to gasification technology. Plants with a capacity to process around 50,000 tons of locally produced feedstock could be feasible, although currently plants tend to be larger with a processing capacity upwards of 150,000 t/year of feedstock. However, pyrolysis oils produced from current pyrolysis processes cannot be directly integrated into a conventional oil refinery, and would require upgrading to a lower acidity and water content. Upgraded pyrolysis oil could be incorporated into an existing refinery process (e.g. hydrocracking or fluid catalytic cracking) to produce conventional refinery products such as diesel or gasoline. Upgrading processes could also be developed that enable use of the pyrolysis oil directly in a diesel blend.

4.8.2.4. Bio-gas

Anaerobic digestion is the biological degradation of biomass in oxygen-free conditions. The main product of anaerobic digestion is bio-gas, a methane-rich gas which can be either burnt in power generation devices for on-site (co)generation, or upgraded to natural gas standards and injected into the natural gas network as bio-methane.

The process of anaerobic digestion is particularly suited to animal manure, sewage sludge from waste-water treatment plants, wet agricultural residues and the organic fraction of municipal sewage waste. The process also occurs naturally underground in landfills and produces gases which can be collected for use in energy applications. It is a well established commercial technology, although it suffers from high capital costs. China is by far the biggest bio-gas producer in the world, with around 18 million farm households using bio-gas and about 3,500 medium to large-scale digester units (DEFRA, 2007). In Germany, partly due to specific public support mechanisms, farm-based units had a combined 550 MWe installed capacity in 2006 (i.e. similar to that of a nuclear power plant). In order to increase productivity, decentralised farm-size units are increasingly relying on supplementary feedstock such as agricultural residues or crops. Sewage sludge digestion and use of landfill gas are both effectively 'subsidised' by waste disposal fees, which means that these are globally the most

common forms of anaerobic digestion generating energy at present (led by UK, Italy and Spain). In contrast, deployment of bio-gas technology in the USA suffers from a poor reliability reputation (EPA, 2008).

The key co-product of anaerobic digestion is a nutrient-rich digestate, which can be used as a fertilizer. However, when using contaminated feedstock, contaminants may end up in the digestate, making it unsuitable for food crop use. Biomass pre-treatment and separation processes to remove these contaminants can help to avoid this, although these are processes which still need to be proven at larger commercial scales.

4.8.2.5. Bio-methane

Bio-gas can also be upgraded to bio-methane and injected into the natural gas network for use in gas powered vehicles. This technology is witnessing significant deployment and development worldwide. A number of known systems (e.g. membranes, absorption washers (water, glycole, amines, NaOH, etc.) or pressure swing adsorption) are being improved to fulfil modern environmental standards and consume less process electricity. New systems such as cryogenic upgrading, in which the separated CO2 can also be used in a pure form, are currently at the research and development stage. Cost reduction and process simplification of this technology is still required.

Bio-gas upgrading to bio-methane is undergoing rapid development, as a result of the worldwide exponential increase of natural gas vehicles (there were 9 million units in 2007 compared with 4 million in 2004). Forecasts for natural gas vehicles fleets in 2030, range between 100 and 200 million vehicles (IANGV, 2008).

5. Competitiveness analysis

5.1. Cost competitiveness analysis

In the absence of government intervention in the ethanol market (in terms of support for crop production, border protection and biofuel policies) the choice of feedstock in different regions of the world would simply be determined by the competitiveness and suitability of particular crops in the different regions. Taking this as the sole basis would mean that ethanol production would gravitate to those countries/regions which have the most competitive volume crop production and associated ethanol processing infrastructure.

Currently this country would be Brazil using ethanol from sugar cane which therefore provides the benchmark for ethanol production worldwide. Brazilian sugar cane continues to be the most competitive raw material on a net production cost basis. EU wheat based ethanol plants have relatively the highest production costs, and they also incur significant operating costs. In this context, typical ethanol plant capital costs currently run at around EU€ 0.70/litre, varying according to *inter alia* stainless steel costs and design specification.

Table 5.1 provides indicative production cost data based on current typical costs of producing biofuel in the world's main biofuel producing countries/regions (namely, Brazil, the US and the EU-27) using a number of different feedstock.

Table 5.1: Production cost analysis, average 2004/5 to 2008/9 (EU€/m³ (EU€ cents/litre))

Country:	Hungary[1]	EU (North West)		US	Brazil [2]
Feedstock:	Maize	Wheat	Sugar beet	Corn (dry)	Sugar cane
Feedstock use (t/m³)	2.49 [3]	2.79	10.00	2.53	12.12
Feedstock price (EU€/t)	122.32 [1]	148.14	24.36	95.69	12.57
Feedstock costs (EU€/m³)	**304.58**	**413.33**	**243.55**	**242.29**	**152.30**
Processing, Labour & Other operating costs (EU€/m³)	**31.73**	**98.59**	**98.60**	**55.42**	**52.21**
Natural gas use (MBTU/m³)	8.91	10.06	11.28	9.26	- [2]
Natural gas price (EU€/MBTU)	9.49	6.81	6.27	6.12	- [2]
Natural gas cost (EU€/m³)	84.53	68.51	70.72	56.71	- [2]
Electricity use (MWh/m³)	0.20	0.25 [3]	0.30 [3]	0.20 [3]	- [2]
Electricity price (EU€/MWh)	109.74	47.02	47.02	44.71	- [2]
Electricity cost (EU€/m³)	21.51	11.76	14.11	8.76	- [2]
Energy costs (EU€/m³)	**106.04**	**80.26**	**84.83**	**65.47**	- [2]
Operating costs (EU€/m³)	**137.77**	**178.85**	**183.43**	**120.89**	**52.21**
Gross production costs (EU€/m³)	**442.35**	**592.18**	**426.98**	**363.18**	**204.51**
Feedstock: co-product (DDGS) conversion factor (tons)	0.33 [3]	0.34	0.06	0.38	-
Co-product (DDGS) price (EU€/t)	140.67	170.36	144.47	75.30	-
Co-product (DDGS) credit (EU€/m³)	116.64	163.04	86.66	72.45	-
Co-product (Vinasse) credit (EU€/m³)	-	-	-	-	5.95
Co-product credits (EU€/m³)	**116.64**	**163.04**	**86.66**	**72.45**	**5.95**
Net production costs (EU€/m³)	**325.71**	**429.14**	**340.32**	**290.72**	**198.56**
Net cost (EU€/litre)	0.33	0.43	0.34	0.29	0.20
Net cost - fuel equivalent (EU€/litre)	0.49	0.65	0.52	0.44	0.30

Notes: [1] data provided by Pannonia, except for feedstock price (2004/5-2008/9 average) and DDGS price; [2] Assumes co-generation of heat and electricity from burning bagasse; [3] Estimate based on industry data sources.

1 m³ = 1,000 litres; therefore costs in EU€/m³ are the equivalent of EU€ cents/litre).

Source: Agra CEAS calculations based on F.O. Licht and Agra CEAS (2009); FAO (2009) and OECD (2006).

Based on the cost comparison set out in Table 5.1, total production costs are highest in the EU and lowest in Brazil. Brazil has a significant overall cost advantage due to low feedstock costs and low energy costs due to the co-generation of electricity and heat through burning bagasse. In the EU, feedstock and operating costs are comparatively high; however, the policy frameworks being developed at both the EU and national level offer considerable incentives for fuel ethanol production, notably including tariff protection. Any country without preferential EU access seeking to export to the EU market has to overcome this tariff barrier. Ethanol produced by Pannonia in Hungary could have a lower gross production cost compared to other EU ethanol production due to relatively low production costs compared to EU wheat and lower non-energy operating costs, subject to feedstock price sensitivity. Similarly on a net production cost basis, ethanol produced by Pannonia in Hungary would appear competitive against EU wheat and sugar beet derived ethanol subject to co-product (DDGS) price sensitivity (see Table 5.2).

Table 5.2: Pannonia plant net production cost sensitivity (EU€/m³ (EU€ cents/litre))

DDGS price EU€/t		Feedstock price EU€/ton										
		152.90	146.78	140.67	134.55	128.44	122.32	116.20	110.09	103.97	97.86	91.74
		+25%	+20%	+15%	+10%	+5%	0%	-5%	-10%	-15%	-20%	-25%
105.50	-25%	431	416	401	385	370	355	340	324	309	294	279
112.53	-20%	425	410	395	379	364	349	334	319	303	288	273
119.57	-15%	419	404	389	374	358	343	328	313	298	282	267
126.60	-10%	414	398	383	368	353	337	322	307	292	276	261
133.63	-5%	408	392	377	362	347	332	316	301	286	271	255
140.67	0%	402	387	371	356	341	**325.71**	310	295	280	265	250
147.70	5%	396	381	366	350	335	320	305	289	274	259	244
155.44	10%	390	374	359	344	329	313	298	283	268	253	237
163.98	15%	383	367	352	337	322	306	291	276	261	245	230
173.46	20%	375	359	344	329	314	299	283	268	253	238	222
181.66	25%	368	353	337	322	307	292	276	261	246	231	216

Source: Agra CEAS calculations

Table 5.3 compares the cost competitiveness of ethanol produced in the world's main bio-ethanol producing countries/regions with that from the proposed Pannonia plant in Hungary on a delivered Rotterdam basis. The production cost comparison (see Table 5.1) highlights that Brazilian production is by far the most competitive at EU€ 199/m³ (EU€ 0.20/litre) in terms of net production costs. However, when including the cost of freight and import duty, the delivered Rotterdam cost of EU€ 434/m³ (EU€ 0.43/litre) for Brazilian ethanol becomes uncompetitive when compared to EU ethanol derived from sugar beet (EU€ 354/m³ (EU€ 0.35/litre)) and more importantly ethanol sourced from the Pannonia plant (EU€ 353/m³ (EU€ 0.35/litre)) in Hungary shipped by barge via the Danube, Rhine-Main-Danube canal, Main and Rhine rivers from Dunaföldvár to Rotterdam.

Table 5.3: Comparative cost analysis, (EU€/m³ (EU€ cents/litre))

Country	Hungary	EU (North West)		US	Brazil
Feedstock	Maize	Wheat	Sugar	Maize	Sugar
Net production cost	**325.71**	**429.14**	**340.32**	**290.72**	**198.56**
Ocean or other freight	27.65	13.82	13.82	32.33	43.11
Import duty	-	-	-	192.00	192.00
Delivered to Rotterdam, c&f, duty paid	**353.36**	**442.97**	**354.14**	**515.06**	**433.67**

1 m³ = 1,000 litres; therefore costs in EU€/m³ are the equivalent of EU€ cents/litre)

Source: Agra CEAS calculations based on Agra CEAS and F.O. Licht (2009); OECD (2006); FAO (2009).

It should be noted that the data in the table is based on the simplifying assumption that EU wheat and sugar beet derived ethanol is produced at plants located closer to Rotterdam and incurring half the transport cost compared to the Pannonia plant with ethanol shipped via inland waterway, whereas in practice other EU ethanol may be competitive to a lesser or greater extent on a delivered Rotterdam basis depending on actual transport costs. It is also recognised that while the target market for imported ethanol from Brazil is generally at fuel refineries in and around Rotterdam itself or at other ports where onward transport from Rotterdam is feasible such as Sweden and the UK, the target market for ethanol produced at the proposed Pannonia plant in Hungary is not Rotterdam, but rather markets in Croatia, Hungary, Austria and Germany. However, in the absence of road and rail freight costs assumed for the Pannonia plant, it is assumed that transport would be via inland waterway.

Appendix 1: Background on the specifications of the Agra CEAS world biofuel and feedstock econometric model

A dynamic partial equilibrium framework has been derived to examine how the global market for biofuel and crops might evolve given identified econometric interactions between policies, biofuel, feedstock and crude-oil prices. The model employs a set of behavioural equations covering biofuel consumption, production, inventory holding and trade in biofuel, for countries with major energy crop programmes together with a 'rest-of-world' aggregate.

In this Appendix, the biofuel component of the model is presented.

A1.1. Biofuel consumption

To begin the derivation of biofuel consumption follows the dichotomy between blended usage and outright usage. The former would encompass markets in which biofuel is used as an additive, e.g., an oxygenator replacement for MTBE, and where biofuel is blended, mandated or otherwise, with fossil-fuels in small ratios, such as E5. As for outright usage, this would represent markets dominated by flex-fuel vehicles. The dichotomy is important since it would govern how biofuel markets respond to fossil fuel prices, that is whether biofuel are complementary to fossil fuels in demand or whether they substitutes in demand.

For the case of **complementarity**, biofuel demand is derived from the cost function for refiners blending petroleum with biofuel, which can be expressed as: $C_t^g = f\left(P_t^b, P_t^f, Pol_t^b, QS_t^g\right)$, where P_t^f is price of oil, Pol_t^b is a set of policy factors affecting refiners' biofuel demand, and QS_t^g denotes petroleum supply. Assuming constant-returns-to-scale, the cost function can be represented as $\widetilde{C}_t^g = f\left(P_t^b, P_t^f, Policy_t^b\right) \cdot QS_t^g$. By Shepherds lemma, the derived demand for biofuel is:

$$QD_t^b = \frac{\partial C_t^g}{\partial P_t^b} = \frac{\partial \widetilde{C}_t^g}{\partial P_t^b} \cdot QS_t^g \tag{1}$$

where $\frac{\partial \widetilde{C}_t^g}{\partial P_t^b} = f\left(P_t^b - TxCr_t^b, P_t^f, mand_t^b, QT_t^b\right)$ is the demand for biofuel per unit of petroleum supplied which is seen as the minimum of the consumer response to fuel prices at the pump, mandated consumption $mand_t^b$ and possibly a minimum quota requirement in consumption, QT_t^b, e.g. the Renewable Fuels Standard of the US. In the equilibrium of the petroleum market:

$$QS_t^g = QD_t^g = g\left(P_t^b - TxCr_t^b, P_t^g, GDP_t, POP_t\right) \tag{2}$$

where $TxCr_t^b$, P_t^g, GDP_t and POP_t denote respectively, a tax concession or credit paid to blenders, the price of petroleum, income and population. Combining (1) and (2), equilibrium in the biofuel market is:

$$QD_t^b = \frac{\partial C_t^g}{\partial P_t^b} = \min\left[f\left(P_t^b - TxCr_t^b, P_t^f\right), mand_t^b, QT_t^b\right] \cdot g\left(P_t^b - TxCr_t^b, P_t^g, GDP_t, POP_t\right).$$

In the case when biofuel is a **substitute** for petroleum, such as in Brazil, biofuel consumption may be modelled as:

$$QD_t^b = f\left[\left(\left(P_t^b - TxCr_t^b\right)/P_t^g\right), GDP_t, POP_t\right] \quad (3)$$

where the coefficient on the term $\left(P_t^b - TxCr_t^b\right)/P_t^g$ is negative.

A1.2. Biofuel production

Biofuel production, QS_t^n, is modelled as a function of gross returns over variable costs per m^3 of biofuel Π_t^b, and production capacity CAP_t^b:

$$QS_t^b = h\left(\Pi_t^b, CAP_t^b\right)$$

Gross returns are represented as $\Pi_t^b = P_t^b - (P_t^e + P_t^p + P_t^c) + \sum_i^k P_t^{by,i} \cdot Q_t^{by,i}$ where P_t^e, P_t^p and P_t^c denote the prices of energy, processing and feedstock, respectively. By-product returns from biofuel production, are captured by the term $\sum_i^k P_t^{by,i} \cdot Q_t^{by,i}$, where $P_t^{by,i}$ is the market price of by-product *i* (*i*= 1,..., *k*) and $Q_t^{by,i}$ is the quantity of by-product yielded from the production process. Production capacity is assumed to rest on the following:

$$CAP_t^b = CAP_{t-1}^b \cdot \left(1 + \theta_t\right)$$

where θ_t denotes the endogenous growth rate in capacity, which is modelled as a function of the level of return in the previous period and expected biofuel demand. A decision rule is incorporated which triggers positive growth in capacity:

$$\theta_t = \begin{cases} j\left(\Pi_{t-1}^b, E\left(QD_{t+3}^b\right)\right) & if \;\; \Pi_{t-1}^b \succ \mathbf{trig} \\ 0 & otherwise \end{cases}$$

A1.3. Biofuel stocks

Inventory demand QI_t^b, is governed by the price of biofuel, and the level of inventories at *t*-1:

$$QI_t^b = f\left(QI_{t-1}^b, P_t^b\right)$$

A1.4. Biofuel net trade

Biofuel trade is assumed to close the model. For net importers:

$$QM_t^b = \begin{cases} 0 & if\ P_t^b < \left(P_t^{b*} \cdot (1+\tau) + tc\right) \\ QS_t^b - QD_t^b - QI_t^b + QI_{t-1}^b & otherwise \end{cases}$$

trade is non-zero if the world price of biofuel, P_t^{b*} plus the tariff, τ, and transport cost, tc, is less than the domestic price. For net exporters, net trade is simply:

$$QX_t^b = QS_t^b - QD_t^b - QI_t^b + QI_{t-1}^b.$$

A1.5. Linkages between the crop and biofuel markets

Both markets interact through the quantity of feedstock made available for biofuel production and the price that farmers receive for energy crop production. As for the former:

$$QS_{b,t}^{c,i} = \alpha_t^{c,i} QS_t^b \cdot \Psi_t^i$$

where $QS_{b,t}^{c,i}$ is the quantity of feedstock *i*, used for the production of biofuel; Ψ_t^i is the share of biofuel produced from feedstock *i* in the aggregate production of biofuel; $\alpha_{tt}^{c,i}$ is the quantity of feedstuff required to produce one unit of ethanol. For a particular feedstock, *i*, the share of $QS_{b,t}^c$ in QS_t^c is governed by the quantity φ:

$$QS_{b,t}^c = \varphi QS_t^c$$

where 0 < φ < 1. Where countries in addition import biofuel feedstock, the share equation would be $QS_{b,t}^c = \varphi\left(QS_t^c + QM_t^c\right)$:

$$\varphi = \min\left(\phi\left(\frac{P_t^c}{P_t^b}\right), \left(\frac{1}{\alpha_t^c}\right) CAP_t^{b,\max}\right)$$

with the coefficient ϕ non-negative. Thus, the quantity of feedstock demanded by biofuel production is assumed to rest on the minimum of a function of the crop – biofuel price relative and the maximum capacity of the biofuel in the same period.

Prices of feedstock in countries which are assumed non-price takers for those commodities in the international arena are determined domestically:

$$P_t^c = m\left(\lambda P_t^b, QI_t^c\right)$$

where the coefficient on the variable QI_t^c is negative. Crucially:

$$\lambda \xrightarrow[\varphi_t \to 0.5, \Pi_t^b \to 0]{} 1$$

that is, when the market share of a crop entering biofuel production nears one-half, and/or when marginal revenues equate to marginal costs in the biofuel sector, price transmission from the biofuel market to the feedstock market approaches one.

A1.6. Market clearing

The model is solved such that global net trade in biofuel is zero with prices of biofuel acting as the equilibrator. Specifically, biofuel prices in each country are determined by the counterpart fossil-fuel price and an endogenous 'margin' between the two prices. In essence, it is this price margin that clears the biofuel market:

$$P_t^b = mar^{endo} + \gamma P_t^f$$

Appendix 2: Agra CEAS world biofuel and feedstock model and modelling assumptions

A2.1. Model description and coverage

A dynamic partial equilibrium framework is derived to examine how the global market for biofuel and crops might evolve given identified econometric interactions between policies, biofuel, feedstock and crude-oil prices. The model employs a set of behavioural equations covering biofuel consumption, production, inventory holding and trade in biofuel, for countries with major energy crop programmes or biofuel initiatives together with a 'rest-of-world' aggregate.

The projection horizon is annual, up to 2020.

The biofuel 'module' forms a component to a much wider model where agricultural economic activity is determined endogenously. The detail and econometric relationship within the biofuel 'module' is described in Appendix 1.

The following countries are covered in the model: United States, Brazil, EU(27), Australia, Argentina, China, Japan, India, New Zealand, Pakistan, Russia, South Africa, Thailand, Viet Nam, Malaysia and Indonesia.

A2.2. Data and modelling assumptions

A2.2.1. Data availability

A base year of 2008/2009 was chosen to calibrate the model from which a 11/12-year projection was generated. All prices and quantities for 2008/2009 were updated with known data. Macroeconomic data are sourced from the World Bank. Transportation fuel composition and projections are from LMC and OECD. Biofuel data (quantities and prices) are taken from the F.O. Licht, feedstock data (quantities and prices) are from FAO.

A2.2.2. General assumptions

The following general economic and political assumptions were programmed into the model:

- All mandated ethanol programmes, present and future, are assumed to be fulfilled
- Indicative programmes and targets are used to condition the projections
- Domestic support where notified to continue
- Market access provisions to remain
- The baseline employs a reference crude oil price of US$ 60/bbl from 2009 onwards
- The first scenario assumes lower crude oil prices of US$ 40/bbl from 2009 onwards
- The second scenario assumes higher crude oil prices of US$ 80/bbl from 2009 onwards

- The second scenario assumes even higher crude oil prices of US$ 100/bbl from 2009 onwards

A2.2.3. Political assumptions

The following provides a review of the major energy crop programmes or biofuel initiatives that exist around the world. These policies and political orientations are encapsulated into the model:

A2.2.3.1. United States

The main biofuel policies and political positions in the US include:

- Bans in over 25 states on the use of ethanol's main oxygenate competitor, methyl-tertiary-butyl-ether (MTBE), has paved the way for ethanol demand. Also
- "The Volumetric Ethanol Excise Tax Credit" (VEETC) is a federal fuel excise tax credit to ethanol blenders of 51¢ per gallon (13¢ per litre) through 2010 on pure ethanol blends. For example, an E10 blend will have a credit available of 5.1¢ per gallon, and E85 will have a credit available of 43¢ per gallon. VEETC went into effect on 1 January 2005. A US$1.00 per gallon excise tax credit granted on bio-diesel.
- Small biofuel producers are allowed a 10¢ per gallon production income tax credit on up to 15 million gallons of production annually. The credit is capped at US$1.5 million per year per producer.
- United States ethanol sector considered less dependent on government support than was the case in the past.
- 'Renewable Fuel Standard' (RFS) stipulates the country's fuel production to include a minimum amount of renewable fuel per annum: 15.14 billion litres in 2006 to 28.38 billion gallons in 2012. On December 19, 2007, the Energy Independence and Security Act of 2007 was signed into law. The law stipulates the utilisation of 36 billion gallons of renewable fuels, of which 15 billion litres from conventional feedstock (57 billion litres by 2015 and maintained to 2022). See box below.
- Regarding trade policy, an ad valorem tariff of 2.5 percent plus a specific duty of 54¢ per gallon is levied on imports.
- The Caribbean Basin Economic Recovery Act (CBERA) created rules for ethanol market access under the Caribbean Basin Initiative (CBI). Under this agreement, if ethanol is derived from at least 50 percent home-grown agricultural feedstock in a CBERA country, it can be admitted into the United States duty free. The volume of ethanol that can be imported duty-free from non-CBERA feedstock is restricted to 227 million litres or 7 percent of the United States domestic ethanol market, whichever is greater. To comply with this requirement, hydrous ethanol imported to a CBI country must be dehydrated before it can be exported to the U.S. Dehydration plants are currently operating in CBI countries of Jamaica, Costa Rica, and El Salvador.

Renewable Fuels Standard

On December 19, 2007, the Energy Independence and Security Act of 2007 (H.R.) was signed into law. This comprehensive energy legislation amends the Renewable Fuels Standard (RFS) signed into law in 2005, growing to 36 billion gallons in 2022. By doing so, the bill seizes on the potential that renewable fuels offer to reduce foreign oil dependence and greenhouse gas emissions and provide meaningful economic opportunity across this country, putting America firmly on a path toward greater energy stability and sustainability.

Summary of the Biofuel Provisions - Title II

DEFINITIONS (Sec. 201)

Establishes definitions for the renewable fuels program, including conventional biofuel, advanced biofuel, cellulosic biofuel and biomass-based diesel.

- ***Conventional biofuel*** is ethanol derived from corn starch. Conventional ethanol facilities that commence construction after the date of enactment must achieve a 20 percent greenhouse gas (GHG) emissions reduction compared to baseline lifecycle GHG emissions. The 20 percent GHG emissions reduction requirement may be adjusted to a lower percentage (but not less than 10 percent) by the U.S. Environmental Protection Agency (EPA) Administrator if it is determined the requirement is not feasible for conventional biofuel.

- ***Advanced biofuel*** is renewable fuel other than ethanol derived from corn starch, that is derived from renewable biomass, and achieves a 50 percent GHG emissions reduction requirement. The definition – and the schedule -- of advanced biofuel include cellulosic biofuel and biomass-based diesel. The 50 percent GHG emissions reduction requirement may be adjusted to a lower percentage (but not less than 40 percent) by the Administrator if it is determined the requirement is not feasible for advanced biofuel. (Cellulosic biofuel that do not meet the 60 percent threshold, but do meet the 50 percent threshold, may qualify as an advanced biofuel.)

- ***Cellulosic biofuel*** is renewable fuel derived from any cellulose, hemicellulose, or lignin, that is derived from renewable biomass, and achieves a 60 percent GHG emission reduction requirement. The 60 percent GHG emissions reduction requirement may be adjusted to a lower percentage (but not less than 50 percent) by the Administrator if it is determined the requirement is not feasible for cellulosic biofuel.

RENEWABLE FUEL STANDARD (Sec. 202)

- Directs EPA to promulgate regulations ensuring that applicable volumes of renewable fuel are sold or introduced into commerce in the United States annually.
- Regulations apply to refiners, blenders and importers.
- The applicable volume for 2008 is set at 9.0 billion gallons.
- Sets forth a phase-in for renewable fuel volumes beginning with 9 billion gallons in 2008 and ending at 36 billion gallons in 2022.

Year	Renewable Biofuel	Advanced Biofuel	Cellulosic Biofuel	Biomass-based Diesel	*Undifferentiated Advanced Biofuel*	Total RFS
2008	9.0					9.0
2009	10.5	.6		.5	*0.1*	11.1
2010	12	.95	.1	.65	*0.2*	12.95
2011	12.6	1.35	.25	.8	*0.3*	13.95
2012	13.2	2	.5	1	*0.5*	15.2
2013	13.8	2.75	1		*1.75*	16.55
2014	14.4	3.75	1.75		*2*	18.15
2015	15	5.5	3		*2.5*	20.5
2016	15	7.25	4.25		*3.0*	22.25
2017	15	9	5.5		*3.5*	24
2018	15	11	7		*4.0*	26
2019	15	13	8.5		*4.5*	28
2020	15	15	10.5		*4.5*	30
2021	15	18	13.5		*4.5*	33
2022	15	21	16		*5*	36

Source: Renewable Fuels Association

A2.2.3.2. Brazil

The main biofuel policies and political positions in Brazil include:

- Brazilian government supports ethanol production through market regulations and tax incentives. By way of the former, a blending ratio between 20 and 25 percent of anhydrous ethanol with gasoline in transport fuel is imposed.
- Production costs of ethanol in Brazil compare favourably with gasoline production costs, and hence producers have no recourse to any subsidies.
- Credit provisions for the storage of ethanol via lower excise taxes for ethanol than for gasoline and through the use of strategic reserves.
- At the retail level, ethanol benefits from a zero excise duty.
- Imports of ethanol to Brazil are subject to an ad valorem tariff of 20%.

A2.2.3.3. EU

The main biofuel policies and political positions in the EU include:

- Directive 2003/30/EC sets out a target for biofuel to account for 5.75% of total transport fuel requirements by 2010, from a target of 2% in 2005. These targets were indicative and not mandatory. However, in early 2007 the European commission increased the target to 10% by 2020, and made it a requirement. In December 2008 this 10% target became mandatory. The distinction between biofuel mandates and biofuel obligations is not transparent. The latter can be thought of as a requirement for fuel suppliers to achieve a given biofuel share of their total fuel shares while a biofuel mandate is a requirement under which every litre sold must contain a given percentage of biofuel. However, biofuel mandates are not compatible with existing Community law and as a consequence, it is assumed that by 2020 only the 5.75% target will be met.
- Directive 2003/96/EC permits Member States to exempt excise tax on biofuel as long as these exemptions do not lead to overcompensating production cost differentials relative to fossil fuels. Member States pursue own bio-energy policies – no common framework for subsidies and incentives other than EC Directives. For example, the UK provides a US$0.39 per litre subsidy for biofuel production.
- Under the Kyoto protocol, the EU is committed to reduce CO_2 emissions by 8% at the end of 2012.
- A subsidy of EU€ 45 (US$59) per hectare for land used to produce energy crops has been agreed (this will not apply on set-aside land, though certain energy crops (e.g. short rotation coppice) on set-aside land will be eligible for set-aside payment). A maximum guaranteed area of 1.5m hectares is fixed for the entire EU and the subsidy will be reduced if production exceeds that area. In addition, ethanol will be excluded from sugar production quotas.

- Import tariffs on ethanol of 87 cents per gallon. When imported for industrial use, bio-diesel tariffs are close to zero. However, imports of bio-diesel or oilseed for industrial usage must comply with (stringent) EU standards.

A2.2.3.4. Japan

The main biofuel policies and political positions in Japan include:

- Government of Japan's renewable fuels policy has targeted the replacement of 500 million tons of petroleum-based transport fuels with ethanol and is supporting an ethanol blend of 3%.
- National strategy to decrease petroleum dependency by 20% by the end of 2030. To this end, the maximum blending rate may be increased to 10% by 2010.
- Under the Kyoto protocol, Japan is committed to reduce CO2 emissions by 6% at the end of 2012.
- Import tariffs of 23.8% but will be lowered incrementally to 10% by the end of 2010.

A2.2.3.5. India

The main biofuel policies and political positions in India include:

- Government currently mandates the 5% blending of ethanol E5 with gasoline in 9 out of 29 Indian states and 4 out of 6 union territories.
- Government intervenes in the pricing of ethanol, currently at Rupees 18.25 per litre (approximately US$1.55 per gallon).
- 'Phase II' of India's ethanol programme is to be launched in 2006/07. The programme aims to distribute E5 ethanol-blended gasoline nationwide. This would entail 600 million litres of ethanol. However, government disputes with processors have delayed the implementation of Phase II.
- Sugar mills that show interest in establishing ethanol production facilities are offered subsidised loans of up to 40% of the capital cost. There is no other form of government assistance.
- Tariffs of up to 600% on imported fuel ethanol render imports virtually non viable.

A2.2.3.6. China

The main biofuel policies and political positions in China include:

- Ethanol sector is subject to strict national control. Private sector involvement is negligible.
- Government policy is to produce 12 million tons of biofuel by 2020: equivalent to 15% of the nation's transport fuel needs.
- A host of financial incentives have been put in place by the authorities to ensure the viability of ethanol production and distribution. These include a US$172 million ton subsidy on ethanol production (the level of subsidy has fallen recently), value added tax refunds, 5% sales tax

exemption, the application of food reserve subsidies, and the Government of China will cover any loss incurred with the cost of distributing ethanol.

- However, owing to rising domestic prices of maize in early 2007, the Government has placed a moratorium on new maize ethanol plants. The Government is encouraging non-food commodities (especially cassava and biomass) to be used for biofuel production.
- Imports of ethanol attract duties of 30%.

A2.2.3.7. Malaysia and Indonesia

The main biofuel policies and political positions in Malaysia and Indonesia include:

- It is mandatory for diesel to be blended with 5% bio-diesel derived from palm oil by 2008.
- Indonesia plans to halve its national consumption of petroleum by 2025 through substitution with biofuel - 10% is mandated
- Both countries have announced a joint commitment to each produce 6 million tons of crude palm oil per year to feed the production of bio-diesel.

A2.2.3.8. Other countries

- South Africa: Biofuel usage of 4.5% by 2013.
- Russia: Bio energy: 16% by 2020.
- Thailand: Biofuel usage of 10% by 2012.
- Argentina: Biofuel usage of 5% in 2009.
- New Zealand: 0.05 million tons of ethanol by 2012.
- Australia: 350 million litres of E10 fuel by 2010.
- Canada: E5 and B2 by 2012.

Appendix 3: Biofuel and feedstock outlook to 2020 statistical tables

Biofuel forecasts 2009-2020 – baseline oil price scenario (US$ 60/barrel crude oil)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oil Prices (US$ Barrel)														
World Oil (Brent)	**72.5**	**99.3**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**
Feedstock Prices (US$ Tonne)														
US Maize No. 2	159	218	178	166	161	167	172	171	174	175	169	168	168	167
US Wheat No.2 Soft	204	340	263	211	210	212	214	208	209	208	204	204	204	204
Brazil Sugar Cane	14.6	13.7	14.2	14.1	13.7	13.2	12.7	12.3	11.8	11.5	11.1	10.8	10.6	10.4
Rape oil Dutch fob	969	1460	933	931	928	926	923	921	919	916	914	912	909	907
Soybean oil Dutch Fob	881	1409	1243	1240	1236	1233	1230	1227	1224	1221	1218	1215	1211	1208
Palm oil crude cif N.W.	778	1099	766	764	762	760	758	756	754	753	751	749	747	745
Biofuel Prices (US$ Barrel)														
US Ethanol	84.2	102.6	83.0	80.3	80.0	82.5	84.6	85.1	86.6	87.8	86.9	87.8	88.1	88.4
Brazil Ethanol	41.1	47.9	47.6	46.1	44.3	42.4	40.7	39.1	37.7	36.5	35.4	34.4	33.7	33.1
EU(27) Bio-diesel	102.6	144.9	125.3	124.5	123.6	122.8	122.0	121.2	120.5	119.7	119.0	118.3	117.5	116.6
Bio-fuel NET Costs (US$ Liter)														
US Ethanol	0.39	0.48	0.39	0.37	0.37	0.38	0.39	0.40	0.40	0.41	0.40	0.41	0.41	0.41
Brazil Ethanol	0.24	0.23	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26
EU(27) Bio-diesel	0.70	0.99	0.82	0.82	0.81	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77
EU(27) Ethanol	0.67	0.90	0.75	0.65	0.64	0.67	0.67	0.66	0.66	0.66	0.67	0.68	0.67	0.68
Biofuel Production (million liters)														
United States Ethanol	28,714	34,463	39,780	44,550	46,459	46,972	49,417	52,597	54,081	54,369	55,641	54,509	54,863	54,910
Brazil Ethanol	17,932	22,239	26,145	27,618	29,445	31,514	33,763	36,159	38,685	41,334	43,660	46,052	48,546	50,966
Canada Ethanol	839	1,083	1,079	1,092	1,110	1,121	1,125	1,132	1,135	1,138	1,148	1,159	1,172	1,187
Japan Ethanol	110	110	110	110	110	110	110	110	110	110	110	110	110	110
China Ethanol	3,679	3,964	4,082	4,267	4,479	4,661	4,819	4,985	5,135	5,277	5,456	5,631	5,818	6,017
India Ethanol	2,007	1,725	1,960	2,221	2,516	2,849	3,225	3,648	4,120	4,643	5,217	5,843	6,546	7,332
E27 Ethanol	3,887	5,021	5,681	6,695	6,838	6,654	6,718	6,876	6,971	7,038	7,083	7,065	7,205	7,279
Russia Ethanol	750	932	985	1,018	1,041	1,062	1,085	1,112	1,142	1,177	1,215	1,259	1,314	1,375
Thailand Ethanol	423	615	700	795	903	1,028	1,171	1,334	1,521	1,734	1,974	2,244	2,552	2,902
South Africa Ethanol	16	16	21	28	38	50	65	85	109	140	180	229	292	371
ROW Ethanol	2,748	2,886	3,071	3,273	3,501	3,762	4,059	4,396	4,779	5,212	5,701	6,251	6,871	7,566
World Ethanol	61,104	73,055	83,613	91,666	96,440	99,782	105,557	112,434	117,789	122,172	127,386	130,353	135,290	140,017
EU(27) Bio-diesel	6,492	8,064	8,820	10,005	11,185	12,359	13,529	14,694	15,853	17,006	18,154	19,296	20,434	21,565
Brazil Bio-diesel	402	1,089	2,057	2,221	2,395	2,579	2,774	2,978	3,192	3,415	3,645	3,881	4,161	4,454
Argentina Bio-diesel	459	1,364	1,534	1,715	1,903	2,096	2,289	2,475	2,648	2,798	2,917	2,995	3,051	3,082
Canada Bio-diesel	87	100	1,461	2,144	2,826	3,508	3,636	3,768	3,905	4,047	4,195	4,348	4,506	4,670
United States Bio-diesel	2,405	2,709	2,908	3,119	3,341	3,576	3,822	4,082	4,354	4,640	4,938	5,250	5,576	5,919
Malaysia Bio-diesel	211	536	854	928	1,009	1,096	1,191	1,294	1,406	1,528	1,660	1,804	1,961	2,131
Indonesia Bio-diesel	288	356	566	607	649	692	737	781	825	867	906	941	993	1,045
China Bio-diesel	216	296	296	308	320	333	347	360	375	389	405	420	438	456
ROW Bio-diesel	921	1,218	1,535	1,541	1,548	1,554	1,562	1,569	1,577	1,585	1,593	1,602	1,605	1,607
World Bio-diesel	11,482	15,731	20,032	22,587	25,176	27,795	29,886	32,002	34,135	36,276	38,414	40,538	42,724	44,930
Biofuel Consumption (million liters)														
United States Ethanol	30,963	36,069	40,773	45,455	47,727	50,000	52,273	54,545	56,818	56,818	56,818	56,818	56,818	56,818
Brazil Ethanol	14,367	17,846	21,922	23,148	24,556	26,080	27,683	29,346	31,064	32,835	33,824	34,806	35,845	36,809
Canada Ethanol	1,334	1,587	1,540	1,660	1,879	2,099	2,127	2,156	2,185	2,214	2,244	2,274	2,304	2,335
Japan Ethanol	631	1,066	1,077	1,087	1,098	1,109	1,120	1,132	1,143	1,155	1,167	1,179	1,191	1,204
China Ethanol	3,456	3,787	3,816	3,937	4,100	4,280	4,462	4,640	4,811	4,974	5,129	5,276	5,385	5,479
India Ethanol	2,007	1,991	1,960	2,221	2,516	2,849	3,225	3,648	4,120	4,643	5,217	5,843	6,546	7,332
E27 Ethanol	5,011	6,698	7,552	7,741	7,934	8,132	8,336	8,544	8,758	8,977	9,201	9,431	9,667	9,909
Russia Ethanol	750	932	985	1,018	1,041	1,062	1,085	1,112	1,142	1,177	1,215	1,259	1,314	1,375
Thailand Ethanol	369	694	630	715	813	925	1,054	1,201	1,369	1,560	1,776	2,020	2,297	2,611
South Africa Ethanol	16	16	21	28	38	50	65	85	109	140	180	229	292	371
ROW Ethanol	2,701	3,470	2,937	2,357	3,038	4,695	5,127	5,775	6,270	7,679	9,413	11,218	13,630	15,772
World Ethanol	61,604	74,157	83,213	89,366	94,740	101,282	106,557	112,184	117,789	122,172	126,186	130,353	135,290	140,017
EU(27) Bio-diesel	6,875	9,200	9,568	10,746	11,919	13,087	14,251	15,409	16,562	17,710	18,852	19,989	21,120	22,245
Brazil Bio-diesel	402	1,089	1,530	1,560	1,591	1,622	1,654	1,686	1,719	1,753	1,787	1,822	1,858	1,894
Argentina Bio-diesel	459	400	383	393	403	413	425	438	454	472	492	514	527	540
Canada Bio-diesel	87	100	1,674	2,482	3,290	4,098	4,290	4,487	4,689	4,897	5,111	5,331	5,557	5,789
United States Bio-diesel	1,325	1,383	2,182	2,202	2,223	2,243	2,263	2,283	2,303	2,323	2,343	2,362	2,385	2,408
Malaysia Bio-diesel	100	267	277	288	299	310	322	334	347	360	374	388	403	419
Indonesia Bio-diesel	148	220	245	248	251	254	257	260	263	266	270	273	276	280
China Bio-diesel	216	296	296	308	320	333	347	360	375	389	405	420	438	456
ROW Bio-diesel	1,401	1,813	2,930	3,295	3,689	4,113	4,629	5,174	5,649	6,052	6,482	6,937	7,469	8,143
World Bio-diesel	11,013	14,767	19,085	21,522	23,984	26,474	28,437	30,433	32,362	34,223	36,115	38,037	40,033	42,174
Biofuel Net Trade (million liters)														
United States Ethanol	-2,249	-1,605	-1,992	-2,905	-2,968	-3,028	-2,856	-2,949	-2,737	-2,449	-2,378	-2,309	-1,955	-1,908
Brazil Ethanol	3,565	4,393	4,222	4,470	4,889	5,434	6,081	6,813	7,621	8,499	9,836	11,245	12,701	14,157
Canada Ethanol	-495	-504	-361	-568	-769	-979	-1,002	-1,024	-1,049	-1,076	-1,095	-1,115	-1,133	-1,148
China Ethanol	223	177	266	330	379	381	357	345	324	303	327	356	433	538
Japan Ethanol	-521	-620	-967	-977	-988	-999	-1,010	-1,022	-1,033	-1,045	-1,057	-1,069	-1,081	-1,094
Thailand Ethanol	54	-79	70	79	90	103	117	133	152	173	197	224	255	290
E27 Ethanol	-1,124	-1,677	-1,871	-1,045	-1,096	-1,479	-1,618	-1,668	-1,786	-1,938	-2,118	-2,366	-2,461	-2,629
ROW Ethanol	47	-584	133	916	464	-934	-1,069	-1,379	-1,491	-2,467	-3,713	-4,966	-6,759	-8,206
Brazil Bio-diesel	0	0	600	735	880	1,035	1,199	1,372	1,555	1,745	1,943	2,146	2,391	2,650
Malaysia Bio-diesel	112	268	577	640	710	786	869	960	1,059	1,168	1,286	1,416	1,558	1,713
Indonesia Bio-diesel	140	136	321	359	398	439	480	521	562	601	637	668	717	765
EU(27) Bio-diesel	-852	-1,136	-748	-741	-734	-728	-722	-715	-709	-704	-698	-692	-686	-680
Canada Bio-diesel	0	0	-162	-238	-314	-390	-404	-419	-434	-450	-466	-483	-501	-519
USA Bio-diesel	1,080	1,326	807	998	1,201	1,417	1,645	1,886	2,040	2,107	2,187	2,281	2,386	2,607
ROW Bio-diesel	-480	-594	-1395	-1754	-2141	-2559	-3067	-3605	-4072	-4467	-4889	-5334	-5865	-6536

Source: Agra CEAS Consulting world biofuel econometric model

Biofuel forecasts 2009-2020 – higher oil price scenario (US$ 80/barrel crude oil)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oil Prices (US$ Barrel)														
World Oil (Brent)	**72.5**	**99.3**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**
Feedstock Prices (US$ Tonne)														
US Maize No. 2	159	218	180	168	165	172	177	177	181	183	177	177	178	178
US Wheat No.2 Soft	204	340	272	211	210	224	228	223	226	226	224	225	226	228
Brazil Sugar Cane	14.6	13.7	14.1	14.1	13.8	13.5	13.2	12.9	12.7	12.5	12.3	12.1	11.9	11.8
Rape oil Dutch fob	969	1460	1120	1117	1114	1111	1108	1105	1102	1100	1097	1094	1091	1088
Soybean oil Dutch Fob	881	1409	1492	1487	1483	1480	1476	1472	1468	1465	1461	1458	1453	1449
Palm oil crude cif N.W.	778	1099	920	917	915	912	910	908	905	903	901	899	896	894
Biofuel Prices (US$ Barrel)														
US Ethanol	84.2	102.6	88.7	86.2	86.1	88.9	91.2	91.9	93.7	95.1	94.4	95.5	96.1	96.6
Brazil Ethanol	41.1	47.9	47.8	46.9	45.8	44.6	43.5	42.5	41.6	40.8	40.1	39.5	39.2	39.0
EU(27) Bio-diesel	102.6	144.9	133.8	133.0	132.1	131.3	130.5	129.7	128.9	128.2	127.4	126.7	125.9	125.1
Bio-fuel NET Costs (US$ Liter)														
US Ethanol	0.39	0.48	0.41	0.40	0.40	0.41	0.42	0.43	0.44	0.44	0.44	0.44	0.45	0.45
Brazil Ethanol	0.24	0.23	0.24	0.24	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.27	0.27	0.27
EU(27) Bio-diesel	0.70	0.99	0.87	0.87	0.86	0.86	0.85	0.85	0.84	0.83	0.83	0.83	0.82	0.81
EU(27) Ethanol	0.67	0.90	0.79	0.70	0.71	0.71	0.71	0.70	0.71	0.71	0.72	0.72	0.72	0.73
Biofuel Production (million liters)														
United States Ethanol	28,714	34,463	39,914	42,349	47,970	48,630	51,296	54,739	56,401	56,707	58,056	56,875	57,231	57,283
Brazil Ethanol	17,932	22,239	35,923	37,203	38,909	40,857	42,953	45,145	47,409	49,732	51,323	52,890	54,484	55,788
Canada Ethanol	839	1,083	1,186	1,252	1,326	1,393	1,455	1,521	1,585	1,648	1,725	1,803	1,888	1,978
Japan Ethanol	110	110	110	110	110	110	110	110	110	110	110	110	110	110
China Ethanol	3,679	3,964	4,229	4,570	4,954	5,323	5,679	6,057	6,430	6,805	7,239	7,683	8,156	8,661
India Ethanol	2,007	1,725	2,016	2,349	2,732	3,173	3,680	4,259	4,918	5,661	6,495	7,424	8,483	9,685
E27 Ethanol	3,887	5,021	6,676	7,645	7,651	7,748	7,803	7,970	8,039	8,125	8,167	8,213	8,280	8,349
Russia Ethanol	750	932	990	1,035	1,076	1,116	1,160	1,207	1,259	1,315	1,377	1,444	1,527	1,618
Thailand Ethanol	423	615	719	840	980	1,143	1,333	1,554	1,810	2,104	2,443	2,832	3,280	3,795
South Africa Ethanol	16	16	23	34	50	72	104	148	210	295	415	579	807	1,123
ROW Ethanol	2,748	2,886	3,143	3,428	3,747	4,106	4,512	4,971	5,489	6,073	6,733	7,478	8,319	9,264
World Ethanol	61,104	73,055	94,930	100,814	109,504	113,672	120,085	127,682	133,658	138,577	144,085	147,331	152,563	157,655
EU(27) Bio-diesel	6,492	8,064	7,275	8,422	9,563	10,698	11,827	12,950	14,066	15,176	16,279	17,375	18,465	19,548
Brazil Bio-diesel	402	1,089	2,203	2,381	2,571	2,773	2,987	3,212	3,450	3,698	3,957	4,224	4,537	4,869
Argentina Bio-diesel	459	1,364	1,547	1,743	1,951	2,167	2,386	2,602	2,808	2,993	3,148	3,261	3,351	3,416
Canada Bio-diesel	87	100	1,551	2,324	3,096	3,868	4,086	4,308	4,535	4,767	5,005	5,248	5,496	5,750
United States Bio-diesel	2,405	2,709	2,932	3,170	3,424	3,694	3,982	4,287	4,610	4,953	5,315	5,696	6,101	6,529
Malaysia Bio-diesel	211	536	907	1,031	1,172	1,331	1,447	1,573	1,710	1,859	2,020	2,195	2,387	2,595
Indonesia Bio-diesel	288	356	572	642	750	874	930	988	1,044	1,100	1,152	1,198	1,267	1,335
China Bio-diesel	216	296	296	323	352	384	419	456	475	494	513	533	556	580
ROW Bio-diesel	921	1,218	1,725	1,731	1,738	1,745	1,752	1,760	1,767	1,776	1,784	1,793	1,796	1,798
World Bio-diesel	11,482	15,731	19,009	21,767	24,616	27,534	29,816	32,136	34,465	36,814	39,171	41,524	43,955	46,419
Biofuel Consumption (million liters)														
United States Ethanol	30,963	36,069	44,810	48,605	51,050	53,521	56,022	58,557	61,131	61,478	61,877	62,336	62,864	63,471
Brazil Ethanol	14,367	17,846	26,261	27,557	29,005	30,548	32,157	33,820	35,532	37,293	38,162	39,021	39,932	40,752
Canada Ethanol	1,334	1,587	1,640	1,759	2,011	2,267	2,319	2,372	2,425	2,480	2,535	2,592	2,650	2,709
Japan Ethanol	631	1,066	1,077	1,093	1,104	1,115	1,126	1,137	1,149	1,161	1,173	1,185	1,197	1,210
China Ethanol	3,456	3,787	3,797	3,869	3,967	4,071	4,175	4,273	4,365	4,450	4,527	4,598	4,634	4,657
India Ethanol	2,007	1,991	2,016	2,349	2,732	3,173	3,680	4,259	4,918	5,661	6,495	7,424	8,483	9,685
E27 Ethanol	5,011	6,698	9,069	9,296	9,528	9,766	10,011	10,261	10,517	10,780	11,050	11,326	11,609	11,899
Russia Ethanol	750	932	990	1,035	1,076	1,116	1,160	1,207	1,259	1,315	1,377	1,444	1,527	1,618
Thailand Ethanol	369	694	647	756	882	1,029	1,200	1,399	1,629	1,894	2,199	2,548	2,952	3,416
South Africa Ethanol	16	16	23	34	50	72	104	148	210	295	415	579	807	1,123
ROW Ethanol	2,701	1,470	6,300	6,266	7,037	8,666	9,329	10,220	10,570	11,841	13,272	13,602	15,260	16,796
World Ethanol	61,604	72,157	96,630	102,619	108,441	115,346	121,282	127,653	133,704	138,648	143,082	146,655	151,915	157,335
EU(27) Bio-diesel	6,875	9,200	8,050	9,190	10,325	11,453	12,576	13,692	14,803	15,906	17,004	18,094	19,178	20,254
Brazil Bio-diesel	402	1,089	1,603	1,635	1,667	1,699	1,733	1,767	1,801	1,836	1,872	1,909	1,946	1,985
Argentina Bio-diesel	459	400	525	537	549	562	576	592	611	631	654	680	695	711
Canada Bio-diesel	87	100	1,724	2,582	3,440	4,298	4,540	4,787	5,039	5,297	5,561	5,831	6,107	6,389
United States Bio-diesel	1,325	1,383	2,247	2,268	2,290	2,311	2,331	2,352	2,372	2,393	2,413	2,433	2,456	2,480
Malaysia Bio-diesel	100	267	280	294	308	323	339	355	372	390	409	429	450	472
Indonesia Bio-diesel	148	220	250	254	258	262	267	271	276	280	285	290	294	299
China Bio-diesel	216	296	296	323	352	384	419	456	475	494	513	533	556	580
ROW Bio-diesel	1,401	1,813	3,111	3,561	4,091	4,683	5,252	5,860	6,406	6,889	7,409	7,964	8,614	9,419
World Bio-diesel	11,013	14,767	18,087	20,643	23,278	25,974	28,032	30,132	32,154	34,117	36,121	38,163	40,297	42,589
Biofuel Net Trade (million liters)														
United States Ethanol	-2,249	-3,605	-3,896	-4,255	-4,280	-4,891	-4,725	-4,818	-4,930	-4,971	-5,121	-6,461	-6,633	-6,888
Brazil Ethanol	3,565	4,393	9,662	9,645	9,904	10,310	10,796	11,326	11,877	12,438	13,162	13,869	14,552	15,036
Canada Ethanol	-495	-504	-253	-408	-554	-706	-672	-635	-600	-566	-519	-470	-417	-357
China Ethanol	223	177	432	701	987	1,251	1,504	1,784	2,065	2,356	2,712	3,085	3,522	4,005
Japan Ethanol	-521	-620	-967	-977	-988	-999	-1,010	-1,022	-1,033	-1,045	-1,057	-1,069	-1,081	-1,094
Thailand Ethanol	54	-79	72	84	98	114	133	155	181	210	244	283	328	380
E27 Ethanol	-1,124	-1,677	-2,393	-1,651	-1,877	-2,018	-2,208	-2,290	-2,478	-2,655	-2,883	-3,113	-3,330	-3,550
ROW Ethanol	47	1,416	-3,156	-2,838	-3,290	-4,560	-4,817	-5,249	-5,081	-5,768	-6,538	-6,124	-6,941	-7,532
Brazil Bio-diesel	0	0	600	747	905	1,074	1,254	1,446	1,649	1,862	2,084	2,315	2,591	2,884
Malaysia Bio-diesel	112	268	627	737	864	1,008	1,109	1,218	1,338	1,468	1,611	1,766	1,937	2,124
Indonesia Bio-diesel	140	136	322	388	492	611	664	717	769	819	867	908	972	1,036
EU(27) Bio-diesel	-852	-1,136	-775	-768	-762	-755	-749	-743	-737	-731	-725	-719	-713	-706
Canada Bio-diesel	0	0	-272	-358	-444	-530	-554	-579	-604	-630	-656	-683	-711	-739
USA Bio-diesel	1,080	1,326	884	1,084	1,298	1,529	1,776	2,041	2,223	2,324	2,444	2,584	2,742	3,023
ROW Bio-diesel	-480	-594	-1386	-1829	-2353	-2938	-3500	-4100	-4638	-5113	-5625	-6171	-6818	-7621

Source: Agra CEAS Consulting world biofuel econometric model

Biofuel forecasts 2009-2020 – lower oil price scenario (US$ 40/barrel crude oil)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oil Prices (US$ Barrel)														
World Oil (Brent)	**72.5**	**99.3**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**
Feedstock Prices (US$ Tonne)														
US Maize No. 2	159	218	177	163	157	161	163	161	162	161	154	151	149	147
US Wheat No.2 Soft	204	340	250	199	196	196	197	190	189	187	182	180	178	177
Brazil Sugar Cane	14.6	13.7	13.5	13.0	12.4	11.9	11.5	11.0	10.7	10.3	10.0	9.7	9.5	9.3
Rape oil Dutch fob	969	1460	840	838	835	833	831	829	827	825	823	821	818	816
Soybean oil Dutch Fob	881	1409	1119	1116	1113	1110	1107	1104	1101	1098	1096	1093	1090	1087
Palm oil crude cif N.W.	778	1099	690	688	686	684	682	681	679	677	676	674	672	670
Biofuel Prices (US$ Barrel)														
US Ethanol	84.2	102.6	77.3	74.2	73.4	75.5	77.1	77.1	78.1	78.7	77.5	78.0	77.9	77.8
Brazil Ethanol	41.1	47.9	44.6	41.2	38.1	37.1	35.7	34.4	33.5	32.5	31.7	31.1	30.4	29.7
EU(27) Bio-diesel	102.6	144.9	111.8	111.0	110.1	109.3	108.5	107.7	107.0	106.2	105.5	104.8	104.0	103.2
Bio-fuel NET Costs (US$ Liter)														
US Ethanol	0.39	0.48	0.36	0.34	0.34	0.35	0.36	0.36	0.36	0.37	0.36	0.36	0.36	0.36
Brazil Ethanol	0.24	0.23	0.23	0.22	0.22	0.22	0.23	0.23	0.23	0.22	0.23	0.24	0.24	0.25
EU(27) Bio-diesel	0.70	0.99	0.63	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.57	0.57
EU(27) Ethanol	0.67	0.90	0.71	0.62	0.63	0.62	0.63	0.62	0.62	0.62	0.62	0.63	0.63	0.63
Biofuel Production (million liters)														
United States Ethanol	28,714	34,463	40,598	43,923	46,740	47,159	49,636	52,875	54,340	54,635	55,940	54,741	55,146	55,189
Brazil Ethanol	17,932	22,239	22,101	23,570	25,108	26,695	28,596	30,641	32,599	34,765	36,782	38,862	41,284	43,854
Canada Ethanol	839	1,083	1,117	1,123	1,138	1,147	1,152	1,161	1,169	1,178	1,198	1,220	1,248	1,281
Japan Ethanol	110	110	110	110	110	110	110	110	110	110	110	110	110	110
China Ethanol	3,679	3,964	3,975	4,062	4,178	4,267	4,336	4,418	4,490	4,562	4,671	4,781	4,907	5,051
India Ethanol	2,007	1,725	1,942	2,198	2,502	2,832	3,194	3,590	4,010	4,454	4,912	5,374	5,868	6,397
E27 Ethanol	3,887	5,021	4,611	5,311	5,331	5,422	5,479	5,610	5,673	5,745	5,781	5,822	5,884	5,946
Russia Ethanol	750	932	924	909	895	928	952	977	1,014	1,049	1,090	1,137	1,184	1,234
Thailand Ethanol	423	615	662	717	782	849	920	996	1,073	1,152	1,231	1,307	1,386	1,466
South Africa Ethanol	16	16	19	23	28	33	39	47	55	64	75	87	101	118
ROW Ethanol	2,748	2,886	3,073	3,058	3,071	3,082	3,099	3,121	3,142	3,164	3,186	3,204	3,224	3,245
World Ethanol	61,104	73,055	79,130	85,003	89,883	92,522	97,512	103,543	107,673	110,878	114,975	116,645	120,342	123,891
EU(27) Bio-diesel	6,492	8,064	10,365	11,587	12,806	14,021	15,231	16,438	17,640	18,837	20,030	21,219	22,403	23,583
Brazil Bio-diesel	402	1,089	2,057	2,218	2,388	2,567	2,756	2,953	3,158	3,370	3,587	3,808	4,072	4,347
Argentina Bio-diesel	459	1,364	1,521	1,686	1,856	2,028	2,195	2,354	2,496	2,614	2,701	2,749	2,774	2,777
Canada Bio-diesel	87	100	1,299	1,905	2,512	3,118	3,232	3,349	3,471	3,598	3,729	3,865	4,005	4,151
United States Bio-diesel	2,405	2,709	2,884	3,068	3,259	3,460	3,668	3,885	4,110	4,343	4,584	4,834	5,092	5,360
Malaysia Bio-diesel	211	536	802	871	947	1,028	1,117	1,213	1,318	1,432	1,555	1,689	1,835	1,994
Indonesia Bio-diesel	288	356	503	539	576	614	653	691	729	765	798	827	871	914
China Bio-diesel	216	296	296	297	298	299	300	300	301	302	303	304	305	306
ROW Bio-diesel	921	1,218	1,502	1,508	1,515	1,523	1,531	1,539	1,547	1,556	1,566	1,575	1,578	1,581
World Bio-diesel	11,482	15,731	21,230	23,681	26,158	28,658	30,682	32,722	34,771	36,818	38,854	40,868	42,935	45,013
Biofuel Consumption (million liters)														
United States Ethanol	30,963	36,069	39,773	45,455	47,727	50,000	52,273	54,545	56,818	56,818	56,818	56,818	56,818	56,818
Brazil Ethanol	14,367	17,846	18,486	19,998	21,625	22,784	24,136	25,561	26,922	28,396	29,162	29,907	30,826	31,726
Canada Ethanol	1,334	1,587	1,440	1,660	1,879	2,099	2,127	2,156	2,185	2,214	2,244	2,274	2,304	2,335
Japan Ethanol	631	1,066	1,077	1,087	1,098	1,109	1,120	1,132	1,143	1,155	1,167	1,179	1,191	1,204
China Ethanol	3,456	3,787	3,663	3,570	3,863	3,969	4,121	4,277	4,391	4,520	4,632	4,733	4,839	4,945
India Ethanol	2,007	1,991	1,942	2,198	2,502	2,832	3,194	3,590	4,010	4,454	4,912	5,374	5,868	6,397
E27 Ethanol	5,011	6,698	6,035	6,185	6,340	6,499	6,661	6,828	6,998	7,173	7,352	7,536	7,725	7,918
Russia Ethanol	750	932	924	909	895	928	952	977	1,014	1,049	1,090	1,137	1,184	1,234
Thailand Ethanol	369	694	595	645	703	764	828	896	966	1,037	1,108	1,176	1,247	1,320
South Africa Ethanol	16	16	19	23	28	33	39	47	55	64	75	87	101	118
ROW Ethanol	2,201	2,970	2,398	2,946	1,844	1,080	1,587	2,015	2,605	3,386	4,558	5,725	7,494	9,090
World Ethanol	61,104	73,657	76,351	84,675	88,506	92,097	97,040	102,023	107,106	110,265	113,118	115,945	119,598	123,105
EU(27) Bio-diesel	6,875	9,200	11,085	12,301	13,513	14,721	15,925	17,126	18,322	19,513	20,701	21,884	23,062	24,236
Brazil Bio-diesel	402	1,089	1,457	1,486	1,515	1,545	1,575	1,606	1,637	1,669	1,702	1,736	1,770	1,804
Argentina Bio-diesel	459	400	474	477	482	496	511	526	545	566	589	615	629	644
Canada Bio-diesel	87	100	1,624	2,382	3,140	3,898	4,040	4,187	4,339	4,497	4,661	4,831	5,007	5,189
United States Bio-diesel	1,325	1,383	2,101	2,120	2,140	2,159	2,177	2,196	2,215	2,233	2,251	2,269	2,290	2,312
Malaysia Bio-diesel	100	267	277	288	299	310	322	334	347	360	374	388	403	419
Indonesia Bio-diesel	148	220	239	242	245	248	251	254	257	260	263	267	270	273
China Bio-diesel	216	296	296	297	298	299	300	300	301	302	303	304	305	306
ROW Bio-diesel	1,401	1,813	2,548	2,796	3,069	3,366	3,811	4,279	4,768	5,277	5,805	6,349	6,960	7,602
World Bio-diesel	11,013	14,767	20,102	22,390	24,700	27,042	28,911	30,808	32,731	34,679	36,650	38,642	40,696	42,784
Biofuel Net Trade (million liters)														
United States Ethanol	-2,249	-1,605	-1,675	-1,532	-1,987	-2,841	-2,637	-2,671	-2,479	-2,183	-2,079	-2,077	-1,672	-1,629
Brazil Ethanol	3,565	4,393	3,614	3,572	3,483	3,910	4,460	5,080	5,676	6,369	7,620	8,956	10,458	12,128
Canada Ethanol	-495	-504	-323	-536	-741	-952	-976	-995	-1,016	-1,036	-1,046	-1,053	-1,056	-1,054
China Ethanol	223	177	312	492	315	298	215	140	99	42	39	49	69	105
Japan Ethanol	-521	-620	-967	-977	-988	-999	-1,010	-1,022	-1,033	-1,045	-1,057	-1,069	-1,081	-1,094
Thailand Ethanol	54	-79	66	72	78	85	92	100	107	115	123	131	139	147
E27 Ethanol	-1,124	-1,677	-1,423	-875	-1,009	-1,077	-1,182	-1,218	-1,325	-1,428	-1,571	-1,714	-1,841	-1,972
ROW Ethanol	547	-84	396	-215	849	1,577	1,038	586	-30	-834	-2,029	-3,222	-5,014	-6,631
Brazil Bio-diesel	0	0	600	732	873	1,023	1,181	1,347	1,521	1,700	1,885	2,073	2,302	2,543
Malaysia Bio-diesel	112	268	525	583	648	718	795	879	971	1,071	1,181	1,300	1,432	1,575
Indonesia Bio-diesel	140	136	264	297	331	367	402	438	472	505	535	560	601	641
EU(27) Bio-diesel	-852	-1,136	-720	-713	-707	-700	-694	-688	-682	-676	-671	-665	-659	-652
Canada Bio-diesel	0	0	-325	-476	-628	-780	-808	-837	-868	-899	-932	-966	-1,001	-1,038
USA Bio-diesel	1,080	1,326	742	918	1,105	1,304	1,513	1,735	1,877	1,938	2,012	2,098	2,195	2,398
ROW Bio-diesel	-480	-594	-1046	-1288	-1554	-1843	-2280	-2740	-3220	-3721	-4240	-4773	-5382	-6021

Source: Agra CEAS Consulting world biofuel econometric model

Appendix 4: Bio-ethanol production capacities

Bio-ethanol plants (operational)

Ownership	Location	EtOH capacity (mln litres)	Processing capacity (tons)	Feedstock
Austria				
Agrana	Lower Austria	240	380,000 t wheat, 90,000 t maize, 48,000 t sugar beet juice	Wheat, sugar beet, maize
Belgium				
Syral (Tereos)	Aalst	32	80,000	Wheat
Alcogroup SA n/a Alcofinance (B), EDF (F)	Ghent	150	n/a	Wheat
Bio Wanze SA – Tirelemontoise (D), CropEnergies (D)	Wanze (Liège)	300	1,000,000	Wheat, sugar beet
Bulgaria				
Euro Ethyl, Alfastar	Silistra	40	27,000 – 30,000	Maize, wheat
Zahraini Zavodi	Gornia Oriashovitca	18	n/a	Grains, molasses
Czech Rep.				
Cukrovari TDD AS/ Agroetanol TDD	Mlada Boleslav, Central Bohemia	100	600,000	Sugar beet
Moravsky lihovar	Kojetin	20	n/a	n/a
Bioferm	Mlada Boleslav, Central Bohemia	20	n/a	n/a
Slovliker	Kunovice	5	n/a	n/a
Ethanol Energy	Vrdy	70	n/a	n/a
PLP	Northern Bohemia	100	280000	Grain
Denmark.				
Svensk Etanolkemi AB (SEKAB)	Örnsköldsvik	120	n/a	Dehydration/Pulp
France				
Cristanol	Aube	150	1,000,000	Sugar beet
Cristanol	Marne	0	500,000	Sugar beet
Deulep S.A.(Cristanol)	Gard	40		Dehydration
St. Louis Sucre (SLS), Ryssen	Somme	90	600,000	Sugar beet
Tereos	Loiret	40	n/a	Dehydration / Sugar beet
Tereos, BCE	Seinen/aetn/aMarne	15	75,000	Wheat
Tereos, DRC	Marne	40	400,000	Sugar beet
Tereos	Pasn/aden/aCalais	80	800,000	Sugar beet
Tereos, SDHF (BENP)	Aisne	300	n/a	Sugar beet, wheat
Tereos	Aisne	40	n/a	
CropEnergies (exn/aRyssen)	Nord	100	n/a	Dehydration / Sugar beet
Cristal Union (Cristanol (55%), Blétanol)	Marne	150	1,500,000	Sugar beet, syrup, wheat
Abengoa Bioenergy France (ABF)	Pyrénées Atlantiques	250	40,000/ 500,000	Wine alcohol (50 Dehydration / maize
BENP (Tereos, Episn/acentre, Agralys, Oceal, Senalia)	Seinen/aMaritime	250	840,000	Wheat
Bourdon	Puyn/aden/aDôme	1.2	n/a	n/a
Sedalcool	Mesnil St. Nicaise	9	n/a	n/a
SVI	St. Emilie	15	n/a	n/a
SVI	Toury	15	n/a	n/a
Vallée du Loing	Souppes	4	n/a	n/a
Roquette	Bas Rhin	150	n/a	Wheat
Finland				
St1	Lappeenranta	1.5	n/a	Bakery waste
St1	Närpiö	1.4	n/a	Bakery waste
St 1	Hamina	45	n/a	Dehydration
Germany				
KWST	Niedersachsen	40	n/a	Molasses
Sasol	North Rhine Westphalia	76	n/a	Raw alcohol
Mitteldeutsche Bioenergie (MBE)/Verbio AG	Saxonyn/aAnhalt	125	250,000	Rye, wheat, triticale
Nordbrandenburger Bioenergie (NBE), Verbio AG	Brandenburg	225	600,000	Rye
CropEnergies (Südzucker)	Saxonyn/aAnhalt	360	700,000	Wheat, sugar beet
Fuel 21 GmbH (Nordzucker AG)	Sachsenn/aAnhalt	130	1,300,000	Sugar beets
Danisco A/S (DK)	Mecklenburgn/a Western Pomerania	52	450,000	Sugar beet juice
Prokon Nord, Norsk Hydro	Lower Saxony	120	270,000	Grain
Müllermilch	Saxonyn/aAnhalt	10	400 mln litres	Cheese whey
Wabio Bioenergietechnik (Private investors 49%), Re.fuel AG (46%), Stadtwerke Leipzig (5%))	Thuringia	8 Nonn/afuel	24,000	Grain
Hungary				
Hungrana (Agrana, Tate&Lyle/ADM)	Féjer	170	160,000	Maize
Györ Distillery	Györ	50	160,000	Molasses

Italy				
Alcoplus	Faenza, Ferrara	70	n/a	Molasses?
IMA, Bertolino	Trapani	200	n/a	Dehydration
Silcompa	n/a	60	n/a	
Latvia				
Jaunpagastsn/aPlus	Riga	12	37,500	Grains
Lithuania				
Biofuture	Silute	45	60.000n/a75.000	Rye, triticale, wheat
The Netherlands				
Royal Nedalco	Sas van Gent	14	39,000	Starch
Poland				
Akwawit SA	Leszno	170	300,000	Crude alcohol distilled from grain, mainly rye
Cargill	Wroclaw	30	48,000	Wheat
Slovakia				
Enviral	Leopoldov	120	300,000	Maize
Spain				
Bioetanol Galicia (Abengoa Bioenergia, Xes Galicia)	Galicia	195	375,000	Wheat, Barley (126 mln litres);Wine alcohol (50 mln litres)
Ecocarburantes Espanoles (Abengoa Bioenergia, IDAE)	Murcia	150	300,000	Wheat and Barley (300,000 tons); Wine alcohol
Biocarburantes de Castilla y Leon (Abengoa Bioenergia, Dosbio 2010 (Ebro Puelva))	Salamanca	200	581,000	Wheat, Barley (175 mln litres);Wine alcohol (20 mln litres)
Bioetanol de la Mancha (Acciona, Uriel Inversiones)	Ciudad Real	33	n/a	Wine Alcohol
	Castilla y Leon		n/a	
Sweden				
Lantmännen Agroetanol AB	Nörrköping	200	n/a	Wheat
United Kingdom				
British Sugar plc	Downham (Suffolk)	70		Sugar beet juice
Switzerland				
Booregard Schweiz AG	Solothurn	11	n/a	Cellulose
Turkey				
Tarimsal Kimya Teknolojilero A.S. (Tarkim)	Marmara	40	100,000	Wheat and corn
Kazakhstan				
Biokhim (Titan, Basko)	Tainysha	72	220000	Wheat
Tadjikistan				
Fonn/aDarje	Dushanbe	25	n/a	Maize
Ukraine				
UkrSpyrt	Ternopil	60	n/a	n/a
UkrSpyrt	Zhytomyr	30	n/a	n/a
UkrSpyrt	Kyiv	20	n/a	n/a
UkrSpyrt	Sumy	20	n/a	n/a
UkrSpyrt	Kharkiv	20	n/a	n/a
UkrSpyrt	Poltava	20	n/a	n/a

Notes: n/a – unknown; n/a proposed project, no further details

Dehydration n/a Wine alcohol

Source: F.O. Licht

Bio-ethanol plants (under construction)

Ownership	Location	EtOH capacity (mln litres)	Processing capacity (tons)	Feedstock
Bulgaria				
Crystal Chemicals	Chaskowo	13	n/a	n/a
Spain				
Alcoholes Biocarburantes de Extremadura (Albiex)	Extremadura	110	n/a	Maize
Cech Rep.				
Korfil	Hustopece	100	n/a	Wheat
Denmark				
Genencor, Inbicon (DONG Energy), Statoil	Kalundborg near Copenhagen	5.4	30,000	Lignocellulose (straw)
France				
Cristal Union (Cristanol (55%), Blétanol)	Marne	200	500,000	wheat
Greece				
Konya Sugar Factory Inc.		80	800,000	Sugar beet
Lithuania				
UAB Bioetan LT	Telsiai	100	n/a	n/a
The Netherlands				
Abengoa	Rotterdam	480	1,250,000	n/a
Russia				
Titan, Alta (CZ)	Siberia	190	400,000	Grains
Slovakia				
Slovnafta (98% zu MOL (HU))	Bratislava	75	210,000	Wheat
Ukraine				
Koron Agro	Cherkassy	125	n/a	n/a
United Kingdom				
Ensus	Teesside	400		Wheat
Vivergo	Hull	420		Wheat

Notes: n/a – unknown; n/a proposed project, no further details

Dehydration n/a Wine alcohol

Source: F.O. Licht

Bio-ethanol plants (project)

Ownership	Location	EtOH capacity (mln litres)	Processing capacity (tons)	Feedstock
Belarus				
Belbiopharm, Greenfield Project Management Ltd. (IRE), PvT Capital Gmbh (D)	Gomel	550	n/a	n/a
Belbiopharm, Greenfield Project Management Ltd. (IRE), PvT Capital Gmbh (D)	Mogilev	100	n/a	n/a
Beldzyarzkharchpram	Zhabinka	75	n/a	n/a
Belgium				
4Biofuel SA (4Energy Invest SA)	Brussels	n/a	n/a	n/a
Bulgaria				
Zaharna Zavodi	Veliko Tarnovo	12	n/a	Wheat, maize
Slunchevi Luchi	Silistra	125	n/a	Wheat, maize
Alco Holding Group, Prophex	Sofia	13.5	30,000	Wheat, maize
Farin	Varna	25	n/a	Wheat, maize
Green Fuel Corp.	Pleven	75	n/a	n/a
Fikon, Energy Seeds	Targovishte	n/a	300,000	Wheat, maize
Ethanol Bio (Zahraini Zavodi (51%), Bultechinser vice (49%))	n/a	3	n/a	n/a
Verbio (D)	n/a	38	n/a	n/a
Bosnia				
Mashal Khazar Darya (MKD) (IR)	n/a	n/a	n/a	Maize
E&I Group	n/a	50	n/a	Maize, millet
Czech Rep.				
SWP Trading	Horni Sucha	40	n/a	n/a
Biopal	Central Bohemia	40	n/a	Wheat
Aliachem	Napajadela	40	n/a	n/a
ADW Bio	Okrisky	40	n/a	n/a
Cukrovari TDD AS/ Agroetanol TDD	East Bohemia		n/a	Sugar beet
Spice Energy Ltd. (IND), NewCo. A.S.	Skalice nad Svitavou	92	230000	Grains
Denmark				
Biogasol	n/a	n/a	n/a	n/a
Danish Biofuel Holding	Grenaa	n/a	n/a	n/a
Domsjö Fabriker	Örnsköldsvik	11	n/a	Cellulosic
Elsam, Fynsvaerket	Odense	127	n/a	
Härjedalens Miljöbränsle AB; National Bio Energy (China), Dragon Power (China).	Sveg	3.8	n/a	Cellulosic

Ownership	Location	EtOH capacity (mln litres)	Processing capacity (tons)	Feedstock
Belarus				
Belbiopharm, Greenfield Project Management Ltd. (IRE), PvT Capital Gmbh (D)	Gomel	550	n/a	n/a
Belbiopharm, Greenfield Project Management Ltd. (IRE), PvT Capital Gmbh (D)	Mogilev	100	n/a	n/a
Beldzyarzkharchpram	Zhabinka	75	n/a	n/a
Belgium				
4Biofuel SA (4Energy Invest SA)	Brussels	n/a	n/a	n/a
Bulgaria				
Zaharna Zavodi	Veliko Tarnovo	12	n/a	Wheat, maize
Slunchevi Luchi	Silistra	125	n/a	Wheat, maize
Alco Holding Group, Prophex	Sofia	13.5	30,000	Wheat, maize
Farin	Varna	25	n/a	Wheat, maize
Green Fuel Corp.	Pleven	75	n/a	n/a
Fikon, Energy Seeds	Targovishte	n/a	300,000	Wheat, maize
Ethanol Bio (Zahraini Zavodi (51%), Bultechinser vice (49%))	n/a	3	n/a	n/a
Verbio (D)	n/a	38	n/a	n/a
Bosnia				
Mashal Khazar Darya (MKD) (IR)	n/a	n/a	n/a	Maize
E&I Group	n/a	50	n/a	Maize, millet
Czech Rep.				
SWP Trading	Horni Sucha	40	n/a	n/a
Biopal	Central Bohemia	40	n/a	Wheat
Aliachem	Napajadela	40	n/a	n/a
ADW Bio	Okrisky	40	n/a	n/a
Cukrovari TDD AS/ Agroetanol TDD	East Bohemia		n/a	Sugar beet
Spice Energy Ltd. (IND), NewCo. A.S.	Skalice nad Svitavou	92	230000	Grains
Denmark				
Karlskoga Biofuel	Karlskoga	120	n/a	n/a
Nordisk Ethanolproduktion AB	Karlshamn	130	n/a	Wheat
Sala Heby Energi	Sala	5	n/a	Cellulosic
Scandinavian Etanol	Blekinge / Halland	150	n/a	n/a
Statoil, DLG	Kalundborg	125	n/a	n/a
Umea and Skelleftea Biofuel Ind.	n/a	100	n/a	
Verbio AG (D)	Tondern	150	n/a	Wheat
n/a	Harnösand	105	n/a	n/a
Estonia				
n/a	Kunda	125	350000	Grains
Eesti Energia	Narva	110	300000	Rye
France				
Groupe Soufflet	Aube	190	560000	Wheat
Tereos	Normandie	n/a	n/a	n/a
Futurol (Total, Tereos et al)	Marne	0.18	n/a	Cellulose
Finland				
St1	Lahti	1.5	n/a	Bakery waste
Lännen Tehtaat	Säkyla	83.5	250,000	Barley
Altia	Koksenkorva	76	400,000	Barley
Germany				
Getreide AG	Saxonyn/aAnhalt	100	n/a	Cereals
Getreide AG	Saxonyn/aAnhalt	100	n/a	Cereals
Getreide AG	Mecklenburgn/a Western Pomerania	100	n/a	Cereals
Getreide AG	Schleswign/aHolstein	100	n/a	Cereals
NAWARO Chemie GmbH	Mecklenburgn/a Western Pomerania	100	350,000	Rye
Abengoa (E)	Mecklenburgn/aWestern Pomerania	500	1,100,000	Grains
Ecopower Biofuel GmbH	Saxonyn/aAnhalt	200	570,000	Rye
Georg Tuma, BKB AG	Brandenburg	190	500,000	Rye
Georg Tuma	Brandenburg	n/a	n/a	
Verbio	Mecklenburgn/a Western Pomerania	158	680,000	Grain
Agravis Raiffeisen AG	Lower Saxony	180	450,000	Rye and other grains
Theodor Heuss Investitions und Beteiligungs GmbH & Co. KG	Saxony/Anhalt	43	n/a	n/a
Bio/Raffinerie Kusey GmbH	Saxony/Anhalt	3	n/a	n/a
Cargill	Saxony Anhalt	100	n/a	Wheat
Bioneos GmbH & Co. KG	Bavaria	25	120,000	Grains, later biomass
Standard Ethanol	Lower Saxony	100	n/a	n/a
Bioneos	Saxony	40	n/a	Grains, sugar beets, potatoes

Bioneos	Bavaria	30	n/a	Grains, sugar beets, potatoes
Bio Ethanol Nordwest GmbH	Lower Saxony	Nonn/afuel	n/a	Grain
Agro Bördegrün	Saxonyn/aAnhalt	130	360000	Grain
BioMa Engerie AG (A), InfraServ GmbH&Co. Gendorf KG	Bavaria	94.8	420,000	Wheat, maize
Agravis, Epuron (Conergy AG), MAN Ferrostaal	Saxonyn/aAnhalt	200	600,000	Grains
Bioethanol Emsland, ex BEP GmbH (Air System Barlage GmbH u.a.)	Lower Saxony	90	300,000	Wheat
Bio Ethanol Arneburg GmbH& Co. KG	Saxonyn/aAnhalt	225	575,000	Maize (mainly), wheat
Greece				
Hellenic Sugar, EBZ	Thrace	150	38,000 t molasses, 300,000 t sugar beet, 37,000 t cereals	Molasses, sugar beet, cereals
Kontect Energy (A)	Evros	n/a	n/a	n/a
Hellenic Sugar, EBZ	Central Greece	200	n/a	n/a
Hungary				
First Hungarian Bioethanol Kft (Elsö Magyar Bioetanol Termelö Kft, Eastern Sugar)	Hajdun/aBihar	85	300,000	Maize
CSLM (US)/Bio Tech Energie	Somogy	126	500,000	Maize
United Biofuel Holdings Europe AG/ Duna Fejlesztesi Holding Rt.	Baranya	100	300,000	Maize
United Biofuel Holdings Europe AG/ Duna Fejlesztesi Holding Rt.	Somogy	100	300,000	Maize
United Biofuel Holdings Europe AG	Békés	125	300,000	Maize
Svensk Etanolkemi AB (Sekab), BKZ Developments Beruhazasfejleszt Rt., EBP Europai Bioenergia Zrt	Gonyu/Györ, Marcali, Mohacs, Kaba	600	1,500,000	Maize
Svensk Etanolkemi AB (Sekab)	Southeast Hungary	150	300,000	
Rodeport Kft (Sirabel (CH) et al	Tolna	n/a	300,000	Maize
Bio Tech Energie, CSLM (US)	Hajdun/aBihar	430	1,000,000	Maize
Amidonn Kft (Catelli Holding (I))	Borsodn/aAbaujn/aZemplen	n/a	n/a	n/a
US investor	Komáromn/a Esztergim	405	1,000,000	Maize
Magyar Bioenergetikai Zrt (Mabio)	Békés	125	350,000	Maize
Magyar Bioenergetikai Zrt (Mabio)	Bácsn/aKiskun	125	350,000	Maize
Bio MA Magyarorszag	n.a.	n/a	n/a	n/a
Bács Bio Etabol Kft	Bácsn/aKiskun	83	n/a	Maize
Global Green One AS (NOR)	Békés	60	200,000	Maize
Global Green One AS (NOR)	Vas	n/a	n/a	Maize
Global Green One AS (NOR)	Bácsn/aK iskun	n/a	n/a	Maize
Global Green One AS (NOR)	Vas	n/a	n/a	Maize
Duna Development Ltd. (Regional Development Holding Corp. (44.45%), Silbergie AG (44.45%) (CH), Hungarian Investment and Trade Development Agency (ITDH) (1.92%, Tibor Ersek (9.1%)	Békés	100	280,000	Maize
Italy				
Italia Zuccheri	Lombardy	215	n/a	Maize, sorghum
Italia Zuccheri	Veneto	215	n/a	Maize, sorghum
Alcoplus	North Italy	500	n/a	
IMA, Bertolino	Palermo	200	n/a	Sweet sorghum?
Grandi Molini Italiani, Triera	Venice	130	350,000	Maize
Mossi&Ghisolfi (M&G)	Piedmont	250	n/a	Maize, cellulosic
Ormoz Sugar Factory	Ormoz	55	55,000 t wheat, 77,000 t maize	Maize, wheat
Kazakhstan				
KazAgro	North Kazakhstan	33	100 000	Grains
JSC Food Corporation	n/a	125	n/a	n/a
JSC Food Corporation	n/a	125	n/a	n/a
Lithuania				
UAB Nordetanolis	Kedainiai	140	317000	Grains
UAB Pasvalio Agrochemija		23	n/a	n/a
Alfabioetanolis 101	Mestilla	130	368000	Grains
Moldovia				
Seminte Nord	Drochia	40	n/a	Wheat, maize
The Netherlands				
Harvest Biofuel, Blue Ocean Associates	Amsterdam	110	375,000	Grain
TMO Renewables (UK), Bioethanol Rotterdam (BER)	Rotterdam	140	n/a	Wheat / Cellulose
N2 Energie	Overijssel	33.5	n/a	n/a
Poland				
Biopaliwa (Polskie Mlyny), Sekab (SW)	Nysa	140	350,000	Wheat
SNIACE (E), local partner	Kostrzyn	250	n/a	n/a
Krajowa Spolka Cukrowa (KSC)	Wozuczyn, Mala Wies, Czestocice, Tuczno, Ostrowy	n/a	n/a	n/a
PKM DUDA	Southwest Poland	125	n/a	n/a
Unicorn Chemical LLC (US)	Brzeg Dolny, Wroclaw	45	n/a	Grain
J&S Energy	Stobno	190	n/a	n/a
J&S Energy	Skarbimierz	190	n/a	n/a
Portugal				
Formentinveste, EDIA, Copam	n/a	125	n/a	n/a
Romania				

Amochim	n/a	18		Maize
Inter Agro	Southern Romania	100	300,000	Maize
TCE Trei Brazi	n/a	60	190,000	Maize
New Energy (Belgian/US consortium), EuroMediu Co. (HU)	n/a	110	340,000	Maize
Magyar Bioenergetikai Zrt (Mabio)	n/a	n/a	n/a	n/a
US / Romanian investors	Western Romania	n/a	n/a	n/a
Russia				
VolgaEthanol (Vipoil)	Volgograd	200	900,000	Feed wheat
Yugtranzitservis	Rostov	320	800,000	n/a
Bashneft Yug	Rostov	200	500,000	n/a
440	Tatarstan	n/a	n/a	n/a
Agrotop (ISR)	Penza	n/a	n/a	n/a
Vinagradov	Lipezk	65	200,000	Wheat, maize
Extrasib		19	n/a	n/a
Titan	Adygea	n/a	n/a	n/a
CJSC Biotechnology, Russian Holding Co.	Tambov	315	212,000 (Molasses), 710,000 (Grains)	Grains, molasses
Pava	Siberia	250	n/a	Wheat
n/a	Novosibirsk	190	n/a	n/a
BioEthanol, Vnesheconombank (VEB)	Tambov	300	n/a	n/a
RusAgro	Lipetsk	90	n/a	Grains
BioEnergia	Stavropol	250	760,000	Grains
BioEnergia	Stavropol	250	760,000	Grains
Serbia				
CSLM (US), Commerzbank (D), eight Hungarian companies	n/a	430	1,500,000	Wheat (1 mln t), maize (500,000 t)
Alltech	Vojvodina	n/a	n/a	n/a
Slovakia				
BGV	Stara Lubovna	50	n/a	n/a
IRAF	Prietrz	5	n/a	n/a
Biopark	Caka	125	n/a	n/a
	Liehovar	125	n/a	n/a
Spain				
SNIACE, Cantabria Capital	Cantabria	125	150,000	Grains
Ecobarcial (Iberdrola, SNIACE et al)	Zamora	150	400,000	Wheat, barley, maize
Dosbio 2010 (Ebro Puelva)	Castilla y Leon	65	650,000n/a1,000,000	Sugar beet
Bio Europa 2 (Biocarburantes Europa)	Ciudad Real	85	250,000n/a300,000	Grains
Citrotecno	Valencia	6.3	n/a	n/a
Ukraine				
Kreativ	Kirovohrad	315	n/a	n/a
Delta T (US)	Kherson	125	n/a	n/a
Agroinvest	n/a	170	500,000	Maize
Ukrspyrt	Chechelnyk	n/a	n/a	n/a
Astarta	Poltava	60	n/a	n/a

Notes: n/a – unknown; n/a proposed project, no further details

Dehydration n/a Wine alcohol

Source: F.O. Licht

APPENDIX J
Action Plan

PANNONIA ETHANOL ZRT. SOCIAL AND ENVIRONMENTAL ACTION PLAN			
CONSTRUCTION			
	ACTION	DELIVERABLE	DEADLINE/NOTES
1	Hire HSE Manager	Employment Contract w/ 3 month probationary period Final Hire	September 30, 2010 December 31, 2010
2	Grievance Mechanism	Develop a written system to deal with external queries, concerns and grievances that is used and well understood locally (and is made available locally). Must be reviewed and approved by Mayor of Dunaföldvár or her designee.	July 2010
3	Final Issuance of all Required Permits	Permits	Ongoing
4	Spot Audits of Construction Work	Written reports by the HSE Manager (or by Ethanol Europe CTO/COO until the HSE Manager is hired) confirming compliance by Fagen and other contractors with all (i) Hungarian laws and standards, (ii) all contractual EHS requirements, (iii) all requirements of Project insurers, and (iv) all substantive concerns reflected in the IFC Standards. In the event of any material negative information, recommendation on actions to the Ethanol Europe CTO/COO.	Once per month starting July 2010
5	Archaeological Oversight	Must ensure that archaeologist is on site for any excavation works.	As applicable
6	Operating Procedures	Approximately 20 volume set of facility operating procedures prepared by Fagen in Hungarian and English representing best ethanol practices. In the aggregate, these should be an entire EMS system. Note that Fagen has a similar system for construction that it will use for the Site during construction.	June 2011
7	Fagen Trainings	Approximately 3-4 month Fagen training course in the	July-September 2011

		United States for approximately one dozen Pannonia employees (see Appendix D), including training on computers, laboratory procedures, field operating procedures, and overall plant section performance expectations.	
8	Special Trainings	Special trainings for any Project staff performing sensitive tasks not covered by the Fagen trainings. Only issue identified to date involves Project staff who will drive trucks from Project to the local train station for rail ethanol deliveries. Road safety training will need to be provided to relevant staff.	Action point to be revised/detailed in January 2011
9	Community Consultations	Written reports by the HSE Manager (or by Ethanol Europe CTO/COO until the HSE Manager is hired) based on qualitative review of community relations (including, as deemed appropriate, meetings with city/county officials, meetings with NGOs, reviews of critical media reports, etc.). The HSE Manager will ensure that this Action Plan is available in Hungarian for public comment and will solicit community feedback on its contents, in particular from the mayor and from local fire and police authorities. In the event of any material negative information, recommendation on actions to the Ethanol Europe CTO/COO.	Once per month starting July 2010 Translation of Action Plan to be placed in public information center and provided to Dunaföldvár authorities by May 31, 2010.
10	Landscaping Plan	Final decisions on and actual landscaping of Site in a manner that is aesthetically pleasing and, through use of native vegetation, increases biodiversity value of the Site above the Baseline value. To be managed by the Ethanol Europe CTO, together with the Pannonia Operations Director.	Plan to be finalized by June 2011 Landscaping to be finalized by April 2012
11	Seveso Preparedness Plans	Emergency preparedness and response plans that will be developed and approved within the framework of the continuing Seveso process.	Ongoing
11	Public Information	Continue to maintain the public information center in the local public library; continue to maintain the Project web	Ongoing

		site.	
12	"Clean-up" ESA	Phase I Environmental Site Assessment of Project land not covered by previous assessments.	July 15, 2010
OPERATIONS			
	ACTION	DELIVERABLE	DEADLINE/NOTES
1	Reassess SEMP	Revised SEMP/Report to Management	March 15 of every year starting in 2011
2	Grievance Mechanism	Develop a written system to deal with external queries, concerns and grievances that is used and well understood locally (and is made available locally). Must be reviewed and approved by Mayor of Dunaföldvár.	October 2011
3	Air and Water Emissions Monitoring	Monitoring of compliance with permit conditions and Cargill agreement (for quality of wastewater discharge)	Quarterly beginning December 31, 2011. To be expanded when exact permit conditions are know and understood
4	GHG Quantitative Monitoring	Revised Ecofys GHG Report (including on indirect land use regulations and including if Pannonia elects to participate in a voluntary certification scheme under the Renewable Energy Directive)	March 15 of every year starting in 2011
5	GHG Qualitative Programs	Capital projects and operational improvements to reduce Project direct and indirect GHG emissions, as advised from time to time to the management	Ongoing
6	Associated Facilities Audit	Written reports by the HSE Manager confirming compliance by Cargill, any applicable jetty site (in respect of Project infrastructure), and the local train station (and Transpetrol) with all (i) Hungarian and EU laws and standards, (ii) all contractual EHS requirements, (iii) all requirements of Project insurers, and (iv) all substantive concerns reflected in the IFC Standards. In the event of any material negative information, recommendation on actions to the Ethanol Europe COO and CTO.	Twice per year starting in 2012

7	Water Transportation Audit	Written reports by the HSE Manager confirming compliance by third party vessel operators with all (i) Hungarian and EU laws and standards, (ii) all contractual EHS requirements, (iii) all requirements of Project insurers, and (iv) all substantive concerns reflected in the IFC Standards. In the event of any material negative information, recommendation on actions to the Ethanol Europe CTO/COO. To be performed in conjunction with Pole Shipping S.A., the Project's logistics consultant.	Twice per year starting in 2012
8	Surface Transportation Audit	Written reports by the HSE Manager confirming compliance by third party vessel operators with all (i) Hungarian and EU laws and standards, (ii) all contractual EHS requirements, (iii) all requirements of Project insurers, and (iv) all substantive concerns reflected in the IFC Standards. In the event of any material negative information, recommendation on actions to the Ethanol Europe CTO/COO. To be performed in conjunction with Pole Shipping S.A., the Project's logistics consultant and Transpetrol.	Twice per year starting in 2012
9	Truck Safety Program	Written policy prepared by the HSE Manager and approved by management to ensure that any Pannonia employees acting as truck drivers and/or any Pannonia-owned trucks are operated safely and responsibly. Will include driver education, testing and monitoring standards, use of GPS locaters in trucks, Hungarian laws concerning road safety and licensing, and insurance procedures, at a minimum.	As needed
10	Internal Grievance Procedure	Develop a written system to deal with internal queries, concerns and grievances by employees. To be administered by the Human Resources Manager.	October 2011
11	New Employee Information	Develop a written set of materials to be provided to all new employees setting forth their rights and pertinent SEMP information. To be prepared by the HSE Manager and administered by the Human Resources Manager.	October 2011 and updated annually

12	New Employee Training	Develop a 6 hour training program for all new employees to cover (i) Project operations (to be led by the Operations Director and based on Operating Procedures), (ii) reporting and employee rights (to be led by the Human Resources Manager), (iii) environmental health and safety (to be led by the HSE Manager), and (iv) Ethanol Europe social and environmental values and goals (to be led by the CEO). To be prepared by the HSE Manager in consultation with management.	October 2011 and updated annually
13	Additional Training	Trainings to be prepared and conducted by the HSE Manager in the event that any deficiency is discovered in the SEMP or if there is at any time a lost time accident at the Site for any reason.	As needed
14	Firearms Training/Plan	Develop a written and field training program in case security guards are provided with firearms. This training should be consistent with International Association of Oil & Gas Producers 2010 (and any update thereto).	In the event that there is a decision to arm security guards.
15	Community Consultations	Written reports by the HSE Manager based on qualitative review of community relations (including, as deemed appropriate, meetings with city/county officials, meetings with NGOs, reviews of critical media reports, etc.). The HSE Manager will ensure that this Action Plan is available in Hungarian for public comment and will solicit community feedback on its contents, in particular from the mayor and from local fire and police authorities. In the event of any material negative information, recommendation on actions to the Ethanol Europe CTO/COO.	Quarterly
16	Community Report	Written report by the HSE Manager to the community of Dunaföldvár, signed by the Pannonia CEO, outlining (i) Project performance and successes, (ii) grievances, and (iii) other issues of community importance. Provisionally anticipated to be published in the local paper.	Annually beginning December 20, 2011

17	Public Information	Continue to maintain the public information center in the local public library; continue to maintain the Project web site.	Ongoing
18	Waste Report	Declaration to applicable governmental authority of wastes produced by the Project in the preceding year.	Annually, with clarification of details of receiving agency and deadlines to be made prior to commercial operation
EXPANSION			
	ACTION	DELIVERABLE	DEADLINE/NOTES
1	Preparation of Expansion Social and Environmental Impact Assessments	Social and Environmental Impact Statement.	As soon as practicable after decision made to expand the Project
2	Preparation of Expansion Action Plan	Expansion Action Plan. The Expansion Action Plan will combine the current Construction Action Plan (with a much simpler scope of work) with the Operations Action Plan. It will require a new Social and Environmental Impact Assessment for the expansion.	As soon as practicable after decision made to expand the Project
DECOMMISSIONING			
	ACTION	DELIVERABLE	DEADLINE/NOTES
1	Decommissioning Due Diligence	the HSE Manager will stay abreast of any changes in law, in the IFC Standards or in the environmental attributes of the Project that may impact decommissioning, scope, responsibilities, costs and obligations and will inform management of the same on an ongoing basis. If these rise, in the aggregate, into a material burden, then as soon as that is the case, it will trigger preparation of the Decommissioning Action Plan.	Ongoing
2	Preparation of Decommissioning Action Plan	Decommissioning Action Plan	As soon as practicable after decision made to decommission the Project or as triggered above