Non-technical summary of the environment impact analysis on the Bee Power Gent biomass power plant at the Port of Ghent

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‘This is the non-technical summary of an environment impact analysis, i.e. a brief summary of the full environment impact analysis intended for the public and interested parties. An environment impact analysis is a public document that examines the environmental impact of a planning process or project and any alternatives to it. The environment impact analysis does not decide whether or not the project is approved. This decision is taken by the body responsible for granting approval, taking the environment impact analysis into account.

The aim of the non-technical summary is to communicate the relevant information from the environment impact analysis on the project or plan to the public and interested parties, thus promoting public participation in the approval process. You must consult the full environment impact analysis for comprehensive technical information.’

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Brief description of the project

Belgian Eco Energy intends to build a new power plant in the Ghent canal zone, with a thermal output of around 460-580 MWth and a corresponding electricity output of around 200-250 MWe. The gross yield of the plant will be ~ 43% and the net yield ~ 41%.

Two scenarios for the location of this new plant have been taken into consideration in the EIA: scenario 1, at the Ghent Coal Terminal (hereinafter referred to as GCT) site, and scenario 2, on land nearby belonging to Electrabel Rodenhuize.

The fuel used will be biomass (waste) in the form of pellets, chips and dust. The name of the plant will be the BEE Power Gent biomass plant (hereinafter referred to as BPG). The main equipment at the plant will be a boiler (of the Circulating Fluidised Bed Boiler (CFB) type), a steam turbine and generator installation and a flue gas cleaning installation. The biomass (waste) will be transported by ship and unloaded by Sea Invest in a large warehouse. The amount of fuel processed each year will be 800,000 to 1,200,000 tonnes[1].

The cooling water to condense the steam in the water-cooled condenser will be drawn from the Ghent-Terneuzen canal. After use, this cooling water will be recooled by cooling cells with artificial draft (for scenario 1) or the existing cooling tower operated by Electrabel Rodenhuize for scenario 2.

The intention is for the plant to be capable of supplying hot water to a heating network that has yet to be designed. BPG will have a broader feasibility study on supplying hot water in the port area conducted with partners that have yet to be identified.

A laboratory will be set up on site to conduct analyses into the quality of the water cycle and the fuel supplied.

BPG wishes to obtain an environmental permit for this plant. This EIA will be part of the application for the permit. A building permit is also required for this project.

Requirement for an EIA

The issue of which projects require an EIA is addressed in the Decree of 18 December 2002, which supplements the decree of 5 April 1995, which contains general environmental policy provisions and has a section on environmental and safety reports. In implementation of European Directive 97/11/EC (since replaced by Directive 2011/92/EU, published on 28 January 2012), this decree draws a distinction between projects for which an EIA is always required and projects where the obligation to have an EIA drawn up depends on thresholds or on decisions made in each individual case by the competent authority.

These two types of projects were described in a single implementing decision: the implementing decision specifying the categories of projects requiring an environment impact analysis, approved by the Flemish Government on 10 December 2004 (Belgian Gazette February 2005) and amended by the Decision of the Flemish Government of 15/07/2011 (Belgian Gazette 6/09/2011).

[1] Estimate based on 100% pellets (maximum moisture content 10%) = 800,000 tonnes a year and 100% wood chips (moisture content up to 40%) = 1,200,000 tonnes a year. The fuel will be a mix of both sources. See also section 2.

Appendices I & II of this Decision specify the categories of projects for which a project EIA is required, in accordance with art. 4.3.2.§2 and §3 of the decree. The proposed activities of BPG fall into the following category:

Appendix I category 2 a): Thermal power plants and other incineration facilities with a heat output of at least 300 megawatts.

The proposed power plant has a heat output of 460-580 MWth.

Reason for the project

The new BPG power plant is being constructed for the following reasons:

- It will help Belgium achieve the 20/20/20 renewable energy production targets imposed by Europe in the most cost-effective way.
- The chosen size of the plant has been dictated by the potential benefits of scale in terms of investment and the electricity yield that can be achieved as a result. The gross electricity yield of the new biomass plant will be 43% (net ŋ: ~ 41%), higher than biomass incineration in a grate incinerator (around 28%) or biomass fermentation (around 27%). In addition, this plant should be able to meet the current strict requirements for dust and NO_x emissions efficiently.
- Its strategic location in the port should allow the required quantities of biomass to be delivered in the best way from both an environmental and an economic point of view.
- The location in an industrial area should minimise the impact on the environment, and the impact on people and nature should be very small. The existing location already has most of the infrastructure needed to unload and store biomass. Consequently, little additional investment should be required, which will have a positive impact on the necessary support via green electricity certificates.
- The location next to, and connection to, an existing under-used Elia station means that there is no need for new high-voltage cables to connect the power station to the electricity grid.
- Unlike other green power production units which use wind and sun, the plant will be able to support the Elia high-voltage grid for frequency regulation and reserve capacity.
- The plant is designed to be capable of being converted in the future to be able to supply hot water for heating. The plant will be able to supply this hot water to new or existing industrial and private users, with the option of connecting them to the existing heating grid that EDF is operating in Ghent. A cost-benefit analysis still has to be conducted on this.
- The new BPG power plant is also intended to help make Belgium more self-sufficient in production capacity. Belgium is no longer able to generate enough electricity to meet its own needs at present. The import of electricity from abroad is increasing. No (large) new power plants are being built at the moment, despite the various permits that have been awarded to CCGT plants (powered by natural gas).

Location of the new biomass power plant

BPG plans to build a new power plant on the right bank of the Ghent-Terneuzen canal, about 9 kilometres north of Ghent.

Scenario 1

The proposed site is on land owned by the Port of Ghent and given into concession to GCT, and occupies a total area of approximately 5 ha. The boundaries of the proposed site, immediately adjacent to the GCT land, are:

- to the west: the Ghent-Terneuzen canal with a BP Belgium plant (lubricating oils blending facility) on the other side;
- to the north and north-east: the Electrabel Rodenhuize company;
- to the east: the R4 road and behind it the Gates company (storage of miscellaneous cargo in warehouses);
- to the south: the VLS Group Gent company (storage of chemical and petrochemical products)

Summary of land registry plots for GCT:

Province	Municipality	Department	Section	Plot number	Size
East Flanders	Ghent	12	A	970d-g-h-k-l-p-r-s-t 790 b/2-c/2-d/2-e/2 798 a/2-d/2 803 b/2-c/2	Ca 65 ha
East Flanders	Ghent	13	R	1146 h-k-l-m 1155 c	

Scenario 2

The proposed site in scenario 2 is located on nearby land belonging to Electrabel Rodenhuize in an industrial area, occupying a total surface area of ca. 90 ha on the right bank of the Ghent-Terneuzen canal, about 10 kilometres north of Ghent and 7 kilometres south of Zelzate. The land is listed in the regional plan as suitable for polluting industries.

Summary of land registry plots for EBL Rodenhuize:

province	municipality	department	section	plot number	Size (ha)
East Flanders	Ghent	13 13 13	R R R	1121W 1121N 1131E2	42 ha 94 a 41 ca 00 ha 00 a 64 ca 00 ha 65 a 80 ca
Total					**43 ha 60 a 85 ca**

The location of both sites is clarified in the figures below:

- Appendix 1: BPG position for the two alternative locations on the Port of Ghent plan
- Appendix 2: Position of project areas and residential areas for scenarios 1 and 2 on the topographical map

- Appendix 3: Position of project areas and residential areas for scenarios 1 and 2 on the Regional plan
- Appendix 4: Position of project areas for scenarios 1 and 2 on an aerial photograph

The location of the proposed sites is indicated on the extract from the “Ghent and canal zone” regional plan as fully enclosed in an area shown as intended for use by port- and water-related businesses (coloured purple, with the letter ‘Z’ printed on top).

The premises of the proposed sites are in the port area as defined in the “Demarcation of the Ghent Port Area - Establishment of the R4-East and R4-West” regional spatial implementation plan which was finalised on 15 July 2005. This plan indicates the boundaries within which the Flemish Government wants the Port of Ghent to develop. It also defines 10 sub-areas within the port area with particular indications of use and rules of establishment. These are new areas for industry, agriculture and nature. Finally, this spatial implementation plan establishes the R4-East and the R4-West as primary roads. The proposed site for the BPG is not in one of these sub-areas, which means that the intended use specification in the regional plan for port- and water-related businesses continues to apply.

According to the Flemish Structural Spatial Plan (FSSP), the land where the plant is to be set up is located in an "Area for Economic Activities". Due to the high significance of the Port of Ghent to the economic structure of Flanders, the area is described in the binding section of the plan as “Port”. This means that for this area future development and spatial and functional integration and the acquisition of port-related activities are guaranteed.

The most important residential areas around the proposed sites are shown in Table 1 below.

Table 1: Residential areas near the two project sites

	Scenario 1 (GCT)	**Scenario 2 (Electrabel)**
Desteldonk	ca. 0.9 km (SE)	ca. 1.4 km (SE)
Oostakker	ca. 2.9 km (S)	ca. 3.5 km (S)
Doornzele	ca. 1.5 km (N)	ca. 0.8 km (W)
Wippelgem	ca. 3.2 km (NW)	ca. 3.5 km (W)
Mendonk	ca. 3.7 km (NE)	ca. 3.3 km (NE)
St.-Kruis-Winkel	ca. 4.4 km (NE)	ca. 3.7 km (NE)
Kerkbrugge	ca. 2.5 km (W)	ca. 3 km (SW)
Rieme	ca. 5.5 km (N)	ca. 4.8 km (N)

Description of the new biomass power plant

The location of the installations and buildings described in the sections below are indicated in:

- Appendix 9: Ground plan with situation of the installations for the location on the GCT site
- Appendix 10: Ground plan with situation of the installations for the location on the Electrabel Rodenhuize site

1. Circulating fluidised bed boiler - CFB

The biomass power plant which BPG wishes to build consists of a boiler (circulating fluidised bed boiler, hereinafter referred to as CFB) powered by biomass (waste), a steam turbine and generator installation with a maximum electricity output of 200-250 MWe. The gross yield of the plant will be ~ 43% and the net yield ~ 41%. The plant's facilities can be subdivided into primary installations and secondary installations.

Principle of action

As no concrete information about the definitive design is yet available, the principle of action of the CFB boiler is described in general terms below.

Fuel is taken by the transport system to the boiler silos, from where it is taken to the furnace. In the furnace, the fuel's intrinsic energy is converted into thermal energy by incineration. A stream of hot air is blown upwards into the furnace, passing through a hot layer of sand so that the sand is disturbed. The air passes through the sand so quickly that the sand behaves like a fluid. The biomass (waste) is injected in the sand bed of the furnace. The turbulence causes the fuel to come into close contact with the sand, allowing for good heat transfer. The fuel ignites when it comes into contact with the sand. Incineration takes place as the sand, the air flow and the biomass (waste) move from the bottom of the furnace to the top.

After incineration the flue gases (with fly ash) are passed over a cyclone, which captures the sand and large ash particles and takes them back down to the bottom of the furnace. The flue gases are sent to the heat exchangers to produce steam. The steam produced is transferred to the steam turbine, while the flue gases are taken to the flue gas cleaning system.

Ignition burners are used to start up the plant. In scenario 1 (GCT site) these are powered by diesel, while in scenario 2 (Electrabel Rodenhuize) they are powered by natural gas.

The incineration system has built-in emission control systems.

The installation will also be designed to be able to supply hot water to a heating grid that has yet to be set up.

Supply of sand and additives to the CFB boiler

Some sand losses will occur during the process, and therefore it will be necessary for it to be topped up. Sand particles that are too small will be removed via the fly ash system and end up in the ash silos. The consumed sand is taken away with the fly ash and is included in these quantities.

Additional supplies of sand will be provided via a lorry that fills the sand silo. The silo will have a storage capacity of 150 m³ (225 tonnes). Approximately 19,000 tonnes of sand to replace consumed sand will be needed each year. The average freight load will be around 25 tonnes. This means approximately 760 lorry loads a year will be brought to the site.

Ammonia will be injected into the flue gas stream during selective non-catalytic reduction, and this will reduce the NOx into nitrogen and water. It is estimated that the plant will need 360 tonnes of ammonia a year, equivalent to about 14 lorry-loads being brought to the site. The ammonia will be transported through a pipe from the storage tanks. Scenario 1 provides for the ammonia to be stored in a new surface storage tank with a capacity of 60 m^3, while in scenario 2 the existing storage tanks (2 x 110 m^3) at the Rodenhuize Electrabel site will be used.

Kaolin and elemental sulphur may also be added. This will require storage capacity for 100 tonnes (40 m^3). These substances will be stored in silos in the boiler house.

2. The fuels

The following types of biomass (waste) may be used:

- biomass fuel
- untreated wood waste
- uncontaminated treated wood waste
- agriculture and forestry plant residues
- food industry residues
- fibrous residues
- biogas (if from an external source)

The biomass (waste) used will be a combination of pellets (brought from a considerable distance), chips and wood dust for biomass (waste) (brought from nearby). They are unloaded and stored at GCT premises and then taken to the BPG power plant. No crushing or other preliminary treatment takes place.

Examples of the types of biomass streams that may be used are:

- woody, grassy and/or fast-growing plants;
- biomass of agricultural origin, such as sunflower husks, oilcake and peanut husks;
- wood streams that are not industrial raw materials in Flanders. Current legislation specifies that only streams not suitable for material recycling can be incinerated.

Table 2: Composition of the biomass (waste) streams on the basis of the basic ratio (average and extreme values) shows the average and extreme composition of the intended fuel mix (50% wood chips, 20% wood pellets, 20% agro pellets and 10% wood dust).

Uncontaminated treated wood waste will comply with the composition requirements of articles 5.2.3 bis. and 4.8 of Vlarem 2 [Flemish Regulation on Environmental Permits]. BPG will make arrangements with the supplier of the wood dust being brought in to ensure that these composition requirements continue to be met.

Table 2: Composition of the biomass (waste) streams on the basis of the basic ratio (average and extreme values)

		Mix Design BPG	
		average	extreme
Analysis			
LHV	MJ/kg as received	15	12
Moisture content	% as received	12	27
Ash content	% on dry	2	7
Volatile components	% on dry	78	84
Melting temperature	°C	not relevant	
Elemental analysis			
carbon	% on dry	47	48
hydrogen	% on dry	6	6
nitrogen	% on dry	1	1
sulphur	% on dry	0.1	0.12
fluorine	mg/kg DM	13	21
chlorine	mg/kg DM	895	1830
phosphorous	mg/kg DM	516	1064
Heavy metals			
As	mg/kg DM	1.09	1.84
Cd + Tl	mg/kg DM	1.1	1.72
Cr	mg/kg DM	19.2	45.3
Cu	mg/kg DM	8.94	24.54
Hg	mg/kg DM	0.06	0.13
Pb	mg/kg DM	10.11	36.14
Zn	mg/kg DM	48.4	187

As it will not be possible to obtain enough biomass (waste) for the plant from within Belgium, most of the material will have to be transported from abroad. In addition to a limited amount of uncontaminated treated wood waste, one of the main sources of biomass (waste) for the planned power plant will be woody, grassy and/or fast-growing plants imported on large ocean-going vessels mainly from the Atlantic basin, Western Africa and Northern and Southern Europe. Another important source will be biomass (waste) of agricultural origin, such as sunflower seed husks, olive cake and peanut husks brought in on smaller ocean-going vessels, mainly from the Mediterranean and Eastern Europe.

The sustainability of the biomass (waste) used will be a major priority. A verification system (involving external auditors) will be used to demonstrate sustainability. This system will comply with the current European and Flemish sustainability criteria that apply to solid biomass (waste). At the moment, the SGS Verification scheme, developed in conjunction with Laborelec, can be used for this purpose. BPG will eventually use the sustainability criteria system currently being developed in the context of the Sustainable Biomass Partnership (previously known as “Initiative Wood Pellet Buyers” (IWPB)).

3. Transport and storage of the biomass (waste)

The pellets and wood chips will be brought in by ship via the Ghent-Terneuzen canal. Wood dust will be transported by lorry. BPG will for the most part use GCT's existing installations for unloading pellets and wood chips from (ocean-going) vessels. A new hopper will be acquired only for unloading wood chips.

The incineration system is designed to incinerate predefined fuel mixtures. In order to obtain the right mixtures, the pellets and chips will be transported from the storage site on covered conveyor belts to mixing silos at the BPG site: one 5,000 m³ silo for the wood pellets and one 2,500 m³ silo for the agro pellets. Depending on the desired fuel mix, the biomass (waste) will be taken from each silo and transported by conveyor belt to the two 350 m³ boiler silos (enough for five hours operation) that are part of the incineration system (CFB boiler).

The wood chips are stored in a covered storage facility on the BPG site that has a capacity of 15,000 m^3 (or two 5,000 m^3 silos). The wood dust is drawn by suction straight from the 5,000 m^3 silo located alongside the boiler and injected into the boiler.

The procedure for unloading and transporting the pellets and wood chips (as far as the mixing silos) and the wood dust is described below.

Depending on the type of fuel mix used, the amount of material that will need to be brought in is estimated at 800,000 (100% pellets) to 1,200,000 (100% wood chips) tonnes a year. It is estimated that 100,000 to 130,000 tonnes of wood dust a year will need to be brought in.

The location of the transport systems to the plant for both alternative sites is shown on the ground plans for both alternative sites, in Appendix 5 and Appendix 6.

Pellets

Ships are unloaded by cranes that can move on rails alongside the quay of the Ghent-Terneuzen canal.

The grab is used to unload the cargo into the hopper, and the cargo is then taken to the existing wood and agricultural pellet warehouse via a system of conveyor belts. A stacker is used to pass the pellets into the warehouse through an opening in its side. The total area of the storage warehouse is ca. 32,000 m² and its total capacity is ca. 100.000 tonnes.

Material is taken from the warehouse to the power plant by a reclaimer that rakes the pellets loose and places them on a conveyor belt. This covered conveyor belt runs straight to the plant's mixing silos.

GCT also has two silos with a capacity of 6,700 m³ which are used for reserve storage. These silos are filled via a removable roof. The pellets can be fed into the supply circuit via doors with wheel loaders leading from the silos through a separate hopper.

Wood chips

Wood chips are unloaded by the same crane, but a new hopper will need to be obtained. This is necessary because the 'flow behaviour' of the chips is different; they do not flow from the hopper as easily as pellets.

The cargo is taken to the rear part of the site via the same conveyor belt system. Once there, they are stored in the open air. The same stacker is used as for the pellets, but when it is being used to unload wood chips it is adjusted so that the cargo is stored outdoors rather than in the warehouse. This is because wood chips can be stored outside.

The total area available for storing chips is ca. 10,850 m². The silos mentioned earlier can also be used to store wood chips.

The chips are taken to the power plant by being loaded by an automatic loader onto a covered conveyor belt system that is connected to the same supply circuit as the pellets.

Wood dust

Wood dust will be brought in by a lorry that fills the wood dust silo without creating dust. The storage capacity of the silo is 5,000 m³ and it is located next to the boiler. It is estimated that around 100,000 to 130,000 tonnes of wood dust will be needed each year. The average freight load will be around 25 tonnes. This means approximately 4,000 to 5,200 lorry loads a year will be brought to the site.

4. Steam turbine (water/steam cycle)

The steam turbine consists of three sections:

- High-pressure section
- Medium-pressure section
- Low-pressure section

The fuel is incinerated in the combustion chamber. The heat generated by incineration is emitted via radiation to the steam/water mixture in the condenser, and by convection to the convection bundles located in the convection section.

The topping-up water for the water/steam cycle is sent to the feedwater storage after water treatment has taken place. Here it is first heated, which causes venting. The vented water is pumped over to the CFB boiler where it is heated and converted to steam. The high pressure and temperature are then transferred to the high-pressure part of the steam turbine. This steam is then returned to the boiler for reheating. This reheated steam is then sent to the medium-pressure part of the steam turbine and then to the low-pressure part of the turbine. Thermal energy is converted into mechanical energy during these transfers to the various sections of the steam turbine.

At the end of the low-pressure section the steam leaves the turbine and goes to the condenser. Here the remaining steam is cooled by the cooling water system. This process converts the steam into condensate, which is led back to the feedwater tank where the cycle begins again.

The water/steam cycle is in theory a closed cycle. Leaks may lead to a small loss of steam, which is made up for by demineralised water.

5. Alternator with transformer

The mechanical energy of the steam turbine is converted into electrical energy in the alternator. A three-phase synchronous turbo generator will be used. The electrical energy produced in the alternator is sent to the transformer where its voltage is increased and it is injected into the high-voltage grid.

6. Flue gas cleaning

The flue gases undergo further cleaning after the sand and large ash particles have been separated out in the two cyclones. The flue gas cleaning system uses a bag filter to remove medium-sized and small ash particles so that the emission limits for dust are met. Particular attention is paid here to managing the emission of fine dust.

The flue gas cleaning system further reduces levels of nitrogen oxides (NO_x) via selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR).

As the sulphur content of biomass (waste) is very low, there is no sulphur removal installation for flue gas. Sodium bicarbonate can be injected just before the bag filter or limestone is placed in the boiler to help meet the compulsory emission limits.

DeNOx system

An SNCR system, either alone or linked with an SCR DeNOx system (selective (non) catalytic reduction), will be set up to reduce NO_x emissions from the proposed biomass power plant.

Selective non-catalytic reduction involves injecting ammonia into the flue gas stream, which reduces the NO_x into nitrogen and water. The chemical reactions in selective catalytic reduction are the same, but can take place at a much lower temperature range because of the use of a catalyst.

The denitrification process that takes place in the $DeNO_x$ system occurs thanks to the following chemical reactions:

- between ammonia and nitrogen oxide: $4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$
- between ammonia and nitrogen dioxide: $2\ NO_2 + 4\ NH_3 + O_2 \rightarrow 3\ N_2 + 6\ H_2O$.

Thus, the nitrogen oxides are converted by ammonia into nitrogen and water.

The ammonia for the power plant is added by injection just before the entrance to the cyclones (SNCR) and before or after the bag filter with the SCR. The SCR process can be used for efficient NO_x reduction at the lower flue gas temperatures which exist downstream of the boiler after the gases have been cooled. The reaction takes place on a catalyst. The present generation of catalysts use TiO2 as the carrier and tungsten or vanadium dioxide as the active components. The catalysts are placed in the reactor house in several layers. Soot-blowers are used to clean the catalyst layers.

The ammonia will be transported through a pipe from the storage tanks. Scenario 1 provides for the ammonia to be stored in a new surface storage tank with a capacity of 60 m³, while in scenario 2 the existing storage tanks (2 x 110 m³) at the Rodenhuize Electrabel site will be used.

Bag filter

A bag filter will be installed to reduce dust emissions from the proposed biomass plant. The design and type of installation for the plant is not yet known. A general description of the operation and cleaning mechanism(s) is given below.

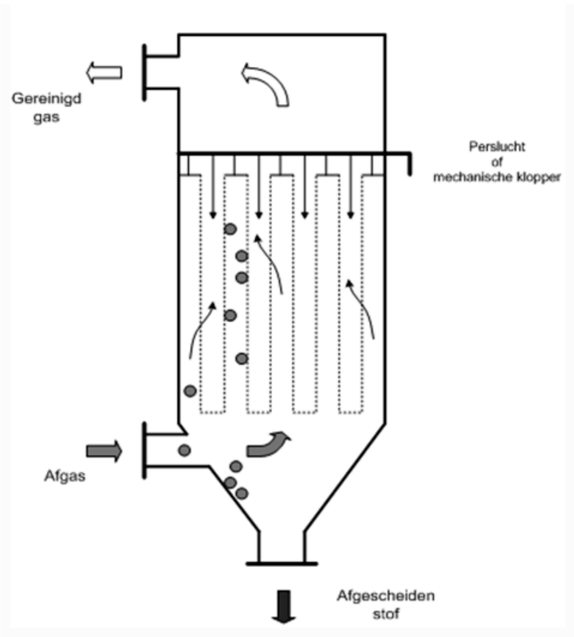
Principle of action

A bag filter system consists in principle of a housing containing a filter medium (the bag). This bag divides the housing of the filter into a “dirty” part and a “clean” part.

The dirty part, where the dust-laden flue gases enter, is generally in the lower or middle section of the housing. The flue gases which enter do not usually flow straight to the filters but pass through one or more dividing plates. The aim of this is to achieve better distribution among the bags so that they are more evenly exposed. This process also causes the flue gases to lose a large proportion of their kinetic energy, leading to pre-separation due to gravity.

The flue gases contaminated with dust pass through the bag filter, where dust particles are removed. The dust is regularly removed from the filter and collected in a hopper placed below the filter system. The principle of action is shown schematically in Figure 1.

Figure 1: principle of action of the bag filter



Cleaning mechanism

The dust that accumulates in and on the filter during the filtering process needs to be removed from time to time. The most widely used systems are:

- agitation mechanism;
- blow-back system (reversing the direction of flow);
- compressed air;
- a combination of various systems.
- ultrasonic cleaning

Beater cleaning (via an agitation mechanism) is the oldest method. It involves agitating the filter bag back and forth. This method is rarely used nowadays partly because it exposes the filter bag to considerable mechanical stress. The only exceptions are very small installations that do not operate continuously.

In backflow cleaning the filter is divided into a number of compartments. The outlet of each compartment can be sealed off from the rest of the bag filter, and then a fan blows purge air through the filter material in the opposite direction. This purge air is taken from the clean flue gas channel. It flows through the bag from outside to inside, and the dust is trapped in the filter bag. This cleaning process exposes the filter material to relatively low mechanical strain because the pressure at which air is blown back is low.

In compressed air cleaning, a brief burst of compressed air lasting for 0.05 to 0.3 seconds is applied to the filter bag, causing the filter material to swell suddenly. This causes the layer of dust on the outside of the bag to fracture and fall down into the hopper. In high-pressure compressed air cleaning (4 to 8 bar), the compressed air flows through a venturi, and in well-designed systems it carries a considerable amount of surplus secondary air with it. This secondary air is vital to good cleaning. No venturi is used in low-pressure cleaning (1 to 2 bar).

Compressed air cleaning can be carried out while the plant is operating or while it is idle. These options are referred to as “on-line” and “off-line” cleaning respectively. In off-line cleaning, one compartment of the filter is sealed off and then cleaned. This makes it easier for fly ash particles to descend as they are not impeded by the dirty gas.

The benefit of off-line cleaning is that no valves are needed to seal off a compartment, and that the entire filter surface is used to filter flue gas.

Cleaning can be controlled by a time switch or a pressure difference regulator. The drawback of having a set time is that if little dust is present the filter is cleaned more often than necessary. Using a pressure different regulator overcomes this drawback.

7. Waste and residual streams

Waste and residues are generated during the incineration process as a result of the operation of the plant and ancillary installations, such as residues of maintenance activities, used catalyst and filter material, waste water sludge, etc.

Incineration process residues consist of the incineration ashes (bottom ash and fly ash), the bed material and any additives such as kaolin.

The quantity of ash will be 40,000 to 60,000 tonnes a year depending on the nature of the biomass (waste) stream used and the addition of additives. If the percentage ratio is 90/10, about 36,000 to 54,000 tonnes of fly ash and about 4,000 to 6,000 tonnes of bottom ash will be produced each year.

The bottom ash collects at the base of the boiler and is removed from the boiler by screws. The ashes are then taken by a bucket lift to the storage silo which has a storage capacity of (70 m³). The silo is emptied by a lorry travelling underneath the silo. The ashes are transferred to the lorry via a system with direct connections, so that no ashes can be released during this process. The average freight load will be around 25 tonnes. This means around 160 to 240 lorries a year.

The fly ash is captured at various points in the boiler: after the first and second draft, after the air preheaters and in the bag filter. The ashes are taken from these various points to two collection silos, each with a capacity of 2 x 600 m³.

The silos are emptied by a lorry travelling underneath the silos. The ashes are transferred to the lorry via a system with direct connections, so that no ashes can be released during this process. The average freight load will be around 25 tonnes. This means around 1,440 to 2,160 lorries a year.

Under Flemish legislation, these residues are initially regarded as waste. If they meet the VLAREMA criteria and there is a market for them, they lose the status of waste and can be used as raw material. Technology is not yet sophisticated enough to allow biomass (waste) incineration ashes to be recycled, and they must therefore be disposed of. BPG is investigating ways of making use of these ashes.

8. Cooling concept

Power plants can be cooled in various ways, such as open cooling systems, hybrid cooling towers, aërocondensors, cooling towers with natural draft and cooling towers/cooling cells with artificial draft.

The purpose of the main cooling system is to provide cooling water for the steam turbine condenser and for the closed cooling circuit of the hot water exchangers.

There is also a completely closed cooling circuit (CCW) which cools the residual heat in the ancillary systems. This is a completely closed system with no fluid loss.

The cooling water for the main cooling is pumped from the canal and recooled after use by cooling cells with artificial draft (for scenario 1) or by the existing cooling tower with natural draft (for scenario 2).

Scenario 1

BPG will use cooling cells with artificial draft if the plant is built according to scenario 1 on the proposed GCT site.

In these cooling cells, water is fed from above to below via a distribution system, passing through a filling (pack) where it comes into contact with air passing in the opposite direction (air is drawn up by suction from below the pack). As a result, some of the water fed in evaporates, causing a cooling effect. The filler often consists of packs made from plastic (or other material) with a large internal surface. The water flows along these as a thin film, resulting in optimum air/water contact. The choice of filling depends on water quality and the specific operating regime. Objects known as drip-catchers are often placed above the water distribution system to save water. These drip-catchers capture a large proportion of the water drops that are sucked into the air stream. Air suction usually involves the use of a fan placed above the cooling cell or inside it (near the bottom, at the side). The air is often drawn in through louvres. Well-designed louvres stop too much water being lost through the side of the cooling cell as a result of spattering losses, and also stop material (soil particles, leaves, litter) being blown into the cooling cells.

In cooling cells with artificial draft, the cooling water is pumped over the open cooling cell via a circuit. The cooling water captured in the cooling cell trough is always fed back to the cooling cell for further cooling after it has passed through the processes that are to be cooled. Salts and minerals become more concentrated as a result of cooling water evaporation. A quantity of cooling water needs to be drained to limit the concentration of these substances. This drainage water is discharged into the Ghent-Terneuzen Canal (hereinafter referred to as Canal). The additional water needed to compensate for evaporation and drainage is taken from the Canal, upstream of the drainage discharge point. The main causes of water loss in recirculating systems are evaporation, drainage and spatter/wind losses. Water is constantly added to the cooling circuit to make up for the loss of water by evaporation and drainage. The water for the cooling cells will be drawn from the Ghent-Terneuzen Canal.

Scenario 2

If scenario 2 is chosen, BPG will use the existing cooling tower with natural draft at the proposed Electrabel Rodenhuize site.

The cooling water for the condenser will be pumped round via a circuit over the existing large hyperbolic cooling tower. The shape and height of the cooling tower creates a natural draft, causing surrounding air to rise. The hotter water flowing back from the condenser is distributed in the cooling tower. The water comes into contact with large amounts of air at this point. The contact between the hotter water and the surrounding air causes some of the water to evaporate. This evaporation draws energy from the remaining water, which cools as a result. The cooled water is fed back to the condenser.

Salts and minerals become more concentrated as a result of cooling water evaporation. A quantity of cooling water needs to be drained to limit the concentration of these substances. This drainage water is discharged into the Moervaart. The additional water needed to compensate for evaporation and drainage is captures in the Ghent-Terneuzen canal, upstream of the point at which the Moervaart empties into the Ghent-Terneuzen canal.

Ancillary installations and utilities

Water preparation

The main objective of the water treatment system is to purify the canal water from the Ghent-Terneuzen canal so that it can be used for the cooling and steam cycles.

The water treatment system consists of 3 stages:

- **Physical purification** using a coarse grid to remove coarse fractions. Only particles 4-5 mm in size are left after this purification stage.
- **Physicochemical purification**: the water is free from particles after this purification stage. This pre-treated water can be used as cooling water in the cooling water system, as fire extinguishing water (for the sprinklers) and as service water.
- **Reverse osmosis:** The water for the water/steam cycle undergoes an additional reverse osmosis step in which dissolved salts are removed.

For scenario 2 on the Electrabel Rodenhuize site it has been decided to use the existing approved demineralisation unit, which involves using ion exchange resins to produce process water (demineralised water).

Ancillary steam boiler

In scenario 1 on the GCT site, a diesel-powered ancillary steam boiler (ca 5 MWth) will be used to start up the plant. During this period the combustion chamber and the sand bed of the CFB boiler will be heated to a certain temperature before the main fuel (biomass (waste)) can be used. A limited amount of low-pressure steam will be generated during start-up. This will be used to preheat and vent the demineralised water and the preheaters of the CFB boiler.

In scenario 2 on the Electrabel Rodenhuize site, the existing ancillary steam boiler powered by natural gas (22.9 MWth) will be used.

Emergency power supply

A diesel-powered emergency power array will be provided to protect the installation and employees in the event of a total power failure. The electricity output of this array is 1,000 to 1,500 MVA.

Effects on the environment

The sections below summarise the relevant environmental effects and list the mitigating measures which have already been taken (scenario 2) or which are proposed.

The following environmental effects are considered:

- Impact on air quality
- Impact on surface water quality
- Impact on soil and groundwater
- Impact on noise
- Impact on public health
- Impact on traffic congestion
- Impact on fauna and flora
- Impact on other aspects (landscape, light)

1. Air discipline

Disciplines involved

Air, people, and fauna and flora.

Effects

BPG plans to build a biomass power plant in the Ghent canal zone. At present 2 alternative locations are being considered: the GCT site and the Electrabel Rodenhuize site.

One relevant emission source has been identified for the power plant: the CFB boiler flue. Smaller, negligible emissions from the ancillary steam boiler and the emergency diesel facility will take place in addition to these emissions.

The average annual air quality targets for NO_2 (40 µg/m³) ,SO_2 (20 µg/m³) and PM_{10} (40 µg/m³) have been respected in the area around the project site(s). This is not the case for the maximum number of instances when daily values can be exceeded (maximum 35 instances). 39 instances have been recorded.

The total emissions of the plant are collected for the relevant contaminants. The most important emissions are selected using the selection scheme, namely nitrogen oxide (NO_2), sulphur dioxide (SO_2), fine dust, carbon monoxide (CO) and the heavy metals lead, copper, arsenic and cadmium. Distribution calculations have been performed for these contaminants.

No relevant contributions from the proposed plant to immission concentrations of CO and heavy metals in the environment have been observed. The contributions are regarded as negligible.

Nitrogen dioxide and sulphur dioxide are the most important contaminants emitted. It should however be noted that the modelling was based on the emission limits and a maximum emission regime of 8,760 hours a year (= worst case). The main effect of this is that SO_2 is overestimated since the sulphur content of the fuel will be low. The maximum average annual background levels of these two substances in the area are 28 and 5 µg/m^3 respectively. For the new plant, the contribution at the point of the peak plume will be 1.19 (nitrogen dioxide) and 1.08 (sulphur dioxide) µg/m^3 for both alternative locations.

This means that the annual limit will not be exceeded at the point of the peak plume. This peak plume lies 1.3 kilometres north-east of the project sites, in an industrial area with no residential population.

There are not expected relevant diffuse emissions resulting from the storage and transhipment of the biomass (waste) brought in via the GCT installations. GCT has already taken the necessary action to limit these emissions as far as possible.

The project is not expected to produce any relevant emissions, or to make any significant contribution to immission concentrations in the area compared to the current situation.

Mitigating measures

The new power plant will comply with all the emission limits specified in VLAREM II. The power plant will have a bag filter for dust and an SNCR system, either alone or in combination with an SCR system, for NO_x.

It has been established that the immission concentrations of NO_x are negligible at both alternative sites. A limited contribution has been observed only at Doornzele and Desteldonk in scenario 1 and at Doornzele in scenario 2. A significant contribution for the sulphur dioxide parameter has been established at Doornzele in scenario 1, while the contributions in the other residential areas examined are negligible to low in both scenarios. The contribution is likely to be lower in fact because the sulphur content of the biomass (waste) will be low.

The contributions to immission concentrations for the parameters CO, fine dust (PM_{10} and $PM_{2.5}$) and heavy metals (Cd, Cu, As and Pb) are always negligible for the receptors used.

Emissions from the proposed biomass power plant will be significant mainly for nitrogen dioxide and sulphur dioxide. The models always assumed maximum emissions with regard to emission limits and an operating regime of 8,760 hours a year.

There is considerable interest in nitrogen dioxide emissions in Flanders at the moment, as air quality targets are not being met in a number of places. It is therefore also important that the business continues to monitor its NO_x emissions in future, but there is no need for additional mitigating measures.

2. Climate discipline

In the basic ratio for the fuel mix, the amount of CO_2 will be approximately 1.5 million tonnes a year if all the carbon in the fuel is converted into CO_2. These estimates were worked out on the assumption that the plant will operate for 8,000 hours a year.

BPG guarantees that the biomass (waste) will be purchased on the basis of sustainability criteria. A verification system (involving external auditors) will be used to demonstrate sustainability. Current regulations do not allow BPG to use wood streams that are an industrial raw material in Flanders. Current legislation specifies that only streams not suitable for material recycling can be incinerated.

BPG will require potential suppliers of biomass (waste) to adhere to contractual results obligations with regard to the amount of energy used during the pre-treatment and transport of the biomass. This is very important to BPG from an environmental and an economic viewpoint, as the current subsidy system is based on this. Current legislation requires audits to be performed by an independent firm every two years to determine the exact amounts of energy.

BPG will eventually use the sustainability criteria system currently being developed in the context of the Sustainable Biomass Partnership (SBP) (previously known as "Initiative Wood Pellet Buyers" (IWPB)). These criteria aim to protect the quality of the living environment and biodiversity, respect for human rights and working conditions, and the living conditions of the people involved in the production of the biomass.

SBP follows 9 principles with regard to the harvesting, exploitation and treatment of woody biomass. The order in which they are listed does not indicate any particular priority among them. SBP requires its biomass suppliers to adhere equally to all 9 principles. Compliance with these principles has to be verified once a year by independent inspection firms.

Principles 1-3 are taken from criteria recommended by the European Commission in the renewable energy directive (RED)[2] and the solid biomass reports[3]. Principle 3 also refers to the Vattenfall[4] agreement with the Berlin Senate.

The supply chain is acceptable to SBP if:

- A sufficient reduction in greenhouse gases compared to the use of fossil fuels is demonstrated
- Deforestation is excluded
- Raw materials from sensitive areas such as tropical primeval forests, peat land and swamps is not used

Principles 4-8 relate to the environmental and socioeconomic issues clarified in the NTA 8080[5] (2009). The level of detail of the investigation and the quality of the audit require the supplier and/or country to reflect specific risks regarding compliance with these principles. The SBP expects suppliers and producers of biomass to use the findings of the inspection to introduce corrective measures and to strive to constantly improve their performance.

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[2] RED = Directive 2009/28/EC on the promotion of the use of energy from renewable sources

[3] Report from the Commission to the Council and the European Parliament on the sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling COM(2010)11 final and related Impact Assessment (SEC (2010)66 – linked to COM(2010)11 final).

[4] VATTENFALL Agreement on Sustainability of Procured Biomass between the State of Berlin and Vattenfall Europe AG

[5] NTA 8080 (2009) Dutch Technical Agreement, NTA 8080, , Sustainability criteria for biomass for energy purposes

Principle 9 relates to Corporate Social Responsibility (CSR) issues such as health and safety, human rights, discrimination, corruption etc. These issues are not restricted to the exploitation of and trade in biomass, but apply to all raw materials used by utilities firms.

The 9 principles are set out below:

- **Principle 1**: Savings in greenhouse gas (GG) emissions throughout the life cycle, taking into account the whole of the supply chain from production through processing and transport until final use, are at least 60% compared to the use of fossil fuels as a benchmark.
- **Principle 2:** The production of woody biomass does not take place at the expense of significant carbon reservoirs in plants and soil.
- **Principle 3:** The production of woody biomass may not take place in areas of high biodiversity unless it is shown that the production of this raw material does not have a negative effect on nature conservation objectives.
- **Principle 4:** The production of woody biomass must at least maintain or improve soil quality.
- **Principle 5:** The production of woody biomass must not exhaust the groundwater and soil water and must avoid or significantly reduce negative effects on water.
- **Principle 6:** The production of woody biomass must avoid or significantly reduce negative effects on air quality.
- **Principle 7:** The production of woody biomass must not endanger local supplies of food, water or materials essential to life, where the use of this particular biomass or water is vital to basic needs.
- **Principle 8:** The production of woody biomass must respect property rights and contribute to local welfare and the well-being of workers and the local population.
- **Principle 9:** Ethical values with which the organisation must comply:
    - provide a healthy and safe working environment
    - respect for human rights established at international level
    - no forced or compulsory labour
    - no child labour
    - no discrimination regarding work and profession
    - encouraging greater respect for the environment
    - high integrity standards, including combatting corruption in all its forms

3. Water discipline

Disciplines involved

Water, people, and fauna and flora.

Effects

BPG will use surface water from the Ghent-Terneuzen canal and tap water to operate the biomass plant.

In scenario 1 on the GCT site, tap water will be used only for sanitary facilities. The amount of surface water taken from the canal is estimated at 10,464 m^3/day (436 m^3/h). This water will undergo physicochemical pre-treatment and will then be used mainly as process water and cooling water. The industrial waste water from the demineralisation unit will be discharged into the Ghent-Terneuzen canal along with residual streams from other users. Discharge will take place via a separate discharge point on the GCT site, and the rate of flow is estimated at 3.6 m^3/h (86.4 m^3/day).

In this scenario a new cooling tower will be built to cool the cooling water. It will have a forced draft and 7 cooling cells. The rate of drain in the cooling circuit will be approximately 144 m^3/h, 234 m^3/h evaporates in the cooling tower. Drain water from the cooling circuit will be discharged into the canal.

The additional sanitary waste water in the construction and operation phase will be discharged into the Ghent-Terneuzen canal via an IWWTF [individual waste water treatment facility]. The sanitary installations will be supplied with tap water.

For scenario 2 on the Electrabel Rodenhuize site, BPG will use the existing approved demineralisation unit to produce process water (demineralised water). This installation is supplied with tap water. The regeneration effluent (and other residual streams) will be collected in the same way as in the current situation in the industrial waste water well and discharged in batches via the approved discharge point into the Ghent-Terneuzen canal. In the planned situation, it is expected that the amount of industrial waste water to be discharged will be 80,000 m^3 a year.

In this scenario the existing cooling tower of the Rodenhuize plant will be used on the BPG site as well as on the Rodenhuize site. Drainage water will be discharged into the Moervaart at a rate of 3.000 m^3/h. The additional water needed to compensate for evaporation and drainage will be captured in the Ghent-Terneuzen canal at a rate of approximately 3,700 m^3/h (1,850 m^3/h for each). In the planned situation, the capture of surface water and discharge of cooling water will fall to approximately 46% and 39% of the amounts involved in the benchmark situation as a result of the higher concentration factor.

The additional waste water from sanitary installations will be discharged into the Ghent-Terneuzen canal via the approved Electrabel Rodenhuize IWWTF. The sanitary installations will be supplied with tap water.

The design data available for scenario 1 and the measurement data available for scenario 2 indicate that the discharge standards for cooling water and surface water will be met. As no significant changes are expected to the nature and composition of the waste water and cooling water to be discharged (scenario 2), it is assumed that this will also be the case in the planned situation.

The impact of the discharges has been determined first by testing the closest measuring points in the measuring grid operated by the Flemish environmental agency VMM against the environmental quality standards for the surface waters affected. Critical parameters for both the Moervaart and the canal are dissolved oxygen, COD and the phosphorus and nitrogen parameters. For heavy metals, the standards are met at measuring point 34.100.

The impact of the industrial waste water on the Ghent-Terneuzen canal is negligible for all parameters tested in scenario 1 (<1%). This was determined on the basis of the estimated rate of flow and maximum emission loads (= 10 x quality standard receiving water) for an average and 10th percentile rate of flow of the canal. This is also the case for the cooling water discharged into the canal. The increase in canal temperature for a 10th percentile flow is calculated at 0.058 °C. The quality standard of 25°C is not exceeded.

In scenario 2 the impact of the industrial waste water on the canal is found to be negligible both in the benchmark situation (approved rate of flow of 60,000 m^3/year and emission standards) and in the planned situation (planned rate of flow of 80,000 m^3/year and approved emission standards). All the parameters investigated have a negligible impact on the canal.

The discharge of cooling water into the Moervaart has a limited impact on the situation. On the basis of the average temperatures and rates of flow of the Moervaart and the waste water discharged, the impact is negligible at maximum temperatures and rates of flow (in summer). There is an improvement on the benchmark situation, as the impact falls from 2.49 °C to 1.26 °C for the average situation and from 0.51°C to 0.24°C in the maximum situation. The environmental quality standard of 25°C is not exceeded.

Mitigating measures

It can be concluded from the foregoing findings that no additional mitigating measures will be needed for either alternative location.

4. Soil and Groundwater disciplines

Disciplines involved

Soil and groundwater, water

Effects on soil and groundwater

The table below summarises the assessment of the environmental effects for the Soil and Groundwater discipline for the locations examined.

Effect	Scenario 1	Scenario 2
Construction phase		
Change in soil and groundwater quality:		
- as a result of earth-moving	0	0
- as a result of leaks or disasters	0	0
Change in groundwater balance	0	0
Change in stability	0	0
Operation phase		
Change in soil and groundwater quality	0	0
Change in groundwater balance:		
- as a result of changes in infiltration capacity	+1	0
- as a result of deeper constructions	0	0
change in soil use	+2	+3

With

Effect	Negligible (0)	Limited contribution (+/- 1)	Relevant contribution (+/-2)	Significant contribution (+/-3)
Change in soil and groundwater quality	No change in current quality level	Enrichment of 0.01 to 0.1 x soil contamination standard	Enrichment of 0.1 to 1 x soil contamination standard	Enrichment of more than 1 x soil contamination standard
Change in groundwater status and direction of flow	No change in groundwater status, flow pattern	Minor change in groundwater status but flow pattern remains the same. No effect on groundwater extraction, critical groundwater layers or nature conservation areas (dryer/wetter conditions)	Local change in groundwater status and flow pattern and/or effect on groundwater extraction, critical groundwater layers or nature conservation areas (dryer/wetter conditions)	Regional change in groundwater status and flow pattern and/or effect on groundwater extraction, critical groundwater layers or nature conservation areas (dryer/wetter conditions)
Change in stability	No settling or subsidence to be expected	Settling or subsidence may occur in a fairly small area	Settling or subsidence likely throughout the entire area of the project	Relatively significant settling or subsidence likely
change in soil use	No change in efficiency of use of space.	Slightly more efficient use of space, with little or no impact on soil water and groundwater. No relationship / synergy with the surrounding area	More efficient use of space, but with little or no impact on soil water and groundwater. Some synergy with the surrounding area	More efficient use of space, with little or no impact on soil water and groundwater. Considerable synergy with the surrounding area

Mitigating measures

The machines must be thoroughly inspected in the shipyard in order to prevent soil contamination by disasters as far as possible. The use of well-maintained machinery will minimise the likelihood of leaks. If a disaster occurs, the necessary action must be taken immediately in order to minimise contamination. Dangerous products and fuels must be stored in accordance with the statutory provisions in force.

The project does not require any drainage. The excavation depth will only be below the groundwater level in specific cases. In these cases, dehydration can take place by pumping the groundwater out of the excavation pit. If groundwater needs to be pumped out of the excavation pit and discharged elsewhere, it will be necessary to ascertain whether this can be done in accordance with the general discharge requirements (art 4.2.2.1.1 of VLAREM II for discharge into surface water and art 4.2.2.3.1. for discharge into the public sewers). It will also be necessary to determine whether any hazardous substances are present at concentrations higher than the classification criterion (Hazardous Substances Information) specified in Appendix 2.3.1. of VLAREM II.
The decision as to whether further purification of the water to be discharged is necessary should ideally be taken on the basis of at least two samples of the influent. Water purification will be mobilised if necessary.

5. Noise and Vibrations Discipline

Disciplines involved

Noise, people, and fauna and flora

Effects on background noise

The following decisions can be taken on the basis of measurements taken in the surrounding area and noise immission transmission modelling carried out in the design and operational phases:

Current background noise (= benchmark situation 2013):

Examination of noise measurements taken in the surrounding area according to environmental quality standards shows that these standards are met for MP1 at all times. The acoustic quality can be described as not too loud for homes located in industrial areas.
The situation for MP2 is somewhat different. Although the noise levels measured are not very different from those measured at MP1, the environmental quality standards are exceeded during the day and evening periods because of the less strict quality standards for measuring points located in a (rural) residential area within 500 metres of an industrial area.
The situation for MP3 is also different. Environmental quality standards are not exceeded during the day period, but are exceeded during the evening and night periods.
We can conclude that the environmental quality standards for the day period are not exceeded at MP4 (in the buffer zone) but are exceeded at MP5 (in zone 2).

Measurements were also taken at measuring point 2 in 2008 and 2010, and here we observe that there has been hardly any change during the week (for daytime, evening and night periods) between 2008 and 2013, but a clear rising trend at the weekend. This rise is probably due to heavier traffic on J.F. Kennedylaan at the weekend.

Construction phase:

The relevant construction phases were only examined for the day period, as the various mobile sources will only be in operation during the day at that time. An acoustic calculation model was used to calculate a scenario with continuous simultaneous operation of 1 dumper, 1 bulldozer, 1 grab crane and a screw pile driving machine (construction phase 1) and cleaning/testing the boiler and steam turbine with steam (construction phase 2). The specific noise of these construction phases does not exceed the limit for incidental/fluctuating noise during the daytime. As the sources are fluctuating in nature during the construction phase, and so will be very similar to the current fluctuating traffic noise from the N474 and R4 roads, they can be compared to the measured equivalent surrounding noise. The noise is never significantly higher than the current equivalent and stable surrounding noise. Present maximum noise immissions (caused mainly by traffic) are at least 7 dB(A) higher than the calculated specific immissions.

Operation scenario 1:

An acoustic calculation model was used to calculate the specific noise at the assessment points on the basis of the noise capacity (according to information provided by the manufacturer of the equipment or on the basis of previous measurements performed on similar equipment). In scenario 1 “initially with

LwA per cooling cell of 110.2 dB(A)", it is likely that the limits will be exceeded at a number of assessment points. If the noise emission from these 7 cooling cells is reduced to 107 dB(A), and the LwA of each individual source is at maximum, these limits can be met.

Well-thought-out acoustic design in the design phase will mean that no additional mitigating measures are required. However, it is considered that inspections by a recognised noise expert will be necessary once the site is fully operational.

Operation scenario 2:

It is not expected that the limits will be exceeded at any of the assessment points in scenario 2. No additional mitigating measures other than those provided for in the acoustic design are necessary.

Comparison of benchmark situation and planned situation:

The benchmark situation is defined as the surrounding noise at the various measuring points. This surrounding noise will “initially” be strongly influenced by the specific contribution of the planned site in scenario 1 (maximum increase of 7.1 dB(A)). The Vlarem II conditions are met in the planned situation for scenario 1 after mitigating measures have been taken and for scenario 2. According to the Noise significance framework, the impact is regarded as moderately negative or negligible. No additional mitigating measures are necessary.

Mitigating measures

Construction phase

- An acoustic damper on the pressure relief device, for cleaning/testing the equipment (maximum LwA ca. 130 dB(A)) is indicated in scenarios 1 and 2 to limit the impact to MP1 and MP3 respectively.
- The best location for this pressure relief device from an acoustic point of view is near the boiler and turbine buildings. It should therefore be placed in this location or as close to it as possible.

Operation phase

In scenario 1, the noise emission from the 7 cooling cells must be limited to no more than 107 dB(A) per cooling cell. The maximum noise emission for each sub-source is listed below:

- noise emission from the pressure relief device of each cooling tower: max. 101 dB(A).
- noise emission from the engine of each cooling tower: max. 98 dB(A).
- noise emission from the NW air intake side of each cooling tower: max. 101 dB(A).
- noise emission from the NE air intake side of each cooling tower: max. 103 dB(A).

The proposed design already includes several measures on noise. No additional mitigating measures in relation to noise are required for the proposed project beyond those described above.

However, it is considered necessary for actual noise emissions to be measured once the plant has been built and is fully operational, and for transmission calculations to be performed by a recognised noise expert.

6. People discipline

Disciplines involved

People (social-organisational, toxicological and psychosomatic aspects), air, noise, landscape.

Effects on public health and mobility

In this discipline the impact of the biomass plant on the health of nearby residents is assessed. This assessment is based on data from the other disciplines: water, air, soil and groundwater, and noise.

The NO_x, SO_x, fine dust (PM_{10}), Pb, Cd, As and Cu are considered relevant for further examination with regard to air emissions. The highest contributions to immissions by the plant are recorded at Doornzele. The WHO health standard is not exceeded in any single case. The contributions for NO_x, SO_x and arsenic are limited, and they are negligible for fine dust, Pb, Cd and Cu.

The only possible source of odour nuisance is the storage of olive cake pellets. Forestry residues do not constitute a problem in this respect. As BPG only intends to use this material occasionally, it is not expected that the proposed plant will make a significant contribution to odour nuisance. This biomass (waste) will not be crushed, and therefore it is not expected that the proposed plant will contribute to odour nuisance.

The impact of the specific noise produced by the plant equipment affecting nearby homes is not regarded as harmful according to WHO guidelines. Higher noise emissions may occur for a time during the construction phase, but according to the models will never reach the current noise level. Consequently, no additional health effect is expected.

Local residents are not expected to be exposed to chemicals via surface water, soil and groundwater. Soil protection measures will be taken to avoid leaks. The surface water is not intended to be used as drinking water, for fishing or for leisure activities. In addition, discharges for both alternative locations are expected to have a negligible impact on water.

The mobility analysis shows that the project will have a limited impact on the Kennedylaan road. Traffic generated by the transport of goods and people will be 46 PCE per hour. Once the project has been completed, the total load on the Kennedylaan is estimated at around 22%.

Mitigating measures

No additional mitigating measures are proposed as the planned biomass plant does not cause any significant health and mobility effects.

The current (scenario 2) and proposed mitigating measures as indicated in the air, water, soil and groundwater and noise disciplines are sufficient to mitigate the impact of the project on people living close to both project sites.

7. Fauna and Flora Discipline

Disciplines involved

Fauna and flora, air, water, noise, light

Effects on fauna and flora

The most significant effects for fauna and flora relate to:

- eutrophying and acidifying deposition;
- disturbance as a result of noise production;
- impact on surface water (waste water, cooling water).

The loss of biotope will be low and will take place in an industrial area. No valuable biotopes are present at the site where the plant will be built.

The most significant nature conservation areas nearby are:

- The 'Woods and heaths of Flanders on sandy soil (BE2300005)' area protected by a habitat directive;
- The 'Moervaart depression to Durme valley' Large Nature Conservation Area;

The shortest distance between these nature conservation areas and the project area is more than 5 km. The Doornzele buffer zone, shown in green on the regional plan, is closer to the project area (1.6 km).

The contribution of the biomass power plant to eutrophying and acidifying deposition (due to air emissions of NO_x, SO_2 and NH_3) will be negligible at the protected nature conservation areas because of the considerable distance. The contribution to acidifying or eutrophying deposition will be (much) less than 1% of the critical deposition load for dry heathland.

The most significant nature conservation areas are at a considerable distance from the planned biomass power plant (both scenarios). The contribution of the power plant to noise levels in these areas is negligible.

The plant will discharge its waste water and cooling water into the Ghent-Terneuzen canal and/or the Moervaart (cooling water in scenario 2). The contribution of waste water discharge from the plant to worsening water quality is negligible. The plant's contribution compared to the value examined will be less than 1%. This is due mainly to the large volume of water in the Ghent-Terneuzen canal.

The discharge of cooling water does not lead to any significant increase in the temperature of the surface water, and the extent of the hot water plume will also be very small. There is not expected to be any negative effect in terms of biotope loss (parts of the canal becoming unsuitable for fauna and flora because the water temperature is too high) or barrier effects (high temperature zones impeding species migration in the canal).

Mitigating measures

The effects on fauna and flora of the construction of the biomass power plant are negligible (0) to slightly negative (-1) for all the effect groups examined. No significantly negative effects are expected.

As no significantly negative effects are detected, no specific mitigating measures are proposed. The following general objectives are important for the broader environment:

- limiting air pollution emissions (acidifying deposition, eutrophying deposition, toxicological effects);
- limiting noise emissions;
- aiming to improve water quality in the Ghent-Terneuzen canal.

The contribution to acidifying deposition is a consequence of the air emissions from the BPG biomass power plant. Mitigating measures are proposed in the Air discipline to reduce emissions from the plant (source-based measures).

8. Landscape, architectural heritage and archaeology discipline

Disciplines involved

Landscape, people, and fauna and flora.

Effects on the landscape, architectural heritage, archaeology

There are no protected monuments in the area immediately around the project site. The construction of the plant should not cause any change to protected monuments. In the long term, acidifying deposition might harm the architectural heritage.

The BPG biomass power plant will be clearly visible in the landscape at various scale levels (micro, meso and macro). It will attract the attention of passers-by and be a focal point. The tall structures will be visible to some local residents and can be found to be a nuisance. There will be negative effects from observers visiting the more open spaces in the district (nature conservation areas, parks) who are confronted with the sight of the tall industrial structures.

The impact of the biomass power plant is regarded as acceptable from the point of view of the landscape for the following reasons:

- It will be built in an industrial area and in an environment that has already been significantly influenced by humans;
- It enhances the industrial character of the area and so fits in with what already exists. Only the tall chimney of the BPG plant will be visible from a long distance. However, there are already other chimneys in the industrial area, so this one blends in.
- The Rodenhuize plant is close to the new installations, and that plant also has a number of tall structures. Some other tall structures have been added to the landscape in this project.

Scenario 2 is better from the point of view of the Landscape discipline because it does not add any new cooling towers (additional disruptive landscape element) to the landscape. Scenario 1 involves a cooling tower with artificial draft. The visual impact on the landscape of a cooling tower with artificial draft is less than that of a tower with natural draft.

Mitigating measures

It is in principle vital to strive to integrate the power plant into the landscape as much as possible. In view of the height of the structures, it is however impossible to integrate it into the landscape on a meso and macro level.

At micro level, a suitable planting scheme can be followed to create a more natural landscape at this level.

The colour of the cooling tower and the boiler flues must in principle blend into the broader environment as much as possible. This reduces the visibility in the landscape and makes the tall structures less intrusive.

General conclusion

Belgian Eco Energy intends to build a new electricity plant in the Ghent canal zone, with a thermal output of around 460-580 MWth and a corresponding electricity output of around 200-250 MWe. The gross yield of the plant will be ~ 43% and the net yield ~ 41%.

Two scenarios for the location of this new plant have been taken into consideration in the EIA: scenario 1, at the Ghent Coal Terminal (hereinafter referred to as GCT) site, and scenario 2, on land nearby belonging to Electrabel Rodenhuize.

The fuel used will be biomass (waste) in the form of pellets, chips and dust. The name of the plant will be the BEE Power Gent biomass plant (hereinafter referred to as BPG). The main equipment at the plant will be a boiler (of the Circulating Fluidised Bed Boiler (CFB) type), a steam turbine and generator installation and a flue gas cleaning installation. The biomass (waste) will be transported by ship and unloaded by Sea Invest in a large warehouse. The amount of material processed will be 800,000 to 1,200,000 tonnes a year[6].

The cooling water to condense the steam in the water-cooled condenser will be drawn from the Ghent-Terneuzen canal. After use, this cooling water will be recooled by cooling cells with artificial draft (for scenario 1) or the existing cooling towers operated by Electrabel Rodenhuize for scenario 2.

This EIA has been drawn up for this project in the context of the approval procedure. It examines the potential environmental effects on air, water, soil and groundwater, fauna and flora, noise and vibration and people in the area around the potential project sites.

With regard to emissions into air, one relevant emission source has been identified for the power plant: the CFB boiler stack. Smaller, negligible emissions from the ancillary steam boiler and the emergency diesel facility will take place in addition to these emissions.

Nitrogen dioxide and sulphur dioxide are the most important contaminants emitted. It should however be noted that the modelling was based on the emission threshold values and a maximum emission regime of 8,760 hours a year (= worst case). The main effect of this is that SO_2 is overestimated since the sulphur content of the fuel will be low. The maximum average annual background levels of these two substances in the area are 28 and 5 µg/m^3 respectively. For the new plant, the contribution at the point of the peak plume will be 1.19 (nitrogen dioxide) and 1.08 (sulphur dioxide) µg/m^3 for both alternative locations. This means that the annual threshold will not be exceeded at the point of the peak plume. This peak plume lies 1.3 kilometres north-east of the project sites, in an industrial area with no residential population.

The contributions of the proposed power plant to immission concentrations of CO and heavy metals are negligible.

There are not expected to be any relevant diffuse emissions resulting from the storage and transhipment of the biomass (waste) brought in via the GCT installations. GCT has already taken the necessary action to limit these emissions as far as possible.

[6] Estimate based on 100% pellets (max. moisture content 10%) = 800,000 tonnes a year and 100% wood chips (moisture content up to 40%) = 1,200,000 tonnes a year. The fuel will consist of a mix of both sources, see also section 2.

The impact of the industrial waste water on the Ghent-Terneuzen canal is negligible for all parameters tested in scenario 1 (<1%). This was determined on the basis of the estimated rate of flow and maximum emission loads (= 10 x quality standard receiving water) for an average and 10th percentile rate of flow of the canal. This is also the case for the cooling water discharged into the canal. The increase in canal temperature for a 10th percentile flow is calculated at 0.058 °C. The quality standard of 25°C is not exceeded.

In scenario 2, the impact of industrial waste water on the canal in both the benchmark situation and the planned situation is regarded as negligible. The discharge of cooling water into the Moervaart has a limited impact on the situation. On the basis of the average temperatures and rates of flow of the Moervaart and the waste water discharged, the impact is negligible at maximum temperatures and rates of flow (in summer). There is an improvement on the benchmark situation, as the impact falls from 2.49 °C to 1.26 °C for the average situation and from 0.51°C to 0.24°C in the maximum situation. The environmental quality standard of 25°C is not exceeded.

The environmental effects on soil and groundwater in the construction phase are regarded as negligible for all effects examined for the locations studied. The effects examined in the context of this EIA are changes to soil water and groundwater quality as a result of earthmoving, leaks or disasters, changes to groundwater balance and changes to stability. In the operational phase a moderately positive effect is expected for infiltration capacity and a relevant positive effect for land use in scenario 1, while a significantly positive effect for land use is expected for scenario 2. The effect on soil water and groundwater quality is regarded as negligible in both scenarios.

The specific noise at the assessment points was calculated by an acoustic calculation model on the basis of noise capacity levels. Limits are expected to be exceeded at a number of assessment points in scenario 1. If the noise emission from the 7 cooling cells is reduced to 107 dB(A), and the LwA of each individual source is at maximum, these limits can be met. Well-thought-out acoustic design in the design phase will mean that no additional mitigating measures are required. However, it is considered that inspections by a recognised noise expert will be necessary once the site is fully operational. It is not expected that the limits will be exceeded at any of the assessment points in scenario 2. No additional mitigating measures other than those provided for in the acoustic design are necessary.

Atmospheric emissions have not been observed to cause any noticeable impact on local residents. The highest contributions to immissions by the plant are recorded at Doornzele. The WHO health standard is not exceeded in any single case. The contributions for NO_x, SO_x and arsenic are limited, and are negligible for fine dust, Pb, Cd and Cu. The impact of the specific noise produced by the plant equipment affecting nearby homes is not regarded as harmful according to WHO guidelines. Local residents are also not expected to suffer any health effects via surface water, soil and groundwater.

The mobility analysis shows that the project will have a limited impact on the Kennedylaan road. Traffic generated by the transport of goods and people will be 46 PCE per hour. Once the project has been completed, the total load on the Kennedylaan is estimated at around 22%.

The main effects on fauna and flora relate to eutrophying and acidifying deposition, disturbance as a result of noise, and influence on surface water (waste water, cooling water). The contribution of the biomass power plant to eutrophying and acidifying deposition and noise levels will be negligible at the protected nature conservation areas because of the considerable distance. The contribution of waste water discharge from the plant to worsening water quality is negligible. The discharge of cooling water does not lead to any significant increase in the temperature of the surface water, and the extent of the hot water plume will also be very small. There is not expected to be any negative effect in terms of biotope loss (parts of the canal becoming unsuitable for fauna and flora because the water temperature is too high) or barrier effects (high temperature zones impeding species migration in the canal).

The impact of the biomass power plant is regarded as acceptable from a landscape point of view.

Scenario 2 is better from the point of view of the Landscape discipline because it does not add any new cooling towers (additional disruptive landscape element) to the landscape. Scenario 1 involves a cooling tower with artificial draft. The visual impact on the landscape of a cooling tower with artificial draft is less than that of a tower with natural draft.

APPENDICES

Key to Regional plan

8	GENTSE EN KANAALZONE			
Art. Nr.	SYMBOOL	VOORSCHRIFT	DEF.	CODE
1	V	Valleigebieden	14/09/1977	0911
2		Reservegebieden voor industriële uitbreiding	14/09/1977	1081
3		Stortgebieden	14/09/1977	1311
4	K	Bedrijfsgebied met stedelijk karakter	16/03/1994	1110
5	Z	Gebied voor zeehaven- en watergebonden bedrijven	28/10/1998	1044
6	R.O.	Regionaal bedrijventerrein met openbaar karakter	28/10/1998	1011
7	L.O.	Lokaal bedrijventerrein met openbaar karakter	28/10/1998	1111
8	K.D.	Kantoor- en dienstenzone	28/10/1998	1113
9	H	Gebied voor handelsbeursactiviteiten en grootschalige culturele activiteiten	28/10/1998	1014
10	SO	Gebied voor stedelijke ontwikkeling	28/10/1998	0132
11		Teleport	28/10/1998	1035
12.1	K 1	Koppelingsgebied K1	28/10/1998	0610
12.2	K 2	Koppelingsgebied K2	28/10/1998	0611
13		Bijzonder reservatiegebied	28/10/1998	1039
14	N.E.	Natuureducatieve infrastructuur	28/10/1998	0736
15		Pleisterplaats voor nomaden of woonwagenbewoners	28/10/1998	0130
16		Zone met cultureelhistorische waarde	28/10/1998	1610
17		Industriegebied voor milieubelastende bedrijven met nabestemming groengebied	7/07/1998	1040
18		Golfterrein	28/10/1998	0431