Wärtsilä Finland Oy
Project Design Document
Paide Bioenergy Project

ABBREVIATIONS

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AAU	Assigned amount unit
C	Fuel consumption (coal, gas or oil)
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CHP	Combined heat and power plant
DH	District heating
CH_4	Methane
CO_{2eq}	Carbon dioxide equivalent
CO_2	Carbon dioxide
E	Emissions
e	Electricity
ER	Emission Reduction
ERU	Emission Reduction Unit
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFO	Heavy Fuel Oil
HOB	Heat-only-boiler plant
I	Emissions intensity
JI	Joint Implementation
MoU	Memorandum of Understanding
MVP	Monitoring and Verification Plan
N_2O	Nitrous oxide
PDD	Project Design Document
PIN	Project Idea Note
th	Thermal
UNFCCC	United Nations Framework Convention on Climate Change
Baseline	The scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of greenhouse gases that would occur in the absence of the CDM or JI project
Emission Reduction	Reduction of greenhouse gas emissions or enhancement of carbon removals as a result of the CDM or JI project in relation to a defined baseline
Monitoring	Systematic surveillance and measurement of aspects related to the implementation and the performance of the project which enables the measurement or calculation of Emission Reductions
Verification	Periodic review and ex-post determination by an operational entity (independent entity) of the monitored Emission Reductions that have occurred as a result of a CDM (JI) project during the verification period

1 PROJECT SUMMARY

The project Design Document (PDD) includes the information required to implement the installation of a 8 MW biomass fired boiler plant in Paide, Estonia as a JI project within the Finnish CDM/JI Pilot Programme. The plant will provide thermal energy for the municipality's district heating network. The plant is scheduled to start operating in 2003, using bark, saw dust and wood chips. It is also able to utilise peat.

The PDD is mainly based on the Operational Guidelines of Finnish Pilot Programme (Ministry for Foreign Affairs 2002) and the Marrakesh Accords of the UNFCCC (UNFCCC 2001). The project is endorsed by the Government of Estonia and a MoU has been signed by the governments of Estonia and Finland. Estonia and Finland has agreed 17.12.2002 on transferring ERUs to Finland.

The PDD contains a project description, information concerning environmental impacts and stakeholder involvement, a baseline study and an assessment of additionality as well as a monitoring and verification plan.

The emissions reduction of the project is estimated at 72 300 t CO_2 eq. in 2008-2012 and 135 000 t CO_2 eq. in 2003-2012 provided that no peat is used. The emissions reduction during the total estimated lifetime of 20 years is estimated at 294 000 t CO_2 eq. in 2003-2023. Emission reductions will be achieved through replacement of heat production based on shale oil or heavy fuel oil.

In addition to the GHG emission reductions, the project is estimated to contribute to local socio-economic development in a sustainable way.

2 PROJECT DESCRIPTION

2.1 Background and justification

The objective of the project is to introduce a new biomass boiler in the Town of Paide, Estonia. Partners of the project will be OÜ Pogi i.e. the privately owned district heating company, Wärtsilä Finland Oy BioPower and various financial institutions. Consulting services to support Wärtsilä Finland Oy in PDD preparation have been provided by Electrowatt-Ekono Oy, Finland. OÜ Energiaekspert, Estonia has also consulted the project. The Town of Paide strongly supports the project.

The project is planned to be implemented as a part of the Finnish CDM/JI Pilot Programme. Financing is planned to be based on equity and borrowing. Financing has not been finalised as of today but the planned set up is shown in Chapter 2.6.2.

The project will stimulate development of local heat markets and will lead to stabilization of heat prices. It will also have a positive effect on socio-economic development in the area. The project will result in improvement of the local and global environment. The contribution to GHG abatement is important for climate change mitigation.

2.2 JI eligibility

2.2.1 The Kyoto Protocol and the Marrakesh Accords

To participate in JI Projects under the Kyoto Rules a country must:

- Be a country included in Annex I of the UNFCCC;
- Be a party of the Kyoto Protocol;
- Designate a national focal point for approving JI projects;
- Have national guidelines and procedures for approving JI projects;
- Have a national system for the estimation of greenhouse gas emissions by sources and removals by sinks; and
- Have submitted the most recent annual inventory of its emissions

According to the Marrakesh Accords (UNFCCC 2001) there are two different sets or tracks of procedures and guidelines that apply to hosting JI projects.

The first JI track approach allows the host Party to determine the verification requirements for JI projects and to verify whether ERUs are additional. Under the second track the generation of ERUs from a JI project will be governed by procedures set in the Marrakesh Accords and supervised by an international regulatory agency i.e. JI Supervisory Committee (SC). Which track a Party can adopt is determined by its compliance status with the JI eligibility criteria.

The SC will be appointed in the first COP/MOP after the Kyoto Protocol enters into force. During the interim period the likely approach is to develop projects according to the existing rules and register the projects and their documentation with the respective host and investor governments. This kind of approach has been used in many cases i.e. by the Dutch ERUPT/Carboncredits.nl programme and the Prototype Carbon Fund (PCF) of the World Bank.

2.2.2 The Finnish CDM/JI Pilot Programme

As many aspects related to JI and the Kyoto Protocol are still open, the Finnish CDM/JI Pilot Programme has defined some additional eligibility criteria for JI projects:

- Projects must be technically, financially and economically sound;
- The project must comply with the host country legislation, as well as with any criteria and requirements that the host country may have established for JI projects;
- The project must produce real, measurable and long-term benefits related to the mitigation of the climate change;

- The benefits must be produced in a cost-effective way (measured by the purchase price in €/t CO_2eq);
- The projects must undergo an environmental assessment and provisions must be made for public participation in the project cycle;
- The project must not have significant negative environmental impacts and it must be supportive of the Finnish Policy on environmental co-operation with neighbouring countries;
- Projects that promote the exports of Finnish environmental technology and in addition to reducing GHG emissions have other positive environmental impacts in Finland or in the host country will be given priority.

The Finnish Programme also requires independent determination as a prerequisite for project approval based on the second track of JI. An independent entity will determine whether the project design and documents fulfil the requirements of the Kyoto Protocol. Determination is equivalent to validation in the CDM project cycle, although the term 'validation' is not used in the rules for JI.

In the Pilot Programme, the objective of the independent determination is to make sure that the project has a valid baseline and generates emission reductions that can be registered and transferred to Finland.

An independent determination of the project documents is not required under the first track of JI. However, during the Pilot Programme it is not yet known whether the host country will be eligible for the first track. For this reason, the independent assessment of the project documents by an independent entity is required in all cases.

Finland has ratified the Kyoto Protocol in 31.5.2002.

2.2.3 Estonian JI criteria

The Government of Estonia supports the use of JI as an important means to obtain the objectives of the Convention and the Kyoto Protocol. It has signed Memorandum of Understanding with several governments including Finland. JI focal point in Estonia is Ministry of Environment.

There are currently no national evaluation criteria or other special requirements for JI projects in Estonia. Criteria are, however, currently discussed. Estonia has ratified the Kyoto Protocol in 14.10.2002. Estonia and Finland has agreed 17.12.2002 on transferring ERUs to Finland.

2.2.4 Project approval

The project meets all the stated requirements sufficiently and has been endorsed by the government of Estonia (see Annex 1). The PIN has also passed initial screening by the Steering Committee of the Finnish Pilot Programme (see Annex 2). The final approval of the Steering Committee is expected to be based on the PDD. The PDD could be supplemented with additional documents during the project development.

2.3 Project purpose

The core of the project is the installation of a biofuel boiler. The unit is using wood based waste but it is also capable for burning peat up to 30% of the total fuel consumption. Several aims will be reached with the installation of the boiler. From Pogi's point of view the installation aims to ensure profitability of the company in the long run. Simultaneously this means more stable prices and reduced SO_2 and NO_x emissions. The project will also improve the competitiveness of district heating against other heating option that are often less environmentally friendly.

The contribution to GHGs abatement is important as the new plant will replace local heat production based on oil shale oil and/or heavy fuel oil.[1]

2.4 Project's contribution to sustainable development

The project will contribute to sustainable development in several ways:

- GHG emissions are reduced
- Likely reduction of landfill disposal of biomass
- SO_2 and NO_x emissions are reduced thus improving air quality in Paide
- Local development is supported as the fuel is produced in Estonia
- The project stimulates the use of renewable energy sources and the efficient use of natural resources due to efficient production of heat.
- The project provides long term security for local energy supply
- There is a strong local support for the project
- The project stabilises the price of heat

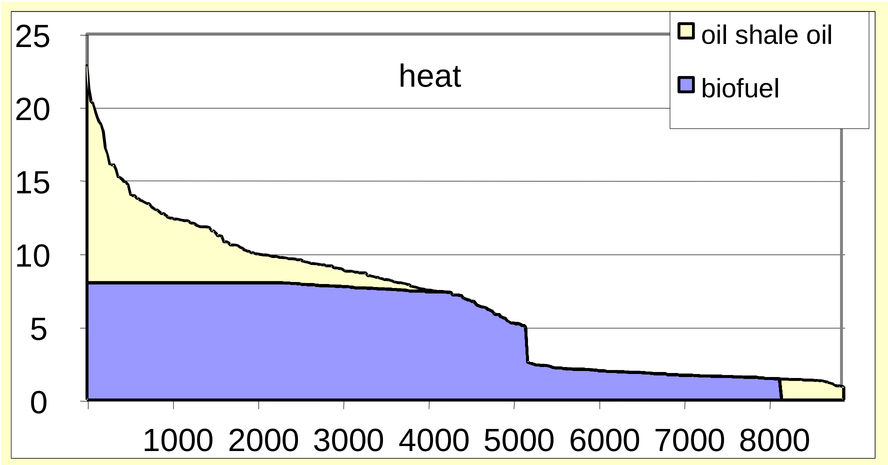
The project is also in the line with Estonian energy policy in increasing the share of renewable energy in primary energy use. There are currently, however, no binding requirements on the local level and neither are there no effective incentives for the above mentioned transfers.

[1] Depending on price. Shale oil has been used in the recent years.

2.5 Technical description

2.5.1 Introduction

The plant is planned to be the base load source in Paide and would supply the district heating network. During summer operation the plant would deliver heat for hot tap water production in local substations covering the whole demand.



heat	biofuel	oil shale oil	production
GWh	43.8	13.7	57.5

Figure 1. The planned load curve of the project.

2.5.2 Boiler house and fuel storage

Fuel receiving station and the push feeders (6 pieces) as well as other fuel feeding equipment will be installed on the foundation, included in the OÜ Pogi's scope of supply. All primary and secondary combustion chambers, pumps, pipeworks, tanks, fittings etc will be installed in a new boiler house facility, which will be build for this purpose. OÜ Pogi will order the foundation as a separate project.

OÜ Pogi will complete all the foundation including concrete work. OÜ Pogi will also purchase all the steel parts attached to the foundation. Also all the railings at the bottom of the fuel storage for the feeders are included in this scope excluding supporting and fastening structures above the foundation. Those are included in Wärtsilä's scope of supply.

2.5.3 Fuel Handling

The plant can be operated on wood based fuels like, bark, sawdust, and chipped wood as well as fuel blend containing peat – if needed - as defined in the warranty terms. The fuel is transported either by truck or wheel loader to a separate new fuel storage next to the boiler house equipped with the push feeders.

The level controller located in the cone of the grate operates the scraper conveyor, carrying the fuel, starting and stopping it when needed. From the cone the fuel is taken by a Stoker screw to the mechanised grate.

2.5.4 Burning equipment

Burning is done using a two phase burning technique. In this technique the fuel is fed onto the grate located in the insulated primary combustion chamber from beneath the grate. The burning process is therefore even and it does not disturb the burning zone. In addition the fuel dries up efficiently before reaching the burning zone.

Primary combustion chamber is constructed of steel plate, which forms a gas tight jacket. On the inside of the jacket there is insulation, insulation masonry and the refractory. The shape of the primary combustion chamber makes it durable and combustion technically efficient. Feed air is led into the primary combustion chamber via dedicated ducts as primary air under the grate and as secondary air into the combustion space within the primary combustion chamber. The fans are speed controlled.

The fans are located on a platform over the primary combustion chamber and the air inlet is directed to the air box located over the secondary combustion chamber. The heated air is taken from the box. No actual air pre-heater will be installed.

The gasifying and partially flammable flue gases are led from the primary combustion chamber to the secondary combustion chamber, where the burning takes place in extremely high temperature (1000-1100 ºC). The flue gases are led after this to a horizontally placed firetube boiler operating with forced circulation. The capacity adjustment is handled by adjusting the fuel feeding with its control mechanism, with the help of lower pressure and by adjusting the speed of the flue gas fan.

2.5.5 Flue gas cleaning

After the boiler the flue gas is led into a multi cyclone cleaner where the gases are put into rotating movement and the coarse particles are separated on the cyclone walls. From there they are dripping down to a collection cone.

The ash, which is separating in the cyclone is collected on a scraper conveyor beneath the cleaner. Ash is then carried with the conveyor to the ash container located in a separate location. The cleaned exhaust gases are the led to a 25-meter steel chimney. The ash generate din the grate falls over the utmost grate to a ash primary container located beneath it. It is then removed with a rotating push feeder to a submerged scraper conveyor and further to the secondary ash container.

2.5.6 District heating pipes and equipment

The scope of supply contains all the necessary piping needed for connecting to the existing district heating network. The equipment – currently used by OÜ Pogi – is used to pumping of district heat as well as keeping up the operation pressure. The pipes and attached equipment required by the boiler system are supplied with installed with insulation.

The pipes are supplied as modules from the factory and final installation takes place at the site. The scope of supply contains the piping needed to join the district heating network between the old and the new plants.

2.5.7 Electrical installation, instrumentation and automation

Electrical installation is carried out according to our standard scope of supply. The scope has been defined for the electrical parts and automation in a separate document.

The scope of supply includes all necessary instrumentation equipment installed in the pipelines and other process equipment. The data collect with the use of measuring device is handled with a logic based automation system, which is used to automatically direct the burning process. The system is planned for the requirements of unmanned operation

See also Chapter 5.2 for further information.

2.6 Economic and financial information

2.6.1 Feasibility

A feasibility study has been completed based upon the cashflow information given by OÜ Pogi. The purpose of this study is to identify the fuel switching possibilities for using biofuel (wood chips, bark, sawdust) and possibly peat for the production of thermal energy in Paide boiler house. The technical and financial feasibility of the project is a precondition for converting the boiler house to biofuel.

The final aim of the feasibility study is to find an optimum technical solution for production of thermal energy in Paide in a way, which ensures a stable price and sufficiently constant supply of thermal energy. A study of the possible technical options has been made by a local consultant based upon the possible conversion from the fossil fuels to renewables (AF-Esteam OÜ 2001). On the drawing board the most feasible option would be the conversion of the existing boilers to use wood. This has been, however, rejected due to specific reasons (see Chapter 5.4)

The feasibility has been calculated from two different standpoints. Firstly there is an analysis of the total investment showing the overall profitability of the project. This calculation is including all the variables in the operation. Secondly the profitability has been estimated using fuel cost and anticipated JI funding as variables. Additionally an up-front contingency provision of 1 million EEK has been added, which corresponds to about 3.5% of the Project Cost.

Supplier	**<--------- fuel max delivery quantity --------->**					**transport**
	peat	**bark**	**sawdust**	**wood chip**	**shale oil**	**distance**
	tn.	**cu.m**	**cu.m**	**cu.m**	**tn.**	**km**
Oil shale oil					1850	146
AS Prelvex	4 500					3
Finnforest Eesti AS		15 000	3 000			4
Aegviidu AS		10 000				58
Naturalis AS		3 000		2 000		35
Tenafor Oü				40 000		96
Imavere Saeveski AS		30 000				29
Total	**4 500**	**58 000**	**3 000**	**42 000**	**1 850**	

Fuel cost has been analysed based upon written offers received from a number of saw-mills and wood processing factories. There may be additional fuel sources still available (see also Chapter 5.1.2) and provided they will reduce the overall cost they can be utilised. Currently the fuel cost is calculated based upon the below listed data.

2.6.2 Cost and financing

The total cost of the project is about 1.899 million EUR. The project consists of:

Equipment supply from Wärtsilä BioPower	1 526 kEUR
Local works	255 kEUR
Project financing during construction	24 kEUR
Other development expenses	30 kEUR
Contingency reservation	64 kEUR
Total investment	1 899 kEUR => 29 713 000 EEK

Local works portion includes (in kEUR);

Foundation	36
Yard	92
Warranty	18
Roads	50
Plot	15
Joining the networks	25
Fence and gates	19
Total	255

About 70% of the Wärtsilä BioPower supply will be delivered from Finland. The building, fuel feeders and a part of the installation work will be locally purchased from Estonia. OÜ Pogi's share of investment consists of financing cost, interest expenses during the construction and local works as defined above.

It is unlikely that projects would commence if the Finnish CDM/JI Pilot Programme simply purchased the emission reductions after they have taken place. This plant will be financed mainly through a leasing arrangement and the lease provider has clearly expressed that for them the JI-funding is a prerequisite. Due to division of Pogi's cashflow over the year an advance JI contribution is essential for project implementation. Pilot Programme can make an advance payment against the expected emission reductions (see Annex 2).

Payment would in this case be split into one down payment during the construction and annual payments based upon monitoring of the emission reductions achieved. The down payment has been considered as part of the project financing while the annual JI payments improve the cash flow until the year 2012.

Table 2-1. Preliminary plan for financing the project.

Equity financing	EUR	EEK
OÜ Pogi contribution	98 000	
Subordinated JI-support	267 000	
Total equity:	365 000	5 713 000
Loan financing		
Hansa Liising credit	1 534 000	
Total debt:	1 534 000	24 000 000

Financing of the project is the biggest single issue from the investors' point of view. In order to get the project off the ground various options were studied. Eventually in December a provisional agreement was reached with Hansa Liising. Hansa Liising has shown green light for the project provided the JI-support will materialise as negotiated and adequate self-financing could be fulfilled.

The profitability has been calculated only for the project. Most important sensitivities have been also analysed. Key project parameters are presented below:

Period:	20 years
Investment:	29 713 tEEK
Joint Implementation:	534 000 EUR
Payment:	50% during construction, 50% over the period 2004-2012
Inflation:	not included in the calculation
Loan period:	10 years
Borrowing rate:	7.4%
IRR without JI	11.6 %
IRR with JI	15.1 %

2.6.3 Risk mitigation

An overview of the key risks are given below.

Political risks: Estonia is today viewed as a fairly stable country. Relations with its neighbours are good and Estonia has applied for EU membership. The Estonian Kroon has since many years been stable, linked to the Euro (originally to German Mark).

Completion risk: Wärtsilä BioPower will engineer, procure and supply the 8 MWth boiler plant. Tasks planned to be performed by OÜ Pogi are such by nature that OÜ Pogi itself is very well equipped to handle, such as the interconnection works to the existing district heating network facilities.

Paide itself is located centrally in Estonia, with good access and communications. The new site is a fairly levelled field with grass, bushes and some trees, so the place itself should not pose any difficulty. The land has been purchased and the required permits are already in place.

Operational risk: The technology used is based on proven, patented technology. Since 1997 Sermet/Wärtsilä BioPower has delivered similar 58 BioGrate boilers to clients in Finland, Scandinavia, Baltic States, Canada and France. Wärtsilä BioPower will also provide a 12 months warranty. Boilers are a well-known technology to the staff of OÜ Pogi. Pogi's management has experience up to 30 years of heat generation.

OÜ Pogi have concluded negotiations about extending the rental agreement of district heating network with Paide Vesi OÜ (owned 100% by the Town of Paide), for a period commencing July 1, 2004 till June 30, 2014. The present contract is valid until June 30, 2004. The existing oil-fired boilers will remain in place as well, not only providing a peak shaving capacity, but can also be used for back-up purposes.

Fuel supply risk: OÜ Pogi's intention is to sign fuel supply agreements with about half a dozen local fuel suppliers, which ought to provide more flexibility than if they were to be relying on only one or two suppliers for the fuel. From a technical point of view the 8 MWth biofuel fired boiler can also burn up to 30% peat if needed. Peat is also available nearby, however, price wise peat is more expensive than wood waste products and would thus not be the first choice fuel. Additionally peat is not classified by IPCC as a biofuel, and therefore the use of peat would decrease the ERUs generated by the project.

Fuel price might prove a more challenging issue that fuel supply itself. The single biggest risk seems to be in case the bio fuel price would start escalating, and if this cost increase could not be reflected in the sales price. The tables below shown how different fuel prices (left column, EEK/m^3) and heat prices would affect the profitability of OÜ Pogi. Heat price is rather conservative in this calculation compared with the current price. Higher heat price would compensate the possible increase of fuel price from the current level, and maintain the profitability of Pogi. As reference has been used Profit Before Tax (PBT) during the second year of operation:

PBT Y02	Heat Price (EEK/MWh)				
850 775	355	375	395	415	435
34,20	-648 283	295 717	1 239 717	2 183 717	3 127 717
36,10	-842 754	101 246	1 045 246	1 989 246	2 933 246
38,00	-1 037 225	-93 225	850 775	1 794 775	2 738 775
39,90	-1 231 695	-287 695	656 305	1 600 305	2 544 305
41,80	-1 426 166	-482 166	461 834	1 405 834	2 349 834
43,70	-1 620 636	-676 636	267 364	1 211 364	2 155 364
45,60	-1 815 107	-871 107	72 893	1 016 893	1 960 893

The so called Base Case scenario is highlighted in colour. The easiest way to try to mitigate this risk element would be by signing as long fuel supply agreements as possible. However, the same logic already today applies to OÜ Pogi's business. Bark, saw dust, wood chips, and possibly peat might prove to be less volatile fuels than oil shale oil or heavy fuel oil in the future. Possible increase can probably be compensated with the heat price as discussed above as heat price in indexed with fuel price in Estonia.

Financial risks: OÜ Pogi itself is a small company in comparison with this project. It is thus quite clear that this Project will be fully reliant on the future cash flows generated by this boiler plant. The Project is, however, profitable on its own merits.

Financing costs or the loan amount seem to be parameters to which this Project is comparably less sensitive. OÜ Pogi cash flow calculation is sort of implicitly presuming 100% financing – JI support of 4 MEEK and a credit of 24 MEEK. The parameters remain the same; Profit Before Tax during the second year.

PBT Y02	Borrowed Amount (EEK)				
850 775	21 500 000	23 000 000	24 000 000	26 000 000	28 722 000
6,5 %	1 343 725	1 135 068	995 964	717 754	339 111
7,0 %	1 273 360	1 059 794	917 416	632 661	245 110
7,4 %	1 213 661	995 930	850 775	560 467	165 357
8,0 %	1 130 342	906 798	757 769	459 710	54 051
8,5 %	1 057 711	829 099	676 691	371 876	-42 978
9,0 %	984 344	750 614	594 794	283 154	-140 988

Accordingly is the Project also comparably less sensitive to the project cost impact:

PBT Y02	Total Project Cost (EEK)				
850 775	25 000 000	27 000 000	29 713 000	31 000 000	33 000 000
65,0 %	1 975 720	1 787 020	1 531 048	1 409 619	1 220 919
70,0 %	1 794 278	1 591 062	1 315 399	1 184 630	981 414
75,0 %	1 612 835	1 395 104	1 099 751	959 641	741 910
80,8 %	1 403 351	1 168 861	850 775	699 881	465 391
90,0 %	1 068 507	807 229	452 806	284 674	23 396

The JI support will provide additional revenues to the Project.

Environmental risks: In comparison with the existing oil fired boiler plant, the project should be a more environmentally friendly with the exception of possibly increasing particle emissions (see Chapter 3 for more details)

In summary, the main risk element seems to be the fuel. Price of fuel probably more than the supply of fuel, as OÜ Pogi has already located local fuel suppliers for delivery of more than 100 000 m^3/year, whereas their need is estimated at 87 000 m^3/year. On top of this could peat be used, up to 30%. One key issue for OÜ Pogi would thus be to try to sign as long fuel supply agreements as possible, in order to obtain a fixed price, at least for a portion of their fuel requirements.

2.7 Location

Paide which is one of the 253 municipalities in Estonia is located some 80 km South-East of Tallinn in Järvamaa region in the central part of North-Estonian plateau, on the upland between the rivers of Pärnu and Reopalu (see Annex 3). The region covers the area of 1 005 ha, which is surrounded by marshlands. The elevation is 60-65 metres above the sea level. Closest neighbours are Reopalu with about 2 000 and Väätsa with about 1 500 inhabitants parishes.

OÜ Pogi owns the plot where the new boiler plant s going to be placed. The plot is located in the outskirts of Paide bordering the plot where the currently used plant is located. See also Annex 4 for details. Paide does not have a gas pipeline available. At the moment the pipeline is not closer than 40 km away and there are no known plans of extending it to Paide.

The main employers in the town are the local municipality, schools and the saw mills and factories producing components for furniture. The town of Paide is a secure local government unit with 12 000 inhabitants, which comprises both densely inhabited areas and some neighbouring villages (Reopalu, Sillaotsa, Kriilevälja, Viraksaare, Mäo, Mündi). The growing profit and income base of the town gives enough opportunities to constantly improve the infrastructure of the region.

The number of families living in their own dwelling houses has increased. Birth rate in the town has risen to a great extent. The network of educational establishments in the region has been optimised. Prerequisites have been created to increase the amount of tangible facilities for comprehensive schools. Paide – the centre of the heartland of Estonia - has become a place for national events. On the enlarged territory of the town different places to provide active recreational opportunities to its residents

2.8 Key parameters

The following key parameters can possibly affect the project and baseline. Expected development in these key factors have been taken into account in various Chapters of this PDD.

- Legal
  - legislative changes related to climate policy
  - energy and environmental regulations
  - regulations related to heat prices
  - rental agreement
- Economic
  - price of heat in Paide
  - development of fuel prices (shale oil, HFO, bio fuel, peat)
  - competitiveness of DH
  - local economic development
  - available funding for JI projects

- Political
  - Progress of the planned energy policy
- Environmental
  - requirements related to EU accession
  - national and/or local environmental requirements
- Technical
  - performance of the selected equipment in the whole project fuel chain
  - condition of DH network

3 ENVIRONMENTAL IMPACTS

The Marrakesh Accords and the Finnish Pilot Programme require sufficient information concerning environmental impacts. According to the Estonian Environmental Protection Law no EIA procedure is required for projects of this size.

Pollution permit is prerequisite for building permit and building permit has been granted to the project. In addition to the building permit there are no additional requirements for constructing a plant according to the information provided by OÜ Pogi and other stakeholders. Local municipality approves the building permit, and therefore all the requirements are fulfilled for the construction according to information provided by project participants.

The project would lower local SO_2 and NO_x emissions in addition to GHG abatement (Table 3-1). There might be a slight increase of particle emissions when comparing the same heat production from the current plant (baseline emissions) with the project. Project emissions are, however, based on guarantee values, and probably overestimated. It is therefore possible that there is no increase of particle emissions.

Project would also decrease landfill disposal of biomass in Paide provided that OÜ Pogi and municipal authorities would agree on the use of biomass taken currently to landfill. Other environmental impacts can be considered rather minor. There would be increase of traffic due to biomass transportation. Location of the plant is, however, rather optimal in this sense, i.e. close to outskirts of Paide.

Emissions from the Peetri plant are the following (Table 3-1). Emissions are clearly below the current permit. There is no emission control equipment installed in the current boiler plant. According to Estonia legislation, there are fees set per tonne of pollutant. OÜ Pogi pays approximately 1 200 EUR annually for particle, CO, SO_2 and NO_x emissions.

LCP Directive might influence the operations of the current plant starting 2008 as the total capacity is over 50 MW. According to tentative analysis, there might be a need reduce PM emissions and also a slight NO_x emission reduction might be needed. It is, however, possible that Peetri plant is subject to a national emissions reduction plan or the plant is operated less that 20 000 hours in 2008-2015. In these cases no additional emission reduction measures might not be needed. It should also be noted that there is overcapacity in the current plant, and approximately only 20-22 MW are needed. i.e. decommissioning might be a possible option.

Table 3-1. Total, allowed and baseline emissions from oil-fired Peetri boiler house, and estimated emissions from the new plant, t/a.

	Peetri boiler house			New plant
Component	**Emissions in 2001**	**Allowed emissions**	**Baseline emissions***	**Emissions**
Particles	31	774	24	37
SO_2	122	331	93	≈ 0**
NO_x	46	173	35	28

* based on the same production as the project (the project do not replace production from the current plant entirely), ** depending on fuel quality

4 STAKEHOLDER INVOLVEMENT

According to the rules for JI, national governments are required to develop guidelines and procedures for stakeholder consultation. The PDD should after completion be made available for stakeholder comments. Confidential information does not have to be disclosed.

Stakeholders are defined as the public, including individuals, groups or communities affected, or likely to be affected, by the project (UNFCCC 2001). In this case they are neighbours, Town of Paide and regional authorities and Estonian Ministry of Environment

The project has been granted a building permit, and therefore all the related official stakeholder involvement has been fulfilled according to Estonian requirements. The mayor of Paide Tõnis Kõiv has expressed that the town will do its best to support Pogi's operations.

Town of Paide has been contacted by OÜ Pogi supported by Wärtsilä in order to renew the lease agreement of the district heating network as well as the Peetri boiler house. The Town council has reviewed the situation and decision is expected in the future.

5 BASELINE STUDY AND ASSESSMENT OF ADDITIONALITY

5.1 Greenhouse Gas and System Boundary Analysis

5.1.1 Definitions and Guidelines followed

GHG emissions (and sinks) of projects can be generally divided into four categories as follows:

- Direct on-site emissions resulting from burning and handling fossil fuels in the actual heat and power generation (is applicable) facilities;

- Direct off-site emissions, which may be "upstream emissions" connected with the production, transmission and distribution of fuels, or "downstream emissions", which are connected, for instance, with off-site heat production capacity that the project is replacing;

- Indirect on-site emissions, which may be, for instance, changes in heat demand due to the project;

- Indirect off-site emissions, which can be any changes in emissions or sinks, which occur from parallel activities, that can be considered to occur indirectly due to the existence of the proposed project (for instance, the project will increase the gas consumption over a critical threshold to justify the gas network expansion also for other consumers).

The Marrakesh Accords of the UNFCCC (UNFCCC 2001) provide basic definitions for baseline issues:

> *"The baseline…is the scenario that reasonably represents the anthropogenic emissions by sources….of greenhouse gases that would occur in the absence of the proposed project. A baseline shall cover emissions from all gases, sectors and source categories…within the project boundary".*
>
> *"The project boundary shall encompass all anthropogenic emissions by sources and/or removals by sinks of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the…project"*
>
> *"Leakage is defined as the net change of anthropogenic emissions by sources… of greenhouse gases which occurs outside the project boundary and that is measurable and attributable to the ...project".*

The Marrakesh Accords provides also some more detailed rules for constructing an emissions baseline:

> *"A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A and anthropogenic removals by sinks within the project boundary.*
>
> *A baseline shall be established:*
>
> *(a) On a project-specific basis and/or using a multi-project emission factor*
>
> *(b) In a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors.*
>
> *(c) Taking into account relevant national and/or sectoral policies and circumstances such as sectoral reform initiatives, local fuel availability, power sector expansion plans and the economic situation in the project sector.*
>
> *(d) In such a way the ERUs cannot be earned for decreases in activity levels outside the project activity or due to force majeure.*

(e) Taking into account of uncertainties and using conservative assumptions.

Project participants shall justify their choice of baseline."

It should be noted that there are no universally applicable methods for baseline determination.

5.1.2 Project boundary

The principle of this study in the definition of the project boundary has been to adopt practical (i.e. easy to monitor) yet conservative (i.e. emission reductions are rather underestimated than overestimated) approaches.

The project will have no[2] carbon dioxide emissions (CO_2) provided that peat is not used. The possible use of peat (or other fuels) is, however, included in monitoring and verification plan. The project has a minor impact on methane (CH_4) and nitrous oxide (N_2O) emissions from combustion of bark, wood chips and possibly peat. The project will have no practical impact on hydrofluorocarbon (HCFs), perfluorocarbon (PCFs) and sulphur hexafluoride (SF_6) emissions.

The GHG emissions from the current Peetri plant (baseline) are based on the same amount of heat production as in the emissions calculation for the project. The baseline has been estimated on a relative basis, i.e. the likely changes in activity level are taken into account in the calculation of emission reductions. The project has no influence on emissions from power generation.

Heat losses

Reduction of DH network heat losses could be a feasible method to reduce costs. According to a tentative analysis, the relatively high heat losses of 18% - when compared to the modern DH systems but rather typical or even low in comparison with many Eastern European countries - are mainly due to the over dimensioned pipes compared with the current heat load. Therefore it is costly to reduce these losses. In order to reduce the losses by 2010 to level of below 10%, investment of approximately 1.5 –2.0 MEUR would be needed according to tentative analyses. This investment would practically replace existing channels that are not pre-insulated to pre-insulated ones. This investment is considered impossible to finance both in baseline and project cases.

Assumptions concerning heat losses (reduction from the current level of 18% to, say, 16% by 2010 baseline case) do not have any major impact on the number of ERUs generated by the project (especially taking into account otherwise rather conservative baseline i.e. the role of possible biomass dumping). No change of heat losses is currently assumed in calculations.

Energy production is the only phase of the fuel chain included in the project boundary. Emissions from the other phases were excluded from the final calculations because they were considered insignificant and would unnecessarily complicate the monitoring process. The results of the calculations are, however, presented below.

[2] CO_2 emissions from biomass are not taken into account in the emisson inventories according to UNFCCC guidelines.

Baseline use of biomass

Methane emissions by anaerobic digestion of dumped biomass residues could be an important source of greenhouse gas emissions. There is currently no evidence of landfill disposal or dumping of biomass in Estonia according to the information provided by OÜ Pogi concerning the fuel that OÜ Pogi is planning to utilize. Current practise is to sell the biomass to other uses. Part of the bark is, for example, currently exported to Ireland to be utilized in gardens improving growth and fertility. No GHG emissions are expected from this use as decomposition is assumed to be aerobic. Approximately 12 m^3/day (4400 m^3/a) is, however, presently being disposed to Paide landfill, and OÜ Pogi is considering to purchase this biomass. This biomass in not currently taken into account as a fuel supply. Landfill disposal of biomass is currently possible in Estonia.

Peat is not produced unless there is a market for it.

A hypothetical calculation based on the IPCC method shows the importance of biomass as a methane source (Table 5-1). Inclusion of methane reductions would clearly increase the generation of ERUs from the project – approximately 14%. For the time being, there is a lack of documentation concerning the role landfilling in Paide, and methane reductions are not taken into account in calculations. Also the EU landfill Directive might influence the possibilities to include methane emission reductions from landfills in JI projects in the future.

Table 5-1. Hypothetical emissions from biomass dumping.

Biomass used by the project approx., m^3/a	100 000
Biomass, t/a	40 000
Biomass approx. landfilled in Paide, t/a	1 600
CH_4-emissions, t/a[3]	96
CO_2 eq. Emission, t/a	2 020

Fuel transportation

Emissions from transportation of biofuels and peat and were calculated using typical[4] emission factors for lorries both in baseline and project cases (see also Chapter 2.6.1 for further information concerning fuels). Emissions are insignificant in comparison with baseline emissions and also a rather small part of project emissions and were therefore excluded from final calculations.

[3] Assumptions:

Fraction disposed	1
MCF	0.6
DOC	0.3
DOCf	0.5
F	0.5
R	0
OX	0.1

[4] http://www.vtt.fi/rte/projects/lipastoe/index.htm

Table 5-2. Estimated project emissions from the transportation of biofuels and peat.

CO_2 emissions	520	g/km
CH_4 emissions	0.016	g/km
N_2O emissions	0.033	g/km
CO_2 eq	531	g/km
Traffic volume	131 362	km/a
Emissions	70	t CO_2 eq/a

Table 5-3. Estimated baseline emissions from the transportation of oil.

CO_2 emissions	520	g/km
CH_4 emissions	0.016	g/km
N_2O emissions	0.033	g/km
CO_2 eq	531	g/km
Traffic volume	21 608	km/a
Emissions	11	t CO_2 eq/a

Fuel production

Moreover, the GHG emissions from oil shale mining and shale oil production as well as from HFO production could also be taken into account. These emissions are, however, not under the control of the project participants and neither are they necessarily measurable and attributable to the project. Exclusion of the shale oil fuel chain emissions lead to an underestimation of emission reductions, i.e. the baseline is conservative also in this sense (positive leakages).

Other factors

Additional possible leakages might result from i.e. activity shifting or market effects but no significant additional leakages have been identified. Since the implementation of the project will not have any significant impact on the availability of energy and the impact on costs is also minor (rather stabilizing the prices), the project is not expected to have an impact on the overall level of heat consumption in Paide.

The selection of the project boundary is illustrated in Figure 2.

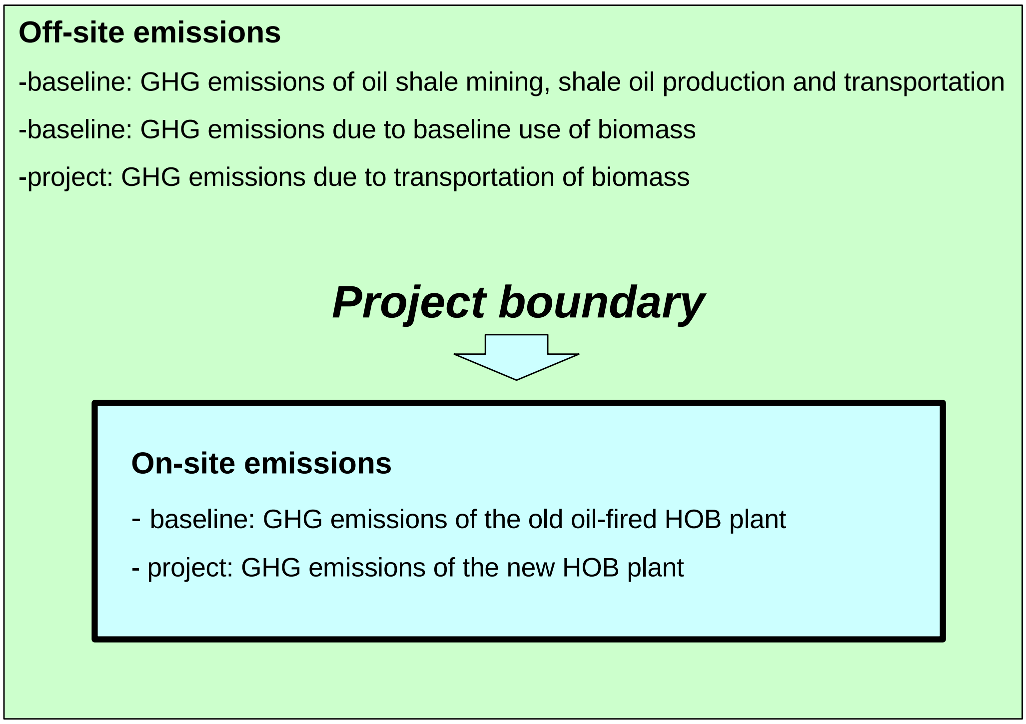


Figure 2. Project boundary.

5.2 Description of the Current Situation

The district heating system of Paide is presently based on oil-fired Peetri boiler house using approximately 7600 tonnes of shale oil annually (2001). Heavy fuel oil has also been used (depending on price).

All the energy sold via the DH network of Paide town is transferred from the Peetri boiler house, where 3 steam boilers DE-25 have been installed, with a total capacity of 51 MW[5] and 1 boiler 3W-4000 with a capacity of 4 MW. All existing boilers commissioned in the year 1991 are in good technical condition, but they can only be heated with heavy fuel oil, mainly shale oil in the recent years.

Since the boilers have been well maintained, the efficiency has stayed comparatively high, which has enabled to offer a good price of heat to the clients. The average heat price in 2002 is 420 EEK/MWh and heat price is indexed to the changes in fuel price. The average annual efficiency of Peetri boiler house is 82%.

OÜ Pogi operates the facilities according to lease agreement. Peetri boiler house and district heating network are 100% owned by Paide municipality though OÜ Paide Vesi.

5.2.1 Heat load

OÜ Pogi distributes to the district heating network (DH) of Town of Paide an annual average of 57 000 to 60 000 MWh of heat energy. 48 000 to 50 000 MWh is sold to the

[5] The current capacity is high in comparison with the current demand.

consumers consisting of private consumers (60%), public consumers (30%) and industry (10%).

The peak load of Paide DH system is from 20 MW to 22 MW. The average heat loss per year in the town network is 18%. All the energy sold via the DH network of Paide town is transferred from the Peetri boiler house.

Considering the future heat load according to the experts of OÜ Pogi the influence of different energy saving methods, such as introduction of new heat substations and the influence of the increased heat consumption by means of new consumers are estimated to compensate each others. Consequently, the future heat load (consumption + network heat losses) is approximated to remain at the current level e.g. at the level of the year 2001.

5.2.2 DH-network

Building of the DH network started in the end of 1950s. The DH network (See the map in Annex 4) is owned by the Paide municipality and operated by OÜ Pogi. The total trench length of DH networks in Paide is about 12.6 km including about 3 km of bonded new pre-insulated ducts. Recently OÜ Pogi has used approximately 1 million EEK per year for the new pre-insulated pipe. The new pipe installations have mainly been targeted to connect new consumers to the DH system.

Majority of the old sections of the network is of typical East-European construction and these sections are constructed by using mineral wool insulted pipes in underground concrete channels. Some sections including the main transmission pipes (DN400) from Peetri boiler plant to centre of the town are built above the ground. Above the ground construction is typical near the former industrial plants, which were previously connected to the DH system. Additionally, few sections of smaller size transmission pipes locate inside of the long buildings in the centre of the town.

The total volume of the DH network is approximately 1200 m^3. The current annual make-up mater demand equals to about 4000 m^3/year. This means that the volume of the entire network changes 3.3 times a year. Majority, about 70%, of total annual make-up water demand is caused by illegal tapping of DH water in internal building installations of consumers, where the direct (elevator) substations still exist. Respectively, the rest of the make-up water demand is resulted in by the leaks and failures in the DH network.

According to the network experts of OÜ Pogi the DH ducts are in satisfactory working order, which is also indicated by the relatively small amount of leaks per year. The quality of DH water is good, which prevents the internal corrosion of the pipes and extends the technical lifetime of the existing network. The skilled and well motivated staff of OÜ Pogi applies all means to keep the mineral wool insulation in concrete ducts dry in order minimize the heat losses. The relatively high heat losses of 18% (when compared to the modern DH systems) are mainly due to the over dimensioned pipes in respect with the current heat load.

The DH load decreased in 1990s since the collapse of several industrial plants in Paide. The new biofuel boiler plant has the highest priority among the future reconstruction measures of Paide DH system. By implementing the new bio fuel boiler plant OÜ Pogi achieves the upper limit of its financial recourses. Additionally, the comprehensive DH network reconstruction programme requires relatively significant amount of funds giving not such a big direct benefits to company's economy in a short time period. Consequently, either OÜ Pogi or Paide municipality has no specific plans to carry out a comprehensive DH network investments by replacing the existing old sections by new pre-insulated ones.

According to information provided by OÜ Pogi about 1 million EEK per year will be used for new DH network installations. This allocation is mainly applied to connect new consumers to the DH system.

5.2.3 Substations and system operation

Customers e.g. housing societies, commercial companies purchasing DH or municipality in case of municipal buildings own the heat substations. The substations do not belong to the balance of OÜ Pogi. There are totally 152 individual heat substations in the DH system of Paide. Most of the substations have recently been rehabilitated by applying the modern compact heat substations with appropriate control devices and plate heat exchangers for both space heating and domestic hot water (DHW) preparation. The technical concepts of the substations analogous to the recommendations of the Finnish District Heating Association are used.

The owners of the substations have financed the substation replacements. Because of economical and financial problems of some customers, the remaining 50-60 substations still have old type tube heat exchangers for domestic hot water preparation and elevators for space heating. Illegal tapping of DH water is a problem among these directly connected customers. Regarding the total heat consumption these remaining old substations form only 10% of the total consumption and 90% of heat is consumed by substations with modern control devices and indirect connection via plate heat exchangers. Like in modern DH systems new substations have enabled the utilisation of the energy efficient variable flow mode in Paide DH system.

District heat is produced and distributed to the consumers according to their respective demand, taken the heat losses of the network into account. In this purpose the network is operated on a variable temperature and flow basis. DH supply temperature (in Paide max 120 ºC) is determined by the prevailing outdoor temperature. The corresponding flow rate is then determined by the actual heat demand at that specific moment by the customers' substation. The pressure levels and differences demanded for the safety and reliable operation of the entire system are set by the DH pumps at the production plant regulated by frequency controllers. There are no booster pump stations. The maximum flow from Peetri boiler house to the network during the heating is 550 m^3/h. Respectively maximum supply pressure at the plant during the heating season is around 6 bar and 4 bar in summer period. The minimum return pressure is kept at the level of 2.5 bar during heating seasons and respectively at 2 bar during the summer period. The current required minimum pressure difference in consumer side is 1 bar.

5.3 Key Factors

Factors that may have an impact on the future development of the heat demand and supply in Paide affecting the selection of the baseline scenario include e.g.:

- fuel prices as delivered to Paide
- technical and economic lifetime of the existing HOBs
- condition of DH network
- investment cost levels and availability of funds
- local interests
- changes in economic and industrial development in Paide as income levels of consumers in Paide
- liberalization of the energy markets promoting free competition and access to the network (especially liberalisation of electricity market and increase of CHP possibilities in future)
- changes in energy legislation, including the harmonization of legislation related to the EU accession.
- environmental legislation, regulating
- changing subsidies
- sectoral reform projects
- institutional aspects and the general financing environment for implementing energy sector projects at the local and national level
- perceived risks and the transaction costs of the different alternatives; and
- changing weather conditions.

These key factors have been discussed and taken into account in various sections of this PDD.

5.4 Baseline Options and Additionality

5.4.1 Options

The guidelines provided by the Marrakesh Accords (see section 2.2.1) have been followed in the identification of the baseline options.

The following theoretical baseline options have been identified:

Option 1: Business as usual i.e. continued use of the existing plant

Option 2: Complete modernisation of the current plant:

a) New coal or oil shale fired HOB or CHP plant

b) New gas/oil fired HOB or gas/oil fired CHP plant

c) Conversion of the current plant to biomass/peat fired plant

Option 3: New biomass fired plant (project)

5.4.2 Selection of baseline

Options 2 were excluded based on the following facts:

- all CHP options were excluded due to the fact that investment costs are too high for both OÜ Pogi and municipality
  - CHP plant with equivalent heat capacity would more that double the investment costs
  - the currently identified fuel supply would be insufficient for a CHP plant
- gas options were excluded due to the fact that there is no gas pipeline and no plans to expand the high pressure gas pipelines (40 km) to Paide; also the high current prices of gas decrease interest in gas based options
- high investment costs of retrofits needed in Peetri Plant for a new fuel (coal or oil shale); also there is a lack of needed infrastructure for use of coal in Estonia
- general lack of funding and investors
- ownership: the current plant and DH network is owned by the municipality and the plant and network is leased to OÜ Pogi; conversion would mean that the elements owned by municipality and OÜ Pogi could not be separated if needed; therefore OÜ Pogi has no interest in investing in current plant
- there is no immediate need for modernisation of the Peetri plant; the remaining lifetime is estimated to be at least 10-15 years (especially taking into account the current overcapacity)

Option 2c) was excluded also due to specific technical reasons (AF-Esteam OÜ 2001):

> Two similar boilers DE 25-14 have been converted to burning wood chips, one in Võru and one in Paldiski in Estonia. Both technological solutions were based on using a prefurnace. The operation of both boilers has highlighted two problems - creation of ash deposits in convector pipes and removal of ash from the boiler.
>
> For cleaning the boiler, the boiler must be shut down approximately for five times a year (during a heating period, once in every two or three months). One cleaning cycle usually lasts 7 days (3 days for cooling the prefurnace, 2 days for removal of ash, cleaning and 2 days for reaching operating temperature). According to the experience of operating series DE boiler in Võru, ash deposits will start building up in convector pipes which are located at the beginning of the duct, directly after the entry of flue gases.
>
> Series DE boilers are special gas-fired and heavy fuel oil-fired boilers and are not the most suitable for being converted into operating on biofuel. Possible conversion would require installation of advanced boiler cleaning technology.

Option 3 was rejected for the following reasons:

Even though the project is profitable without JI-funding, OÜ Pogi is not able to finance the project without additional support due to lack of financing (see Chapter 2.6 for details).

Continued use of the existing plant is therefore the most likely baseline option.

5.4.3 Estimation of Baseline Emissions

The baseline methodologies can generally be divided into two categories:

- Project specific baselines, defining the baseline separately for each project;
- Multi-project baselines, based on aggregated data which can be used as baselines for several projects.

As there are no internationally adopted guidelines for using these methodologies yet, it is suggested that in this project a project specific baseline is used for calculating the net GHG emissions reduction from heat production. A realistic baseline scenario in that regard is possible to determine in the Paide case. The lack of power generation both in baseline and in project simplifies the calculations.

The estimates for the baseline emissions until 2023 are presented in (Table 5-4). After 2012 a re-assessment of the baseline should be conducted. The detailed calculations are presented in Annex 6.

The emission factors used for CO_2 are based on the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996) for HFO. Default IPCC emission factors for oil are also used for CH_4 and N_2O emissions from shale oil. Estonian emission factor (21.1 t C/TJ) is used for shale oil. The factor is the same as HFO factor. According to recent information, Estonia is currently using this factor for UNFCCC reporting (Roos 2002) instead of default IPCC factor of 20 t C/TJ.

Finnish information (Petäjä 2002) concerning CH_4 and N_2O emissions from biofuel is used (see Annex 6 for details). Emissions from current plant are based on the same heat production as in the project case.

Decrease of methane emissions from Paide landfill would clearly influence the baseline and finally increase the amount of ERUs generated by the project provides that OÜ Pogi would be able to utilize the wood waste. As pointed out earlier (see Chapter 5.1.2), methane emission reductions are currently excluded from the project boundary. Minor adjustments would be needed in PDD if they were included in the project boundary.

Table 5-4. Estimation of Baseline Emissions.

	Total Emissions in 2003-2007 [tCO_2eq]	Total Emissions in 2008-2012 [tCO_2eq]	Total Emissions in 2013-2023 [tCO_2eq]	Total Emissions in 2003-2023 [tCO_2eq]
Current HOB	64 000	73 900	162 500	300 400

5.5 Estimation of Project Emissions

The estimates for the project emissions until 2023 are presented in Table 5-5. The calculation principles are the same as in the baseline case. The emissions that have been included in the calculations include the direct GHG emissions from the new plant, based on the estimated heat production. Calculation is based on an assumption of 0% peat.

Table 5-5. Estimate of Project Emissions.

	Total Emissions in 2003-2007 [tCO_2eq]	Total Emissions in 2008-2012 [tCO_2eq]	Total Emissions in 2013-2023 [tCO_2eq]	Total Emissions in 2003-2023 [tCO_2eq]
New HOB	1 300	1 500	3 400	6 300

The possible use of peat and associated emissions are included in the project boundary and are taken into account in the monitoring plan (Chapter 6).

5.6 Estimation of Emission Reduction and Lifetime Analysis

The expected start date of the project is September 1, 2003 and its expected lifetime is 20 years, i.e. until 2023. Therefore, the project crediting period covers the first commitment period of 2008-2012 as a whole. It is assumed that the project will produce 1/3 of the average output in 2003.

The utilisation of the emission reductions from the project for possible later crediting periods can be discussed in advance between the governments of Finland and Estonia. The baseline is suggested to be valid until the end of 2012, after which it could be reassessed for possible future crediting periods. Emission reductions are also calculated for the years 2003 –2007 in order to assess the possible early crediting.

Table 5-6. Estimate of emission reductions achieved by the Project.

Annual Amount of Heat Produced (Net) (2004 ->)	Emissions Red. in 2003-2007 [tCO_2eq]	Emissions Red. In 2008-2012 [tCO_2eq]	Emissions Red. in 2013-2023 [tCO_2eq]	Total Red. in 2003-2023 [tCO_2eq]
Heat: 157 680 GJ	62 600	72 300	159 000	294 100

The undiscounted cost estimates for the emission reductions are presented in Table 5-7 based on assumed JI contribution. Undiscounted cost estimates do not take into account that ERUs are accrued over the observed period.

Table 5-7. Estimated, undiscounted cost of emission reduction.*

Estimated JI Contribution	534 000	EUR
Years 2008-2012	7.39	EUR/t CO_2 eq.
Years 2003-2012	3.96	EUR/t CO_2 eq.
Years 2013-2023	3.36	EUR/t CO_2 eq.
TOTAL (Lifetime)	1.82	EUR/t CO_2 eq.

* assuming 100% transfer of ERUs

6 MONITORING AND VERIFICATION PLAN

6.1 Identification of data needs and quality

The Monitoring and Verification Plan (MVP) is a living document as the project is still in the design phase and slight modifications may occur. Revisions in the baseline (after 2012) may also require modifications in the MVP. The MVP is based on the requirements of the Marrakesh Accords (UNFCCC 2001) and the Finnish Pilot Programme (Ministry for Foreign Affairs 2002).

The MVP defines a project-specific standard against which the project's performance in terms of its GHG reductions will be monitored and verified. Monitoring will be a continuous process, which will be the responsibility of the project entity. The MVP presented here is specific to this project and its circumstances.

Monitoring of project performance is crucial to ensure that emission reduction units can be claimed from a JI project. Monitoring must be conducted in such a way that the indicators related to the GHG emission level from the project can be compared with the baseline emission scenario. Subsequently, the difference in the real and the baseline emissions can be claimed as emission reductions. Monitoring and recording of indicators will also provide a foundation for the verification of emission reductions by an independent entity (see Chapter 2.2.2), and ultimately end up in reporting of Emission Reduction Units (ERU) to the parties involved in the project and towards the UNFCCC.

The Marrakesh Accords require that a monitoring plan includes the components defined in Table 6-1.

Table 6-1. Monitoring plan.

Requirement of the Marrakesh Accords	Measures taken in the Paide project
Collection and archiving data for calculation of project emissions	Monitoring of heat production Monitoring of fuels used (especially peat) Calculation of project emissions
Collection and archiving data for calculation of the baseline	Monitoring of heat production Calculation of baseline emissions
Identification, collection and archiving of data on leakage	No measures (see Chapter 5.1.2)
Collection and archiving of information about environmental impacts in accordance with procedures as required by the host Party, where applicable	To be updated based on EIA or similar procedure if applicable
Quality assurance and control procedures for monitoring	Fulfilment of relevant Estonian, EU and international requirements
Procedures for the periodic calculation of the emission reductions and leakage	Calculation of emission reductions
Documentation of all the steps above	Filing system for the steps above

The Paide project involves the following key element included within the project boundary that leads to GHG emissions reductions:

- Emission reductions from heat production: the direct on-site GHG emissions are displaced through the fuel switch from shale oil or HFO to biomass

There are two main performance indicators that affect the emission reductions generated and should be monitored annually (at minimum):

1) Heat production

Measured heat production of the project (Y_{heat}) is the main determinant of baseline emissions. The heat output will also be used to calculate the total fuel usage. Efficiency of the plant (η_p) is needed for the calculation. Efficiency needs to be determined at the start-up phase by an independent entity.

2) Fuel usage

Project emissions will be calculated based on heat production and efficiency if no peat is used ($Y_{fuel} = Y_{heat}/\eta_p$). Project emissions are rather minor in comparison with baseline emissions provided that no peat is used.

If peat is used the amount of peat is crucial for the amount of ERUs produced ($Y_{biofuel} + Y_{peat} = Y_{fuel}$). The GHG emission factor for peat is very high in comparison with wood. This will be based on delivered loads of peat in tonnes and periodical analyses of the calorimetric value of peat.

Storage capacity at the plant is approximately 2-3 days. Therefore monitoring based on loads is sufficient as emission reductions need to be reported only at an annual level.

In practise a routine system needs to be built up to monitor the total amount of fuel usage (both biomass and peat) based on loads as it cannot be determined beforehand when peat would be possibly used. Routine data concerning delivered loads of biomass (in m^3 and periodic analyses of calorimetric value of biomass) can be utilized in emissions calculations as quality assurance data.

Also invoicing of peat and biomass will be used for quality assurance purposes and later in verification.

It would also be possible in theory to include the changes in heat losses in monitoring. The impact on ERUs generated is, however, expected to be minor, and monitoring would need additional measures.

Monitoring plan should be updated if OÜ Pogi would be able to utilize the wood waste currently dumped at Paide landfill and associated methane reductions could be taken into account. Monitoring could be based on simple monitoring of purchased amounts of wood waste from landfill. In addition, the role of EU Landfill Directive should be assessed in detail in this case (i.e. the length of baseline validity concerning methane emission reductions from landfill).

6.2 Methodology to be used for data collection and monitoring

Emission reductions achieved in the project can be calculated as follows:

$$\Delta E = E_b - E_p$$

$$= (Y_{heat}/\eta_b * I_{oil}) - (Y_{biofuel} * I_{biofuel} + Y_{other} * I_{other}), \text{ where}$$

$$Y_{biofuel} + Y_{other} = Y_{fuel} = Y_{heat}/\eta_p$$

ΔE	=	Total emissions reduction generated (in t CO_2eq/ year)
E_b	=	Baseline emissions (in t CO_2eq / year)
E_p	=	Project emissions (in t CO_2eq / year)
Y_{heat}	=	Heat output of the project (in MWh/year)
η_b	=	Thermal efficiency of the Peetri plant in the baseline
I_{oil}	=	Average emission intensity of oil = 0.2766 t CO_2eq/MWh
$Y_{biofuel}$	=	Biofuel input (in MWh/year)
Y_{other}	=	Input of other fuel(s) (in MWh/year) i.e. peat
$I_{biofuel}$	=	Emission intensity of wood = 0.00601 tCO_2eq/MWh
I_{other}	=	Aggregated emission intensity of other fuels, i.e. 0.3776 t CO_2eq/MWh for peat
Y_{fuel}	=	Total fuel input (in MWh/year)
η_p	=	Thermal efficiency of the new plant

Performance indicators within the project boundary are data that can be derived and verified from the normal annual reporting of the company so that they are consistent with the accounting information according to the Estonian law and acknowledged international accounting principles.

The suggested template for monitoring is presented in Annex 7. Main data will be collected monthly and annual emission reductions are automatically calculated from monthly data.

Monthly monitored indicators are:

- Y_{heat} = Heat output of the project (in MWh/month)
- Y_{other}= Input of peat (in MWh/month)

Heat output data is based on typical metering of this kind of plant. Metering is specific for the new plant. Sufficient monitoring data are needed for monthly compilation of monitoring template. Actual data will depend on final technical solution of metering and data handling.

Peat consumption is based on fuels delivered in emissions calculation. The data will be collected from daily, monthly and annual operation statistics and periodic analyses of the quality of the peat and also compared to invoices from the fuel suppliers.

Also the thermal efficiency of the new plant (η_p) is needed for calculations, but it is assumed to remain constant level once determined during the start-up phase unless there is a specific reason to revise efficiency (technical or major operational changes in the plant).

Project managers and operational staff are responsible for data collection, calculation, and data record keeping. All internal records and invoices must be kept for audit purposes and official sign-off by the responsible manager on all worksheets is required in addition to sign-off by the person responsible for data collection. Back-up copies of all documents are required. Internal audits are recommended.

Monitoring will be conducted during the whole baseline validity. The project staff must collect required information on a monthly basis and information will be linked to a summary worksheet that will provide total annual emissions reductions (see Annex 7).

Calibration of metering devices will be conducted and accuracy determined according to Estonian, EU and other applicable international standards. Uncertainty will be based on standard deviations of the equipment used.

Accurate and complete records will be kept including all original data as well as all invoices. Records should also describe how data uncertainty, scheduled and unscheduled quality assurance processes as well as monitoring errors are taken into account in calculations and reported emissions. Table 6-2 defines the tasks in MVP

Table 6-2. Tasks in MVP.

	Tasks of operator
Monitoring system	Review MVP and suggest adjustments if necessary Develop and establish management and operations system Establish and maintain monitoring system and implement MVP Prepare for initial verification
Data Collection	Establish and maintain data measurement and collection systems for all required MVP indicators and input data for indicators • Heat output of the project (in MWh/month) • Peat usage (in MWh/month) • All input data used for calculation of monthly peat usage • Biomass usage (in MWh/ month) • All input data used for calculation of monthly biomass usage • Thermal efficiency of the new plant • Invoicing data Check data quality and collection procedures regularly
Data computation	Enter data in monthly worksheet Implement sign off system for completed monthly worksheets Calculate emission reductions
Data storage systems	Implement record maintenance system Store and maintain all records (in electronic and/or manual forms as applicable)
Performance monitoring and reporting	Analyse data and compare project performance with projections Analyse system problems and recommend improvements Compare monthly results from fuel usage based on heat production, fuels delivered and invoicing. Correct possible inconsistences. Prepare and forward periodic reports as required by Estonian authorities eventually
MVP Training and Capacity Building	Ensure that operational staff is trained and enabled to meet the needs of MVP
Quality assurance, audit and verification	Establish and maintain quality assurance system with a view to ensuring transparency and allowing for audits and verification Describe how data uncertainty, scheduled and unscheduled quality assurance processes as well as monitoring errors are taken into account in calculations and reported emission reductions. Calibration of the meters and calibration procedures should be discussed Conduct internal audits Prepare verification process

6.3 Justification of the proposed monitoring methodology

The monitoring activities will be focused on the amount of heat produced of the new plant. Detailed monitoring of fuel consumption as such is not essential as the project emissions are minimal in comparison to baseline emissions if peat is not used. It is therefore suggested that fuel consumption is estimated based on the boiler efficiency determined during the start-up phase and the heat generation. The determination of the boiler efficiency must be documented, verifiable, and be renewed in the case of technical or major operational changes in the plant. The possible use of peat (or possibly other emission intensive fuels) is, however, critical in monitoring because peat will have a major impact on ERUs. The possible peat consumption can be monitored based on loads and quality of peat. It is, however, suggested that comprehensive monitoring system will be developed for both biomass and peat delivery as it cannot be determined beforehand when peat would be possibly used and monitoring needs would realize.

The Paide project will increase the need for fuel transport, as the caloric value of biomass is significantly lower than that of oil. Also, oil has been transported to the site by lorries as explained in Chapter 5.1.2. These emissions are however excluded from the monitoring plan as these GHG emissions are minor in comparison with baseline emissions.

6.4 Verification plan

Verification means a periodic review and ex-post determination by an independent entity of the amount of the greenhouse gas emission reductions that the project has generated. During the Finnish Pilot Programme independent verification will be used in all cases.

According to the rules for JI, the host country itself may verify the amount of emissions reductions resulting from the project provided that both the host and the acquiring country are eligible to use the first track of JI. However, independent verification of the amount of emission reductions protects the interests of the investor, as well as the project sponsor and the transferring country.

Verification is based on data collected by the project participants in accordance with the monitoring and verification plan. The project participants shall submit to the verifier a report on the emission reductions recorded in accordance with the monitoring and verification plan. The report shall be made publicly available.

ERUs can be generated from JI projects between 2008-2012. The Finnish CDM/JI Pilot Programme states that emission reductions occurring before 2008 can be verified and transferred as Assigned Amount Units (AAU) through international emissions trading (Article 17 of the Kyoto Protocol), if both project countries agree.

For this reason, it is suggested that results of the monitoring will be verified annually. This will increase the transaction costs of emissions permit generation, but enables a higher certainty on the permit amounts and a better liquidity of the permits. The cost of verification based on a couple of man-days/year is likely to be rather small in comparison with the value of annual emission reductions.

7 REFERENCES

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Annex 1 Letter of Endorsement

Annex 2 Initial approval of Finnish CDM/JI Pilot Programme

Annex 3 Map of Estonia

Annex 4 Map and District heating network in Paide

Annex 5 Pictures of project site

Annex 6 Estimated Emission Reductions

Estimated Emissions Reductions											
Paide											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013 onwards
Baseline											
Heat produced [GJ]	52 034	157 680	157 680	157 680	157 680	157 680	157 680	157 680	157 680	157 680	157 680
Heat delivered to customers [GJ]	42 668	129 298	129 298	129 298	129 298	129 298	129 298	129 298	129 298	129 298	129 298
GHG emissions, existing plant [t CO2eq]	4 876	14 776	14 776	14 776	14 776	14 776	14 776	14 776	14 776	14 776	14 776
GHG Total [t CO2eq]	**4 876**	**14 776**	**14 776**	**14 776**	**14 776**	**14 776**	**14 776**	**14 776**	**14 776**	**14 776**	**14 776**
Project											
Heat produced [GJ]	52 034	157 680	157 680	157 680	157 680	157 680	157 680	157 680	157 680	157 680	157 680
Hear delivered to customers [GJ]	42 668	129 298	129 298	129 298	129 298	129 298	129 298	129 298	129 298	129 298	129 298
GHG emissions from new plant [t CO2eq]	102	310	310	310	310	310	310	310	310	310	310
GHG Total [t CO2eq]	102	310	310	310	310	310	310	310	310	310	310
Emission reductions [t CO2eq]	**4 774**	**14 466**	**14 466**	**14 466**	**14 466**	**14 466**	**14 466**	**14 466**	**14 466**	**14 466**	**14 466**
CUMULATIVE EMISSION [tonnes CO2eq]											
	Peetri	**Project**	**Reduction**			**Emission factors, g/MJ**					
Years 2003-2007	**63 981**	**1 341**	**62 639**				shale oil	biomass			
Years 2008-2012	**73 881**	**1 549**	**72 332**			CO2	76,6	0,00			
Years 2003-2012	**137 862**	**2 890**	**134 971**			CH4	0,003	0,05			
Years 2013-2023	**162 538**	**3 408**	**159 130**			N2O	0,0006	0,002			
TOTAL (Lifetime)	**300 399**	**6 298**	**294 101**			CO2eq	76,8	1,67			
JI Contribution	534 200	EUR									
Years 2003-2007	**8,53**	EUR/tCO2eq									
Years 2008-2012	**7,39**	EUR/tCO2eq									
Years 2003-2012	**3,96**	EUR/tCO2eq									
Years 2013-2023	**3,36**	EÙR/tCO2eq									
TOTAL (Lifetime)	**1,82**	EUR/tCO2eq									

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Annual monitoring

PROJECT CONSTANTS(1)	Unit	Code	Value	Comment!
Emission intensity of wood	tCO2eq/GWh(fuel)	Iwood	6,01	
Emission intensity of peat	tCO2eq/GWh(fuel)	Ipeat	377,6	
Emission intensity of shale oil	tCO2eq/GWh(fuel)	Ioil	276,6	

PROJECTIONS	Unit	Code	Year										Comment!
			1	2	3	4	5	6	7	8	9	10	
			2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Heat production	MWh	Yheat	14454	43800	43800	43800	43800	43800	43800	43800	43800	43800	
Thermal efficiency of project	%	np	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	
Total fuel consumption	MWh	Yfuel, p	17005	51529	51529	51529	51529	51529	51529	51529	51529	51529	
- biomass	MWh	Ywood	17005	51529	51529	51529	51529	51529	51529	51529	51529	51529	
- peat	MWh	Ypeat	0	0	0	0	0	0	0	0	0	0	
Thermal efficiency of baseline	%	nb	0,82	0,82	0,82	0,82	0,82	0,82	0,82	0,82	0,82	0,82	
Baseline fuel consumption	MWh	Yfuel, b	17627	53415	53415	53415	53415	53415	53415	53415	53415	53415	
Baseline emissions	tCO2eq	Eb,heat	4876	14776,15	14776	14776	14776	14776	14776	14776	14776	14776	
Project emissions	tCO2eq	Ep	102	309,79	310	310	310	310	310	310	310	310	
Projected Emission reductions	**tCO2eq**	**E**	**4774**	**14466**	**14466**	**14466**	**14466**	**14466**	**14466**	**14466**	**14466**	**14466**	
Cumulative Emissions reduction 2003-2012	tCO2eq		4774	19240	33707	48173	62639	77106	91572	106038	120505	134971	
Cumulative Emissions reduction 2008-2012	tCO2eq							14466	28933	43399	57865	72332	

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ACTUAL DATA	Unit	Code	Year										Comment!
				1	2	3	4	5	6	7	8	9	10	
				2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Heat production	MWh	Yheat												
Thermal efficiency of project	%	np		0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	To be determined during the start-up phase
Total fuel consumption	MWh	Yfuel, p		0	0	0	0	0	0	0	0	0	0	
- biomass	MWh	Ywood		0	0	0	0	0	0	0	0	0	0	
- peat	MWh	Ypeat												
Thermal efficiency of baseline	%	nb		0,82	0,82	0,82	0,82	0,82	0,82	0,82	0,82	0,82	0,82	
Baseline fuel consumption	MWh	Yfuel, b		0	0	0	0	0	0	0	0	0	0	
Baseline emissions	tCO2eq	Eb,heat		0	0	0	0	0	0	0	0	0	0	
Project emissions	tCO2eq	Ep		0	0	0	0	0	0	0	0	0	0	
Actual Emission reductions	**tCO2eq**	**E**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Cumulative Emissions reduction 2003-2012	tCO2eq			0	0	0	0	0	0	0	0	0	0	
Cumulative Emissions reduction 2008-2012	tCO2eq								0	0	0	0	0	

Annex 7 Monitoring protocol

Monthly monitoring (example)

	Measured heat production			Peat consumption			Completed by	Date	Approved by	Date
	and calculated fuel consumption			based on delivery						
2003	Heat, MWh	Efficiency	Fuel con., MWh	t	MWh/t	MWh				
Jan		0,85	0			0				
Feb		0,85	0			0				
Mar		0,85	0			0				
April		0,85	0			0				
May		0,85	0			0				
June		0,85	0			0				
July		0,85	0			0				
Aug.		0,85	0			0				
Sep		0,85	0			0				
Oct,		0,85	0			0				
Nov.		0,85	0			0				
Dec.		0,85	0			0				
						0				
Total	**0**	**0,85**	**0**	**0**	**-**	**0**				

Annex 8 Rental Agreement for the DH-network

Annex 9 Approval from the bank