JI Project Design Document
Tamsalu Bark Boiler Project
Estonia

Final

Finnish CDM/JI Pilot Programme

ABBREVIATIONS

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AAU	Assigned Amount Unit
C	Fuel consumption
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 independent entity of the monitored Emission Reductions that have occurred as a result of a JI project during the verification period

1 PROJECT SUMMARY

The Project Design Document (PDD) includes the information related to the installation of a 2,5 MW biomass fired boiler plant in Tamsalu, Estonia as a JI project within the Finnish CDM/JI Pilot Programme. The plant provides thermal energy for the municipality's district heating network. The project was implemented in 2001 and received a preliminary determination statement in February 2003. This PDD is an update based on findings during determination of the original PDD.

The PDD is mainly based on the Operational Guidelines of Finnish Pilot Programme (Ministry for Foreign Affairs 2003) and the Marrakesh Accords of the UNFCCC (UNFCCC 2001). The project is endorsed by the Government of Estonia (see Annex I) and the governments of Estonia and Finland have signed a MoU. Estonia and Finland have agreed 17.12.2002 on transferring ERs as ERUs and AAUs 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 32 400 tCO_2 eq. in 2002-2012. 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 has been the introduction of a new biomass boiler in the Town of Tamsalu, Estonia. Partners of the project are AS Tamsalu Kalor, Sermet Oy (currently owned by Wärtsilä BioPower Oy) and various financial institutions. Consulting services for PDD preparation have been provided by VTT Energy, Jyväskylä, Finland; AS Enprima Estivo, Estonia; and Finnish CDM/JI Pilot Programme.

The project has been implemented as a part of the Finnish CDM/JI Pilot Programme. The project 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 several 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 project must not have significant negative environmental impacts and it must be supportive of the Finnish Policy on environmental co-operation with neighbouring countries.

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 transferred to Finland as ERUs (and AAUs).

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 Memoranda of Understanding with several governments including Finland. JI focal point in Estonia is Ministry of Environment.

There are currently no official national evaluation criteria or other special requirements for JI projects in Estonia. Criteria are, however, currently discussed. JI committee has been established in Estonia.

Estonia has ratified the Kyoto Protocol in 14.10.2002. Estonia and Finland have agreed 17.12.2002 on transferring ERUs and AAUs to Finland in Framework agreement "Agreement on Joint Implementation of Emission Reductions of Greenhouse Gases Between the Government of the Republic of Finland and the Government of the Republic of Estonia."

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 project has been approved by the Finnish Government, i.e. the project received preliminary approval of the Steering Committee of the Finnish CDM/JI Pilot Programme in 24.10.2000 and positive decision concerning purchase of ERs was made by the Ministry of the Environment 3.11.2000. Emission Reductions Purchase Agreement has been signed between AS Tamsalu Kalor and Ministry of the Environment, Finland in 10.6.2004.

2.3 Project purpose

Sermet Oy has delivered a new 2,5 MW bark boiler to the district heating system in Tamsalu. The new boiler will satisfy approximately 80% of the annual energy demand in the district heating system. The estimated production is 8050 MWh/a. The bark and other biofuels to the new boiler come from several sawmills in the region.

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.

2.4 Project's contribution to sustainable development

The project will contribute to sustainable development in several ways:

- GHG emissions are reduced
- SO_2 and NO_x emissions are reduced thus improving air quality in Tamsalu
- Local development is supported as the fuel is produced locally
- The project stimulates the use of renewable energy sources and the efficient use of natural resources due to efficient production of heat
- There is a strong local support for the project
- The project helps to stabilise 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 and practical incentives for the above-mentioned transfers.

2.5 Technical description

Sermet Oy has delivered a bark boiler to the district heating system in Tamsalu in Estonia based on Sermet's Biograte Compact technology (Figure 1). The bark boiler will replace heat production of the older shale oil boilers.

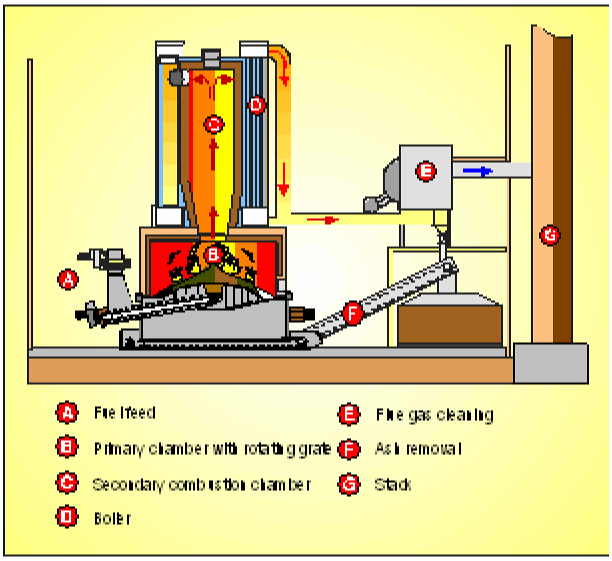

Figure 1. Sermet Biograte Compact 1 – 5 MW.

The plant can be operated on wood based fuels like, bark, sawdust, and chipped wood as well as fuel blend containing some peat – if needed - as defined in the warranty terms. The special feature of the Biograte technology is its ability to utilise wet fuels like wet bark.

The plant uses 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 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 fire tube boiler operating with forced circulation. 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 chimney.

2.6 Economic and financial information

The total cost of the project is approximately 15,2 million EEK, i.e. 0,98 MEUR. The project consists of:

Equipment supply from Sermet (Wärtsilä)	0,73 MEUR
Local works	0,25 MEUR
Total investment	0,98 MEUR

Sermet's supply has been mainly delivered from Finland. The building, fuel feeders and a part of the installation work will be locally purchased from Estonia. Tamsalu Kalor's share of investment consists of financing cost, interest expenses during the construction and local works as defined above.

It is unlikely that the projects would have commenced if the Finnish CDM/JI Pilot Programme simply purchased the emission reductions after they have been generated. Pilot programme's share through advance payment is 0,36 MEUR i.e. 37 % of the investment costs. The rest of the financing has been arranged through commercial channels.

Tamsalu Kalor is a small company. 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 taking into account the considerable funding provided by the Finnish CDM/JI Pilot programme based on ER purchase. Without JI funding, investment can be considered very high (MEEK/MW) and most likely unfeasible.

2.7 Risks

No major risks are identified. Political risks are low as Estonia is today viewed as a stable, new EU Member State. There is no completion risk as the plant is already completed. Operational risks are typical for this kind of technology, and some technical problems have been experienced. Heat production has met or exceeded the target.

Fuel supply risk need to be considered as demand for biomass has increased in Estonia. 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. This is, however, unlikely, as the Tamsalu Kalor is municipality owned utility and justified rise of costs could eventually be reflected in the price of heat, that is set locally based on costs of production.

If the price of biofuel would increase considerably more that the price of fossil fuels, i.e. shale oil, Finnish CMD/JI Pilot Programme may have a risk of losing some of the ERs produced by the project.

In comparison with the existing oil fired boiler plant, the project is a more environmentally friendly with the exception of possibly increasing particle emissions and increased transportation of fuel. Environmental risks can be considered small.

2.8 Location

Tamsalu is one of the 253 municipalities in Estonia it is located some 60 km Southeast of Tallinn. Population is 2800.

2.9 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
- Economic
  - price of heat in Tamsalu
  - 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
  - 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.

All the needed permits have been granted to the project. 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. There might be a slight increase of particle emissions when comparing the same heat production from the current plant (baseline emissions) with the project. There would be some increase of traffic due to biomass transportation (see Chapter 5.1.2 for details).

4 STAKEHOLDER INVOLVEMENT

Stakeholders are defined as the public, including individuals, groups or communities affected, or likely to be affected, by the project (UNFCCC 2001).

The project has been granted a building and all other needed permits, and therefore all the related official stakeholder involvement has been fulfilled according to Estonian requirements.

The original Baseline study was made public via various channels including Internet page of the Ministry of the Environment of Finland, and the updated PDD has been made public via Climate L –mailing list and web page of KPMG. Final JI agreements related to the project will eventually be public.

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 (if 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* <u>*baseline*</u>*…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".*
>
> *"*<u>*The project boundary*</u> *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"*
>
> *"*<u>*Leakage*</u> *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 currently 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[1] carbon dioxide emissions (CO_2) provided that peat is not used. The possible but very unlikely 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. These emissions are likely to be very minor and due to uncertainties in emission factors, these are not taken into account. The project will have no practical impact on hydro fluorocarbon (HCFs), perfluorocarbon (PCFs) and sulphur hexafluoride (SF_6) emissions.

The GHG emissions from the old plant (baseline) are based on the same amount of heat production as in the emissions calculation for the project. No changes related to heat consumption and heat losses could be attributed to 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.

[1] 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. While it is likely that some biomass has previously been landfilled or dumped, there is currently no evidence of landfill disposal or dumping of biomass in Tamsalu region.

Fuel transportation

Emissions from transportation of biofuels were calculated using typical[2] emission factors for lorries in project cases. It was assumed that average one-way distance is 20 km and an average of 2,2 deliveries per day are needed. Emissions are insignificant in comparison with baseline emissions and were therefore excluded from final calculations.

Emissions from transportation in baseline scenario were not calculated, but they are assumed to be lower than project emissions due to lower traffic volume.

Table 1. Estimated project emissions from the transportation of biofuels.

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	32 120	km/a
Emissions	17,1	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 leakage).

Other factors

Additional possible leakages might result from e.g. 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 heat price is also rather minor, the project is not expected to have an impact on the overall level of heat consumption in Tamsalu.

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

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

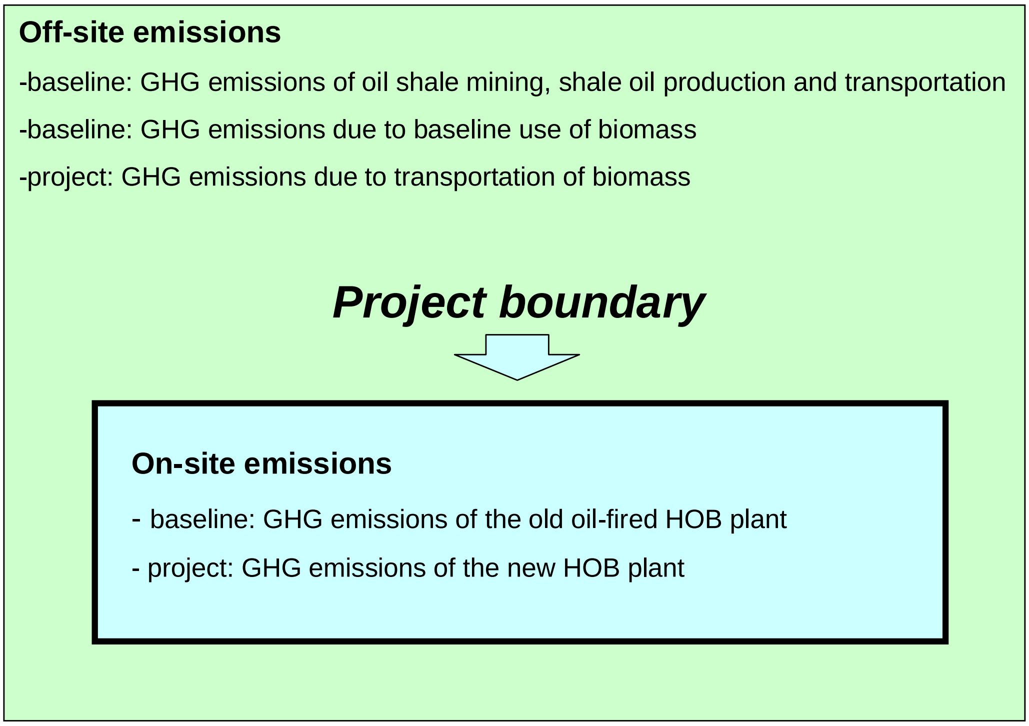

Figure 2. Project boundary.

5.2 Description of the Current Situation

The district heating system in Tamsalu has been based on old DKVR 6,5 type boilers (2*4,5 MW) and one 1,9 MW K100 boiler. There is a clear over-capacity compared to energy need of the town. The boilers use shale oil, they have been are in good operation condition with the possible exception of one 4,5 MW boiler. The annual heat production has been 8050 MWh. Conservatively estimated efficiency of the old boilers has been estimated to be 75 %.

5.3 Key Factors

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

- fuel prices as delivered to Tamsalu
- 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 Tamsalu as income levels of consumers in Tamsalu
- 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 and environmental legislation
- 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 as applicable. No major issues affecting the project have been identified.

5.4 Baseline Options and Additionality

5.4.1 Options

The guidelines provided by the Marrakesh Accords have been followed in the identification of the baseline options.

Three main baseline options were identified based on the studies made by Estivo (1994) and AVM-TERM AS (1999)[3].

Option 1: Business as usual: continued use of the existing plant with some renovations

Option 2: Conversion to natural gas

Option 3: New biomass fired plant

No CHP option can be seen as feasible due to very high investments needed in comparison with heat only boilers (HOB).

5.4.2 Selection of baseline

Option 2 was excluded based on the fact that approximately 12 km of new gas pipeline would have been needed to be built (see the maps below). The cost for one kilometre of gas pipeline is around 1 million EEK. Together with gas pressure reduction unit, the pipeline cost would be approximately 15-18 MEEK. In addition, technological changes in boilers would have been needed, but no practical benefits would have been gained from lower fuel prices. This option is unfeasible.

[3] See also Summary of the studies made by Estive, annexed in: KPMG, 2003

Figure 3. Estonian gas grid in 2003 (source: AS Eesti Gaas 2004).

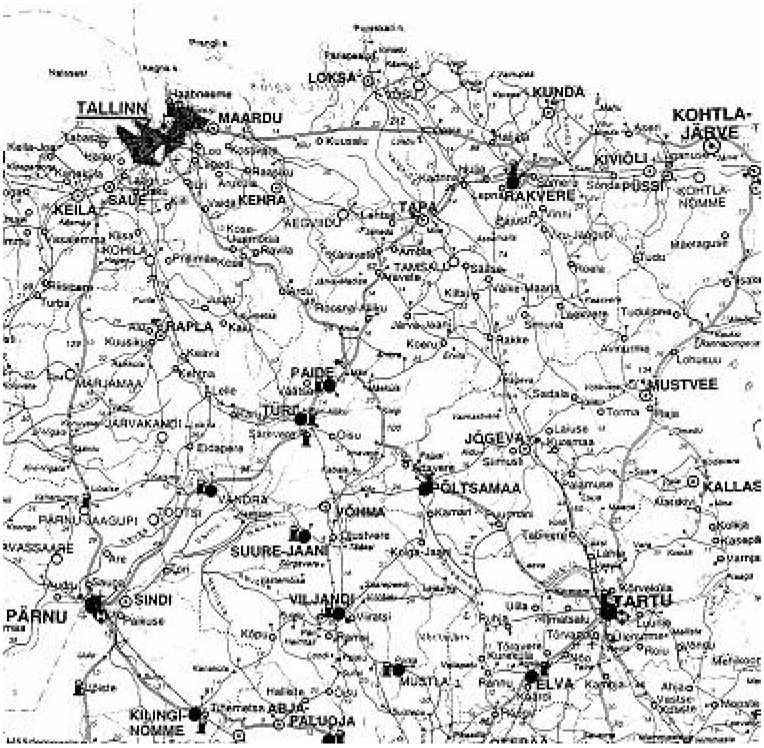

Figure 4. Map of the project area.

Option 3 was excluded based on the fact that investments needed for a new biomass fired boiler are very high, 15,2 MEEK. The price is for example about seven times higher in a project case than a comparable oil boiler according to information provided by an experienced Estonian consultant in energy field (Mets 2004). The cost of an oil boiler is approximately 1 MEEK/MW in Estonia market. In this case the cost would have been even lower due to existing boiler house and other infrastructure.

No detailed financial calculations are available, but some calculations are available concerning the estimated cost savings of the use of biomass as an alternative to shale oil. Tentative calculations based on the price of shale oil of 1800 EEK/t and the price of biofuel of 35 EEK/m^3 and annual heat production of 10 000 MWh lead to the annual savings of fuel costs of about 1,3 MEEK. Earlier calculation showed higher savings, but due to changes in fuel prices, saving were over-estimated. It can be concluded that the project is rather unfeasible with investment of 15,2 MEEK (and with some additional operational costs) without JI funding. Exclusion of option 3 is further supported by the fact that the financial situation of Tamsalu Kalor at the time was weak.

One sub option could have been conversion of the current plant to biomass-fired plant. This option can be excluded due to specific technical reasons (AF-Esteam OÜ 2001), e.g. two similar kind of boilers have been converted to burning wood chips, one in Võru and one in Paldiski in Estonia. Both technological solutions were based on using a pre-furnace. 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) making the conversion unfeasible for district heating purposes. Possible conversion would require installation of advanced boiler cleaning technology. In addition, boiler conversion would have most likely hindered the use of cheaper biofuels, i.e. wet bark whereas the utilisation of wet bark is recommended in Biograte technology.

Business as usual i.e. continued use of the existing plant is therefore the most likely baseline option. There are also no foreseen reasons that would have prevented the use of oil-fired boilers also in the future, and no major renovation would have been needed.

Even in the case that old oil fired boilers (possibly one of the boilers) would have been renovated within next few years, the renovation of the boiler based on oil firing would have been clearly more feasible investment than the project option as discussed above, i.e. maximum cost would have been around 2 MEEK.

The specific barrier in this case is clearly investment barrier as recently discussed for example by de Jong et al. (2004) related to CDM additionality tests. Tamsalu Kalor would not have been able to finance the bioboiler without JI funding from the sale of ERs accounting for 37% of the investment. Therefore, it can be concluded that the new biomass fired plant is clearly additional as only the advance payment based on sale of future ERs made the project feasible.

5.4.3 Estimation of Baseline Emissions

The estimates for the baseline emissions until 2021 are presented in (Table 2). After 2012 a re-assessment of the baseline should be conducted. The emission factors used for shale oil CO_2 emission are based on the factors used in Estonia, i.e. 77g CO_2/MJ with fraction of carbon oxidised of 0,99, following closely the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996) for HFO.

Table 2. Estimation of Baseline Emissions

	Total Emissions in 2002-2007 [tCO_2eq]	Total Emissions in 2008-2012 [tCO_2eq]	Total Emissions in 2002-2012 [tCO_2eq]	Total Emissions in 2002-2021 [tCO_2eq]
Old HOB	17 700	14 700	32 400	58 900

5.5 Estimation of Project Emissions

The estimates for the project emissions are zero due to the fact that CH_4 and N_2O emissions are not taken into account due to uncertainties. Calculation is based on an assumption of 0% peat usage.

The possible but very unlikely use of peat and associated emissions are, however, included in the project boundary and are taken into account in the monitoring plan.

5.6 Estimation of Emission Reduction and Lifetime Analysis

The start date of the project has been June 2001 and its expected lifetime is approximately 20 years, i.e. until 2021. Crediting period for sale of mission reductions is planned to be 2002-2012. 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 2002 –2007 in order to assess the early crediting of JI.

Projected emission reductions equals to the baseline emissions due to the fact that CH_4 and N_2O emission are note taken into account in project, neither baseline case. No peat use is assumed in project case.

Table 3. Estimate of emission reductions achieved by the Project.

Total emission reductions in 2002-2007 [tCO_2eq]	Total emission reductions in 2008-2012 [tCO_2eq]	Total emission reductions in 2002-2012 [tCO_2eq]	Total emission reductions in 2002-2021 [tCO_2eq]
17 700	14 700	32 400	58 900

6 MONITORING AND VERIFICATION PLAN

The Monitoring and Verification Plan (MVP) defines a project-specific standard against which the Tamsalu Bioenergy 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 in co-operation with Sermet/Wärtsilä Finland Oy. for the period of January 2002 - December 2012. The MVP presented here is based on the requirements of the Marrakesh Accords (UNFCCC 2001), the Finnish Pilot Programme (Ministry for Foreign Affairs 2003) and the circumstances of Tamsalu Bioenergy Project.

6.1 Identification of data needs and quality

In Tamsalu Bioenergy Project the GHG emissions reduction will be achieved via heat production: the direct on-site GHG emissions are replaced through the fuel switch from shale oil or HFO to biomass.

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. Baseline scenario represents the emissions level, which would have been occurred in Tamsalu by shale oil burning, without implementation of the bioenergy project.

Monitoring and recording of indicators will also provide a foundation for the verification of emission reductions by an independent entity, and ultimately end up in reporting of Emission Reduction Units (ERU) to the parties involved in the project and towards the UNFCCC.

The Tamsalu monitoring plan includes the components defined in Table 4.

Table 4. Monitoring plan.

Tasks of operator	Implementation and terms
Monitoring system	Establish and maintain monitoring system and implement MVP Prepare for initial verification Define responsibilities
Heat production data registration	With commercial heat meter register the amount of heat produced by the biofuel boiler, fix the boiler efficiency • Heat production by biofuel (MWh/month) • Heat production by biofuel (MWh/year) • Thermal efficiency of the bio-boiler
Fuel consumption	Register the amount of bio fuels consumed by the bio fuel boiler, especially the amount and calorific value of peat used (if any) : • Biomass usage (MWh/month; MWh/year) • Peat usage (MWh/month; MWh/year) • All additional biofuel data (loads, invoicing, statistics, moisture content and calorific values etc.)
Emission calculation	Calculate project (biofuels) emissions; Calculate baseline (in case the same amount of heat to be produced by shale oil) emissions;
Data computation	Enter data in monthly worksheets Implement sign off system for completed monthly worksheets Enter data in yearly worksheets Calculate yearly emission reductions
Data quality assurance and analyses	Analyse data and compare project performance with projections Compare and analyse monthly results from fuel usage based on heat production, fuels delivered and invoicing. Correct possible inconsistencies. Analyse system problems and recommend improvements
Data storage systems	Implement record maintenance system Store and maintain all records (in paper and/or electronic forms as applicable) until the end of 2013
Verification	Maintaining of records and additional data for audits and verification, including descriptions how data uncertainty, scheduled and unscheduled quality assurance processes as well as monitoring errors are taken into account in calculations and reported emission reductions

There are two main performance indicators that affect the emission reductions generated and should be monitored monthly (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 only on heat production and efficiency if no peat is used ($Y_{fuel} = Y_{heat}/\eta_p$). In this case project GHG emissions are zero as CH_4 and NO_2 are not taken into account.

If peat is used the amount of peat is crucial for the amount of emission reductions generated ($Y_{biofuel} + Y_{peat} = Y_{fuel}$). 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. The energy content of peat (in MWh) will be calculated according these data. Monitoring based on peat loads is sufficient as emission reductions need to be eventually reported only at an annual level.

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.

For quality assurance purposes and later in verification also invoicing data of peat and biomass will be used, as well the fuel consumption data to be submitted monthly to the Estonian Statistical Office.

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 boiler (0,75) in the baseline
I_{oil}	=	Average emission intensity of oil = 0.274tCO_2/MWh (77gCO_2/MJ, fraction of carbon oxidised 0,99)
$Y_{biofuel}$	=	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 tCO_2eq/MWh (CH_4 and N_2O emissions are not considered in this case based on determination)
I_{other}	=	Aggregated emission intensity of other fuels, i.e. 0,378 t CO_2eq/MWh for peat
Y_{fuel}	=	Total fuel input (in MWh/year)
η_p	=	Thermal efficiency of the new plant (0,85)

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 2. 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 metering of the bio-boiler with the registered commercial heat meter. The data will be stored monthly to the monitoring protocol.

Peat consumption, if any (MWh) is based on fuels delivered and the average calorific value of peat. The data will be compared to invoices of the fuel suppliers.

The thermal efficiency of the new plant (η_p) is needed for calculations (if other fuels than biofuels are used), but it is assumed to remain constant (0,85) 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 of Tamsalu Kalor 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 managing director 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 2).

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.

Data will be analysed monthly for quality assurance purposes and all the possible inconsistencies will be corrected

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.

6.3 Justification of the proposed monitoring methodology

The monitoring activities will be focused on the amount of heat produced by the new boiler. 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 (0,85) 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 in case other fuel that biofuels are used.

The possible use of peat (or possibly other emission intensive fuels) is, however, critical in monitoring because peat will have a major impact on emission reductions. The possible peat consumption can be monitored based on loads and quality of peat. Peat usage has been considered exceptional and is not foreseen in boiler warranty conditions.

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. Verification will be arranged and paid by Finnish Pilot Programme.

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 in current situation.

Verification is based on data collected by the project participants in accordance with the monitoring and verification plan. Tamsalu Kalor shall submit to the verifier a monitoring 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 for period 2008-2012. 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.

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Annex 1 Letter of Endorsement

MINISTRY OF THE ENVIRONMENT
REPUBLIC OF ESTONIA

TELEFAX MESSAGE

To:	Mr. Jaakko Henttonen Ministry of the Environment of Finland
Fax: E-mail	+(358-9) 1991 9515
From:	Allan Gromov Deputy Secretary General
Pages:	1
Date:	16 October 2000

Subject: assistance project on boiler conversion in Tamsalu

Dear Jaakko,

Government of the Tamsalu municipality has applied a Finnish assistance for the boiler conversion project to be implemented as a project of activities implemented jointly in co-operation between AS Tamsalu Kalor (Estonia) and Sermet OY (Finland)

We support the proposed project and confirm that the overall greenhouse gas emission reduction, which is estimated to achieve, will be credited to Finland.

Sincerely Yours,

Allan Gromov

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Annex 2 Monitoring protocol (example)

MONITORING PROTOCOL:

TAMSALU BIOENERGY PROJECT

	Used for emission reduction calculations					Used for quality assurance purposes			Used for emission reduction calculations			Used for quality assurance purposes				
	Measured average capacity, opating hours and calculated heat production and fuel consumption					Biomass consumption based on delivery			Peat consumption based on delivery			Total fuel consumpt. based on delivery	Completed by	Date	Approved by	Date
2002	MW	h	MWh	Efficiency	Fuel con., MWh	m3	MWh/m3	MWh	t	MWh/t	MWh	MWh				
Jan	1,6	744	1209	0,85	1 422	2427	0,6	1456	0		0	1456				
Feb	1,9	672	1271	0,85	1 495	2552	0,6	1531	0		0	1531				
Mar	2,3	744	1677	0,85	1 973	3368	0,6	2021	0		0	2021				
April	1,6	648	1022	0,85	1 202	2052	0,6	1231	0		0	1231				
May	0,5	744	347	0,85	408	697	0,6	418	0		0	418				
June	0,5	720	374	0,85	440	750	0,6	450	0		0	450				
July	0,0	648	28	0,85	33	56	0,6	34	0		0	34				
Aug.	0,4	432	167	0,85	196	335	0,6	201	0		0	201				
Sep	1,0	720	720	0,85	847	1405	0,6	843	0		0	843				
Oct,	2,1	744	1562	0,85	1 838	3206	0,6	1924	0		0	1924				
Nov.	2,4	720	1728	0,85	2 033	3640	0,6	2184	0		0	2184				
Dec.	3,0	744	2232	0,85	2 626	4420	0,6	2652	0		0	2652				
								0	0		0	0				
Total			**12 337**	**0,85**	**14 514**	**24908**	-	**14945**	**0**	-	**0**	**14945**				

Annex 2 Monitoring protocol (example)

MONITORING PROTOCOL: TAMSALU BIOENERGY PROJECT

PROJECT CONSTANTS(1)	Unit	Code	Value	Comment!
Emission intensity of wood	tCO2eq/GWh(fuel)	Iwood	0,000	CH4 and N2O are not taken into account
Emission intensity of peat	tCO2eq/GWh(fuel)	Ipeat	378	
Emission intensity of shale oil	tCO2eq/GWh(fuel)	Ioil	274	

PROJECTIONS	Unit	Code	Year 1 2002	2 2003	3 2004	4 2005	5 2006	6 2007	7 2008	8 2009	9 2010	10 2011	11 2012	Comment!
Heat production	MWh	Yheat	8050	8050	8050	8050	8050	8050	8050	8050	8050	8050	8050	
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	0,85	
Total fuel consumption	MWh	Yfuel, p	9471	9471	9471	9471	9471	9471	9471	9471	9471	9471	9471	
- biomass	MWh	Ywood	9471	9471	9471	9471	9471	9471	9471	9471	9471	9471	9471	
- peat	MWh	Ypeat	0	0	0	0	0	0	0	0	0	0	0	
Thermal efficiency of baseline	%	nb	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	
Baseline fuel consumption	MWh	Yfuel, b	10733	10733	10733	10733	10733	10733	10733	10733	10733	10733	10733	
Baseline emissions	tCO2eq	Eb,heat	2946	2945,53	2946	2946	2946	2946	2946	2946	2946	2946	2946	
Project emissions	tCO2eq	Ep	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Projected Emission reductions	**tCO2eq**	**E**	**2946**	**2946**	**2946**	**2946**	**2946**	**2946**	**2946**	**2946**	**2946**	**2946**	**2946**	
Cumulative Emissions reduction 2002-2012	tCO2eq		2946	5891	8837	11782	14728	17673	20619	23564	26510	29455	32401	
Cumulative Emissions reduction 2008-2012	tCO2eq								2946	5891	8837	11782	14728	

ACTUAL DATA	Unit	Code	Year 1 2002	2 2003	3 2004	4 2005	5 2006	6 2007	7 2008	8 2009	9 2010	10 2011	11 2012	Comment!
Heat production	MWh	Yheat	12337	14568	0	0	0	0	0	0	0	0	0	
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	0,85	
Total fuel consumption	MWh	Yfuel, p	14514	17139	0	0	0	0	0	0	0	0	0	
- biomass	MWh	Ywood	14514	17139	0	0	0	0	0	0	0	0	0	
- peat	MWh	Ypeat	0	0	0	0	0	0	0	0	0	0	0	
Thermal efficiency of baseline	%	nb	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	
Baseline fuel consumption	MWh	Yfuel, b	16449	19424	0	0	0	0	0	0	0	0	0	
Baseline emissions	tCO2eq	Eb,heat	4514	5330	0	0	0	0	0	0	0	0	0	
Project emissions	tCO2eq	Ep	0	0	0	0	0	0	0	0	0	0	0	
Actual Emission reductions	**tCO2eq**	**E**	**4514**	**5330**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Cumulative Emissions reduction 2002-2012	tCO2eq		4514	9845	9845	9845	9845	9845	9845	9845	9845	9845	9845	
Cumulative Emissions reduction 2008-2012	tCO2eq									0	0	0	0	