**JOINT IMPLEMENTATION
PROJECT DESIGN DOCUMENT (JI PDD)
Version 03 – 9 August 2006**

Onega Town Coal-to-Waste Wood Energy Switch, NW-Russia

CONTENTS

Foreword

The project mission for the Onega Coal-to-Waste Wood Energy Switch took place in the period 1-15 February, 2006.The project falls under the international JI regulations, which are still under development. Given the lack of applicable methodology for this project as a large-scale project, small-scale CDM methodologies have been applied but with higher requirements on accuracy of methodology, monitoring and baseline calculation.

In the period when the mission took place and the PDD was developed, the avoided methane emissions were calculated using the latest approved specific methodology, published by the CDM EB for small-scale projects (AMS III-E, Version 7 of 28 November 2005) as no such specific methodology was available for large-scale projects. After completion of the PDD, the project developer noticed that by 3 March 2006 a new Version 8 of this AMS III-E methodology has been published by the EB. Therefore, the project developer commissioned an analysis from a methane specialist (IFAS Institute, Hamburg, see Annex 8) who concluded that only the formula used in the Version 7 of the AMS III-E is appropriate to determine correctly the methane emissions avoided by the project proposal. In contrast, the formula used in Version 8 is inappropriate and should not be used for such type of projects. Consequently, the project developer maintained the calculations based on Version 7 of AMS III-E. However, the project developers took into account the enlarged project boundary proposed by Version 8 of AMS III-E, which includes the itineraries between the solid waste deposits and the biomass combustion place.

All financial calculations use the following **exchange rate**: 1 EUR = 34.0 RUB = 1.20 USD (February, 4, 2006). Decimal points are used and comas to separate numbers for every 10^3 digits.

SECTION A. General description of the project

A.1. Title of the project:

Coal-to-Waste Wood Energy Switch in the Town of Onega, Archangelsk Oblast, North-West Russia ("Onega Wood Energy Project")

JI PDD version number: 3.0

Date: August 9, 2006

A.2. Description of the project:

The purpose of the proposed JI project "Coal-to-Waste Wood Energy Switch" is to replace outdated and inefficient municipal heating installations of fossil coal boilers build in the 1950s and 1970s by modern wood-fired boilers.

The project plans to install one biomass heating plant (total capacity 43 $MW_{thermal}$) in Onega Town, Archangelsk Oblast in North-West Russia. The project owner is Onega Energy JSC ("Onega Energy"), a company set up especially for the purpose of delivering biomass thermal power to half of the 23,000 people in Onega town. Onega Energy is a joint stock company. The share distribution is 75% (minus 1 share) Onega Sawmills JSC and 25% (+ one share) Municipality of Onega.

The fuel of the new plant will be wood waste from the production of Onega Sawmills JSC ("Onega Sawmills"), a producer of sawn-wood and wood chips located in Onega Town. The biomass fuelled thermal plant will replace an old outdated coal fired CHP plant leading to greenhouse gas emission reductions. The wood fuel (mainly bark and some saw dust) comes from sustainably managed forests, certified by the internationally most recognized Forest Stewardship Council (FSC) label[1]. Hence, a closed carbon emission cycle will be established, avoiding the GHG emissions from fossil coal firing. Another noxious non-Kyoto gas, i.e. SO_2 from coal firing, will also be avoided. The coal is derived from various distant sources. Hence, transportation emissions are significant as the coal mines are situated between Vorkuta, Ural (at about 1,500 km) and Novokusnetsk, Siberia (at about 4,000 km distance). The use of biomass will also reduce methane emissions from anaerobic digestion in stockpiles and avoid the environmental impacts of such waste wood stockpiles on groundwater. The total emission reductions expected from the project activities between 2008-2012 amounts to 788,054 tonnes of CO_2 equivalent while applying an ex-ante calculation[2].

Project participants and stakeholders expressed their expectation of additional benefits in form of reliability and quality of heat production in Onega. This will reduce the presently serious disruptions and malfunctioning of the heating infrastructure and significantly improve the health and quality of life for 12,000 people. The modernization of the thermal plant will also eliminate the serious health hazards related to working in the present coal fired CHP plant with high noxious smoke emissions, dust and noise. It will further help to limit and reduce the already large industrial stockpile near the town.

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[1]   Website: www.fsc.org/fsc

[2] For more detailed information on ex-ante and ex-post scenarios refer to section B.1 of this document.

A.3. Project participants:

Name of Party involved (´#)	Legal entity / project participant (as applicable)	Party involved wishes to be considered as project participant (Yes/No)
Germany	GFA Consulting Group GmbH, Public entity	No
Russia#	Onega Energy JSC, Public entity	No

(host) indicates a host Party

A.4. Technical description of the project:

A.4.1. Location of the project:

The project activity is located in the town of Onega, Arkhangelsk Oblast in the North-west Federal Region of Russia. Onega is a district centre situated 200 km to the South-West of the town of Arkhangelsk.

A.4.1.1. Host Party(ies):

Russian Federation.

Russia ratified the UNFCCC in December 1994. It signed the Kyoto Protocol in March 1999, and ratified it November 18, 2004. Russia has submitted its first and second national communications under the UNFCCC.

A.4.1.2. Region/State/Province etc.:

Arkhangelsk Oblast situated in the North-west Federal Region of Russia.

A.4.1.3. City/Town/Community etc:

The population of Onega amounts to 23,000 inhabitants. Most households (95%) are connected to the municipal heating system, half of which belong to the thermal station of the former Hydrolytic Plant which is considered to be replaced. The main economic activity is related to timber industries.

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project:

The project activity is located in the town of Onega, Arkhangelsk Oblast in the North-west Federal Region of Russia. The geographic coordinates are 38°05' East and 63°55' N.

The town of Onega is connected by railroad and by unpaved road to Arkhangelsk and by harbor to the White See.

A.4.2. Technology to be employed by the project:

Background situation

Heating and hot water in Onega Town is largely centrally produced and delivered. The main producer of thermal heat is the former Hydrolytic Plant JST that produced technical alcohol from wood hydrolysis. At the time of operation, 30% of thermal production of the plant was delivered as heat and hot water to about half of Onega Town. The hydrolytic plant went into insolvency in November 2004 and was set under administration in May 2005. The District of Archangelsk came up with the solution to let the newly established public company PKTS JST ("PKST") rent the thermal station at the Hydrolytic Plant for one year in order to continue delivering heat and hot water to the town. The contract will end in July 2006.

PKTS JST also administers and runs the remaining eight boiler houses in Onega as well as the pipeline network.

The thermal station at the Hydrolytic plant (hereafter named "Hydrolytic thermal plant") delivers heat to 11,997 people living in 4,782 households distributed in 309 buildings across Onega town (no industrial users). Of the 11,997 people, 5.314 also receive hot water from the same thermal station, representing 2,414 households in 72 buildings. In 2005, the annual heat production of the Hydrolytic Thermal Plant system for the Onega district heating network amounted to 85,058 Gcal. Five boilers are installed in the Hydrolytic Thermal Plant with a total capacity of 116 MW. Three were constructed in 1954 (each with a capacity of 17.2 MW) and two in 1968/1969 (each with a capacity of 32.3 MW). All five boilers run on coal with mazut and diesel being used for starting up the boilers. Currently, due to the closure of the wood alcohol production, the Hydrolytic Thermal Plant is working at 30% of total capacity, i.e. at 43 MW, to supply hot water and heat to Onega Town. Table A.4.2.1. shows the capacity and population supplied with hot water and heat.

Table A.4.2.1 Heat& Hot Water Production and Delivery to Onega from Hydrolytic Thermal Plant, in the year 2005

Production Unit	MW	% of full capacity	Annual heat production (Gcal)	Buildings serviced	People serviced
Heat Supply	37.9[1]	30%[2]	85,058[2]	4,782[3]	11,997[3]
Hot Water Supply	4.9[1]	30%[2]		72[3]	5,314[3]

[1] Method applied to calculate value: MDS 41-4.2000. Approved according to the order of Russian Gosstroi No 105 from 6.05.2000. ; [2] PKTS, 2005a, [3] PKTS, 2005b.

Average consumption of coal between 2002 and 2005 represented nearly 22,978 tce and 240 t mazut. Mazut was mainly used for lighting up coal boilers. Due to the price development of mazut, the Hydrolytic Thermal Plant has increasingly replaced the use of mazut with diesel. For conservative reasons, the baseline emissions exclude emissions from the use of mazut (See Section E).

According to the average monthly temperatures in Onega over the last 20 years, heat production needs to ensure a total capacity of 100,000 Gcal. Table A.4.2.2 gives an overview of the monthly temperatures and necessary heat loads and production in order to comply with federal state heat regulations. However, due to technical deficiencies in the current heat production and supply system and lacking investment and maintenance, heat production has lacked behind the target of 100,000 Gcal for several years, with an average of 82,725 Gcal between 2002 and 2005 (See Annex 2).

The winter of 2005/2006 was no exception. Due to very low temperatures (less than minus 35ºC) combined with a lack of maintenance works prior to the winter, delivery of poor quality coal and partly damaged pipelines (e.g. isolation missing), output temperatures dropped from the normal 90°C to 42°C making indoor temperatures of client houses fall from the normal 18-20°C to 7-10°C. It took the heat system one week to reach normal performance after repairing broken lines and using better quality coal.

According to PKTS managing the heat production and pipeline network in Onega, a yearly investment of EUR 147,000 would be needed to maintain the performance of the network in addition to EUR 58,800 per year of running costs.

Table A.4.2.2 Temperature, Heat Loads and Necessary Heat Production

Month	Temperature[1]	Heat Loads		Heat Production
	ºC	Gcal/h	MW (thermal)	Gcal
January	-12	23,18	26,96	15,000
February	-11,6	22,89	26,62	14,500
March	-7,2	19,70	22,91	13,500
April	0,1	14,41	16,76	9,500
May	6,4	9,85	11,46	4,500
June	2[2]	2,6	3,02	2,000
July	2[2]	2,6	3,02	2,000
August	2[2]	2,6	3,02	2,000
September	8,4	8,40	9,77	3,000
October	1,9	13,11	15,25	8,500
November	-3,6	17,09	19,88	11,500
December	-9	21,01	24,43	14,000
Total	**-3,9**			**100,000**

[1] Average temperatures over 20 years in Onega
[2] No heating, only hot water supply

Boiler Technology to be used by the project

The proposed project activity comprises two biomass heating boilers (17 MW each) (See Figure A.2.1) and one diesel boiler (9 MW) for emergency purposes, for the supply of heat and hot water to the town of Onega, i.e. to the same private households which are currently connected to the Hydrolytic Plant. Onega Energy will purchase bark and sawdust from Onega Sawmills, located 3.1 km from the site of the biomass heating plant. Bark is planned to represent 85% and sawdust 15% of biomass consumption. The biomass boilers, produced by the Finnish company Wärtsilä Biopower Oy, were chosen because of the ability to combust biomass up to a moisture content of 65%. Softwood bark is estimated to contain between 50-65% moisture content (Bioenergy Solutions from Wärtsilä, Wärtsilä Biopower). Bark and sawdust available from the sawmill production at Onega Sawmills will cover 93% of the yearly consumption needed to produce 100,000 Gcal of heat (ex post baseline). The remaining 7% will be supplied from the permanent stockpile, located 4.7 km from the biomass heating plant. Onega Sawmill has deposited approximately 520,000 m^3 biomass since 1978 at the stockpile (Onega Sawmills, 2005a).

Due to safety reasons, the site of the biomass heating plant cannot store more than 300 $m^3_{(space)}$ representing ca. 5 hours of fuel during peak periods. Onega Sawmills will create and manage a temporary deposit located 500m from the biomass heating plant. The temporary deposit will be built up during summer periods where the heating plant only supplies hot water and no heating. During heating periods from September to May, the temporary deposit will be reduced to zero. Table A.4.2.3 gives an overview of the biomass fuel flows on a monthly basis of the ex post baseline: a) from Onega Sawmills to the biomass heating plant; b) from Onega Sawmills to the temporary deposit; c) from the temporary deposit to the biomass heating plant and d) and from the permanent stockpile to the biomass heating plant.

A maximum of 54,928 $m^3_{(space)}$ will be stored at the temporary deposit for a maximum of five months. The maximum capacity of the temporary deposit will be 66,667 $m^3_{(space)}$ and biomass will be stored outdoor with a maximum height of 2.5 m to avoid methane emissions.

Table A.4.2.3 Annual Wood Fuel Consumption & Origin, ex post baseline estimates

	Heat Production	Biomass consumption[i]	Directly available biomass from sawmill production	Use of temporary deposit[ii]	From sawmill directly to biomass boilers	Additional supply from permanent stockpile to biomass boilers[iii]
Month	*Gcal*	m^3_{space}				
January	15,000	30,529	14,073	-16,456	14,073	
February	14,500	29,511	14,703	-13,548	14,703	1,260
March	13,500	27,476	17,507	0	17,507	9,969
April	9,500	19,335	16,853	0	16,853	2,482
May	4,500	9,159	14,698	5,539	9,159	
June	2,000	4,071	16,746	12,676	4,071	
July	2,000	4,071	16,307	12,236	4,071	
August	2,000	4,071	17,702	13,632	4,071	
September	3,000	6,106	16,951	10,845	6,106	
October	8,500	17,300	12,163	-5,136	12,163	
November	11,500	23,405	16,200	-7,205	16,200	
December	14,000	28,494	15,911	-12,582	15,911	
Total	**100,000**	**203,525**	**189,813**	**0**		**13,711**

[i] 2.035 m^3 space = 1 Gcal according to letter from boiler manufacturer Wärtsilä Oy of 11.10.2005

[ii] Negative numbers mean a net removal of biomass from temporary deposit. Positive numbers mean a net supply of biomass to the temporary deposit

[iii] Energetically useful material (not rotten), accounted on a specific weight basis with defined moisture content

Production of ashes is estimated by Onega Sawmills to amount to 1,425t per year. There are several types of use for ashes, including agriculture as fertilizer, road construction, construction or deposit. Distances for the transport of ashes vary depending on the usage from 200m to max. 4km.

Figure A.1 Diagrams of Biomass Boilers
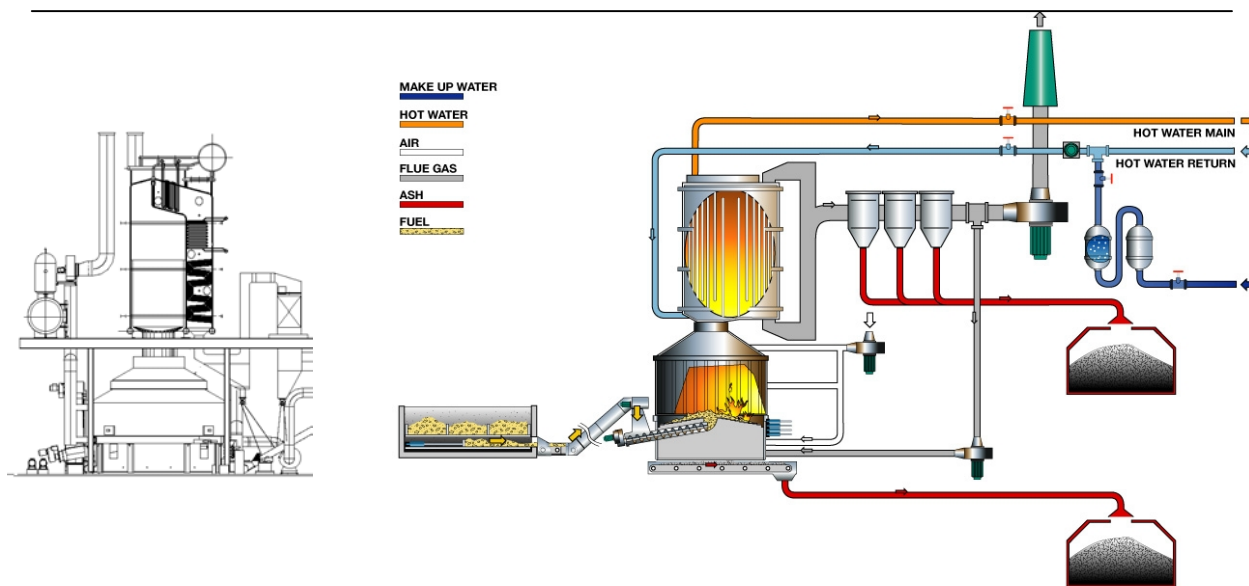
Project Assumptions and connected Risks

Potential risks for developing such a project could arise if one or more of the following assumptions should not be realized:

- The biomass boilers are constructed and function as scheduled;

- Sufficient wood waste from non-destructive forest use will be available;

- Heat users continue to pay the agreed tariff for the delivered hot water; or

- The generated ERUs can be sold at the expected price.

All the mentioned assumptions are considered fairly safe and therefore the project risk is moderately low: The biomass boilers will be delivered and installed by a big Finnish company which has ample experience in this business. Onega sawmills are FSC certified, which proves that the supply basis is sustainable and the business is profitable. Heat users have paid in the majority of cases their heat bills and this situation is most likely to continue in future. ERUs will be sold to the European market which will absorb these amounts at probably increasing prices. Price risk will be checked through sensitivity analysis.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

The presently old supply system of district heating with the coal fired boilers is no more reliable, but the municipality of Onega has no budget to invest in a new heating system. The investment sum of 206 million Rubles is two thirds of the annual municipal budget income of 300 million (2005)[3].

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[3] The net budget of Onega Municipality for 2005 was minus 16.5 million Rubles, financed with loans & liquidations (Onega District, 2005). Implementation of budget is done by municipal union "The City of Onega and Onega

As part of sectoral policy heating tariffs are fixed at moderate levels by the Administration of Arkhangelsk Oblast (Commission on Tariffs and Prices). Private investors are therefore normally not interested to venture into district heating systems. Hence, the precarious situation is bound to continue until a major breakdown of the coal boilers because of lack of viable economic alternatives. The presently old boilers could however well last for more than another decade. No administrative decrees, laws or national policies stipulate or promote the replacement of such old equipment.

The success of fuel switch projects, continuing national economic growth and raising prices on the international markets for fossil fuels may create national circumstances that other industries and district heating companies could be inclined for financial reasons to use organic waste materials instead of coal, oil or gas. This may question in the future the continuation of the presently given additionality of the project approach. Hence during the renewals after the first and second crediting period (i.e. after 7 years and 14 years) the business-as-usual situation will have to be re-evaluated[4].

With the possibility of receiving additional benefits by selling emission reduction units, Onega Energy JSC was founded with the aim to invest into a new waste-wood fed heating system based on a feasibility study on this subject[5]. As mentioned above, there are two shareholders: The town of Onega contributes the supply network (water tubes), and Onega Sawmills finances the new heating system (boilers, boiler house).

With the start of the new project boilers, the old coal boilers shall stop operation and emitting GHG, which are then fully accountable as emission reductions. The project related CO_2 emissions from burning of waste-wood are not accountable because they originate from a renewable energy, i.e. a closed emission-sequestration cycle[6].

The avoided emissions from the distant transport of coal over 1,500 to 4,000 km are conservatively disregarded.

Additionally the use of waste-wood (mainly saw-dust) will prevent the dumping in landfills, and in February, March and April additional waste-wood will be directly taken from the stockpile. Therefore, emissions of methane from rotting biomass will be avoided. This also creates accountable emission reduction units.

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district in 2005". The total receipts are 299.69 million Rubles. Biomass boiler investment is 206 million Rubles according to personal communication with Alexander Doikov.

[4] All calculations made in this document refer only to the period of 2008-12, the 1st Commitment Period of the Kyoto Protocol. Nevertheless, in principle the project duration has been planned according to the options provided for the CDM, i.e. it is assumed that there will be a follow-up period for JI after 2012. Therefore, in Annex 4 calculated emission reductions for the whole lifetime of the project are provided.

[5] Energy Efficiency Fund of Arkhangelsk Region (2005): Reconstruction of a heating system in the town of Onega, Arkhangelsk Region. Feasibility Study, Arkhangelsk, 25 pp.

[6] At its 23rd meeting (22-24.02.2006), the EB defined that "Biomass is 'renewable', if one of five conditions applies:" "5. The biomass is the non-fossil fraction of an **industrial** or **municipal waste**." In the case of the present project, the utilized biomass is clearly the non-fossil fraction of a wood-industrial waste, and hence renewable by the EB definition.

A.4.3.1	Estimated amount of emission reductions over the crediting period:

Although the project plans to start work in October 2006 with scheduled ex ante emission reductions of 50,435 tCO2e[7] (2006) and 157,611 tCO2e (2007); ERU crediting will only account emission reductions from 2008 onwards after the start of the first commitment period (CP)[8].

Table A.4.3.1 Estimated amounts of Ex Ante emission reductions over the 1st CP

Year	Years of Project	Annual estimation of emission reductions in tonnes of CO2 e
2008	1	157,611
2009	2	157,611
2010	3	157,611
2011	4	157,611
2012	5	157,611
Total estimated reductions, 1st crediting period (tonnes of CO2 e)		**788,054**

Annex 9 contains the full calculations of estimated ex ante emission reductions per year. Taking into consideration possible extension of the Kyoto Protocol after 2012, Annex 4 contains ex-ante calculations of the expected emission reductions of the two subsequent crediting periods, each renewable for 8 years.

No public funding, other than the contributions in kind (tube network) of the municipality, is involved in the financing of the project. The Energy Efficiency Fund of Arkhangelsk Region, a regionally based federal programme to promote energy efficiency, administers a yearly budget of 2 million Rubles for the whole region of Arkhangelsk. It is highly unlikely that the project would be eligible for this fund, should the project operator choose to apply, for the following reasons: a) the funding available is very limited, b) mainly energy efficiency is supported rather than fuel switch projects and c) private investors are very unlikely to receive funding from the programme.

A.5.	Project approval by the Parties involved:

The project has received Letters of Endorsement from the Russian Ministry of Economic Development and Trade on 19 January 2006 (see Annex 12) and from the German Ministry of Environment, Joint Implementation Coordination Office on 29 September 2005 (see Annex 13).

Russia has not yet informed the UNCCC secretariat of its designated focal point for approving JI projects. However, the Russian Ministry of Economic Development and Trade communicated on 3 April 2006 that it was looking to start work with the government on Kyoto Protocol joint implementation projects. Deputy Economic Development and Trade Minister Andrei Sharonov said a draft regulation for the approval of joint implementation (JI) projects and a scheme for targeted environmental investment would be submitted to the government in a few weeks in a bid to launch approval procedures in July. Minister Sharonov said the ministry would also submit to the Cabinet by May 15 a draft bill defining the government's trading quotas and outlining its authority within the framework of the Kyoto Protocol (RIA Novosti, http://en.rian.ru/business/20060403/45120670.html).

As soon as the Russian JI Focal Point is in place, the project developers will apply for official project approval.

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[7] Estimate is based on the share of heat production between September and December 2005 of total annual heat production in that year, i.e.32%.

[8] Decision -/CMP.1 (2006) Guidelines for the implementation of Article 6 of the Kyoto Protocol. Article 5.
"…emission reduction units shall only be issued for a crediting period starting after the beginning of the year 2008."

SECTION B. Setting of the baseline

B.1. Description and justification of the baseline chosen:

Selection of methodology with type and categories of project activity

When searching for an appropriate baseline methodology none of the presently 30 approved CDM AM methodologies and presently 9 approved consolidated ACM methodologies covered one of the two distinct parts of the proposed project: switching coal to biomass; and avoiding methane emissions from biomass stockpiles by controlled combustion. However, there were two approved CDM small-scale project methodologies available which exactly covered these two parts. Thus the approved CDM-methodologies for small-scale projects under the type (III) are used in this large-scale project. Considering that projects under the type (III) fulfill the requirements of the CDM EB as follows: '*Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually'*. The ex ante total annual emissions of the project amount to 1.8 kilo tonnes of CO_2eq[9] only.

Therefore, the most appropriate and approved baseline methodology categories for the two distinct parts of the proposed project activity that are presently available are as follows:

- Type III, Other Project Activities; Category III.B – *Fossil fuel switching in existing industrial applications.* Recovered biomass is used to replace coal for thermal energy services. Reference: CDM-Executive Board (2006): Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities. Version 6 of 30 September 2005, Bonn.

- Type III, Other Project Activities; Category III.E – *Avoidance of methane production from biomass decay through controlled combustion.* Methane emissions will be avoided because of project activity. Reference: CDM-Executive Board (2006): Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities. For reasons explained in the foreword and below, elements of both Version 7 of 28 November 2005 and Version 8 of 03 March 2006 are used.

After realizing the project, an Ex-Post Baseline will be applied determining actual emission reductions in the project, based on the actual heat produced in the project. This allows fine-tuning for effects of the temperature regime of each year, heating efficiency improvements and possible isolation measures realised in future in the buildings.

Meanwhile, an Ex-Ante Baseline for the fossil fuel switch component is applied for determining conservatively and provisionally the accountable emission reductions based on the average fossil fuel consumption and heat production between 2002 and 2005. This provides an estimation regarding the ERUs which a project could expect to receive from its activities. A further discussion on alternative baseline scenarios is provided below (see B.2) and in the Baseline Information (Annex 2).

In the ex-post scenario it is assumed that the supply of fresh wood waste material will not be sufficient to cover the fuel demand of the new biomass boilers. Therefore, it might be required to use wood waste from the existing landfill. The share of such old material will not exceed 6.7% of the total estimated ex-post demand of 56,977 tons of wood waste per year, i.e. the share of old material won't be higher than 3,817 tons per year. For these 3,187 tons however, not the full amount of avoided methane emissions can be calculated as the material has fumigated already.

This reduction caused by outgassing can be expressed by the formula :

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[9] This related to emissions caused by the project activities (See Formula 7, Section D)

$$MB_y = 16/12 * F * DOC_f * MCF * \sum_{x=1}^{y} \sum_{j=A}^{D} A_{j,x} * DOC_j *(1-e^{-k_j}) * e^{-k_j*(y-x)}$$

DOCy = DOCj * (1-e-kj*t)

DOCy = C-fraction at observation yearKohlenstoffanteil im Betrachtungsjahr

T   = Time (a) the material has remained on the landfill

Taking a half-life period of 5 years the C-fraction of deposits dumped in 2006 at a landfill therefore is reduced from 30% (the value for fresh material) to :

	DOC (2006)	DOC (2005)
2006	30,00	26,12
2007	26,12	22,74
2008	22,74	19,79
2009	19,79	17,23
2010	17,23	15,00
2011	15,00	13,06
2012	13,06	11,37
2013	11,37	9,90
2014	9,90	8,62
2015	8,62	7,50
2016	7,50	6,53
2017	6,53	5,68
2018	5,68	4,95
2019	4,95	4,31
2020	4,31	3,75
2021	3,75	3,26
2022	3,26	2,84
2023	2,84	2,47
2024	2,47	2,15
2025	2,15	1,88
2026	1,88	1,63
2027	1,63	1,42
2028	1,42	1,24
2029	1,24	1,08
2030	1,08	0,94
2031	0,94	0,82
2032	0,82	0,71
2033	0,71	

In the ex-post scenario the annually produced CO2eq of methane emissions will therefore slowly decrease after 2007 if old material from a landfill needs to be used. Assuming an amount of 3,817 tons/year, the reduction until 2012 would come up to a maximum of 3.8%. Further information on the reduction calculation is provided in Annex 10.

The ex-ante calculation is not affected by this as the annual amount of wood fuel can be covered by fresh material from the sawmill!

(a) *AMS-III.B. Switching fossil fuels.*

This category comprises fossil fuel switching in existing[10] industrial, residential, commercial, institutional or electricity generation applications. Fuel switching may change efficiency as well. If the project activity primarily aims at reducing emissions through fuel switching, it falls into this category. If fuel switching is part of a project activity focussed primarily on energy efficiency, the project activity falls in category II.D or II.E. Measures shall both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually.

The project activity falls under this baseline methodology because it is a fuel switch from coal to renewable biomass in an existing industrial application aiming at reducing emissions through fuel switching. It is not focussed on energy efficiency. It reduces anthropogenic emissions by sources and directly emits less than 15 kilotonnes of carbon dioxide equivalent annually. The present project will emit 1.8kt CO_2-eq./year[11].

AMS III B defines the baseline as follows: "The emission baseline is the current emissions of the facility expressed as emissions per unit of output (e.g. kg CO_2 equ/kWh). Emission coefficients for the fuel used by the generation unit before and after the fuel switch are also needed."

The basic **assumptions** of the baseline methodology in the context of the project activity are, that:

- Emission coefficients for the fuel used before and after the fuel switch can be derived;
- Records for the heat output can be generated.

The assumptions can be met: The first assumption is also non-critical, as the methodology foresees alternatively the use of IPCC default values for emission coefficients. The record will be generated by Onega Energy technical administration.

The following **key information and data** are used to determine the baseline scenario:

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[10] This does not preclude project participants from proposing, in accordance with paragraphs 7 and 8 of the simplified modalities and procedures for small-scale CDM project activities, simplified baselines for switching of fossil fuels for new applications.

[11] See Formula (7), Section E2.

Table B.1.1 List of variables and parameters used for EX ANTE AMS-II.B baseline determination

No.	Variable or Parameter	Value	Source of data	Comments
1	Coal boiler heat output (MWh)[i]	96,192	PKTS	Yearly average value 2002-2005
2	Coal input for the above heat (t)	22,978	PKTS	Yearly average value 2002-2005
3	Thermal efficiency of Hydrolytic CHP (MWh / t coal)	4.1863	Variable No. 1 and No. 2	Calculated
4	Energy unit of coal equivalent (MWh/t coal equivalent)	8.140	Hartmann (2003)	Internationally agreed value.
5	Energy content of coal used in the boiler (MWh/t coal)	6.705	Onega Sawmills	This estimated value has to be measured before monitoring
6	CO_2-Emissions of coal (t CO2-eq./t coal eq.)	2.759	Batalov et al. (2000)	Exogenously given
7	CH_4-Emissions of coal (t CO2-eq./t coal eq.)	0.01	Batalov et al. (2000)	Exogenously given
8	N_2O-Emissions of coal (t CO2-eq./t coal eq.)	0.01	Batalov et al. (2000)	Exogenously given
9	CO_2-Emissions from coal firing (kg/MWh)	543	Parameter No. 3, 4, 5 and 7	Calculated
10	CH_4-Emissions from coal firing (kg/MWh)	2.56	Parameter No. 3, 4, 5 and 8	Calculated
11	N_2O-Emissions from coal firing (kg/MWh)	2.50	Parameter No. 3, 4, 5 and 9	Calculated
12	Future annual heat production (MWh)	96,192	Onega Energy	Estimated value which has to be monitored
13	Annual CO_2-Emissions (t CO_2-eq.) if future heat production were generated by old coal boiler	52,232	Parameter 9, variable 12	Calculated
14	Annual CH_4-Emissions (t CO_2-eq.) if future heat production were generated by old coal boiler	246	Parameter 10, variable 12	Calculated
15	Annual N_2O-Emissions (t CO_2-eq.) if future heat production were generated by old coal boiler	240	Parameter 11, variable 12	Calculated

[i] **The 96,192 MWh correspond to 82,725 Gcal. These values represent the ex ante baseline (See Annex 2 for further information).**

In contrast to the presently supplied amount, 116,279MWh (=100,000Gcal) is necessary to supply heat and hot water in conformity with existing regulations (See Table A.4.2.2). The current hydrolytic thermal plant, given the necessary investment and maintenance, could supply this.

(b) *AMS III.E. Avoidance of methane production from biomass decay through controlled combustion.*

This project category comprises measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay as a result of anthropogenic activity. Due to the project activity, decay is prevented through controlled combustion and less methane is produced and emitted to the atmosphere. The project activity does not recover or combust methane (unlike III D). Measures shall both reduce anthropogenic emissions by sources, and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually.

The project activity falls under this baseline methodology because the project biomass boilers use wood waste in form of bark and sawdust from a certified sustainable source, which would otherwise continuously be dumped and emitting constantly methane. The source of methane is directly eliminated through the project activity. Hence, the project reduces anthropogenic emissions by sources and directly emits less than 15 kilotonnes of carbon dioxide equivalent annually, i.e. 1.8 kt CO_2-eq./year[12].

AMS III E defines the baseline as follows: "The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane from decay of the biomass content of the waste treated in the project activity".

The basic **assumptions** of the baseline methodology in the context of the project activity are, that:

- Specific weight of waste wood coefficients can be obtained periodically, and
- Records for the fuel use and heat output can be generated.

And that, additionally and in accordance with the latest version 8 of this methodology, the

- Incremental transport distances and consequent emissions of biomass and ashes can be measured.

The assumptions can be met and Onega Energy will establish an adequate monitoring system to generate this information (see Section D).

The following **key information and data** are used to determine the methane from biomass decay baseline scenario:

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[12] See Formula 13, Section D.1.1.4.

Table B.1.2 List of variables and parameters used for EX ANTEAMS III.E baseline determination

No.	Variable or Parameter	Value	Source of data	Comments
1	CH_4 emission factor for decaying biomass in the region of the project activity (t CH4/ton of biomass)	0.1078	IPCC	Calculated based on methane emissions formulae from AMS III.E and adapted methane correction factor (MCF) to the height of the baseline deposit[1]
2	Greenhouse Gas Warming Potential (GWP) of CH_4 (t CO_2-eq./t CH_4)	21	IPCC	Internationally agreed value.
3	Baseline methane emissions from biomass decay (t CO_2-eq./t biomass)	2.2638	Parameter No. 1 and No. 2	Calculated
4	Annual biomass input of new biomass boilers, ex ante baseline (m³ space)	168,336	Variable 7 and Parameter 9	Based on the ex ante Gcal heat production of 96,192 MWh. Biomass consumption is calculated based on the ex ante estimated heat production and will be periodically monitored.
5	Specific weight of biomass input (t/m³ space)	0.28	Onega Sawmills	Initial value received from Onega Sawmills at 55% moisture of 85% bark and 15% sawdust. Will be monitored on a sample basis during the first year.[1]
6	Annual biomass input of new biomass boiler (t)	47,134	Variable No. 4 and Parameter No. 5	Calculated on the basis of the average annual heat output of the years 2002-05.
7	Annual heat output of new biomass boiler (MWh)	96,192	PKTS	Ex ante estimation, based on the average of the years 2002-05. Will be continuously monitored.
8	Thermal efficiency of new biomass boiler (MWh / t biomass)	2.04	Variable No. 7 and 6	Calculated. May serve later to check biomass input
9	Thermal efficiency of new biomass boiler (MWh / m³ biomass)	0.5714	Wärtsilä Biopower Oy	Default value for wood biomass. After calibration it may serve later to check biomass input
10	CO_2-Emissions factors from truck transport (kgCO2/km)	0.77	IPCC (1996)	Exogenously given, based on local truck performance
11	CH_4-Emissions factors from truck transport (kgCO2/km)	0.03*10-3	IPCC (1996)	Exogenously given, based on local truck performance
12	N_2O-Emissions from truck transport (kgCO2/km)	0.06*10-3	IPCC (1996)	Exogenously given, based on local truck performance
13	Quantity of biomass combusted transported from baseline deposit (t)	11,654	Onega Energy	Ex ante value, which has to be monitored
14	Average truck capacity for biomass transportation (m3 space)	35	Onega Sawmills	Exogenously given
15	Quantity of ashes produced (t)	1,425	Onega Energy	Estimated value, which has to be monitored
16	Average truck capacity for ash transportation (t)	10	Onega Energy	Estimated value, which has to be monitored
17	Average distance for transport of ashes (km)	4	Onega Energy	Estimated value, which has to be monitored

[1] See Formula (13) under Section D.1.1.4.and Section E.6.

B.2. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the JI project:

Step 0: Preliminary screening based on the starting date of the project activity

The starting date of the project activity is expected to be around 1st of October 2006. A fact-finding mission of the project developer took place in August 2005, which identified the proposed project. A Project Idea Note was developed for the Joint Implementation project and finalised in October 2005. The development of the Project Development Document started with a mission by the project developer in February 2006. Subsequently, a Letter of Endorsement for the Joint Implementation project was issued by the Russian Ministry of Economic Development and Trade in January 2006.

Onega Sawmills commissioned a feasibility study in 2005 '*Reconstruction of a heating system in the town of Onega, Arkhangelsk Region'* (Energy Efficiency Fund of Arkhangelsk Region, 2005), which looked at replacing the existing coal-fired CHP with a Russian or Western biomass heat plant technology.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity

The following alternatives are identified for this project activity:

Alternative 0: Joint Implementation project activity

Alternative 1: Business as usual

Alternative 2: The proposed project activity without JI participation and carbon credit trading

Following **business as usual alternatives** have been considered for the supply of hot water and heat to about half the population of Onega town:

- *Gas fired heat plant* – as there is no connection to the gas net, not even in Arkhangelsk, this option was disregarded;

- *Cogeneration of heat and electricity* – due to the monopolistic electricity market in Russia, any production of electricity to the grid would not be remunerated. Hence this option was disregarded;

- *Utilization of partly installed equipment bought by Hydrolytic Plant in 199*6. This alternative is not deemed financially feasible because the size (340 MW) of boilers are not suitable and many parts have been already removed;

- *New coal-fired heat plant* – would necessitate a major investment, which cannot come out of the municipal budget (see below). As the heat production in this case would only generate income from heat customers and the regional energy authorities determine heat tariffs centrally, no private investor would venture into this sector. This option was therefore disregarded;

- *Continued use of the Hydrolytic thermal plant* – in the absence of the present project, the coal fired boilers at the hydrolytic plant can continue to operate during the lifetime of the crediting period and meet the minimum requirements for heat production[13]. This would necessitate additional investment and maintenance compared to the present condition. This option is by far

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[13] The baseline coal fired boilers are inspected periodically and receive a certification of the operationality for a four-year period (max. period granted). The latest inspection date was carried out successfully in 2005.

not as expensive as the proposed project activity. The municipality of Onega would in this case prolong the operation contract with PKTS, which is set to end on 26th June 2006.

Based on the alternatives to the proposed project activity, only the continued use of the Hydrolytic thermal plant can be considered an alternative under business as usual.

Substep 1b: Enforcement of applicable laws and regulations

The alternative 1 is within applicable legal and regulatory requirements. The Hydrolytic thermal plant was inspected in 2005 and granted the maximum possible period of operationality, which are 4-years. This is a standard routine in the Russian Federation. Alternatives 0 and 2 would need to comply with all applicable legal and regulatory requirements according to the Order of the State Committee of the Russian Federation for Environmental Protection as of 15.04.2000 #372. The proposed project activity has obtained the necessary permissions for the biomass heating site (See Section F for more details).

Step 2: Investment analysis

Sub-step 2a: Determine the appropriate analysis method

Investment comparison analysis will be used.

Sub-step 2b: Apply investment comparison analysis

The investment comparison analysis is based on the Net Present Value using a discount rate of 5%, which is the same interest rate of the commercial bank loan available for the proposed project net of inflation (the nominal interest rate of the specific bank loan for the proposed project activity is 12%). Also the Internal Rate of Return is applied. The following calculations are net of inflation.

Sub-step 2c: Calculation and comparison of the financial indicators

Onega Energy is a joint stock company with Onega Sawmills JSC owning 75% (minus 1 share) and Onega Municipality owning 25% (+ 1 share). It was set up specifically to supply heat to about half the inhabitants of Onega town. Onega Municipality transferred the district heating system to Onega Energy as capital asset, worth a value of € 306,176 and Onega Sawmills finance the new heating system (boilers, boiler house).

The total investment costs for the proposed project is € 6 million. Onega Energy is expected to cover the investment costs with an external bank loan, repayable in 5 annuities and amounting to € 6.6 million. No additional funding or grants can be expected for the proposed project, including from renewable energy funds, due to scarcity of funds.

The financial analysis is based on the current level of heat tariffs in Onega Town (860 rubles/Gcal) and is calculated over the expected 21 year lifetime of the proposed project. It shows clearly that only the project activity under Joint Implementation (Alternative 0) holds enough economic viability (NPV € 4.7 million and IRR 13%). Business as Usual (alternative 1) has no effect and the project activity without the carbon credits would generate a negative NPV of € -468,135 and IRR of 4%. Without carbon credits and at the current heat tariff level, the pay-back period is 13 years compared to 6 years when carbon credits can be accounted for. Table D.1 below summarises the financial analysis and Annex 9 provides a detailed calculation of cash flows and financial analysis.

Table B.2.1 Summary of financial analysis

Alternatives	Estimated investment costs (€)	Estimated project costs (€)	Estimated project revenues (€)	NPV 20 years (5%) (€)	IRR
1	0	0	0	0	0
2	6,051,079	40,106,964	50,789,235	-468,135	4%
JI Project (0)	6,051,079	40,106,964	74,746,088	4,742,473	13%

Note: Calculations are made over 21 years' lifetime of the proposed project. NPV is calculated with 5% net interest rate
Alternative 0 includes 5 years' carbon credit from 2008 to 2012. The analysis is conducted based on the current level of heat tariff (860rubles/Gcal = €25.3/Gcal.) applying in the case of JI Project ex ante emission reductions of 157,611tCO_{2e} (See Annex 8).

Sub-step 2d: Sensitivity analysis

The heat tariffs in Onega are determined by the Administration of Arkhangelsk Oblast (Commission on Tariffs and Prices), which settles the prices yearly based on factors such as costs and revenues of the local utility company and inflation but also on a politically acceptable maximum heat tariff € 0,74 per m[2]. Given the exogenously determined level of heat tariffs, the suboptimal level of tariffs and lack of long term price policies, private investors are not normally interested in investing in municipal heating systems. The impacts of 10% and 20% increases and decreases of heating tariffs from the current level are investigated in the sensitivity analysis, presented in Table D.2. The calculations show that a 20% reduction in heat tariffs would cause the JI project to become unviable with a negative NPV. However, a 10% reduction would produce a reasonable positive return on the JI project and an IRR of 8%. The proposed activity without the carbon credits would not be viable under a negative price development. Alternative 2 shows a positive return for increases in heat tariffs with a NPV of € 5.6 million for a 20% price increase and € 2.5 million for a 10% price increase. The JI project would at least generate the double return for the 10% and 20% price increases. Annex 9 provides more details on this analysis.

Table B.2.2 Sensitivity analysis

%	RUB/Gcal	Alternative 2 (without carbon credits)		Alternative 0 JI Project	
		IRR	NPV (€)	IRR	NPV (€)
Reduction in heat tariffs					
20%	688	<0%	(6,513,428)	2%	(1,301,467)
10%	774	-0.48%	(3,491,458)	8%	1,720,503
Increase in heat tariffs					
20%	1,032	12%	5,574,453	21%	10,786,414
10%	946	8%	2,552,483	17%	7,764,444

Note: Calculations are made over 21 years' lifetime of the proposed project. NPV is calculated with 5% net interest rate
Alternative 0 includes 5 years' carbon credit from 2008 to 2012.

Based on the investment analysis comparison und Sub-step 2c and the sensitivity analysis in Sub-step 2d, it is clear that the project activity would not occur without participation in Joint Implementation at the current price level, due to the negative NPV and low IRR of Alternative 2. Speculating on an increase in heat tariffs would be a risky option for a private company, given the centrally controlled price structure. Onega Sawmills would therefore never wish to venture into the proposed project activity without the JI component. Given lack of public resources, Onega Municipality would not have other options than to continue with Business as Usual, namely the continued utilisation of the old Hydrolytic thermal power plant (See Step 3, Investment barriers).

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of type of the proposed project activity

Investment barriers

The proposed project activity would have not occurred in the absence of the JI component due to mainly an *investment barrier*, whereby in the absence of the JI mechanism, a financially more viable alternative to the project activity would have led to higher emissions, i.e. the continued use of the hydrolytic thermal plant[14]. The investment barrier is based on the inability of the municipality of Onega to cover the investment costs of the project: The municipality received an annual income of 299.7 million Rubles (€ 8.8 million) in 2005 and had costs of 316.2 million Rubles (€ 9.3 million), with the fiscal deficit balanced through sales of properties and credits. Therefore, the project investment of 205.8 million Rubles (€ 6.1 million) cannot come out of the municipal budget (See Section A.4.3).

Onega Sawmills who joined the Municipality in the new company Onega Energy could possibly undertake such an investment. However, as heating tariffs are fixed by the Administration of Arkhangelsk Oblast (Commission on Tariffs and Prices), private investors are normally not interested to venture into district heating systems (See Step 2). No administrative decrees, laws or national policies stipulate or promote the investment into renewable energy. Only the possibility of receiving additional benefits by selling emission reduction units motivated Onega Sawmills to participate in the foundation of Onega Energy JSC with the aim to invest into a new waste-wood fed heating system. The decision was based on a feasibility study on this subject (Energy Efficiency Fund of Arkhangelsk Oblast, 2005). The town of Onega contributes with the supply network (water pipelines) as capital asset, while Onega Sawmills finance the new heating system (boilers, boiler house).

With the start of the present project, the coal boilers of the Hydrolytic thermal plant will stop operation and emission of GHGs, which are then fully accountable as emission reductions.

The project related CO_2 emissions from burning of waste-wood are not accountable because they originate from a renewable energy, i.e. a closed emission-sequestration cycle[15]. This can be guaranteed because Onega Sawmills hold a Forest Stewardship Council Certificate (GFA-COC-1194 valid from 14.10.2005-13.10.2010). In 2005, 72.6% of wood resources delivered to Onega Sawmills originate from FSC certified forests (Onega Sawmills, 2005b). The remaining originates from FSC controlled forests according to the FSC-Controlled Wood Standard FSC-STD-40-005, which excludes illegally harvested wood or wood from natural forests that have been converted to plantations or non-forest use. Besides, the use of wood wastages is not the cause of any logging activity, triggered by the sawn timber production of the company (compare footnote 6).

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[14] Compliant to the additionality test described in the Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities (Version 7: 28 November 2005) developed in accordance with the correspondent stipulations of Decision 21/CP.8.

15 "In the case of project activities using biomass, emission reductions may only be accounted for the combustion of "renewable biomass" (Appendix B of the simplified modalities and procedures for small-scale CDM project activities, Version 7: 28 November 2005).

Technological barriers

The present project further encounters a *technological barrier*[16] because the less technologically advanced alternative of running the old coal boiler technology involves lower risks regarding the still low market share of the new waste wood burning technology and so would have led to higher emissions. Biomass boilers are still very exceptional in NW-Russia and very little or no experience exists about their performance and durability.

Prevailing practice barriers

Finally the present project will also encounter a *barrier due to prevailing practice*, because the prevailing practice would have led to the implementation of the existing coal boiler technology with higher emissions. The prevailing practice in Russia is characterized by coal, mazut or natural gas heating systems. Most of Russian district heating systems are owned and managed either by municipalities or private industries. Since early nineties these heating systems experienced significant lack of funds. Therefore the majority of running district heating installation is extremely outdated and inefficient. Due to regular budgetary gaps and increasing inflation level municipalities are not in the position to invest into new heating installations. Still, there is no inflow of funds into municipal budgets from regional or federal levels. On the other side private industries avoid investments in the public sector without commercial incentives. As a result of energy price limitations at the regional level most of private industries continue to run coal, gas or mazut heating systems.

Sub-set 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

As indicated in Step 2 and Sub-step 3a, the project activity without the JI component (Alternative 2) will not occur without the inclusion of Joint Implementation. Therefore, the only other likely alternative is the Alternative 1 – Business as Usual. This will mean a continuation of the current heat production infrastructure.

Step 4: Common practice analysis

Sub-step 4a: Analyse other activities similar to the proposed project activity:

The proposed project activity of switching from fossil fuel to locally available biomass resources in district heating networks would be the first of its kind in the region of Arkhangelsk and is extremely rare at the Russian Federal level. Examples do exist at the private industry level, of which Onega Sawmills is a good example.

Sub-step 4b: Discuss any similar options that are occurring:

The fuel switch at the district heating level towards biomass is uncommon in the Russian Federation, mainly due to the large investment requirements needed for the biomass boiler plant. The experience from Onega shows, that to date, only western technology is capable of combusting biomass with a moisture content up to 60%, as is the case when using primarily bark.

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16 According to the stipulations of Attachment A to Appendix B of the Indicative simplified Baseline and Monitoring Methodologies for selected Small-scale CDM Project Activity Categories, CDM EB Version 8.

Step 5: Impact of Joint Implementation

The JI component of the proposed project activity would ensure that the fuel switch is financially viable (See Sub-step 2c and 2d) and can take place. The involvement of a private investor in district heating in the Russian Federation is uncommon given the highly inefficient market structures described previously and high risk of ensuring the necessary payments from customers. Only the prospects of additional revenues from the carbon credits can make the project financially viable and hence interesting for a private investor. Without the private investor, the municipality would not have the possibility to raise or loan the necessary capital.

With the proposed project activity, global GHG emissions will be reduced by 157,611 tCO_2-eq. In addition, local air pollution will be significantly reduced (See Section F and Table G.4) and the delivery of heat to customers will be more reliable with less disruption and higher temperatures (See Section G) thanks to a modern heat production unit. In addition, the project will in the medium term allow for financial resources to improve maintenance of the existing district heating system, thereby also improving the quality of life in the town of Onega.

B.3. Description of how the definition of the project boundary (related to the baseline methodology selected) is applied to the project:

In accordance with the selected baseline methodology AMS IIIB, "the project boundary is the physical, geographical site where the fuel combustion affected by the fuel-switching measure occurs".

Furthermore, in accordance with the selected baseline methodology AMS IIIE (in its enlarged Version 8), "the project boundary includes the physical, geographical sites:

   a.   where the solid waste would have been disposed and the avoided methane emission occurs in the absence of the proposed project activity,

   b.   where the treatment of biomass through controlled combustion takes place,

   c.   and the itineraries between them, where the transportation of wastes and combustion residues occurs.

The project boundary therefore comprises the equipment and facilities used to produce heat for distribution through the district heating network, i.e. the boiler house with the boilers and heat exchanging system and the fuel handling facilities at the heating installation, but not the heat distribution system.

The project boundary also comprises the fraction of the 520,000 m^3 permanent sawdust and bark stockpile, located 4.7 km from the projected biomass heating plant which will be used in a share of 7 % for the combustion.

The project boundary further includes the GHG emissions (CO_2, CH_4 and N_2O) from the auxiliary combustion of fossil fuels for heat production at the Project site and the emissions from trucks delivering the bark and sawdust. Only incremental distances will be included in the calculation of project emissions. The distance between Onega Sawmills and the baseline deposit and between Onega Sawmills and the biomass boiler is identical (3 km). Therefore, this transport is not incremental and will be ignored in the project. However, the transport of wood waste from the baseline deposit to the biomass boiler(4.7 km) is incremental and will be included in the project emissions as well as the transportation of ashes from the project to different users or to a permanent deposit (4.0 km).

Figure B.3.1 Project boundary
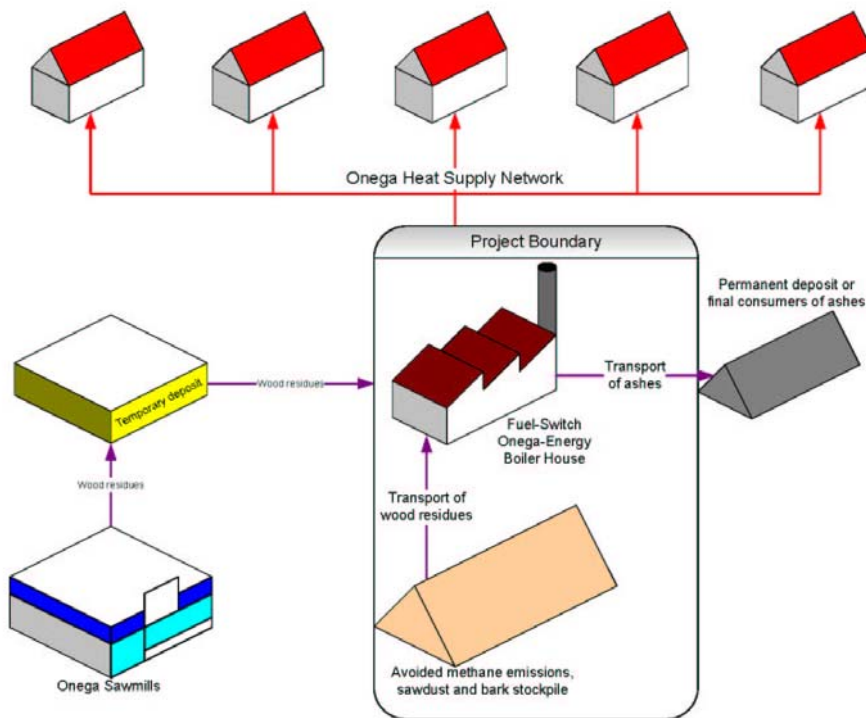
B.4. Details of baseline information, including the date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

Baseline description

The project will use an ex-post baseline approach (see Annex 2 for details).

a) In compliance with the chosen methodology AMS IIIB the fuel switching emission baseline is the current emissions of the facility expressed as emissions per unit of output (kg CO2eq./kWh). Emission coefficients for the fuel used by the generating unit before (i.e. coal) and after the fuel switch (i.e. wood waste) are provided, using the average GHG emission factors listed in the GHG inventory of Arkhangelsk Oblast (2000). IPCC default values for emission coefficients were used for cross-checking (e.g. coal energy content, GHG emissions from coal).

b) In compliance with the chosen methodology AMS IIIE the methane baseline scenario is the situation where, in the absence of the project activity, wood waste (bark and sawdust) is left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane from the decay of the wood waste treated (i.e. burnt) in the project activity. IPCC default emissions factors are used.

Date of baseline completion: 28.02.2006

Baseline development

The baseline study was carried out by GFA Consulting Group (Mission Team: Gerald Kapp, Marianne Zandersen, Ksenia Brockmann), a project participant, listed in Annex 1.The project site at Onega was visited by a multidisciplinary team of three international experts in the period 01.02.-15.02.2006.

SECTION C. Duration of the project / Crediting period:

C.1. Duration of the project:

C.1.1. Starting date of the project:

Starting date of the project was 1.4.2006. This date was considered due to finalizing the special survey for preparation of JI PDD.

C.1.2. Expected operational lifetime of the project:

Operational project lifetime will be more than 21 years, depending on the advancement of technology and economic development. Technologically, biomass boilers have a similar lifetime than coal boilers, i.e. well maintained they can be run over 30 years.

C.2. Length of the period within which emission reduction units are to be earned:

The option 'renewable crediting period' was chosen. The first crediting period is 5 years. Starting date of the first crediting period will be 01 January 2008.

SECTION D. Setting of the monitoring plan

D.1. Description and justification of monitoring plan chosen:

Monitoring will be done according to the following methodologies referenced on the UNFCCC CDM website (as stipulated in the Guidelines for Users of the JI PDD – Version 01):

AMS III.B.   Switching fossil fuels; and

AMS III.E.   Avoidance of methane production from biomass decay through controlled combustion.

The proposed project combines the two monitoring methodologies. After starting the new wood biomass heating system, the actual emission reductions in the project will be monitored, based on the actual heat produced in the project. (Ex Post baseline).

The monitoring methodology III.B. for '**Switching Fossil Fuels'** requires a monitoring of fuel use and output after the fuel switch, e.g. wood fuel use and heat output by the new district heating plant, using the following variables and coefficients:

- Emission coefficients for waste wood [kg CO_2-eq./MWh]
- Emission coefficients for diesel [kg CO_2-eq./MWh],
- Heat output of district heating biomass plant [MWh/year]
- Heat output of the diesel boiler [MWh/year]

The monitoring methodology for the '**Avoidance of Methane Production from Biomass Decay through Controlled Combustion'** requires the monitoring of the annual amounts of biomass combusted by the project activity. The project will measure the volume combusted and moisture content and specific weight of samples in order to calculate the weight of biomass. Weight of biomass is used in the monitoring methodology to determine the emissions of N_2O and CH_4 used in the monitoring methodology. The following variables and emission factor are used:

- Biomass volume used in the biomass boilers [m³ of biomass]
- Biomass quality:
    - Moisture content of biomass used in the boiler [t of water / t of dry biomass]
    - Specific weight of biomass used in the boiler [t / m³ of dry biomass]
    - Calorific value of biomass used in the boiler [MWh/t moist biomass]
- IPCC CH_4 emission factor for decaying biomass in region of project activity [tonnes CH_4 / tonnes biomass]
- Baseline methane emissions from biomass decay [tonnes of CO_2-equivalent]
- Emissions from trucks for incremental collection activities of biomass and ashes [tonnes of CO_2-equivalent], according to the latest version 8 (followed for the project boundary setting)

D.1.1.   Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

There are three basic calculations that will be carried out in order to calculate the annual emissions reductions of the project: CO_2-eq. emission reductions due to the fuel switch from coal to biomass, methane emissions avoided from controlled combustion of wood waste and CO_2-eq. emissions from project activities:

Table D.1.1 Overview of Sources, Methods and Required Input

Source of Emissions or Emission Reductions	Methods	Inputs required
CO_2 emissions reductions due to the displacement of coal by biomass wastes	The heat output of the biomass boiler is used to determine the coal that would have been used by the hydrolytic CHP to produce the same heat output.	• Monthly biomass boiler heat output • Thermal efficiency of Hydrolytic CHP plant • Calorific value of coal • Emission coefficient for coal
CH_4 emissions reductions due to combustion of fresh wood waste and stockpiled waste	The volume, humidity, specific weight and energy content of wood waste is used to determine the weight of wood waste used in the calculation of CH_4 emitted if brought to the stockpile (for fresh wood waste) or if continued to be stored on the stockpile (for stockpiled wood waste). Once the first year measurements are available, the calculation of methane avoidance is based on the energy output (MW) of the plant, the seasonal profile of humidity and energy content of wood waste and the measured volumes delivered.	• Monthly m^3 of wood waste delivered to biomass heating plant from a) fresh wood waste and b) stockpiled wood waste • Weekly measurements of specific weight and moisture on a sample basis during the 1st year of a) fresh wood waste and b) stockpiled wood waste • Weekly measurements of energy content on a sample basis during the 1st year of a) fresh wood waste and b) stockpiled wood waste • CH_4 emission factor for wood waste
CO_2-eq. emissions from project activities	Project emissions from the use of diesel boiler will be subtracted from the project emission reductions. Transportation of biomass from baseline deposit to project and transportation of ashes from the project will be included	• Monthly consumption of diesel in diesel boiler • Emission coefficient for diesel • Emission coefficient for diesel and truck performance (km/l) • Number of trips and distances of transportation

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how this data will be archived:

Table D.1.2 Data to monitor project emissions EX POST from the Onega Energy Project

ID Nr.	Data variable	Source of data	Data unit	Record (*)	Recording frequency	Pro-portion of data moni-tored	How will the data be archived?	Comment	Responsible
1	Heat production	Boiler-house	MWh	m	continuously	100%	Paper and electro-nically	Data will be recorded in log every hour in a heat flow meter and data will be aggregated to MWh/month and MWh/year. Meters will have less than 0.2% error margin	Head of boiler house is responsible for the daily record keeping and verification of heat production and biomass input, including training of personnel in handling heat flow meters. Competent manager collects information for biannual reporting.
2	Heat production efficiency of biomass boilers	Boiler-house	%	c	continuously	100%	Paper and electro-nically	Data will be calculated on a daily basis based on the input of wood waste (with corresponding water content) and output of heat. Data will be aggregated to thermal efficiency of boiler per month	
3	Wood waste delivered to project site	Onega Sawmills	m³ space	m	continuously	100%	Paper and electro-nically	Data from invoices of biomass deliveries. Data from delivery sheets. Trucks with a capacity of 35m³ will be used for delivery. Drivers are paid by Onega Sawmills on a m3/km basis. This ensures that truck loads correspond to 35m³. Personnel working at the biomass feeder at Onega Energy will confirm on delivery sheet whether truck load is full.	Accountant registers, compares and stores delivery sheets and invoices; Head of boiler house officially signs off delivery sheets; Competent manager collects information for biannual reporting.
4	Origin of wood waste	Onega Sawmills	m³ space	m	continuously	100%	Paper and electro-nically	Invoices must specify whether delivery originates from stockpile or directly from production	
5	Average truck capacity	Onega Sawmills	Tonnes/truck	m	continuously	100%	Paper and electro-nically	Truck loading capacity of 35m³ will be applied for biomass transports; 10t trucks will be used for the transport of ashes. Weight of biomass from sampling will be used to convert volume per truck to weight per truck	Competent manager converts truck capacity to weight. Accountant registers number of deliveries from the baseline deposit.

6	Average distance biomass transport	Onega Sawmills	km /truck	m	continuously	100%	Paper and electronically	Origin of biomass from a) sawmills b) baseline deposit and c) temporary deposit will figure on invoices and delivery sheets. Only deliveries from the baseline deposit will be included in the project emissions, as the remaining deliveries are not incremental.	Competent manager compiles and calculates annual tonnage and distance from the baseline deposit and calculates emissions.
7	Average distance ashes transport	Onega Sawmills	km /truck	m	continuously	100%	Paper and electronically	Destination and usage of ashes will be registered on receipts by Onega Sawmills. These include a) permanent deposit (4,7km), b) agriculture (2,3-4km), c) road construction, d)construction (200m-2,3km).	Boilerhouse personnel signs receipts to ash users, including number of trucks and km distance. Accountant registers and competent manager comiles and calculates annual transport emissions from ash
8	Energy content of biomass	Wood waste storage	kWh/t	m	Weekly during 1st year	On a sample basis	Paper and electronically	The heating value of biomass is determined at 0% humidity. Representative split samples must be made between stockpile waste and fresh wood waste	Competent manager is responsible for the correct representative sampling of biomass; aiming at a minimum level of confidence of one times the standard deviation.
9	Moisture content of biomass	Wood waste storage	%	m	Weekly during 1st year	On a sample basis	Paper and electronically	Determined by weighing and drying of biomass sample. Representative split samples must be made between stockpile waste and fresh wood waste.	Certified laboratory at Onega Sawmills will conduct measurements.
10	Weight of biomass	Wood waste storage	kg/m3 space	m	Weekly during 1st year	100 On a sample basis	Paper and electronically	Determined by weighing and drying of biomass sample. Representative split samples must be made between stockpile waste and fresh wood waste	See Annex 3 for specifications of the sampling of biomass.
11	Diesel fuel consumption	Diesel power station (in reserve)	ton	m	continuously	100%	Paper and electronically	2 metering appliances on diesel circulation system between diesel tank and diesel boiler. Data will be recorded in log every hour and aggregated to ton/month	Head of boiler house is responsible for the daily record keeping and verification of heat production and biomass input, including training of personnel in handling heat flow meters. Competent manager collects information for biannual reporting.

*Record: Measured (m) calculated (c) estimated (e)

The measurements of moisture and energy content during the first year serves the purpose of building a profile that can be applied in the following years. The profile is necessary in order to calculate the weight of wood waste used in the calculation of avoided methane emissions. It is expected that moisture content changes with season. Also differences will be significant according to the origin of wood fuel (i.e. stockpile or fresh wood wastes). Annex 3 describes the standards and approaches for sampling and measuring moisture and energy content. It is planned that deliveries from the stockpile will only take place in February and March and represent 7% of total wood waste consumption over the year or 11% during the 3 months of delivery (See Table A.4.2.3).

The monitoring methodology III.E requires that total annual project activity related emissions be monitored in order to determine whether the project activity is higher than 15 kt CO_2-eq. Electricity consumption of the project activities is estimated at 6.9 MWh per year representing 5,500 tCO_2-eq.[17]. Due to the low amounts of electricity consumption, and considering that in the baseline case of the coal boilers electricity consumption has been disregarded as well, the project activity will not monitor electricity consumption. Incremental transportation from the baseline deposit to the biomass boilers and the transportation of ashes from the biomass boilers have been included, which is also in accordance with the revised methodology of 3 March 2006 (III.E./Version 08).

All data collected will be electronically archived as part of the monitoring for a period of two years after the end of the crediting period. The proposed samples should be taken without bias over the whole population and should have as minimum level of confidence one times the standard deviation (one sigma), although a higher level of precision is proposed (see Annex 8). Further stipulations regarding monitoring are listed under the section D.2 (Quality control and quality assurance procedures).

The currently not used grid interconnection between the hot water grid of Onega Sawmills and the grid of the hydrolytic plant has to be either disconnected in the project case or, if this should not be feasible, monitored and thus considered in the emission calculations.

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Additional information regarding the following formulae is provided in Tables B.1.1 and B.1.2.

Non-CO_2 GHG emissions from the controlled combustion of biomass is calculated in formulae (1), (2) and (3) below:

CH_4-Emissions per tonne of waste wood burnt in biomass boiler

(1) $CH_4\_E_{wood\ 55\%} = CH_4\_EF_{WW} * EC_{wood\ 40\%} * CF / EC\ c.e.$

   $CH_4\_E_{wood\ 55\%}$ = CH_4-emissions of waste wood at 55% moisture [t CO_2-eq./t]

   $CH_4\_EF_{WW}$ = GHG emission factor for waste wood = 0.042447[18] [t CO_2-eq./ t c.e.]

   $EC_{wood\ 40\%}$ = Energy content of wood at 40% moisture of IPCC[19] = 3.0278 [MWh/t]

   CF = Correction factor: 0.8[20] = $EC_{wood\ 55\%}$ / $EC_{wood\ 40\%}$

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[17] An emission factor of 0.8kg CO_2/kWh is used (Ministry of Economic Affairs of the Netherlands, 2003, Operational Guidelines for project design documents of joint implementation projects).

[18]   A. Batalov, A. Samorodov, M. Yulkin (2000)

[19]   Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, Table 1-13, p.1.45.

20 Hartmann, H. (ed.) (2003): Handbuch Bioenergie-Kleinanlagen. Fachagentur Nachwachsende Rohstoffe e.V., p. 53, Gülzow, Germany.

$\text{EC}_{\text{c.e.}}$ = Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

Note: There is no significant energetic difference for the used fresh or deposited wood based on the specific wood weight at the same moisture content.

N_2O-Emissions per tonne of waste wood burnt in biomass boiler

(2) $N_2O\_E_{\text{wood 55\%}} = N_2O\_EF_{WW} * EC_{\text{wood 40\%}} * CF / EC_{\text{c.e.}}$

$N_2O\_E_{\text{wood 55\%}}$ = N_2O-emissions of waste wood at 55% moisture [t CO_2-eq./t]

$N_2O\_EF_{WW}$ = N_2O emission factor for waste wood[21] = 0.0363 [t CO_2-eq./ t c.e.]

The project is conceived with a 9MW diesel boiler in order to ensure security of heat production in peak periods and/or during maintenance periods. The GHG emissions produced by the diesel boiler in the proposed project activity are calculated with the formulae (3), (4), and (5) below:

CO_2-Emissions per tonne of diesel burnt in biomass project diesel boiler

(3) $CO_2\_E_{\text{Diesel}}$ = $CO_2\_EF_{\text{diesel}} * EC_{\text{diesel}} / EC_{\text{c.e.}}$)

$CO_2\_E_{\text{Diesel}}$ = CO_2-emissions of diesel fuel [t CO_2-eq./t]

$CO_2\_EF_{\text{diesel}}$ = GHG emission factor for diesel = 2.1491[22] [t CO_2-eq./ t c.e.]

EC_{diesel} = Energy content of diesel fuel = 11.7[23] [MWh/t]

CH_4-Emissions per tonne of diesel burnt in biomass project diesel boiler

(4) $CH_4\_E_{\text{Diesel}}$ = $CH_4\_EF_{\text{diesel}} * EC_{\text{diesel}} / EC_{\text{c.e.}}$)

$CH_4\_E_{\text{Diesel}}$ = CH_4-emissions of diesel fuel [t CO_2-eq./t]

$CH_4\_EF_{\text{diesel}}$ = GHG emission factor for diesel = 0.002885[24] [t CO_2-eq./ t c.e.]

N_2O-Emissions per tonne of diesel burnt in biomass project diesel boiler

(5) $N_2O\_E_{\text{Diesel}}$ = $N_2O\_EF_{\text{diesel}} * EC_{\text{diesel}} / EC_{\text{c.e.}}$)

$N_2O\_E_{\text{Diesel}}$ = N_2O-emissions of diesel fuel [t CO_2-eq./t]

$N_2O\_EF_{\text{diesel}}$ = GHG emission factor for diesel = 0.0056648[25] [t CO_2-eq./ t c.e.]

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21 A. Batalov, A. Samorodov, M. Yulkin (2000)
22 idem
23 Hartmann, H. (ed.) (2003): Handbuch Bioenergie-Kleinanlagen. Fachagentur Nachwachsende Rohstoffe e.V., p. 53, Gülzow, Germany.
24 idem
25   idem

CO_2 Emissions from incremental collection activities within the project boundary are calculated applying the formula provided in AMS Type III-E, Version 8. Parameters and values are provided below:

(6) $PE_{y,transp}$ $= (Qy/CT_y) * DAF_w * EFCO2 + (Q_{y,ash}/C_{Ty,ash}) * DAF_{ash} * EFCO2$

         $PE_{y,transp}$ = Project activity emissions from incremental collection activities [t CO_2-eq]

         $Q_{y\_baseline\ deposit}$ = 13,711m^3 * 0.85[26] [tonne combusted from baseline deposit]

         CT_y = 35m^3 * 0.85 [tonne per truck]

         DAF_w = 4,7*2 [km per truck return]

         EF_{CO2} = 0,77*10^{-3} [$tCO_{2\text{-}eq}$/km]

         $Q_{y,ash}$ = 1,425 [tonnes]

         $C_{Ty,ash}$ = 10 [avg. tonnes/truck]

         DAF_{ash} = 4*2 [km/truck return]

where:
- Q_y quantity of waste combusted in the year "y" (tonnes)
- CT_y average truck capacity for waste transportation (tonnes/truck)
- DAF average incremental distance for waste transportation (km/truck)
- EF_{CO2} CO2-eq. emission factor from fuel use due to transportation (kgCO2/km, IPCC default values[27] for emission coefficients and local values for truck performance.
- $Q_{y,ash}$ quantity of combustion residues produced in the year "y" (tonnes)
- $CT_{y,ash}$ average truck capacity for combustion residues transportation (tonnes/truck)
- DAF_{ash} average distance for combustion residues transportation (km/truck)

Total project emissions of biomass district heating project combines the above formulae (1) to (6):

(7)   TAPE $= (CH_4\_E_{wood\ 55\%} + N_2O\_E_{wood\ 55\%}) * AWWI + (CO_2\_E_{Diesel} + CH_4\_E_{Diesel} + N_2O\_E_{Diesel}) * ADFI + PE_{y,transp}$

        TAPE   = Total annual project emissions [t CO_2-eq.]

        AWWI   = Annual waste wood input [t]

        ADFI   = Annual diesel fuel input [t]

        $PE_{y,transp}$ = Incremental transport emissions [t $CO_{2\text{-eq.}}$]

Alternative Calculation: Total project emissions of biomass district heating project

This alternative calculation may be used in future when the BEOww value can be determined precisely enough to allow the emission calculation to be based on the produced heat energy corrected by the diesel fuel energy share.

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[26] Onega Sawmills conversion rate from m3 space to tonne

[27] Calculated based on Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, Module 1, Table 1-39, p.1.82 and local truck performance (See Annex 9, Working sheet 'Transport').

(8)   TAPE1 $= (CH_4\_E_{wood\ 55\%} + N_2O\_E_{wood\ 55\%}) / BEOww * AHPww + (CO_2\_E_{Diesel} + CH_4\_E_{Diesel} + N_2O\_E_{Diesel}) * ADFI + PE_{y,transp}$

        TAPE1   = Total annual project emissions [t CO_2-eq.]

        BEOww   = Boiler energy output per waste wood [= 2.0408 MWh / t waste wood]

(9)   AHPww $= AHPtotal - ADFI * EC_{diesel} * DBE$

        AHPww   = Annual heat production from waste wood [MWh]

        AHPtotal   = Total annual heat production (biomass & diesel boilers) [MWh]

        DBE   = Diesel boiler efficiency: 0.83

        $PE_{y,transp}$ = Incremental transport emissions [t $CO_{2-eq.}$]

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary, and how such data will be collected and archived:

This project document applies an EX ANTE baseline of anthropogenic emissions by sources of GHGs (See Annex 2 for more details). Table D.3. below lists the data necessary for determining the ex ante baseline. Once the project is started, Onega Energy will employ an EX POST baseline, where the avoided GHG emissions from the fuel switch will be based on the actual heat production rather than a historic average of heat production of the fossil fuel based hydrolytic thermal plant. The Monitoring Plan (See annex 3) specifies the data necessary to determine the EX POST baseline and provides a calculated example using EX ANTE data..

Table D.1.3 Relevant Data Necessary for Determining the EX ANTE Baseline of Anthropogenic Emissions by Sources of GHGs

ID Nr.	Data variable	Source of data	Data unit	Record (*)	Recording frequency	Proportion of data monitored	How will the data be archived?	Comment	Responsible
12	Coal boiler heat output	PKTS	MWh	m	Monthly 2002-2005	100%	Paper and electronically	Data will be stored with the project operator. Detailed monthly measurements will be archived in paper and aggregate annual and average results will be archived in electronic form	A. Doykov, managing director of Onega Energy is responsible for the records of baseline emissions from the hydrolytic thermal plant. He was previously managing director of the Hydrolytic Plant and is intimately familiar with the baseline.
13	Coal input for coal boiler	PKTS	t	m	Monthly 2002-2005	100%	Paper and electronically		
14	Thermal efficiency of Hydrolytic CHP	PKTS	%	c	Yearly 2002-2005	100%	Paper and electronically	Calculated based on variable No. 12 and 13	
15	Coal boiler heating value (CBHV)	PKTS	MWh/t coal	c	Once at project inception	100%	Paper and electronically	CBHV is calculated using the average heat production for district heating divided by the amount of coal consumed at PKTS for district heating from 2002-2005	
16	CO_2 emission coefficient of coal	Batalov et al. (2000)	tCO_2-eq./t.c.e.	eg	Once at project inception	100%	Paper and electronically	Emission coefficients are developed for the Arkhangelsk Region. Data will be stored with the project operator.	Competent manager at Onega Energy
17	CH_4 emission coefficient of coal	Batalov et al. (2000)	tCO_2-eq./t.c.e.	eg	Once at project inception	100%	Paper and electronically	Emission coefficients are developed for the Arkhangelsk Region. Data will be stored with the project operator.	Competent manager at Onega Energy
18	N_2O emission coefficient of coal	Batalov et al. (2000)	tCO_2-eq./t.c.e.	eg	Once at project inception	100%	Paper and electronically	Emission coefficients are developed for the Arkhangelsk Region. Data will be stored with the project operator.	Competent manager at Onega Energy

19	CH4 emission factor decaying biomass	IPCC	tCH$_4$/t biomass	c	Once at project inception	100%	Paper and electronically	Calculation based on formula from AMS Type III-E, Version 7 using variables No. 19, 20, 21	Competent manager at Onega Energy
20	CH4 correction factor	IFAS		m	Once at project inception	100%	Paper and electronically	The methane correction factor for unmanaged shallow waste sites is assessed by Prof. Stegmann, Hamburg Technical University & IFAS to a default value of 0.7 (See Annex 7). It is based on the height of the baseline deposit, which is up to 25m high, and laboratory measurements of fresh bark from Onega Sawmills and sawdust and bark from the surface of the baseline deposit. Data will be stored with the project operator.	Competent manager at Onega Energy
21	Degradable organic carbon (DOC)	EB	fraction	eg	Once at project inception	100%	Paper and electronically	DOC is a fraction, set at a default value 0.3 in AMS Type III-E Version 7. Data will be stored with the project operator.	Competent manager at Onega Energy
	Fraction DOC dissimilated to landfill gas	EB	fraction	eg	Once at project inception	100%	Paper and electronically	DOC$_F$ is set at the default value 0.77 in AMS Type III-E Version 7. Data will be stored with the project operator.	Competent manager at Onega Energy
22	Fraction of CH$_4$ in landfill gas (F)	EB	fraction	eg	Once at project inception	100%	Paper and electronically	F is set at the default value 0.5 in AMS Type III-E Version 7. Data will be stored with the project operator.	Competent manager at Onega Energy
23	Baseline methane emissions from biomass decay (BE$_y$)	EB	tCO$_2$-eq.	eg	continuously	100%	Paper and electronically	BEy is calculated using the formula of AMS Type III-E Version 7. Data will be stored with the project operator.	Competent manager at Onega Energy

24	CH$_4$ GWP	IPCC	factor	eg	Once at project inception	100%	Paper and electronically	The global warming potential of methane is internally agreed at 21. Data will be stored with the project operator.	Competent manager at Onega Energy
25	Wood waste delivered to project site	Onega Sawmills	m$_3$ space	m	continuously	100%	Paper and electronically	Data from invoices of biomass deliveries. Data from delivery sheets. Trucks with a capacity of 35m^3 will be used for delivery. Drivers are paid by Onega Sawmills on a m3/km basis. This ensures that truck loads correspond to 35m^3. Personnel working at the biomass feeder at Onega Energy will confirm on delivery sheet whether truck load is full.	Accountant registers, compares and stores delivery sheets and invoices; Head of boiler house officially signs off delivery sheets; Competent manager collects information for biannual reporting
26	Moisture content of biomass	Wood waste storage	%	m	Weekly during 1st year	On a sample basis	Paper and electronically	Determined by weighing and drying of biomass sample. Representative split samples must be made between stockpile waste and fresh wood waste.	Competent manager is responsible for the correct representative sampling of biomass; aiming at a minimum level of confidence of one times the standard deviation. Certified laboratory at Onega Sawmills will conduct measurements. See Annex 3 for specifications of the sampling of biomass.
27	Weight of biomass	Wood waste storage	kg/m3 space	m	Weekly during 1st year	On a sample basis	Paper and electronically	Determined by weighing and drying of biomass sample. Representative split samples must be made between stockpile waste and fresh wood waste	

* Record: Measured (m) calculated (c) estimated (e) exogenously given (eg)

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The baseline emissions comprise i) the emissions caused by coal burning in the Hydrolytic thermal CHP, which are calculated in formulae (10) to (11), and ii) the methane emissions from deposits of biomass to the waste deposit in the absence of the proposed project activity. These are calculated using the formulae (13) and (14), which are derived and adapted from AMS Type III-E, Version 7.

CO_2-Emissions per tonne of coal burnt in old district heating plant

(10) $CO_2\_E_{Coal}$ $= CO_2\_EF_{Coal} * EC_{Coal} / ECc.e.)$

      $CO_2\_E_{Coal}$ $=$ CO_2-emissions of Coal fuel [t CO_2-eq./t]

      $CO_2\_EF_{Coal}$ $=$ GHG emission factor for Coal = 2.759[28] [t CO_2-eq./ t c.e.]

      EC_{Coal} $=$ Energy content of Coal fuel = 6.705[29] [MWh/t]

      $ECc.e.$ $=$ Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

CH_4-Emissions per tonne of coal burnt in old district heating plant

(11) $CH_4\_E_{Coal}$ $= CH_4\_EF_{Coal} * EC_{Coal} / ECc.e.)$

      $CH_4\_E_{Coal}$ $=$ CH_4-emissions of Coal fuel [t CO_2-eq./t]

      $CH_4\_EF_{Coal}$ $=$ GHG emission factor for Coal = 0.013029[30] [t CO_2-eq./ t c.e.]

N_2O-Emissions per tonne of coal burnt in old district heating plant

(12) $N_2O\_E_{Coal}$ $= N_2O\_EF_{Coal} * EC_{Coal} / ECc.e.)$

      $N_2O\_E_{Coal}$ $=$ N_2O-emissions of Coal fuel [t CO_2-eq./t]

      $N_2O\_EF_{Coal}$ $=$ GHG emission factor for Coal = 0.012720[31] [t CO_2-eq./ t c.e.]

Methane emissions (formulae adapted from AMS III.E Version 7)

(13) $CH_4\_IPCCdecay = (MCF * DOC * DOCF * F * 16/12)$ [t CH_4/tonne of biomass]

      $CH_4\_IPCCdecay =$ IPCC CH_4 emission factor decaying biomass in project activity region

      $MCF =$ methane correction factor for unmanaged shallow waste sites under 5 meters[32]:

      Default value is 0.4. For the present stock pile of 15 m depth, MCF is put at 0.7[33]

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[28] A. Batalov, A. Samorodov, M. Yulkin (2000)

[29] International value for coal energy: www.eia.doe.gov/kids/energyfacts

[30] A. Batalov, A. Samorodov, M. Yulkin (2000)

[31] idem

[32] IPCC, 1996, *Chapter 6, Waste, Table 6-2 SWDS Classification and Methane Correction Factors*, p.6.8, Revised 1996 IPCC Guidelines for National Greenhouse Gas Emissions, Reference Manual.

DOC = degradable organic carbon: default for wood waste is 0.3[34]

DOCF = fraction DOC dissimilated to landfill gas: default is 0.77[35]

F = fraction of CH_4 in landfill gas: default is 0.5[36]

(14)   BEy   = Qbiomass * CH4_IPCCdecay * GWP_CH4 [t CO2-eq. CH_4/t saw waste]

BEy   = Baseline methane emissions from biomass decay [tonnes of CO2 equivalent]

Qbiomass = Quantity of biomass treated under the project activity [tonnes]

CH4_GWP = GWP for CH_4 [t CO2 equivalent/t CH_4]. Default value is 21[37]

Total annual EX ANTE baseline emissions

Total annual EX ANTE baseline emissions are calculated based on i) the average heat production and hence average coal consumption during the period 2002 to 2005 and on ii) the quantity of biomass necessary to generate the heat at the biomass thermal plant, which in turn avoids methane emissions through controlled combustion. The formula is presented below:

(15$_{ex ante}$) $TABE_{ante}$ = $(CO_2\_E_{Coal} + CH_4\_E_{Coal} + N_2O\_E_{Coal})$ / CBHV* AHPtotal + BEy

$TABE_{ante}$ = Total annual ex ante baseline emissions [t CO_2-eq.]

CBHV   = Coal boiler heating value[38] [=4.1863 MWh / t coal]

$AHPtotal_{ante}$ = Total annual heat production (generated by the Hydrolytic thermal plant, average of 2002-2005) [= 96,192 MWh]

BEy   = Baseline methane emissions from biomass decay [t CO2 equivalent]

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[33] The methane correction factor for unmanaged shallow waste sites is assessed by Prof. Stegmann, Hamburg Technical University & IFAS (See Annex 7) It is based on the height of the baseline deposit, which is up to 25m high, and laboratory measurements of fresh bark from Onega Sawmills and sawdust and bark from the surface of the baseline deposit.

[34] IPCC, 1996, *Chapter 6, Waste, Table 6-3 Default DOC Values for Major Waste Streams*, p.6.9, Revised 1996 IPCC Guidelines for National Greenhouse Gas Emissions, Reference Manual.
[35] IPCC, 1996, *Chapter 6, Waste*, p.6.9, Revised 1996 IPCC Guidelines for National Greenhouse Gas Emissions, Reference Manual
[36] IPCC, 1996, *Chapter 6, Waste, Equation I Methane emissions*, p.6.5, Revised 1996 IPCC Guidelines for National Greenhouse Gas Emissions, Reference Manual
[37] IPCC, 1995, *Climate Change 1995: The Science of Climate Change : Contribution of Working Group I to the Second Assessment Report*, Table 4, p. 22.
[38] Calculated based on average annual heat production between 2002-2005 (96,192MWh) and average annual coal input 2002-2005 (22,978 t).

Total annual EX POST baseline emissions

Total annual EX POST baseline emissions are calculated based on i) the actual heat production of the proposed project activity, where the emission reductions are calculated based on the equivalent quantity of coal at the Hydrolytic thermal plant needed to produce the same amount of heat, and on ii) the quantity of biomass necessary to generate the heat at the biomass thermal plant, which in turn avoids methane emissions through controlled combustion. The formula is presented below:

$(15_{ex\ post})$ $TABE_{post}$ $= (CO_2\_E_{Coal} + CH_4\_E_{Coal} + N_2O\_E_{Coal}) / CBHV * AHPtotal + BEy$

         $TABE_{post}$ = Total annual ex post baseline emissions [t CO_2-eq.]

         $CBHV$ = Coal boiler heating value[39] [= 4.1863 MWh / t coal]

         $AHPtotal_{post}$ = Total annual heat production (generated by project biomass & diesel boilers) [MWh]

         BEy = Baseline methane emissions from biomass decay [t CO2 equivalent]

D.1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E):

Direct monitoring of emission reductions from the project is not feasible.

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how this data will be archived:

Not applicable.

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.):

Not applicable.

D.1.3. Treatment of leakage in the monitoring plan:

Leakage is defined as the net change of anthropogenic emissions by sources of greenhouse gases (GHG) which occurs outside the project boundary, and which is measurable and attributable to the project activity.

In the 23rd meeting of the EB (22-24.02.2006) some Guidance on Leakage in Biomass Projects is provided, if i.e., the biomass used in the project activity could be used for other purposes in the absence of the project. In such case, the project participant shall evaluate if there is a surplus of the biomass in the region of the project activity, which is not utilised. If it is demonstrated that the quantity of available biomass in the region, is at least 25% larger than the quantity of biomass that is utilised including the project activity, then this source of leakage can be neglected. Alternative use of sawdust could be the energetic utilization by the Onega Sawmill. However, the existence of the stockpile clearly indicates the huge surplus of waste biomass available in the project region.

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[39] Calculated based on average annual heat production between 2002-2005 (96,192MWh) and average annual coal input 2002-2005 (22,978 t).

Therefore, in the present project case, no GHG emissions attributable to the project will occur outside the project boundary.

As no leakage effects will be present during the project activities leakage monitoring is not required for both methodologies AMS-IIIB and AMS-IIIE.

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

Not applicable.

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Total annual project emission reductions of biomass district heating project using the EX ANTE baseline is calculated as:

(16)   TAPER $= TAPE - TABE_{ante}$

           TAPER   = Total annual project emission reductions [t CO_2-eq.]

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impact of the project:

No significant negative environmental impacts will be generated by the project (see section F). However, due to the closure of the hydrolytic plant, some transient negative social impacts may occur, which should be mitigated and consequently monitored.

Table D.4. overleaf recapitulates the applied formulae in Section D.

Table D.1.4 Recapitulation of applied formulae in Section D.

Formula	Result
(1) $\quad$ $CH_{4}\_E_{wood\,55\%} = CH_4\_EF_{WW} * EC_{wood\,40\%} * CF / EC\,c.e.$ $\quad$ [t CO_2-eq./t] CH_4-emissions of waste wood $= 0.042447 * 3.0278 * 0.8 / 8.14 =$	$12.6 * 10^{-3}$
(2) $\quad$ $N_2O\_E_{wood\,55\%} = N_2O\_EF_{WW} * EC_{wood\,40\%} * CF / ECc.e.$ $\quad$ [t CO_2-eq./t] N_2O-emissions of waste wood $= 0.0363 * 3.0278 * 0.8 / 8.14 =$	$10.8 * 10$-3
(3) $\quad$ $CO_2\_E_{Diesel} = CO_2\_EF_{diesel} * EC_{diesel} / ECc.e.)$ $\quad$ [t CO_2-eq./t] CO_2-emissions of diesel fuel $= 2.1491 * 11.7 / 8.14 =$	3.09
(4) $\quad$ $CH_4\_E_{Diesel} = CH_4\_EF_{diesel} * EC_{diesel} / ECc.e.)$ $\quad$ [t CO_2-eq./t] CH_4-emissions of diesel fuel $= 0.002885 * 11.7 / 8.14 =$	$4.1 * 10$-3
(5) $\quad$ $N_2O\_E_{Diesel} = N_2O\_EF_{diesel} * EC_{diesel} / ECc.e.)$ $\quad$ [t CO_2-eq./t] N_2O-emissions of diesel fuel $= 0.0056648* 11.7 / 8.14 =$	$8.1 * 10$-3
(6) $\quad$ $PE_{y,transp} = (Qy/CTy) * DAF_w * EFCO2 + (Qy,ash/CT_{y,ash}) * DAF_{ash} * \qquad EFCO2$ Total annual incremental transport emissions $= (11,654.4/29.8) * 9,4 * (0.77 * 10^{-3}) + (1425/10) * 8 * (0.77 * 10^{-3})$	3.714
(7) $\quad$ $TAPE = (CH_4\_E_{wood\,55\%} + N_2O\_E_{wood\,55\%}) * AWWI +$ $\qquad (CO_2\_E_{Diesel} + CH_4\_E_{Diesel} + N_2O\_E_{Diesel}) * ADFI + PE_{y,transp}$ [t CO_2-eq.] Total annual project emissions $= (12.6 * 10^{-3} + 10.8 * 10^{-3}) * 47,134 +$ $(3.089 + 4.1 * 10^{-3} + 8.1 * 10^{-3}) * 224.3 + 3.71 =$	1,804
(8) $\quad$ $TAPE1 = (CH_4\_E_{wood\,55\%} + N_2O\_E_{wood\,55\%}) / BEOww* AHPww +$ $\qquad (CO_2\_E_{Diesel} + CH_4\_E_{Diesel} + N_2O\_E_{Diesel}) * ADFI + PE_{y,transp}$ [t CO_2-eq.] Total annual project emissions $= (12.6 * 10^{-3} + 10.8 * 10^{-3}) / 2.0408 * 94,014 +$ $(3.089 + 4.1 * 10^{-3} + 8.1 * 10^{-3}) * 224.3 + 3.714 =$	1,779
(9) $\quad$ $AHPww = AHPtotal - ADFI * EC_{diesel} * DBE$ $\quad$ [MWh] Annual heat production from waste wood $= 96,192 - 224.3 * 11.7* 0.83$	94,014
(10) $\quad$ $CO_2\_E_{Coal} = CO_2\_EF_{Coal} * EC_{Coal} / ECc.e.)$ $\quad$ [t CO_2-eq./t] Baseline CO_2-emissions of Coal fuel $= 2.759 * 6.705 / 8.14 =$	2.27
(11) $\quad$ $CH_4\_E_{Coal} = CH_4\_EF_{Coal} * EC_{Coal} / ECc.e.)$ $\quad$ [t CO_2-eq./t] Baseline CH_4-emissions of Coal fuel $= 0.013029 *$	$10.7 * 10$-3
(12) $\quad$ $N_2O\_E_{Coal} = N_2O\_EF_{Coal} * EC_{Coal} / ECc.e.)$ $\quad$ [t CO_2-eq./t] Baseline N_2O-emissions of Coal fuel $= 0.012720 * 6.705 / 8.14 =$	$10.5 * 10$-3
(13) $CH_4\_IPCCdecay = (MCF * DOC * DOCF * F * 16/12)$ [t CH_4/t biomass] IPCC CH_4 emission factor decaying biomass $= 0.7 * 0.3 * 0.77 * 0.5 *1.333 =$	0.1078
(14) $BEy = Qbiomass * CH_4\_IPCCdecay * GWP\_CH_4$ [t CO2-eq. CH_4/t biomass] Baseline methane emissions from biomass decay $= 47,134* 0.1078 * 21$	106,702
(15) $\quad$ $TABE_{ante} = (CO_2\_E_{Coal} + CH_4\_E_{Coal} + N_2O\_E_{Coal}) / CBHV* AHPtotal_{ante} + BEy$ Total annual baseline emissions [t CO_2-eq.] $= (2.27 + 10.7 * 10^{-3} + 10.5 * 10^{-3}) / 4.1863 * 96,192 + 106,702$	159,415
(16) $\quad$ $TAPER = TAPE - TABE_{ante}$ Total EX ANTE annual project emission reductions [t CO_2-eq.] $= 1,804 – 159,415$	-157,611

Table D.1.5 Data to be monitored Ex Post on Social Effects

ID Nr.	Data variable	Source of data	Data unit	Record (**)	Recording frequency	Proportion of data monitored	How will the data be archived?	Comment	Responsible
16	Employment situation of previous Hydrolytic Thermal Plant employees	Employment Agency, Onega Municipality	People unemployed	m	Continuously during 12 months	100%	Paper and electronically	The unemployment agency must set up an office at the hydrolytic thermal plant and provide guidance and support to those in demand. Statistics must be kept on a monthly basis on numbers of unemployment during 1st year	Deputy Mayor, Mr. Nekrassov, is responsible for the collection and registration of variables on social effects. The unemployment agency is responsible for the process helping former employees of the thermal plant to new employment.
17	Vocational training of employees of Hydrolytic Thermal Plant	Employment Agency, Onega Municipality	People unemployed	m	Continuously during 12 months	100%	Paper and electronically	Training activities, number of participants and employment effects must be documented by the Employment Agency . Statistics must be kept on a monthly basis.	

** Record: Measured (m) calculated (c) estimated (e)

D.2. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored:

Quality is controlled and assured by appointing a competent manager who will be in charge of internal monitoring processes and responsible for the transparency of reports and official records. Metering of heat from biomass and diesel boilers should be carried out with state certified calibrated electricity and heat meters and operated according to the requirements of the technical specifications. Periodic state inspection of the meters by the appropriate state bodies for meteorology and standardization further ensures a correct handling of monitoring units. This includes recalibration at appropriate time intervals according to manufacturer specifications, but at least every 3 years.

Table D.2.1 Quality control (QC) and quality assurance (QA) procedures proposed for data monitored:

Data	Uncertainty level of data (High/Medium/Low)	QA/QC procedures planned for these data
Heat production	low	**QA**: State certified meters shall be used and operated according to the requirements of the technical specifications. Data will be recorded in log every hour. Meters will have less than 0.2% error margin; training shall be provided to technical personnel in handling and correctly reading meters; **QC:** Periodic (at least once in three years) state inspection of meters to ensure correct handling and functioning of meters; Head of boiler house signs off paper based on daily summaries of heat production. Backup of daily summaries shall be made on a daily basis.
Wood waste delivered to project site	low	**QA:** Copies and original delivery receipts and invoices shall be kept separately. Delivery receipts must state whether biomass originates directly from production, from permanent or temporary stockpile. Back ups of electronic registration and summaries of deliveries shall be made on a daily basis. **QC:** Manager shall control and sign off the internal registration of daily biomass deliveries.
Energy content of biomass *Moisture content of biomass* *Weight of biomass*	medium	**QA**: In the 1st year, the energy content of biomass, moisture content of biomass and weight of biomass will be measured once a week. This provides the basis for calculations for the quality of wood wastes in the following years. The head of boiler house shall survey the sampling process. Double sampling shall be made during the three months each year when both fresh wood waste and stockpiled waste is delivered. Sampling shall aim at a minimum level of confidence of one times the standard deviation. Annex 8 provides details on the required level of detail in the sampling process. **QC:** The use of a ISO17025 certified laboratory at Onega Sawmills with all appropriate equipment will ensure the quality of measurement. The laboratory will apply measurements according to the Swedish Standard norms.
Diesel fuel consumption	low	**QA:** State certified meters shall be used and operated according to the requirements of the technical specifications; training shall be provided to technical personnel in handling and correctly reading meters; **QC:** Periodic (at least once in three years) state inspection of meters to ensure correct handling and functioning of meters; Head of boiler house signs off summaries of diesel consumption during periods of use of diesel boiler; Backup of daily summaries shall be made on a daily basis during this period.

D.3. Please describe the operational and management structure that the project operator will implement regarding the monitoring plan:

Allocation of Project Management Responsibility

The management and operation of the Biomass Heating Plant is carried out by Onega Energy (the project operator). It is the key responsibility of the project operator to ensure the environmental credibility of the JI project through accurate and systematic monitoring of the operation of the project for the purpose of achieving trustworthy emission reduction.

The operator must appoint a competent manager who will be in charge of and accountable for the generation of ERs including monitoring, record keeping, computation of ERs, audits and determination. The operator will officially sign off on all official paper versions of GHG emission protocols and worksheets. This is to ensure that only one set of official information is available and kept on record. Any discrepancies between official, signed-off records and on-site records will be questioned.

The operator of the biomass heating plant will be responsible for the collection, handling and record keeping of data to be monitored, listed in table D.3.1. This means that the operator will need to develop and implement a management and operational system that meets the requirements needed to monitor emissions and emissions reductions. The initial determination of the project will assess whether the monitoring system is of satisfactory quality to allow the verification of ERs.

Data Handling

The collection and handling of data must be transparent and auditable with appropriate record keeping and data monitoring systems. This includes clarity in procedures and protocols, the use of workbooks, spreadsheets and paper based systems to keep an auditable paper trail and provide for the possibility of electronic system failures. Some monitoring activities will be based on determining appropriate sampling techniques. These will need to be clearly stated and documented. Data monitored and required for determination and issuance are to be kept for two years after the end of the crediting period or the last issuance of ERUs for this project activity, whatever occurs later.

Reporting

The operator will prepare reports as needed for audits and determination purposes. Brief annual and bi-annual reports should be prepared that include information on: overall project performance, emission reductions generated and verified and comparison with targets, compliance with social and environmental targets, information on adjustment of key monitoring assumptions and concepts, calculation methods, and other amendments of the monitoring system. The report can be combined with the periodic verification report.

Training

The operator is responsible for the appropriate training of technical personnel operating the biomass heating station. It is included in the project that the Finnish producer of the biomass boiler technology provides 350 man days of supervision, starting-up, adjustment, and training. In addition, regular trainings and examinations should be carried out for technical personnel to ensure the continued high quality operation of the heating plant. Training should include the procedures and requirements for monitoring. These trainings will also provide the opportunity to assess whether and how to further improve and adjust the monitoring system.

D.4.	**Name of person(s)/entity(ies) determining the monitoring plan:**

Organisation   GFA Consulting GmbH

Department   ENVEST

Represented by   Joachim Schnurr (Director ENVEST))

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GFA is a project participant listed in Annex 1 of this document.

SECTION E. Estimation of GHG emissions:

E.1. Estimated project emissions:

The estimated project emissions are calculated **ex ante** based on the average heat production from 2002-2005 (See Annex 2 for details). The project emissions originate from the **combustion of biomass** (methane and nitrous oxide emissions); from the **combustion of diesel** originating from the diesel boiler, which may be needed during peak periods (CO_2, methane and nitrous oxide emissions); and from the **incremental transport** of biomass within the project boundaries (CO_2, methane and nitrous oxide emissions). The calculation of the total annual project emissions (TAPE) and sub-calculations are shown below:

$$\text{TAPE} = (CH_4\_E_{\text{wood 55\%}} + N_2O\_E_{\text{wood 55\%}}) * \text{AWWI} + (CO_2\_E_{\text{Diesel}} + CH_4\_E_{\text{Diesel}} + N_2O\_E_{\text{Diesel}}) * \text{ADFI} + PE_{y,\text{transp}} \ [tCO_2\text{-eq.}]$$

where,

TAPE	Total yearly project emissions [tCO_2-eq./year]
$CH_4\_E_{\text{wood 55\%}}$	CH_4 emissions from wood burning at 55% moisture [tCO_2-eq./t wood]
$N_2O\_E_{\text{wood 55\%}}$	N_2O emissions from wood burning at 55% moisture [tCO_2-eq./t wood]
AWWI	Annual ex ante estimated waste wood input at 55% moisture [t/year]
$CO_2\_E_{\text{Diesel}}$	CO_2 emissions from diesel combustion in boiler [tCO_2/t diesel]
$CH_4\_E_{\text{Diesel}}$	CH_4 emissions from diesel combustion in boiler [tCO_2-eq./t diesel]
$N_2O\_E_{\text{Diesel}}$	N_2O emissions from diesel combustion in boiler [tCO_2-eq./t diesel]
ADFI	Annual ex ante estimated diesel fuel input [t/year]
$PE_{y,\text{transp}}$	Annual incremental transport emissions within project boundaries [tCO_2-eq./year]

The **methane emissions from wood burning** at 55% moisture were calculated using following formula:

$$CH_4\_E_{\text{wood 55\%}} = CH_4\_EF_{WW} * EC_{\text{wood 40\%}} * CF / EC \text{ c.e.}$$

where,

$CH_4\_E_{\text{wood 55\%}}$	CH_4-emissions of waste wood at 55% moisture [t CO_2-eq./t wood]
$CH_4\_EF_{WW}$	Methane emission factor for waste wood[40] = 0.042447 [t CO_2-eq./ t c.e.]
$EC_{\text{wood 40\%}}$	Energy content of wood at 40% moisture of IPCC[41] = 3.0278 [MWh/t]
CF	Correction factor: 0.8 = $EC_{\text{wood 55\%}}$ / $EC_{\text{wood 40\%}}$
ECc.e.	Energy content of one tonne of coal equivalent[42] = 8.14 [MWh/ t c.e.]

giving:

$$CH_4\_E_{\text{wood 55\%}} = 0.042447 * 3.0278 * 0.8 / 8.14 = 0.0126 \ tCO2\text{-eq./t wood}$$

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[40]   A. Batalov, A. Samorodov, M. Yulkin (2000)

[41]   Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, Table 1-13, page 1.45.

[42]   Hartman (2003) p.182

The **nitrous oxide emissions from wood burning** at 55% moisture were calculated using following formula:

$$N_2O\_E_{wood\ 55\%} = N_2O\_EF_{WW} * EC_{wood\ 40\%} * CF / EC_{c.e.}$$

where,

$N_2O\_E_{wood\ 55\%}$ N_2O-emissions of waste wood at 55% moisture [t CO_2-eq./t]

$N_2O\_EF_{WW}$ GHG emission factor for waste wood[43] = 0.0363 [t CO_2-eq./ t c.e.]

$EC_{c.e.}$ Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

giving:

$$N_2O\_E_{wood\ 55\%} = 0.0363 * 3.0278 * 0.8 / 8.14 = 0.0108\ tCO2\text{-}eq./\ t\ wood$$

The **CO2 emissions from diesel burning** in the project diesel boiler were calculated using following formula:

$$CO_2\_E_{Diesel} = CO_2\_EF_{diesel} * EC_{diesel} / EC_{c.e.})$$

where,

$CO_2\_E_{Diesel}$ CO_2-emissions of diesel fuel [t CO_2-eq./t]

$CO_2\_EF_{diesel}$ GHG emission factor for diesel[44] = 2.1491 [t CO_2-eq./ t c.e.]

EC_{diesel} Energy content of diesel fuel = 11.7 [MWh/t]

$EC_{c.e.}$ Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

giving:

$$CO_2\_E_{Diesel} = 2.1491 * 11.7 / 8.14 = 3.09\ t\ CO_2\text{-}eq./t\ diesel$$

The **CH4 emissions from diesel burning** in the project diesel boiler were calculated using following formula:

$$CH_4\_E_{Diesel} = CH_4\_EF_{diesel} * EC_{diesel} / EC_{c.e.})$$

where,

$CH_4\_E_{Diesel}$ CH_4-emissions of diesel fuel [t CO_2-eq./t]

$CH_4\_EF_{diesel}$ GHG emission factor for diesel = 0.002885 [t CO_2-eq./ t c.e.]

EC_{diesel} Energy content of diesel fuel = 11.7 [MWh/t]

$EC_{c.e.}$ Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

giving:

$$CH_4\_E_{Diesel} = 0.002885 * 11.7 / 8.14 = 0.0041\ t\ CO_2\text{-}eq./t\ diesel$$

[43] A. Batalov, A. Samorodov, M. Yulkin (2000)

[44] Arkhangelsk (2000) (See Annex 10, Sheet 'Emission Factors')

The **N$_2$O emissions from diesel burning** in the project diesel boiler were calculated using following formula:

$$N_2O\_E_{Diesel} = N_2O\_EF_{diesel} * EC_{diesel} / ECc.e.)$$

where,

N$_2$O_E$_{Diesel}$ N$_2$O-emissions of diesel fuel [t CO$_2$-eq./t diesel]

N$_2$O_EF$_{diesel}$ GHG emission factor for diesel[45] = 0.0056648 [t CO$_2$-eq./ t c.e.]

EC$_{diesel}$ Energy content of diesel fuel = 11.7 [MWh/t]

ECc.e.   Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

giving:

$$N_2O\_E_{Diesel} = 0.0056648 * 11.7 / 8.14 = 0.0081 \text{ t } CO_2\text{-eq./t diesel}$$

Incremental **Transportation activities** within the project boundaries is considered as project activity emissions and are calculated following the formula in AMS III.E:

$$PE_{y,transp} = (Qy_{baseline\ deposit}/CT_y) * DAF_w * EFCO2 + (Q_{y,ash}/C_{Ty,ash}) * DAF_{ash} * EFCO2$$

where,

PE$_{y,transp}$ Project activity emissions from incremental collection activities [t CO$_2$-eq]

Q$_{y\_baseline\ deposit}$ Quantity of waste combusted in the year "y" (tonnes) [46] = 13,711 m^3 * 0.85 [tonnes combusted from baseline deposit]

CT$_y$ Average truck capacity for waste transportation (tonnes/truck)[47] = 35 m^3 * 0.85 [tonne per truck]

DAF$_w$ Average incremental distance for waste transportation (km/truck) [48] = 4.7 * 2 [km per truck return]

EF$_{CO2}$ emission factor from fuel use due to transportation (kgCO2/km, IPCC default values for emission coefficients and local values for truck performance[49] = 0.77 * 10^{-3} [tCO$_{2\text{-eq.}}$/km]

Q$_{y,ash}$ Quantity of combustion residues produced in the year "y" (tonnes)[50] = 1,425 [tonnes]

C$_{Ty,ash}$ Average truck capacity for combustion residues transportation (tonnes/truck)[51] = 10 [avg. tonnes/truck]

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[45] Arkhagelsk (2000) (See Annex 10, Sheet 'Emission Factors')

[46] 0.85 is Onega Sawmills conversion rate from m3 space to tonne. Please refer to Table A.4.2.3. for the value of 13,711 m^3

[47] Local truck capacity

[48] Information from Onega Sawmill.

[49] Calculated based on Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, Module 1, Table 1-39, p.1.82 and local truck performance (See Annex 9, Working sheet 'Transport').

[50] Information from Onega Sawmill.

[51] idem

DAF_{ash} Average distance for combustion residues transportation (km/truck) [52] = 4*2 [km/truck return]

The annual incremental transport emissions from the project ($PE_{y,transp}$) activities amount to:

$PE_{y,transp} = (11,654.35/29.75) * 9.4 * 0.77 * 10^{-3} + (1,425/10) * 8 * 0.77 * 10^{-3} = 3.71$ tCO$_2$-eq./year.

Ex ante projected waste wood input at 55% moisture needed to generate 94,014 MWh represent 47,134 t per year. Projected tonnes of diesel used in boiler amount to 224.3 t and the emissions from the incremental transportation of biomass and ashes within the project boundaries amount to 3.71 tCO$_2$-eq. per year.

The total annual project emissions (TAPE) therefore amount to:

$TAPE = (12.6 * 10^{-3} + 10.8 * 10^{-3}) * 47,134 + (3.089 + 4.1 * 10^{-3} + 8.1 * 10^{-3}) * 224.3 + 3.71 = 1,804$ tCO$_2$-eq.

E.2. Estimated leakage:

No leakage effects will be present during the project activities.

E.3. The sum of E.1 and E.2:

Total annual project emissions = 1,804 t CO$_2$-eq.

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[52] idem

E.4. Estimated baseline emissions:

Baseline emission calculations for AMS III.B. (Switching fossil fuels)

To estimate baseline emissions for the fossil fuel switching component of the project, the following equations are applied, as previously specified under Section D.1.1.2., and now including calculated results:

CO_2-Emissions per tonne of coal burnt in old district heating plant

$$CO_2\_E_{Coal} = CO_2\_EF_{Coal} * EC_{Coal} / ECc.e.)$$

where,

$CO_2\_E_{Coal}$ CO_2-emissions of Coal fuel [t CO_2-eq./t]

$CO_2\_EF_{Coal}$ GHG emission factor for Coal[53] = 2.759 [t CO_2-eq./ t c.e.]

EC_{Coal} Energy content of Coal fuel[54] = 6.705 [MWh/t]

$ECc.e.$ Energy content of one tonne of coal equivalent[55] = 8.14 [MWh/ t c.e.]

giving:

$$CO_2\_E_{Coal} = 2.759 * 6.705/ 8.14 = 2.27 \text{ t } CO_2\text{-eq./t coal}$$

CH_4-Emissions per tonne of coal burnt in old district heating plant

$$CH_4\_E_{Coal} = CH_4\_EF_{Coal} * EC_{Coal} / ECc.e.)$$

where,

$CH_4\_E_{Coal}$ CH_4-emissions of Coal fuel [t CO_2-eq./t]

$CH_4\_EF_{Coal}$ GHG emission factor for Coal[56] = 0.013029 [t CO_2-eq./ t c.e.]

EC_{Coal} Energy content of Coal fuel = 6.705 [MWh/t]

$ECc.e.$ Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

giving:

$$CH_4\_E_{Coal} = 0.013029 * 6.705 / 8.14 = 0.0107 \text{ t } CO_2\text{-eq./t coal}$$

N_2O-Emissions per tonne of coal burnt in old district heating plant

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[53] Arkhagelsk (2000) (See Annex 10, Sheet 'Emission Factors')

[54] International value for coal energy: www.eia.doe.gov/kids/energyfacts

[55] Hartman (2003) p.182

[56] Arkhagelsk (2000) (See Annex 10, Sheet 'Emission Factors')

$$N_2O\_E_{Coal} = N_2O\_EF_{Coal} * EC_{Coal} / ECc.e.)$$

where,

$N_2O \_ E_{Coal}$ $\quad$ N_2O-emissions of Coal fuel [t CO_2-eq./t]

$N_2O \_EF_{Coal}$ $\quad$ GHG emission factor for Coal[57] = 0.012720 [t CO_2-eq./ t c.e.]

EC_{Coal} $\quad$ Energy content of Coal fuel = 6.705 [MWh/t]

$ECc.e.$ $\quad$ Energy content of one tonne of coal equivalent = 8.14 [MWh/ t c.e.]

giving:

$$N_2O\_E_{Coal} = 0.012720 * 6.705 / 8.14 = 0.0105$$

The project activity will replace the annual combustion of 22,978 tonnes of coal, which were used on average for the district heating between 2002 and 2005. The GHG emissions from the combustion of this amount of coal represent 52,712 tCO_2-eq. The average annual combustion of the 22,978 tonnes of coal generated on average 82,725Gcal, the equivalent of 96,192 MWh. In the ex ante baseline, the necessary biomass[58] to generate 96,192 MWh in the specific Wärtsilä boilers is projected at 168,336 m$^{3\ space}$. The biomass would in the absence of the project be deposited, thereby causing methane emissions. The formulae for calculating the avoided methane emissions through the project are presented in the following:

Baseline emission calculations for AMS III.E. (Avoidance of methane production from biomass decay through controlled combustion).

The ex ante baseline calculation of avoided methane emissions follows the methodology of the AMS-III.E Version 7 as Version 8 is inappropriate for this type of project (See Annex 8). However, the project includes the enlarged project boundary proposed by version 8 of AMS III-E (See E1), which covers the itineraries between the solid waste deposits and the biomass thermal plant site.

Methane emissions (formulae adapted from AMS III.E Version 7)

To estimate baseline emissions for avoidance of methane production from biomass decay through controlled combustion, the following two equations are used.

$$CH_4\_IPCCdecay = (MCF * DOC * DOCF * F * 16/12) \text{ [t } CH_4/\text{tonne of biomass]}$$

where,

$CH_4\_IPCCdecay$ $\quad$ IPCC CH_4 emission factor decaying biomass in project activity region

MCF $\quad$ methane correction factor for unmanaged shallow waste sites under 5 meters: Default value is 0.4. For the present stock pile of 15 m depth, MCF is put at 0.7[59]

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[57] Arkhagelsk (2000) (See Annex 10, Sheet 'Emission Factors')

[58] Coniferous 1.75 m$^{3\ space}$ = 1MWh (Letter from Wärtsilä Oy of 11.10.2005)

[59] The methane correction factor for unmanaged shallow waste sites is assessed by Prof. Stegmann, Hamburg Technical University & IFAS (See Annex 7). It is based on the height of the baseline deposit, which is up to 25m high, and laboratory measurements of fresh bark from Onega Sawmills and sawdust and bark from the surface of the baseline deposit.

DOC   degradable organic carbon: default for wood waste is 0.3

DOCF   fraction DOC dissimilated to landfill gas: default is 0.77

F   fraction of CH_4 in landfill gas: default is 0.5

giving:

$$CH_4\_IPCCdecay = 0.7 * 0.3 * 0.77 * 0.5 * 1.333 = 0.1078 \text{ t } CH_4/\text{tonne of biomass}$$

$$BEy = Qbiomass * CH_4\_IPCCdecay * GWP\_CH_4 \text{ [t CO2-eq. } CH_4/\text{t saw waste]}$$

where,

BEy   Baseline methane emissions from biomass decay [tonnes of CO2 equivalent]

Qbiomass   Quantity of biomass treated under the project activity [tonnes] = 47,134

$CH_4\_IPCCdecay$ CH_4 emission factor decaying biomass in project activity region = 0.1078

CH4_GWP   GWP for CH_4 [t CO2 equivalent/t CH_4]. Default value is 21

giving:

$$BEy = 47,134 * 0,1078 * 21 = 106,702 \text{ t CO2-eq.}$$

Total annual baseline emissions

Total annual baseline emissions are calculated as the GHG emissions generated by the hydrolytic thermal plant, measured as the amount of coal needed to generate 1 MWh of heat at the hydrolytic thermal plant over the period 2002-2005, times the annual heat production over the same period; and the methane emissions that would occur at the waste deposit in the absence of the controlled combustion of biomass. The formula is described below:

$$TABE = (CO_2\_E_{Coal} + CH_4\_E_{Coal} + N_2O\_E_{Coal}) / CBHV * AHPtotal + BEy$$

where,

TABE   Total annual baseline emissions [t CO_2-eq.]

$CO_2\_E_{Coal}$ CO_2-emissions of Coal fuel = 2.27 t CO_2-eq./ t coal

$CH_4\_E_{Coal}$ CH_4-emissions of coal fuel = 0.0107 t CO_2-eq./ t coal

$N_2O\_E_{Coal}$ N_2O-emissions of coal fuel = 0.0105 t CO_2-eq./ t coal

CBHV   Coal boiler heating value[60] = 4.1863 MWh / t coal

AHPtotal   Total annual heat production (ex ante baseline for biomass & diesel boilers heat production, using average of 2002-2005) = 96,192 MWh

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[60] The coal boiler heating value is calculated from the average coal consumption for district heating at the hydrolytic thermal plant over the period 2002-2005 (22,978 t) and the annual average district heat production over the same period (96,192 MWh), i.e. 96,192MWh / 22,978t = 4.1863 MWh/ t coal.

BEy   Baseline methane emissions from biomass decay = 106,702 t CO2 equivalent

giving total ex ante annual baseline emissions (TABE):

TABE[61] $= (2.27 + 0.0107 + 0.0105) / 4.1863 * 96{,}192 + 106{,}702 = 159{,}415 \text{ t } CO_2\text{-eq./year}$

E.5. Difference between E.4 and E.3 representing the emission reductions of the project:

Table E.1. in Section E.6. presents the emission reductions due to the project activity during the first commitment period 2008-2012.

E.6. Table providing values obtained when applying formulae above:

Table E.6.1 Baseline emission reductions, project emissions, leakage and project emission reductions 2008-2012

Year	Baseline emission reductions (tCO_2-eq.)	Project emission (tCO_2-eq.)	Leakage (tCO_2-eq.)	Emission reductions (tCO_2 -eq.)
2008	159,415	1,804	0	157,611
2009	159,415	1,804	0	157,611
2010	159,415	1,804	0	157,611
2011	159,415	1,804	0	157,611
2012	159,415	1,804	0	157,611
Total	**797,076**	**9,022**	**0**	**788,054**

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[61] The calculation is based on more than four digits. The results presented are therefore more exact than when applying the shown parameters (See Annex 10).

SECTION F.: Environmental impacts:

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts, in accordance with procedures as determined by the host Party:

The Order of the State Committee of the Russian Federation for Environmental Protection as of 15.04.2000 #372 'On the approval of the regulations on the assessment of the impact of the planned economic and other activity on the environment of the Russian Federation' requires that a number of permissions is granted to the project before starting construction and operation of the heating plant.

According to Russian legislation, an industrial project needs a permission to go ahead with construction and operation. If the authorities have no special objections regarding the project, requirements and conditions will be standard. Only when construction works start the operator shall carry out an ecological expertise which needs to be submitted to the authorities for approval. This expertise relates to ecological and epidemiological impacts, fire safety, social norms, as well as an assessment of positive effects on the environment and society and mitigation of any possible negative effects.

The Onega Energy Project has obtained the necessary permissions for the biomass heating site from the authorities of Water resources in Arkhangelsk Region, the Soil and Land Protection Agency, Nature Protection Agency, the Northern Fishing Authorities of Arkhangelsk Region, the Authority for the Protection of Soil and Land of Arkhangelsk Region, the Sanitary and Epidemiological Authorities of Onega, as well as an approval from the Fire Brigade, the Authorities of State Energy Inspection, and the Onega District Planning and Electricity Services (See Annex 6).

The Committee for Nature Resources in Onega approved of the Onega Energy Project on 10. January 2006 and the operator has received a confirmation from Onega Municipality that all formalities needed at this stage have been fulfilled and the project can go ahead. The biomass heating plant site is located in an industrial area. Previously, the site was used by a transportation company.

Due to fire safety deficiencies, the biomass heating plant site will not be able to host more than 300 m^3 of wood-waste (equivalent to 5 hours of wood waste consumption during peak heating periods). Wood waste will be delivered continuously by Onega Sawmills.

Main characteristics of environmental impacts and planned mitigating activities are listed and commented below.

Table F.1.1 Environmental Impacts and Mitigation

Issues	Planned Mitigating Activities
Protection of land	• All project site will be paved with asphalt to avoid breaking of land, landslips or gaps; • To prevent subsoil water pollution, precipitation will be channelled through the drainage system;
Protection of Atmospheric Air	• The use of biomass wood boilers for heat generation largely avoids sulphur and phosphorous emissions, important pollutants of traditional coal heating plants. Particulate matter will be less than 470 mg/nm^3. • Carbon monoxide (CO) content in flue gas will not exceed 450 mg/m^3 (average values) when burning allowed fuels. • Smokestacks will be installed reducing soot emissions by up to 98%. • Bottom ash, ash and fly ash from the wood waste boilers are collected. These will be provided free of charge to consumers as forest fertilizer. • Multi-cyclones will be installed to provide clean flue gas from the stack in air. • The design of the boiler (conical shape with rotating grates) ensures and evenly spread of wood waste which improves combustion and reduces emissions of CO and NO_2. • Combustion air is fed in three stages into the furnace and air distribution is controlled by dampers and speed-controlled fans to ensure low emissions of NO_X and CO. As this type of boiler is used in many European countries, the level of NOx and CO does not present any problem.
Protection of water resources	• Project site is located beyond 30 m of brooks, rivers and lakes; • There is no risk that subsoil waters will emerge at the project site surface.
Other nuisances	• Maximum noise level allowed at the site is 73dB. The biomass heating plant will not exceed this limit. Up to 40 trips are necessary per day to provide fuel in peak heating periods. Although there are no restrictions on transport, Onega Energy will limit transport to periods between 8am to 12pm.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As negative environmental impacts are not considered significant, no EIA is required.

SECTION G. Information on stakeholders' comments, as appropriate:

Invitation of comments from local stakeholders

At an early stage of the project, the Onega Sawmill and the municipality of Onega discussed the possibilities of combining the combustion of locally produced wood waste with a climate change project that would allow for an overdue modernization of a) the thermal heat production unit and b) the neglected pipeline network, where only the utmost necessary repairs have been carried out over the last 10 years. On 20th October 2005, a meeting was held in the Onega District Parliament to discuss different options, including the pros and cons of a fossil fuel switch project. A second Parliament meeting was held on 7th February 2006 during the preparation of the PDD to hear comments directly from members of the Parliament, including concerns about environmental and social impacts.

Three popular articles have been published in the local newspaper; 1 shortly after the October Parliament meeting, a second in early January and a third article after the second Parliament meeting.

Employees in different positions and parts of the thermal plant were interviewed in February 2006 to ascertain their views on future work prospects and current satisfaction with working conditions. Social institutions experiencing problems with heating in Onega town were visited during the first week of February 2006 to discuss the situation and assess the potential impact of the Onega Energy Project.

In order to obtain a regional views on the fuel switch project, meetings were held on 8th February 2006 with the regional Department for tariffs and prices and the Environmental Committee of Arkhangelsk Oblast.

In summary, the following stakeholders were invited for comments

- **Municipality administration**

- **2 meetings in the district parliament**

- **Regional environmental and tariff authorities**

- **General public through 3 newspaper articles**

- **Employees at the hydrolytic thermal plant**

- **Social & cultural institutions in Onega**

- **Media**

Comments from parliamentary meetings and articles from the media have been compiled in paper form and are available upon request from GFA Envest.

Comments from Stakeholder Consultation at the Hydrolytic Thermal Plant

When the Onega Energy Project starts, the Hydrolytic Thermal Plant will close down. A total of 153 people, currently employed by PKTS, work at the Hydrolytic Thermal Plant. Of these, 103, of which 18 are women, will be without a job whilst still in an active working age when the thermal plant closes down. Annex 5 provides a detailed overview of the employment situation at the Hydrolytic Thermal Plant. During the preparation of the PDD, 8 employees in different positions were interviewed during working hours at the Hydrolytic Thermal Plant. Their profiles are listed in Table G.2.1 below.

Table G.1. Profile of Stakeholders interviewed at Hydrolytic Thermal Plant

Job title	Employment duration	Education	Age, Sex
Head of equipment control	11 years	Technician, vocational school	33, male
Head of shifts	11 years	Engineer, university	41, male
Monitoring, turbines	2 years	Technician, forest worker, vocational school	24, male
Monitoring, CHP control room	19 years	School leaving certificate	48, female
Monitoring, CHP control room	22 years	School leaving certificate	46, female
Mechanical Engineer, Repairs	14 years	Mechanical engineer, University	34, male
Mechanic, Repairs of boilers	20 years	School leaving certificate	40, male
Locksmith	27 years	School leaving certificate + 2 years of university (interrupted)	55, male

Main issues concerning the possible closure of the Hydrolytic Thermal Plant included: a) missing out of the above average pay at the Hydrolytic Thermal Plant[62]; b) the uncertainty of what kind of job they would find in future and c) the prospects of maybe having to move away from Onega to find a new job. Employees working under particularly severe conditions expressed positive attitudes of leaving the working place. Five of the interviewed were optimistic about finding another job whereas three were less confident. Annex 5 describes in more detail the opinion of employees interviewed and include a summary table of answers provided.

Stakeholder Consultations at the Onega District Parliament

Two parliamentary meetings have been held in Onega o discuss the Onega Energy Project. At the end of both sessions, votes were cast on the approval of the project. 20 deputies voted in favour and one against during the October session and all voted in favour during the February session. Annex 5 contains names and background of deputies attending the two sessions as well as a more detailed summary of sessions. Protocols in Russian are available from GFA Envest upon request.

During the first session on 20th October, 2005, 21 deputies representing hospitals, schools, companies, media and the Hydrolytic Thermal Plant asked questions on issues such as heat tariffs, privatization of the district heating network versus long term leasing; site location and impacts, heat delivery safety and risks; credit availability and the involvement and conditions of Onega Sawmills. Several deputies expressed positive attitudes towards the project in addition to the questions asked. Onega Sawmills explained it chose to be involved in the project out of a social rather than pure business case. Tariffs are decided centrally, consumers may not all pay and investment is significant. Favourable loans from the bank have been made possible due of the significant social aspects of the project.

The second session took place on 7th February 2006. 18 deputies attended the session. Absent deputies were primarily those representing the wider district rather than the town of Onega. Several deputies noted that the most environmentally friendly way to heat Onega is to use wood fuel that is locally available which can in future also provide more jobs in forests.

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[62] The average pay at the Hydrolytic Plant is above what is paid in similar positions in Onega town. This is a heritage of the former state owned plant and the working conditions in certain parts of the plant, which are particularly hard, e.g. in the boiler house or in the turbine halls

A main theme during the meeting was the serious heating situation in Onega after a particularly hard January month: "The heating problem must be solved, people in town complain to me. The heating situation is getting worse and worse and we are not allowed to wait any longer.." and : "I represent basic heat consumers and had been elected to help solving the serious heating problems and put an end to the winters spent with trembling feet."

Environmental and social aspects of the project were discussed. The severe working conditions at the Hydrolytic Thermal Plant were highlighted as an alleviating factor of closing down the thermal plant. Stakeholders agreed that highly educated employees would always find another job in Onega or elsewhere and that new job openings would be available at the new heating plant. One deputy thought that any unemployment resulting from the closure of the thermal plant should not be blamed on the Onega Energy Project because the employment contract is with the hydrolytic plant. She added that within the last 2 years, 200 people have been made redundant from the hydrolytic plant. Of these, 52 are still registered as unemployed, the remainder either went on pension or found another job. None of the deputies expressed a negative opinion about the Onega Energy Project due to social, environmental or other aspects. Onega Municipality stated their commitment to carry out a social plan, whereby the Employment Agency will set up an office at the Hydrolytic Thermal Plant to facilitate and support the transition phase between the current employment at the thermal plant towards new opportunities (See Section G.3.1).

Stakeholder Consultations at Social Institutions in Onega

Background: Three social institutions were visited in Onega that receive heat from the Hydrolytic Thermal Plant: an Art School, a boarding school for mentally handicapped children and an orphanage. They are all located at the fringe of the district heating network. Serious heating problems prevail in these institutions, partly due to low pressure and temperatures of water in the outskirts of the district heating network, breakdown of the boiler house and repair work on the district heating system, partly due to poor central heat installations. The Onega Energy project would secure the delivery of heating, increase pressure on the pipeline network and allow for increased investment and repair of the district-heating network.

Onega Art School employs 20 people and offers after-school teaching for 185 children from the age of 6 to 18. Time spent in the school varies according to age and activities. Music is taught up to 5-7 hours a week and painting up to 12 hours a week.

According to Russian Federal legislation on sanitary requirements, art schools and kindergarten should have an indoor temperature of 20ºC. Music instruments need temperatures above 16ºC in order not to break or be damaged. Due to heating problems in the past, the school registered temperatures on 1st and 2nd floor from the start of the heating season in October. Table G.2.4.2. lists the average achieved in the art school. The head of the school said: "Parents don't keep the children away from this school despite the cold, but we as a staff are so stressed with the working conditions that we consider giving up working under such conditions." The school reported that at least once a year, the district heating breaks down during winter, but the winter of 2005/2006 has been the worst to date.

Table G.2. Indoor Average Temperatures, Onega Art School

Onega Art School	October	November 2006	December 2005	January 2006 average (minimum)
1st floor	13º (10º)	19.5º (18º)	18º (11º)	15.5º (9º)
2nd floor	11º (9º)	15.5º (14º)	12º (9º)	8º (1º)

The school for mentally handicapped children in Onega provides teaching for 102 children with 50 living in the boarding school. Of these, 17 children are orphans. Age ranges from 7 years to 19 years and teaching covers the 1st to the 9th grade. Heating quality during January 2006 varied significantly between rooms. Temperatures measured in the school hall were as low as 1ºC and on average 5ºC. In the coldest class room, temperatures went down to 0ºC with an average of 4ºC during the same period. The school has not experienced heating problems. Heat was in the past delivered from a decentralised boiler house located close to the school. Due to economic reasons the boiler house was closed down and the school is now receives heat from the Hydrolytic Thermal Plant, the has not experienced this before. None of the children fell ill during the period of cold, but teaching and learning quality suffered dramatically.

The *Orphanage* hosts 100 children in 2 buildings. 40 children aged 3 to 6 years live in one building and 60 children aged 8-18 in the second building. The constructor of the second building did not install radiators in order to save costs. In stead, only heat pipes pass though the rooms, which are far from sufficient to reach sanitary norms. Both due to the misconstruction of the central heating and the remote location of the orphanage in the district heating network, large smudges of mold has built up in several bedrooms and bathrooms causing a serious health hazard. Input water temperature reached 64ºC instead of 90ºC at the day of visit.

Stakeholder Consultations at the Regional Level

Meetings were held on 8th February 2006 with the Department for Tariffs and Prices and the Environmental Committee of Arkhangelsk Region Administration to ascertain whether the Onega Energy Project is well-thought of at the regional level. Both authorities were very positive about a) the use of a private company to restore the outworn pipeline network and b) the use of wood waste for combustion rather than for land filling.

Mr. Vladimir A. Blinov, Director of the Department for Tariffs and Prices said: "we are very happy that Onega Municipality has joined forces with a private company. This is the only way to restore the quality of the pipeline network". Mrs. Dolgoschelova, Director of Environmental Committee of Arkhangelsk Region Administration supports the Onega Energy Project and "looks forward to seeing the successful implementation of the JI project. The region needs such flagship projects as the potential is large in Arkhangelsk region. Many towns have access to wood waste and are in an even more desperate situation than Onega in terms of heating."

The Department of Tariffs and Prices had a meeting with PKTS on 7th February 2006 and is aware of the problems in Onega town caused by too low heating tariffs and subsequent lack of maintenance on the heating infrastructure and non-profitability of PKTS. Solutions are currently being worked at to mitigate the negative economic effects of the tariff levels, e.g. compensating PKTS for losses made from federal funds. The authority does not intend to increase tariffs beyond 25rub/m^2 unless higher fuel and heat efficiency is reached.

Due account taken regarding comments about employment

15 Employees from the Hydrolytic Thermal Plant have already been offered a job at Onega Energy. The job descriptions are listed in Table G.3.2. below and the people have been identified.

In addition to these 15 employees, 34 maintenance and operation employees will switch employer from PKTS to Onega Energy, but will not actually change job description.

Table G.3. Jobs available at Onega Energy for Employees at Hydrolytic Thermal Plant

Positions	Number
Main engineer	1
Head of boiler house	1
Metal worker/locksmith	3
Heat insulator	1
Electric Welder	1
Electrician	2
Machine operator	1
Operator of boiler house	4
Water demineralisation operator	1
Total	**15**

Onega Sawmills employ approx. 1,500 people. Employment fluctuation at the sawmill amounted to 193 in 2005, of which 58 were women. Although these jobs are not available all at one time, the company will be able to absorb a large part of employees at the Hydrolytic Thermal Plant.

During the previous rounds of redundancies at the hydrolytic plant, care was made to support and guide employees towards new job opportunities. The Employment Agency in Onega town installed an office at the Hydrolytic plant where employees could enquire about job opportunities and receive advice of professional training during their last 2 months of contract. The agency also offered seminars and re-trainings to enable people finding jobs in other sectors. Part of the every-day tasks of the Onega employment Agency consists of contacting companies to enquire about job openings, which they pass on to registered unemployed. According to Russian Federal Legislation, a company making more than 50 people redundant will have to contact the Employment Agency one month prior to end of contract.

A similar process will be established when the Hydrolytic Thermal Plant closes. The monitoring plan includes the survey of the process.

Due account taken regarding comments about environment

Stakeholders in parliament enquired about environmental impacts of the new biomass heating plant in terms of air, soil, water and noise and whether it would respect Russian environmental legislation. Concerns were satisfied with explanations of the choice of technology and mitigating activities at the heat production site. The choice of Finnish technology ensures an additional reduction in air pollutants compared with Russian technology and lies far below Russian air emission standards. Transport of wood waste will not take place between 12pm and 8am, although the noise level of the additional traffic would be allowed along the route of transportation.

Table G.4. Air Emissions Biomass & Coal fired Thermal Stations

Pollutant	Annual emissions, Biomass heating plant (tonnes/year) [n]	Annual emissions, Coal fired power plant (tonnes/year) [nn]
SO_2	6	139,309
NO_x	49	83,847
Dust in air	81	48,274
Ashes	691	356,233
CO		65,266

[n] Information from Wärtsilä Biopower Oy
[nn] Information from PKTS

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