JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE PROJECTS
Version 01.1 - in effect as of: 27 October 2006

CONTENTS

Annexes

SECTION A. General description of the small-scale project

A.1. Title of the small-scale project:

Bark and wood wastes to heat at OJSC "Solombala Sawmill and Woodworking Plant", Arkhangelsk, Russian Federation

Sectoral scopes[1]:

1. Energy industries (renewable/non-renewable sources) (1)
2. Waste handling and disposal (13)

Version: 1.2

Date: June 27, 2011

A.2. Description of the small-scale project:

The aim of the project is utilization of on-site generated bark and wood wastes (BWW) in a biofuel boiler house to produce heat for the needs of OJSC "Solombala Sawmill and Woodworking Plant" (SSWP) and termination of heavy fuel oil combustion and BWW disposal to the dump.

Prior to the project implementation heat was supplied to industrial site No.2 of SSWP from two heavy fuel oil boiler houses[2]. Significant quantities of BWW from the Plant's production lines were disposed to the dump due to the lack of waste utilization capacities.

It has to be said that BWW are categorized as a difficult-to-burn fuel due to their non-uniform particle size distribution and high moisture content. Because of the numerous difficulties associated with using BWW as fuel, there are extensive BWW dumping areas next to every sawmill in the Arkhangelsk Region. The sawmills' heat and electricity demand is generally met by fossil fuel combustion at the sawmill itself and/or by outside energy supplying companies.

The absence of the project would mean continuation of the existing heat production and wood waste handling practices that are acceptable for the plant and are not in conflict with the Russian laws and regulations.

The project envisages construction of a biofuel hot-water boiler house with the installed capacity of 18 MW. The boiler house is fitted with three URBAS boilers (Austria), 6 MW each. Two boilers are continuously in operation, one is a standby boiler. The only fuel for the boiler house is bark and sawdust. BWW are delivered from the Plant's own sawmilling and woodworking shops. The boiler house is located on industrial site No.2 of SSWP. Heat from the boiler house is supplied to the end-users which are located on the same site via the existing heat distribution network.

The contract with Austrian company AME GmbH for supply of main equipment was signed on June 6, 2001 (this date is considered to be the starting date of the project), and was preceded by lengthy negotiations with potential equipment suppliers and by elaboration of various boiler house configuration options. The supply of equipment and construction and installation works under the project were started in October 2001. The official commissioning took place in December 2002.

The project resulted in:

- ensuring almost complete utilization of bark and wood wastes from SSWP, thus their disposal to the dump is avoided;

[1] In accordance with the list of sectoral scopes adopted by the Joint Implementation Supervisory Committee. http://ji.unfccc.int/Ref/Documents/List_Sectoral_Scopes.pdf

[2] Heat supply of industrial site No.1 of SSWP is not covered by this project.

- termination of heavy fuel oil combustion in the Plant's old boiler houses;
- mitigation of negative environmental impact;
- reduction in greenhouse gas (GHG) emissions by an average of 38 thousand tCO_2e/year over the period 2008-2012.

The decision to implement the project was taken by the company's management in view of the possibility to offset some costs and to reduce the payback period by selling GHG emission reductions in the international market. Without such possibility the economic parameters of the project were unacceptably low. The project implementation using Article 6 of the Kyoto Protocol was discussed, inter alia, with Autonomous Non-Commercial Organization "Environmental Investments Center" with which a respective protocol of intentions was signed as early as August 2000.

Much hope for joint implementation of this project was given by the fact that at the international research and application conference on climate change which took place in Arkhangelsk in 2000, Arkhangelsk Region was suggested as a pilot region for compliance and implementation of the Kyoto mechanisms. In the following years there were several more conferences and workshops dealing with this issue in Arkhangelsk, and in 2005 a Climate Change and GHG Emission Monitoring Council was established under the Arkhangelsk Regional Administration; one of its stated targets was to review joint implementation projects proposed for implementation by companies and plants of the Arkhangelsk Region.

Since the project brings benefits to the local environment, it got positive reviews from the Chief State Health Inspector of Arkhangelsk (2001) and from the Head of the Northern District Administration of Arkhangelsk (2005). These comments, besides local positive environmental effect, also mention the GHG emission reduction effect.

Eventually, as soon as all necessary JI approval procedures became operational in the Russian Federation (2010), OJSC "Solombala SWP" started cooperation with CCGS LLC, which was chosen among other companies as a partner for preparation of the required documentation and selling GHG emission reductions in the international market.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Russian Federation (host Party)	Open Joint Stock Company "Solombala Sawmill and Woodworking Plant"	No
One of the parties of Annex B to the Kyoto Protocol	To be determined within 12 months after approval of the project by the Russian Government	No

OJSC "Solombala SWP"

OJSC "Solombala Sawmill and Woodworking Plant"[3] is one of the major timber producers in Russia's European North. The plant has been in operation since 1931 and makes a substantial contribution to the region's economy. Its operations are focused on production of export timber. The Plant's sawmilling capacity is over 700 thousand cubic meters per year. Solombala Plant holds 14% of the timber production market in the Arkhangelsk Region.

[3] http://www.solombala.com/sldk/

The wood-sawing facility (industrial site No.1) consists of two shops equipped with 11 wood-cutting lines and three automated sorting lines. The wood-processing facility (industrial site No.2) includes 16 drying ovens, 4 lines for trimming, sorting and packaging, 2 trimming-labelling machines, and a semi-mechanized line. The plant has a customs warehouse equipped with a system that monitors background radiation of the products. A developed network of cranes, docks and access ways allows to ship the products by sea and river, as well as by railroad and motor transport.

The Plant is a major employer offering jobs for 1700 people.

Fig. A.3-1. Solombala SWP

The Plant has a functioning and constantly improved integrated system of quality and environment management to the requirements of international standards ISO 9001 and ISO 14001. The delivery chain is certified for compliance with the requirements of the Forest Stewardship Council (FSC).

Today OJSC “Solombala SWP” is a part of “Solombalales”, a large regional holding, one of the major players in the pulp industry of the Arkhangelsk Region.

A.4. Technical description of the small-scale project:

A.4.1. Location of the small-scale project:

Location of the project: Russian Federation, Arkhangelsk, OJSC “Solombala Sawmill and Woodworking plant” (see Fig. A.4-1, A.4-2).

Fig. A.4-1. Location of the Arkhangelsk Region and the city of Arkhangelsk on the map of Russia

Fig. A.4-2. Google Earth map pinpointing the location of the project activity

A.4.1.1. Host Party(ies):

Russian Federation

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

Arkhangelsk Region

A.4.1.3. City/Town/Community etc.:

City of Arkhangelsk

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

Arkhangelsk Region lies in the North of the European part of Russia and is a part of the North-West Federal District of the Russian Federation.

It covers an area of 587 000 km^2. The population level is 1.3 million, of which urban population is around 1 million. The territory of the region includes Nenets Autonomous Okrug, 21 administrative districts, 14 cities, 31 urban settlements, around 4 000 rural settlements, and the islands of Novaya Zemlya and Franz-Josef Land.

The administrative centre of the region is the city of Arkhangelsk. The city is located in the estuary of the Northern Dvina River, 40-45 km from where it falls into the White Sea, 1133 km North of Moscow. The population is 350 thousand.

The climate is subarctic, maritime with long winters and short cool summers. It is formed under the influence of the northern seas and air mass transfer from the Atlantic under the conditions of low solar radiation. The average temperature of January is –13^{0}C, of July +17^{0}C. The annual precipitation rate is 529 mm.

Geographic coordinates of the project activity (according to Google Earth): latitude: 64°36'N, longitude: 40°31'E. Time zone GMT: +3:00.

A.4.2. Small-scale project type(s) and category(ies):

The project activity falls under the following two types[4]:

1. Type I – Renewable energy projects. Category C – Thermal energy production with or without electricity;
2. Type III – Other projects. Category E – Avoidance of methane production from biomass decay through controlled combustion, gasification or mechanical/thermal treatment.

The project activity meets the conditions for small-scale projects because:

1. Installed thermal capacity of the new biofuel boiler house is 18 MW, which does not exceed the limit of 45 MW set for small-scale projects of Type I;
2. GHG emission reductions generated as a result of the project implementation are estimated at an average of 38 thousand tonnes of CO_2e per year (See Section A.4.4.1), which is within the limit of 60 thousand tonnes of CO_2e per year, set for small-scale projects of Type III.

A.4.3. Technology(ies) to be employed, or measures, operations or actions to be implemented by the small-scale project:

Sources of heat supply prior to the project implementation

Prior to the project implementation heat at industrial site No.2 of SSWP was produced by two own heavy fuel oil fired boiler houses, which are briefly described below.

[4] In accordance with types and categories of projects adopted by the Clean Development Mechanism Executive Board, http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.

"Russian" steam boiler house

The boiler house has 4 heavy fuel oil fired boilers of E-1/9 type with the total output of 4 tonnes per hour. The boiler house is designed only for production of steam which is used for heavy fuel oil heating. Main performance characteristics of boiler are given in Table A.4-1.

Table A.4-1. Main performance characteristics of E-1/9 type boiler[5].

No.	Characteristic	Unit	Value
1.	Nominal output	t/hour	1.0
2.	Working steam pressure	MPa	0.8
3.	Design temperature of saturated steam	ºC	174.5
4.	Efficiency factor	%	89
5.	Fuel oil consumption	kg/hour	70/80

"Finnish" heating plant

The heating plant has 5 heavy fuel oil fired boilers manufactured by "Konepaja A. Gronroos OY", 8.75 MW each. The heating plant is designed to produce hot water at 95-100°C. There are 2 boilers in operation at one time.

The boiler houses were built in 1981 and are operational and could have continued its operation at least until 2012 if the scheduled repairs are carried out.

Wood wastes which are supplied from the plant's own production lines and cannot be used due to the absence of utilization capacities are disposed at dumps.

Table A.4-2. Main performance characteristics of "Konepaja A. Gronroos OY"heating plant's boiler.

No.	Characteristic	Unit	Value
1.	Working pressure	MPa	0.5
2.	Design water temperature (maximum)	ºC	115
3.	Fuel oil consumption	kg/hour	850

Before the project implementation "Finnish" heating plant had been supplying the same amount of heat as produced by the new biofuel boiler house. For instance in 2002 the heat production at this plant was 43 560 Gcal or 182 386 GJ.

The project activity

The project activity comprises construction of a new biofuel boiler house with the total installed capacity of 18 MW.

[5] http://cotlomash.ru/page640768

The source of fuel for the new boiler house is the Plant's own residues from wood working production lines. Bark and sawdust are generated when logs are processed in debarking machines (6 streams). Sawdust is also supplied from four dry timber assorting lines.

The primary purpose of the boiler house is to produce heat for drying chambers that are intended for artificial drying of timber. Besides some heat is also used for heating and hot water supply of the facilities located on industrial site No.2.
The old heavy fuel oil boiler houses are decommissioned.

The new boiler house is fitted with three URBAS UR-FRR-6000 boilers manufactured in Austria with the installed capacity of 6 MW each. The fuel used is a mixture of bark and sawdust in the proportion of 70% to 30%. Fuel is combusted in a bed (layer) on a mechanical shearing grate. Design efficiency of the boilers is 84-86%. The heat medium is water: 105 °C at the outlet and 70 °C at the inlet.

Each boiler unit consists of:

- hydraulic charging tube;
- furnace chamber with a step mechanical shearing grate;
- vertical heat exchanger with an integrated air preheater;
- system of induced and forced draft fans;
- flue gas ducts and automated handling unit for discharge of ash into a container with a scraper conveyor;
- cyclone for removal of solid particles from flue gases;
- pumps for primary circuit water circulation.

A plate-type heat exchanger was installed to separate primary delivery water circuit and secondary heating circuit. Delivery water is supplied to the existing distribution heat networks of industrial site No.2

The boiler room houses water treatment equipment for preparation of boiler feed water.

In order to have a day's supply of wood fuel there are two fuel bunkers. The fuel is charged to the bunkers by a loader.

Fig. A.4-3 shows a general view of boilers at the boiler house installation phase. Fig.A.4-4 shows the general view of the new boiler house.

Fig. A.4-3. URBAS boilers during the boiler house installation phase

Fig. A.4-4. The new commissioned biofuel boiler house

Construction and installation works under the project were implemented from October 2001 to November 2002. The official acceptance of the boiler house took place on December 16, 2002.

<u>Brief description of the waste combustion process</u>

The fuel is fed with the help of a loader to the fuel-handling room onto traveling beds which move it onto the crossover conveyors. The crossover conveyor of boiler No.1 with the help of a pusher delivers fuel into the boiler furnace itself. The second crossover conveyor feeds fuel to the bunker of the fuel distribution system which distributes fuel between boiler units No.2 and 3. From this bunker, depending on the rotating direction of the chain conveyor, fuel with the help of pushers is charged into the furnace of either boiler No.2 or boiler No.3.

Flue gases and ash are produced in the boiler furnace in the process of fuel combustion. The high temperature potential of flue gases serves to heat water and air in the course of heat exchange which takes place in the water heater and air heater, respectively. Hot water is supplied by circulating pumps to meet the process needs of industrial site No.2 and is also delivered to the heating and hot water supply system. Heated air is supplied via air ducts to the boiler furnace by forced draft fans to improve the fuel combustion process.

Then flue gases undergo inertial treatment in cyclones and via flue ducts are fed to the stack from which they are released into the atmosphere due to vacuum created by induced draft fans.

Fly ash is removed from flue gasses in cyclones. Ash collected in the cyclones is fed to the ash handling system by screw conveyors, and from the furnace boilers ash is removed through a damper. The ash handling system delivers ash to the ash bunker.

Implementation schedule

The contract with Austrian company AME GmbH for supply of main equipment was signed on June 6, 2001 (this date is considered to be the starting date of the project), and was preceded by lengthy negotiations with potential equipment suppliers and by elaboration of various boiler house configuration options. The supply of equipment and construction and installation works under the project was started in October 2001. All equipment supplies had been completed by June 2002. The construction works were completed in November 2002. The official commissioning took place in December 2002.

A.4.4. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed small-scale project, including why the emission reductions would not occur in the absence of the proposed small-scale project, taking into account national and/or sectoral policies and circumstances:

Combustion of fossil fuel leads to significant emissions of greenhouse gases (GHG). The primary greenhouse gas from fossil fuel combustion is CO_2. Emissions of N_2O and CH_4 from combustion are negligible compared to emissions of CO_2. Emissions of CO_2 from biomass combustion are regarded as climatically neutral and are, therefore, assumed equal to zero. In the course of anaerobic decay of biomass at dumps CH_4 is released. CH_4 emissions in CO_2 equivalent may be very high.

GHG emission reductions as a result of the project at Solombala SWP are achieved due to reduction in fossil fuel (heavy fuel oil) consumption and due to prevention of anaerobic decay of BWW at dumps. This became possible due to commissioning of a boiler house which fires sawmilling and wood working residues (bark and sawdust) as fuel and due to decommissioning of the heavy fuel oil boiler house.

In the absence of the project the said GHG emission reductions would not have been achieved because in this case the Plant would have continued to rely on the existing heavy fuel oil boiler houses as a source of heat. Large quantities of BWW generated at the Plant would have been disposed to the dump.

It is unlikely that the project would have been implemented in the absence of the joint implementation mechanism taking into account the following:

- The required amount of heat can be generated by firing heavy fuel oil in the existing boilers;
- The project implementation requires significant investments, and return on the project investments in the absence of additional revenue from selling GHG emission reductions is not sufficiently high;
- The project implementation involves fairly new technology of high moisture wood waste

combustion with which Solombala SWP has no prior experience;

- There are no caps on GHG emissions by plants in Russia;
- It is not expected that there will be any significant changes in the Russian environmental legislation, which might force the company to stop operating the equipment which existed prior the project and to discontinue BWW dumping.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	31 469
2009	28 379
2010	33 117
2011	45 699
2012	48 469
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	187 132
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	37 426

A.4.5. Confirmation that the proposed small-scale project is not a debundled component of a larger project:

In accordance with paragraph 15 of "Provisions for joint implementation small-scale projects" [R4] a JI small-scale project is deemed to be a debundled component of a large project if there already exists a JI (small-scale) project:

a) which has the same project participants; and
b) which applies the same technology/measure and pertains to the same project category; and
c) whose determination was made publicly available in accordance with paragraph 34 of the JI Guidelines[6] within the previous 2 years;
d) whose project boundary is within 1 km from the project boundary of the proposed JI small-scale project at the closest point.

Since there are no registered projects which would meet this description, this small-scale project is not a debundled component of a larger project.

A.5. Project approval by the Parties involved:

The Letters of Approval will be obtained later.

[6] Annex to the Decision 9/CMP.1 known as the JI Guidelines

SECTION B. Baseline

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

Selection of the approach to baseline setting

To establish the baseline the PDD developer used a JI-specific approach based on paragraph 9 (a) of the "Guidance on criteria for baseline setting and monitoring" [R3].

The baseline was set in accordance with Annex B of the JI Guidelines. The justification of the choice of the baseline was elaborated in accordance with paragraphs 23-29 of the "Guidance on criteria for baseline setting and monitoring".

The most likely baseline scenario was selected based on the analysis of alternatives which can ensure the end-users with the required amount of heat and on the analysis of alternatives to the project combustion of BWW. The choice of the baseline was justified taking into account Annex 1 to the "Guidance on criteria for baseline setting".

It should be taken into account that the construction and installation works have been completed to date and the project is right now generating physical reductions of GHG emissions. In this connection it appears reasonable to determine specific baseline parameters affecting the projected level of GHG emission reductions till the end of 2012, taking into account the accumulated actual project data (2003-2010).

All key data, factors and assumptions affecting the GHG emission reductions are considered on a transparent and conservative basis.

Description of the likely future scenarios and choice of the baseline scenario

The following alternatives that ensure the consumers of industrial site No.2 with the required amount of heat were identified:

Alternative H1. Continuation of the current situation

Alternative H2. Construction of a gas-fired boiler house

Alternative H3. Construction of a coal-fired boiler house

Alternative H4. Project activity without joint implementation mechanism

The following alternatives to BWW combustion under the project were identified:

Alternative W1. Continuation of the current situation

Alternative W2. Use of BWW as fuel for heat and power generation at Arkhangelsk CHPP

Alternative W3. Use of BWW as feedstock for the Hydrolysis Plant

Alternative W4. Project activity without joint implementation mechanism

Supplying heat to consumers of industrial site No.2

Alternative H1. Continuation of the current situation

This alternative envisages continuation of the situation which existed prior to commencement of the project. The required amount of heat would have been supplied to consumers by means of firing heavy fuel oil in old boiler houses of industrial site No.2 of Solombala SWP.

The old "Finnish" boiler house ensured reliable supply of heat to the drying chambers and other consumers of industrial site No.2. The heat supply process is well organized, the maintenance personnel of the boiler house have the required level of skill and competence, heavy fuel oil supplies are well established.

Switching the boiler house to other type of fuel was hardly possible because it would have demanded lots of reconstruction such as modification of the existing boilers, installation of new boiler equipment, construction of fuel handling, storage and conditioning facilities; all of which requires significant capital investments. Switching to natural gas is not feasible as there is no gas pipeline.

The advantage of Alternative H1 is that there is no need to invest in heat supply sources of Solombala SWP. Investments in modernization and expansion of production capacities, including introduction of up-to-date energy saving technologies may yield much more profit.

Alternative H1 is quite likely and can be considered as the most likely baseline scenario of heat supply of industrial site No.2.

Alternative H2. Construction of a gas-fired boiler house

This alternative is not feasible because there was no gas pipeline to Arkhangelsk at the time when decision regarding the project implementation was taken.

Alternative H2 is not realistic and was therefore excluded from consideration.

Alternative H3. Construction of a coal-fired boiler house

This alternative involves construction of a new coal-fired boiler house at industrial site No2. Heat supply from the heavy fuel oil boiler house of SSWP would in this case have been discontinued. The consumers would get the required amount of heat due to coal combustion in the new boiler house.

Implementation of this alternative would require significant capital investments related to construction of boiler house, coal and ash handling systems. It is unlikely that the company management would decide to build a coal-fired boiler house while there are two own boiler houses running on heavy fuel oil. The coal option was not even considered as the required investments would have been similar to biofuel boiler house, plus fuel costs that would have to be constantly incurred.

Besides, operation of such boiler house would pollute the environment in the region which goes against the corporate environmental policy[7].

Alternative H3 is not realistic and was therefore excluded from consideration.

Alternative H4. Project activity without joint implementation mechanism

This alternative involves construction of a new biofuel boiler house on industrial site No.2. Heat supply from heavy fuel oil boiler houses in this case would have been discontinued. The consumers would have received the required amount of heat due to combustion of BWW in the new boiler house.

Implementation of this alternative would have required significant capital expenditure. The investment analysis in Section B.2 shows that the economic parameters of the project without the joint implementation mechanism would have been unacceptably low.

Implementation of Alternative H4 as the baseline scenario is unlikely.

Handling of BWW that are fired under the project

Alternative W1. Continuation of the current situation

This alternative envisages continuation of the situation which existed prior to the project commencement. The unused BWW from the plant's own production lines would have been disposed at the dump.

[7] http://www.solombala.com/system/system/archives/sldk/Politika_i_ekologicheskie_aspekty_2011_g.doc

If the entire volume of BWW generated at SSWP (and not only that volume which is consumed at the biofuel boiler house) is considered, then it should be mentioned that Solombala SWP has been historically supplying and still supplies a significant part of BWW to the nearby Solombala PPM (SPPM). The volumes of BWW supply from Solombala SWP to Solombala PPM both prior to and after the project implementation remain at the same level, which is confirmed by historical data given in Table B.1-1 below.

Table B.1-1. BWW generated at Solombala SWP and sent to Solombala PPM in 2001-2010, m^3

Year	Total	Sent to SPPM
2001	182 861	137 465
2002	145 313	99 550
2003	187 492	131 923
2004	187 472	133 387
2005	177 102	129 950
2006	150 628	122 797
2007	139 727	112 286
2008	159 105	128 818
2009	101 895	75 258
2010	148 601	112 933

SPPM would not have been able to consume the entire volume of wastes offered by SSWP in the absence of the project, because SPPM has to utilize its own BWW as well and besides SPPM receives BWW from other companies of Maimaksa-Solombala Industrial Hub of Arkhangelsk[8] (not only from SSWP).

Thus, in the absence of the project that waste which is combusted in the SSWP's biofuel boiler house would have been disposed to the dumps.

Disposal of BWW at dumps (places of controlled waste storage) does not conflict with the environmental laws and regulations and is common practice for timber industry of Arkhangelsk and Russian in general. There have been no problems with disposal of unused wood wastes at dumps so far and no such problems are anticipated in the future.

This scenario does not require from the company any investments nor does it entail any additional operating costs connected with construction and operation of sophisticated equipment for BWW utilization to produce heat. This presents an opportunity to spent investment resources on upgrade and expansion of core production capacities of SSWP.

Alternative W1 is quite realistic and can be considered as the most likely baseline scenario.

<u>Alternative W2. Use of BWW as fuel for heat and power generation at Arkhangelsk CHPP</u>

Arkhangelsk has a district heating system based on co-generation of heat and power. The center of energy supply is Arkhangelsk CHPP running on heavy fuel oil. The boilers of Arkhangelsk CHPP are not designed for combustion of solid fuels and therefore combustion of BWW in them is not technically feasible.

Alternative W2 is not realistic and therefore was dismissed.

[8] It must be mentioned that the volume of BWW generated in this Industrial Hub exceeds Solombala PPM's utilizing capacity.

Alternative W3. Use of BWW as feedstock for the Hydrolysis Plant

Indeed, wood wastes can be used by hydrolysis plants as a feedstock for alcohol production. Arkhangelsk hydrolysis plant (AHP) is located not far from SPPM. However since 1995 alcohol production from wood was discontinued at AHP. Alcohol production at the plant switched to molasses, beet sugar production residue, and later on – to sulphite liquors. Currently the plant is barely operational.

Alternative W3 is unlikely and was excluded from consideration

Alternative W4. Project activity without joint implementation mechanism

This alternative envisages construction of a new biofuel boiler house. The BWW produced on site are fired in the boilers of the new boiler house.

However according to what have been earlier stated for Alternative H4, this alternative could not have happened without the joint implementation mechanism.

Implementation of Alternative H4 as the baseline scenario is unlikely.

Thus, based on the above analysis of alternatives and with allowance for the results of the investment analysis given further in the text, the following two alternatives were selected as the most likely baseline scenarios, each of them assuming continuation of the current situation: Alternative H1, which envisages further supply of industrial site No.2 with heat produced by firing heavy fuel oil in old boiler houses, and Alternative W1, which envisages further dumping of on-site generated BWW.

Description of the project and baseline scenarios

The project scenario envisages production of heat (in the form of hot water) in the new biofuel boiler house. The boilers are fuelled with bark and wood wastes generated on site of Solombala SWP; no fossil fuel is used for flame stabilization during combustion process. Heat production by hot water boilers of the old heavy fuel oil boiler house terminated in late 2002 after commissioning of the new boiler house. Both heavy fuel oil boiler houses were taken out of operation.

The baseline scenario envisages continuation of heat supply of industrial site No.2 from the old heavy fuel oil boiler houses. The “Finnish” boiler house serves to heat water which is delivered to the heat supply system, and the “Russian” steam boiler house is operated in order to heat heavy fuel oil. Unused bark and wood wastes that are generated at Solombala SWP are disposed to the dump.

The baseline represents “business as usual” within the framework of the existing rules and standards, which do not prohibit OJSC “Solombala SWP” to either fire heavy fuel oil in the existing boilers or dispose BWW to the dumps. The baseline scenario is much less costly as compared with the project activity. It should be also noted that Russia does not have any GHG emission caps for individual companies and such are unlikely to appear before the end of 2012.

Main factors affecting GHG emission reductions level

Main factors affecting the amount of GHG emission reductions generated by the project:

- heat production at the new biofuel boiler house;
- heavy fuel oil combustion at the old hot water boiler house;
- bark and wood waste combustion volume;
- GHG emission factors and other parameters.

Each of the above factors is considered in detailed further below.

There are no project emissions therefore all calculations boil down to quantification of the baseline emissions.

Heat production at the new biofuel boiler house

Heat production at the new biofuel boiler house $HS_{BBH,y}$ in 2003-2012 are given in table below. For the period from 2003 to 2010 actual heat production data are given. The projections for the years 2011 and 2012 use design data [R1], according to which the heat production is 70 thousand Gcal/year.

Data/Parameter	$HS_{BBH,y}$
Data unit	GJ
Description	Heat production at the new biofuel boiler house
Time of determination/monitoring	March 2011
Source of data (to be) used	2003 – 2010 actual data: Chief Power Engineer Department of OJSC “Solombala SWP” 2011 – 2012 prognosis data: JSC “Solombala SWP”, “Boiler House” design documentation. Developer: JSC “Arkhgiprodrev”. Arkhangelsk, 2002
Value of data applied (for ex ante calculations/determinations)	**2003**: 205653; **2004**: 239827; **2005**: 220592; **2006**: 199469; **2007**: 187724; **2008**: 197702; **2009**: 149074; **2010**: 184195; **2011**: 293090; **2012**: 293090
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Monitored according to the procedure presented in Section D. Determined based on readings of the heat meter/
QA/QC procedures (to be) applied	Subject to regular verification in accordance with the schedule and procedure for verification of instrumentation and control equipment approved at the Plant
Any comment	-

Value of data applied:

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
205653	239827	220592	199469	187724	197702	149074	184195	293090	293090

Heavy fuel oil combustion at the old hot water boiler house

Under the baseline scenario the “Finnish” hot water boiler house is fuelled with heavy fuel oil. This heavy fuel oil is heated up by steam boilers of the “Russian” boiler house. Fuel consumption for fuel heating is neglected due to the complexity and inaccuracy of calculations. This is conservative.

Since heat production for end-users of industrial site No.2 of SSWP is the same under the baseline scenario and under the project, the annual consumption of heavy fuel oil in the old hot water boiler house $FC_{FO,y}$ during the year *y* can be determined as follows, GJ:

$$FC_{FO,y} = \frac{100 \cdot HS_{BBH,y}}{\eta_{FO}}, \qquad \text{(B.1-1)}$$

where $HS_{BBH,y}$ is the heat production in the new biofuel boiler house during the year *y*, GJ;

η_{FO} is the efficiency factor of heavy fuel oil boilers of the old hot water boiler house, %.

Heavy fuel oil consumption under the baseline scenario in 2003-2012 are given in Table B.1-2 below.

Table B.1-2. Baseline consumption of heavy fuel oil in 2003-2012

Parameter	Unit	Years									
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Heavy fuel oil consumption in the hot water boiler house	GJ	241945	282150	259520	234669	220852	232590	175381	216699	344812	344812

Data/Parameter	η_{FO}
Data unit	%
Description	Efficiency factor of heavy fuel oil boilers of the old hot water boiler house
Time of determination/monitoring	March 2011
Source of data (to be) used	Methodological tool to determine the baseline efficiency of thermal or electric energy generation systems. Version 01. CDM Executive Board. Table 1 [R7].
Value of data applied (for ex ante calculations/determinations)	85
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value for old heavy fuel oil boilers
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Bark and wood waste combustion volume

The project scenario envisages combustion of BWW in the new boiler house. Under the baseline scenario this volume of BWW would have been disposed to a dump. The volume of BWW, which would have been disposed to dumps during the year *y*, is determined as follows, t:

$$BWW_y = \frac{100 \cdot HS_{BBH,y}}{\eta_{BBH} \cdot NCV_{BWW}}, \qquad \text{(B.1-2)}$$

where η_{BBH} is the efficiency factor of biofuel boilers of the new boiler house, %;

NCV_{BWW} is the net calorific value of BWW, GJ/t.

The volumes of BWW combustion in 2003-2012 are given in Table B.1-3 below.

Table B.1-3. BWW combustion in the new boiler house in 2003-2012

Parameter	Unit	Years									
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Consumption of BWW in the new boiler house	t	31509	36746	33798	30562	28763	30291	22841	28222	44906	44906

Data/Parameter	η_{BBH}
Data unit	%
Description	Efficiency factor of biofuel boilers of the new boiler house
Time of determination/monitoring	March 2011
Source of data (to be) used	UR-FRR-6000 utilizing energy boilers test report, OJSC "Solombala SWP", Arkhangelsk, 2002 [R2]
Value of data applied (for ex ante calculations/determinations)	86.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	During tests the efficiency of boilers varied in the range of 84.16 to 86.59%. The calculations are based on the highest value. This is conservative.
QA/QC procedures (to be) applied	Not required
Any comment	-

Data/Parameter	NCV_{BWW}
Data unit	GJ/t
Description	Net calorific value of BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	UR-FRR-6000 utilizing energy boilers test report, OJSC "Solombala SWP", Arkhangelsk, 2002 [R2]
Value of data applied (for ex ante calculations/determinations)	7.54
Justification of the choice of data or description of measurement methods and procedures (to be) applied	During tests the fuel moisture varied between 50.55 and 61.74 %. The net calorific value in this case changed invertedly from 7.54 to 5.90 GJ/t (1.8 – 1.41 Gcal/t). Due to the variability of fuel moisture content we assumed a constant value of 50% and the respective calorific value in our calculations. This combination of moisture/calorific value gives the most conservative result of GHG emission reduction calculations.
QA/QC procedures (to be) applied	Not required
Any comment	-

GHG emission factors and other parameters

Data/Parameter	$EF_{CO2,FO}$
Data unit	tCO_2e/GJ
Description	CO_2 emission factor for heavy fuel oil
Time of determination/monitoring	March 2011
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 2, Table 2.2. [R8]
Value of data applied (for ex ante calculations/determinations)	0.0774
Justification of the choice	Default value

of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Numerical estimation of prevented methane emissions from dumps due to anaerobic decay of wood wastes was made using the model "Calculation of CO_2-equivalent emission reductions from biomass prevented from stockpiling or taken from stockpiles" developed by BTG biomass technology group B.V. for the World Bank [R5]. The model is built on the First Order Decay method with experimental adjustment of a number of parameters for waste wood dumps (See Section E.4). The results of calculations for the period 2003-2012 are given in Annex 2-1. Key constants necessary for calculation of prevented methane emissions are given in a tabular form below.

Data/Parameter	$w_{lignin,BWW}$
Data unit	-
Description	Lignin fraction of C for BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 43 [R5]
Value of data applied (for ex ante calculations/determinations)	0.25
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Data/Parameter	k_{BWW}
Data unit	year^{-1}
Description	Decomposition rate constant for BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 42-43 [R5]
Value of data applied (for ex ante calculations/determinations)	0.0462
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Calculated by the formula: $k_{BWW} = -\ln\left(1/2\right)/15$
QA/QC procedures (to be) applied	Based on reference data

Any comment	15 – recommended default value for the half period of wood, years

Data/Parameter	C_{BWW}^{d}
Data unit	%
Description	Organic carbon content in BWW on dry basis
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 43 [R5]
Value of data applied (for ex ante calculations/determinations)	53.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value recalculated on a dry basis
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	M_{BWW}
Data unit	%
Description	BWW moisture
Time of determination/monitoring	March 2011
Source of data (to be) used	UR-FRR-6000 utilizing energy boilers test report, OJSC “Solombala SWP”, Arkhangelsk, 2002 [R2]
Value of data applied (for ex ante calculations/determinations)	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	During test the fuel moisture content varied between 50.55 and 61.74 %. The net calorific value in this case changed invertedly: from 7.54 to 5.90 GJ/t (1.8 – 1.41 Gcal/t). Due to the variability of fuel moisture content we assumed a constant value of 50% and the respective calorific value in our calculations. This combination of moisture/calorific value gives the most conservative result of GHG emission reduction calculations.
QA/QC procedures (to be) applied	Not required
Any comment	-

Data/Parameter	a
Data unit	m^3/kg carbon
Description	Conversion factor from kg carbon to landfill gas quantity
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 24 [R5]
Value of data applied (for ex ante	1.87

calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Calculated by the formula: $a = 22.4/12$
QA/QC procedures (to be) applied	Based on reference data
Any comment	22.4 – is the molar volume of gas at standard conditions, l/mol; 12 – molar mass of C, g/mol.

Data/Parameter	ζ
Data unit	-
Description	Generation factor
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 41 [R5]
Value of data applied (for ex ante calculations/determinations)	0.77
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	φ
Data unit	%
Description	Percentage of the stockpile under aerobic conditions
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 80 [R5]
Value of data applied (for ex ante calculations/determinations)	10
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	ζ_{OX}
Data unit	-
Description	Methane oxidation factor
Time of	March 2011

determination/monitoring	
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 43 [R5]
Value of data applied (for ex ante calculations/determinations)	0.10
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	V_m
Data unit	%
Description	Methane concentration biogas
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 41 [R5]
Value of data applied (for ex ante calculations/determinations)	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value 60%. A more conservative value (50%) was assumed for calculations.
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	ρ_{CH4}
Data unit	kg/m^3
Description	Methane density
Time of determination/monitoring	March 2011
Source of data (to be) used	Methodological tool to determine project emissions from flaring gases containing methane. CDM Executive Board. Table 1. [R10]
Value of data applied (for ex ante calculations/determinations)	0.716
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference value of methane density at normal conditions
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	The Global Warming Potential for methane
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 12 [R5]
Value of data applied (for ex ante calculations/determinations)	21
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the small-scale project:

The approach described in paragraph 2 (a) of Annex 1 to the "Guidelines on criteria for baseline setting and monitoring" [R3] was chosen to demonstrate that reductions in greenhouse gas emissions ensured by the small-scale project are additional to those which might have otherwise occurred.

Within the framework of the chosen approach, the project additionality was analyzed using the project alternatives analysis, investment analysis and common practice analysis.

Analysis of the project alternatives

A detailed analysis of alternatives is given in Section B.1, where it is demonstrated that the project activity without the joint implementation mechanism can be hardly considered as the baseline scenario.

The combination of Alternative H1 and W1 which envisages continuation of heavy fuel oil combustion in the old boiler houses and continuation of BWW dumping was selected as the most likely baseline scenario.

Investment analysis

Main economic parameters of the project were compared for the two project implementation options:

(a) without sale of GHG emission reductions;

(b) with sale of GHG emission reductions.

The investment analysis was undertaken using data and assumptions relevant for the situation before the project starting date.

The internal rate of return (IRR) and net present value (NPV) were determined for each option.

OJSC "Solombala SWP" received an offer from Austrian supplier of boiler equipment (ref No. 672 U dated 20.12.2000) for supply of boiler house equipment totaling around RUR 29 million. If the same amount is provided in the budget for construction and installation works, the total amount of capital investments to the project was estimated at RUR 58 million before the project starting date. The project is financed by Solombala SWP's equity.

The price of early emission reductions (2003-2007) is assumed at the level of 90 RUR/ tCO_2e. The price of emission reduction unit (ERU) is assumed at 300 RUR/ tCO_2e.

The time horizon of the analysis is limited to 2020.

The discount rate was determined with the help of one of the most widely used methods, namely cumulative method of risk premium assessment[9]. This method is based on the following formula:

$$R = R_f + R_1 + ... + R_n , \qquad (Б.2\text{-}1)$$

where R is the sought discount rate;

R_f is the risk-free rate of return;

$R_1,...,R_n$ is the risk premium for different risk factors.

Generally, government securities are considered to be (conditionally) risk-free assets. In Russia such assets could be Russia 2030 Eurobonds with maturity date in 2030. Thus in the last six months of 2000 the rate of return on these bonds was around 14÷18 p.a[10].

Potential risk factors can be country risk, risk of partner unreliability, risk of not getting the income envisaged by the project. Thus, if the project envisages production based on a well-known technology then the recommended risk premium is between 3% and 5%. Other risk premiums are altogether neglected.

The final discount rate was assumed at 20%.

The results of NPV and IRR calculation for the two project implementation options are given in Table B.2-1, detailed calculations are given in Annex 2-2.

Table B.2-1. Investments, NPV and IRR

Parameter	Unit	Project without sale of ERUs	Project with sale of ERUs
NPV	Thousand RUR	-9 131	4 590
IRR	%	16.48	21.69

The economic parameters of the project without the joint implementation mechanism are low (NPV<0). Revenues received from sale of emission reductions account for over 50% of the total amount of required investments. These revenues improve the commercial attractiveness of the project, NPV rises above zero.

The analysis of the project sensitivity to the changes of main parameters is given further below (See Table B.2-2). Due to the revenues received from sale of emission reductions the project becomes much less sensitive to risks demonstrating in majority of considered cases an IRR higher than the discount rate, whereas without sale of emission reductions IRR in all cases is lower than the discount rate.

Table B.2-2. The sensitivity analysis of the main economic parameters of the project

Name	Unit	Project without sale of ERUs	Project with sale of ERUs
1) Increase in investments by 10%			
NPV	Thousand RUR	-14 678	-958
IRR	%	14.82	19.67

[9] http://www.fd.ru/reader.htm?id=1716

[10] http://www.vedi.ru/mfm_r.htm

2) Reduction in investments by 10%			
NPV	Thousand RUR	-3 583	10 137
IRR	%	18.48	24.11
3) Increase in heat production by 10%			
NPV	Thousand RUR	-4 496	10 596
IRR	%	18.28	23.87
4) Reduction in heat production by 10%			
NPV	Thousand RUR	-13 765	-1 417
IRR	%	14.65	19.47
5) Increase in heavy fuel oil price by 10%			
NPV	Thousand RUR	-4 496	9 224
IRR	%	18.28	23.38
6) Reduction in heavy fuel oil price by 10%			
NPV	Thousand RUR	-13 765	-45
IRR	%	14.65	19.98
7) Increase in discount rate by 10%			
NPV	Thousand RUR	-13 246	-766
IRR	%	16.48	21.69
8) Reduction in discount rate by 10%			
NPV	Thousand RUR	-3 789	10 872
IRR	%	16.48	21.69

The investment analysis shows clearly that the project would not have taken place within the framework of common commercial practice without sale of emission reductions.

Common practice analysis

For saw mills and woodworking plants in Russia the common practice at the time of the decision making (2000) was production of heat by energy generating sources (CHPPs and boiler houses) characterized by high rate of fossil fuel consumption (coal, heavy fuel oil, natural gas).

Significant quantities of highly moist bark are still being dumped due to the difficulties associated with its combustion. Disposal of bark and other wood wastes at dumps is permitted by the environmental legislation of Russia.

The biofuel boiler house construction project at OJSC "Solombala SWP" was one of the first projects of this type implemented in the Arkhangelsk Region. Later a number of new biofuel boiler house construction projects were implemented in the Arkhangelsk Region: at Sawmill 25 in Arkhangelsk, also in Onega and in Severoonezhsk. However all these projects were stated as JI[11].

Thus this project is not common practice.

Proceeding from the above, GHG emission reductions as a result of the project are additional to those that might have occurred otherwise.

[11] http://www.sbrf.ru/moscow/ru/concurs/2010/index.php?id114=11006872

B.3. Description of how the definition of the project boundary is applied to the small-scale project:

Fig. B.3-1 shows the principal project boundary, baseline components and fuel flows.

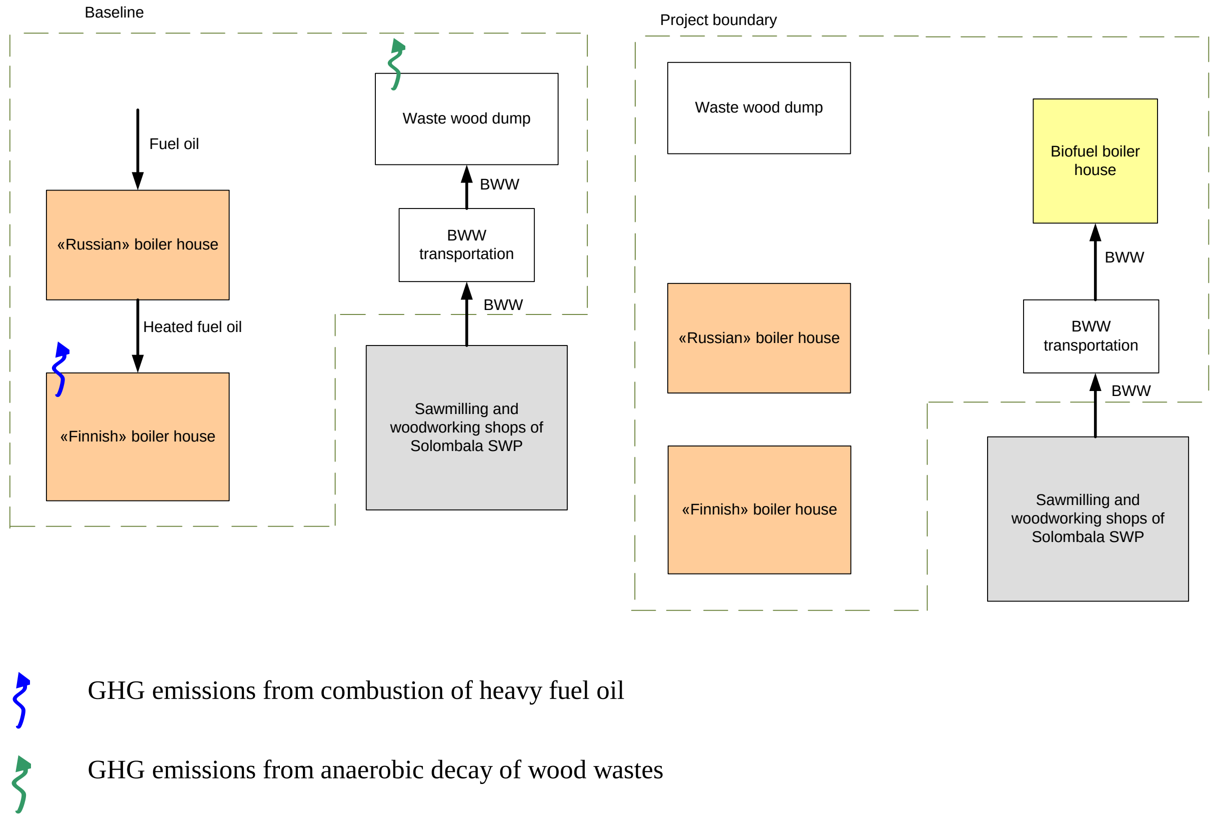

Fig. B.3-1. Main project components and boundary

Table B.3-1 below shows emission sources included and excluded from the project boundary and baseline components.

Table B.3-1. Emission sources included and excluded from consideration

	Source	Gas	Incl./Excl.	Justification / explanation
Baseline	"Finnish" boiler house, combustion of heavy fuel oil	**CO_2**	**Incl.**	**Main emission source**
		CH_4	Excl.	Negligible. Conservative **
		N_2O	Excl.	Negligible. Conservative **
	"Russian" boiler house, combustion of heavy fuel oil	CO_2	Excl.	Deemed to be insignificant. Conservative *
		CH_4	Excl.	Negligible. Conservative
		N_2O	Excl.	Negligible. Conservative
	Power supply from the external power grid for operation of heavy fuel oil boiler houses, combustion of fossil fuel	CO_2	Excl.	Deemed to be negligible. Comparable to the project emissions **
		CH_4	Excl.	Negligible. Conservative
		N_2O	Excl.	Negligible. Conservative
	Waste wood dumps, anaerobic decay of BWW	CO_2	Excl.	Deemed to be equal to zero
		CH_4	**Incl.**	**Main emission source**
		N_2O	Excl.	Negligible. Conservative
	BWW transportation to	CO_2	Excl.	Deemed to be negligible. Comparable to the

	dumps			project emissions **
		CH_4	Excl.	Negligible. Conservative
		N_2O	Excl.	Negligible. Conservative
Project activity	Biofuel boiler house, BWW combustion	CO_2	Excl.	CO_2 emissions from biomass combustion are considered to be climatically neutral
		CH_4	**Incl.**	**Main emission source**
		N_2O	**Incl.**	**Main emission source**
Leakages	Power supply from the external power grid for operation of biofuel boiler house, combustion of fossil fuel	CO_2	Excl.	Negligible**
		CH_4	Excl.	Negligible
		N_2O	Excl.	Negligible
	BWW transportation to biofuel boiler house	CO_2	Excl.	Negligible**
		CH_4	Excl.	Negligible
		N_2O	Excl.	Negligible

* heavy fuel oil combustion in "Russian" boiler house in order to heat heavy fuel oil up before its combusted in "Finnish" boiler house is not considered because of the complexities and low accuracy of calculations. This is conservative.

** below is the numerical estimation of significance of excluded sources

Increase in power supply from the external power grid

Installed capacity of electrical equipment of the new biofuel boiler house is equal to 305 kW. The old "Russian" and "Finnish" boiler houses with the total installed capacity of electrical equipment equal to 320 KW were shut down and laid up. Thus, the project did not result in increase in power consumption.

Wood waste supply to the boiler house

Wood wastes are delivered by motor vehicles from the main industrial site of Solombala SWP which is 3 km away from industrial site No.2. Otherwise the wastes would have been transported to the dump which is 700 m closer to the main industrial site than the new boiler house. Thus, under the project scenario the haul distance will increase by 1.4 km (round trip distance). The average amount of BWW transported to the boiler house during crediting period is 34 233 t/year. According to Wikipedia[12] CO_2 emission factor for trucks is 0.1693 kg CO_2/t-mile. Therefore annual increase in GHG emissions will amount to 34 233×1.4×0.1693/1000/1.609[13] = 5.04 tCO_2e/year, which is extremely small.

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of baseline setting: 03/03/2011

The baseline was developed by CCGS LLC (CCGS LLC is not a Project Participant and is not listed in Annex 1 of the PDD).

Contact person: Egor Ershov

E-mail: e.ershov@ccgs.ru

[12] http://en.wikipedia.org/wiki/Environmental_impact_of_transport#cite_note-14

[13] Conversion between mile and kilometer: 1 mile=1.609 km.

SECTION C. Duration of the small-scale project / crediting period

C.1. Starting date of the small-scale project:

June 6, 2001 (date of contract with AME GmbH for supply of boiler house equipment)

C.2. Expected operational lifetime of the small-scale project:

20 years/240 months (service life of main equipment)

C.3. Length of the crediting period:

Length of crediting period – 5 years/60 months (from January 1, 2008 till December 31, 2012)

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

For development of the monitoring plan the PDD developer used a JI-specific approach based on paragraph 9 (a) of the "Guidance on criteria for baseline setting and monitoring" [R3].

The data (to be registered in any case) required for estimation of GHG emission reductions are collected in accordance with the national standards:

- Federal Law No.102-FZ "On measurements uniformity assurance" dated 26.06.2008;
- RD 34.09.102 "Rules for heat metering" dated 12.09.1995.

Information on the environmental impact of the project will be collected and archived in accordance with the Russian law. The company has reporting obligations as per official annual statistic form 2-tp (air) "Data on Atmospheric Air Protection" containing information on the quantities of trapped and destroyed air pollutants, detailed emissions of specific pollutants, number of emission sources, emission reduction actions and emissions from separate groups of pollutant sources.

All data necessary for monitoring shall be kept in the company's archive for at least two years after the end of the crediting period or the last transfer of ERUs. The information will be archived electronically and on paper.

GHG emission reductions over the year y , tCO_2e:

$$ER_y = BE_y - PE_y \quad (D.1\text{-}1)$$

where PE_y is the project GHG emissions over the year y, tCO_2e;

$$PE_y = \frac{100 \cdot HS_{BBH,y}}{\eta_{BBH}} \cdot \left(EF_{CH4,BWW} \cdot GWP_{CH4} + EF_{N2O,BWW} \cdot GWP_{N2O} \right) \quad (D.1\text{-}2)$$

where $HS_{BBH,y}$ is the heat production in the new biofuel boiler house over the year y, GJ;

η_{BBH} is the efficiency factor of biofuel boilers of the new boiler house;

$EF_{CH4,BWW}$ is the CH_4 emission factor for BWW, tCH_4/TJ;

GWP_{CH4} is the global warming potential of CH_4, tCO_2e/tCH_4;

$EF_{N2O,BWW}$ is the N_2O emission factor for BWW, tN_2O/TJ;

GWP_{N2O} is the global warming potential of N_2O, tCO_2e/tN_2O.

BE_y is the baseline emission reductions over the year y, tCO_2e;

$$BE_y = BE_{FO,y} + BE_{BWW,dump,y} \quad (D.1\text{-}3)$$

where $BE_{FO,y}$ is the baseline emissions of CO_2 from heavy fuel oil combustion in the old hot water boiler house over the year y, tCO_2e;

$BE_{BWW,dump,y}$ is the baseline emissions of CH_4 from BWW decay at the dump over the year y, tCO_2e.

$$BE_{FO,y} = \frac{100 \cdot HS_{BBH,y}}{\eta_{FO}} \cdot EF_{CO2,FO} \quad (D.1\text{-}4)$$

where $HS_{BBH,y}$ is the heat production in the new biofuel boiler house over the year *y*, GJ;

η_{FO} is the efficiency factor of the boilers of the old hot water boiler house, %;

$EF_{CO2,FO}$ is the factor of CO_2 emission from combustion of heavy fuel oil, tCO_2e/GJ.

Numerical value of $BE_{BWW,dump,y}$ is determined using the model "Calculation of CO_2-equivalent emission reductions from biomass prevented from stockpiling or taken from stockpiles" developed by BTG biomass technology group B.V. based on [R5]:

$$BE_{BWW,y} = \left(1 - w_{lignin,BWW}\right) \cdot k_{BWW} \cdot \frac{C^d_{BWW}}{100} \cdot \left(1 - \frac{M_{BWW}}{100}\right) \cdot a \cdot \zeta \cdot \left(1 - \frac{\varphi}{100}\right) \times \\ \times \left(1 - \zeta_{OX}\right) \cdot \frac{V_m}{100} \cdot \rho_{CH4} \cdot GWP_{CH4} \cdot \sum_{x=2001}^{x=y} \left(BWW_x \cdot e^{-k_{BWW} \cdot (y-x)}\right), \qquad \text{(D.1-5)}$$

where BWW_x is the quantity of BWW disposed to dumps under the baseline scenario (combustion under the project) over the year *x*, t;

$w_{lignin,BWW}$ is the lignin fraction of C for BWW;

k_{BWW} is the decomposition rate constant for BWW, year $^{-1}$;

C^d_{BWW} is the organic carbon content in BWW on dry basis, %;

M_{BWW} is the moisture content of BWW, %;

a is the conversion factor from kg carbon to landfill gas quantity, m^3/kg carbon;

ζ is the generation factor;

φ is the percentage of the stockpile under aerobic conditions, %;

ζ_{OX} is the methane oxidation factor;

V_m is the methane concentration in biogas, %;

ρ_{CH4} is the density of methane, kg/m^3;

GWP_{CH4} is the global warming potential of methane, tCO_2e/tCH_4;

y is the year for which to calculate the CO_2-equivalent reduction, year;

x is the year in which fresh biomass is utilized instead of stockpiled, year (since 2003).

$$BWW_x = \frac{100 \cdot HS_{BBH,x}}{\eta_{BBH} \cdot NCV_{BWW}}, \qquad \text{(D.1-6)}$$

where η_{BBH} is the efficiency factor of biofuel boilers of the new boiler house;

NCV_{BWW} is the net calorific value of BWW, GJ/t.

The quantities of BWW disposed to dumps under the baseline scenario (combustion of BWW in the new boiler house) for the period from 2003 to 2010 have been already determined based on actual data (See Table B.1-3).

D.2. Data to be monitored:

Data and parameters to be monitored over the crediting period:

Data/Parameter	$HS_{BBH,y}$
Data unit	GJ
Description	Production of heat in the new biofuel boiler house over the year *y*
Time of determination/monitoring	Continuously
Source of data (to be) used	Chief Power Engineer Department
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Determined based on readings of the heat meter
QA/QC procedures (to be) applied	Subject to regular verification in accordance with the schedule and procedure for verification of instrumentation and control equipment approved at the Plant
Any comment	-

Data and parameters assumed as constant over the crediting period:

Data/Parameter	η_{FO}
Data unit	%
Description	Efficiency factor of heavy fuel oil boilers of the old hot water boiler house
Time of determination/monitoring	March 2011
Source of data (to be) used	Methodological tool to determine the baseline efficiency of thermal or electric energy generation systems. Version 01. CDM Executive Board. Table 1 [R7].
Value of data applied (for ex ante calculations/determinations)	85
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value for old heavy fuel oil boilers
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Data/Parameter	η_{BBH}
Data unit	%
Description	Efficiency factor of biofuel boilers of the new boiler house
Time of	March 2011

determination/monitoring	
Source of data (to be) used	UR-FRR-6000 utilizing energy boilers test report, OJSC “Solombala SWP”, Arkhangelsk, 2002 [R2]
Value of data applied (for ex ante calculations/determinations)	86.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	During tests the efficiency of boilers varied in the range of 84.16 to 86.59%. The highest value is assumed in calculations. This is conservative.
QA/QC procedures (to be) applied	Not required
Any comment	-

Data/Parameter	NCV_{BWW}
Data unit	GJ/t
Description	Net calorific value of BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	UR-FRR-6000 utilizing energy boilers test report, OJSC “Solombala SWP”, Arkhangelsk, 2002 [R2]
Value of data applied (for ex ante calculations/determinations)	7.54
Justification of the choice of data or description of measurement methods and procedures (to be) applied	During tests the fuel moisture varied between 50.55 and 61.74 %. The net calorific value in this case changed invertedly from 7.54 to 5.90 GJ/t (1.8 – 1.41 Gcal/t). Due to the variability of fuel moisture content we assumed a constant value of 50% and the respective calorific value in our calculations. This combination of moisture/calorific value gives the most conservative result of GHG emission reduction calculations.
QA/QC procedures (to be) applied	Not required
Any comment	-

Data/Parameter	$EF_{CO2,FO}$
Data unit	tCO_2e/GJ
Description	CO_2 emission factor for heavy fuel oil
Time of determination/monitoring	March 2011
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 2, Table 2.2. [R8]
Value of data applied (for ex ante calculations/determinations)	0.0774
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Default value

QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Data/Parameter	$EF_{CH4,BWW}$.
Data unit	tCH_4/TJ
Description	CH_4 emission factor for BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 2, Table 2.2. [R8]
Value of data applied (for ex ante calculations/determinations)	0.03
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Default value
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Data/Parameter	$EF_{N2O,BWW}$.
Data unit	tN_2O/TJ
Description	N_2O emission factor for heavy fuel oil
Time of determination/monitoring	March 2011
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 2, Table 2.2. [R8]
Value of data applied (for ex ante calculations/determinations)	0.004
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Default value
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Data/Parameter	GWP_{N2O}
Data unit	tCO_2e/tN_2O
Description	The Global Warming Potential for N_2O
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 12 [R5]
Value of data applied	310

(for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	$w_{lignin,BWW}$
Data unit	-
Description	Lignin fraction of C for BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 43 [R5]
Value of data applied (for ex ante calculations/determinations)	0.25
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Determined based on reference data
Any comment	-

Data/Parameter	k_{BWW}
Data unit	year^{-1}
Description	Decomposition rate constant for BWW
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 42-43 [R5]
Value of data applied (for ex ante calculations/determinations)	0.0462
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Calculated by the formula: $k_{BWW} = -\ln\left(\frac{1}{2}\right)/15$
QA/QC procedures (to be) applied	Based on reference data
Any comment	15 – recommended default value for the half period of wood, years

Data/Parameter	C^{d}_{BWW}

Data unit	%
Description	Organic carbon content in BWW on dry basis
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 43 [R5]
Value of data applied (for ex ante calculations/determinations)	53.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value recalculated on a dry basis
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	M_{BWW}
Data unit	%
Description	BWW moisture
Time of determination/monitoring	March 2011
Source of data (to be) used	UR-FRR-6000 utilizing energy boilers test report, OJSC "Solombala SWP", Arkhangelsk, 2002 [R2]
Value of data applied (for ex ante calculations/determinations)	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	During test the fuel moisture content varied between 50.55 and 61.74 %. The net calorific value in this case changed invertedly: from 7.54 to 5.90 GJ/t (1.8 – 1.41 Gcal/t). Due to the variability of fuel moisture content we assumed a constant value of 50% and the respective calorific value in our calculations. This combination of moisture/calorific value gives the most conservative result of GHG emission reduction calculations.
QA/QC procedures (to be) applied	Not required
Any comment	-

Data/Parameter	a
Data unit	m^3/kg carbon
Description	Conversion factor from kg carbon to landfill gas quantity
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 24 [R5]
Value of data applied (for ex ante calculations/determinations)	1.87
Justification of the choice of data or description of	Calculated by the formula: $a = 22.4/12$

measurement methods and procedures (to be) applied	
QA/QC procedures (to be) applied	Based on reference data
Any comment	22.4 – is the molar volume of gas at standard conditions, l/mol; 12 – molar mass of C, g/mol.

Data/Parameter	ζ
Data unit	-
Description	Generation factor
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 41 [R5]
Value of data applied (for ex ante calculations/determinations)	0.77
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	φ
Data unit	%
Description	Percentage of the stockpile under aerobic conditions
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 80 [R5]
Value of data applied (for ex ante calculations/determinations)	10
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	ζ_{OX}
Data unit	-
Description	Methane oxidation factor
Time of determination/monitoring	March 2011

Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 43 [R5]
Value of data applied (for ex ante calculations/determinations)	0.10
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	V_m
Data unit	%
Description	Methane concentration biogas
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 41 [R5]
Value of data applied (for ex ante calculations/determinations)	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value 60%. A more conservative value (50%) was assumed for calculations.
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

Data/Parameter	ρ_{CH4}
Data unit	kg/m^3
Description	Methane density
Time of determination/monitoring	March 2011
Source of data (to be) used	Methodological tool to determine project emissions from flaring gases containing methane. CDM Executive Board. Table 1. [R10]
Value of data applied (for ex ante calculations/determinations)	0.716
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference value of methane density at normal conditions
QA/QC procedures (to be) applied	Based on reference data

Any comment	-

Data/Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	The Global Warming Potential for methane
Time of determination/monitoring	March 2011
Source of data (to be) used	Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. Page 12 [R5]
Value of data applied (for ex ante calculations/determinations)	21
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recommended default value
QA/QC procedures (to be) applied	Based on reference data
Any comment	-

D.3. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, and why such procedures are necessary.
Heat production in the new biofuel boiler house	Low	To determine heat production volumes a KM-5 electromagnetic heat meter is used. Serial number 011149. The primary instruments are: - flow transducers. Supply pipe – KM module, serial number B1-200-96; return pipe – PPS module, serial number B1-40-840. - platinum resistive temperature transducers. KTPTR-01 type; - pressure transducer, type IPN-Du-1.6 MPa. Heat meter is subject to regular verification in accordance with the adopted schedule and procedure for verification of instrumentation and control equipment

Actions undertaken during verification of measuring devices

Verification of measuring devices is carried out during scheduled shutdowns of the equipment. If necessary the removed measuring device is replaced with a standby calibrated measuring device. Operation of equipment without instrumentation and control equipment is not permitted.

Emergency monitoring procedures

In case of emergency situations that affect the project monitoring system (equipment breakdown, failure of measuring devices) specialists of SSWP and CCGS shall analyze the situation and develop alternative monitoring and measuring schemes for the duration of such situations as well as corrective actions for equipment and/or monitoring plan.

If any measuring device fails the parameter shall be monitored by a duplicate device, if there is no duplicate device the failing equipment is replaced with a standby calibrated one. Operation of equipment without control and instrumentation equipment is not permitted.

Cross-check

Primary data are verified by cross checking various sources that keep the record of these data.

The monitoring reports are checked by specialists of both Solombala SWP and CCGS.

In CCGS the project monitoring report is checked by the Director of the Project Implementation Department or, on his instructions, by a specialist of the same Department who is not directly involved in preparation of this report.

Additionally, the monitoring report is double-checked by the Director of the Project Development Department of CCGS or, on his instructions, by another specialist of this Department.

As soon as all comments made by the Project Development Department are closed, the monitoring report is submitted for internal check out to the company that implements the project.

Internal verification

Internal verification by the company includes checking primary data provided to CCGS during information collection period as well as checking the project monitoring reports.

Test verifications

Regularly, but not less than once per year, specialists of CCGS shall carry out test verifications with a view to verifying the observance of the monitoring plan.

D.4. Brief description of the operational and management structure that will be applied in implementing the monitoring plan:

Information transfer

The initial request for input monitoring data is made by the Director of the Project Implementation Department of CCGS LLC to the Chief Power Engineer of OJSC “Solombala SWP”, who in his turn gives instructions to collect the required data at the plant. There are a number of people (working group) at the plant who are responsible for collection, control and transfer of monitoring data. The responsibility of these persons is stipulated in corresponding orders.

The information collected at the plant is transferred to the Director of the Project Implementation Department of CCGS LLC. All information is transferred via email.

Based on the received data, the Project Implementation Department of CCGS LLC prepares a project monitoring report and submits it for additional cross-check to the Project Development Department of CCGS LLC. As soon as all comments made by the Project Development Department have been incorporated, the project monitoring report is transferred to the company where the project is implemented.

At CCGS LLC the procedures for checking the project monitoring reports are laid out in the “CCGS LLC’s internal regulation on the procedure for quality control of the project documentation and monitoring reports developed for GHG emission reduction projects”.

After checking and making all necessary corrections to the report, the Director of the Project Implementation Department at CCGS LLC shall inform the Chief Power Engineer of OJSC “Solombala SWP” about the preliminary monitoring results and if there are no objections on his part, the General

Director of CCGS LLC makes a final decision to submit the project monitoring report for verification to an independent auditor.

Registration and collection of monitoring data

The information required for calculation of GHG emission reductions is collected in accordance with the procedures for resources monitoring and accounting adopted at the company.

The location of the monitoring points is shown in Fig. D.4-1.

The procedure for collection and transfer of information necessary for fulfilment of the project monitoring plan is shown in Fig. D.4-2.

The GHG emission reductions are calculated at the end of each reporting period by CCGS LLC specialists.

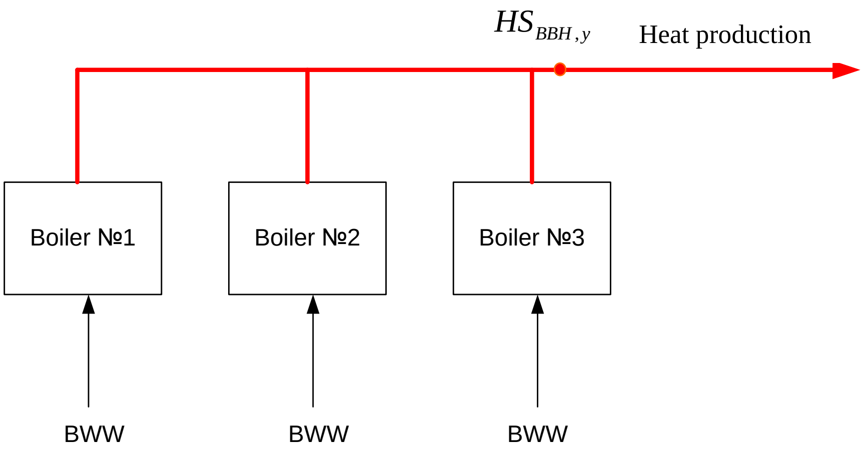

Fig. D.4-1. Location of monitoring points

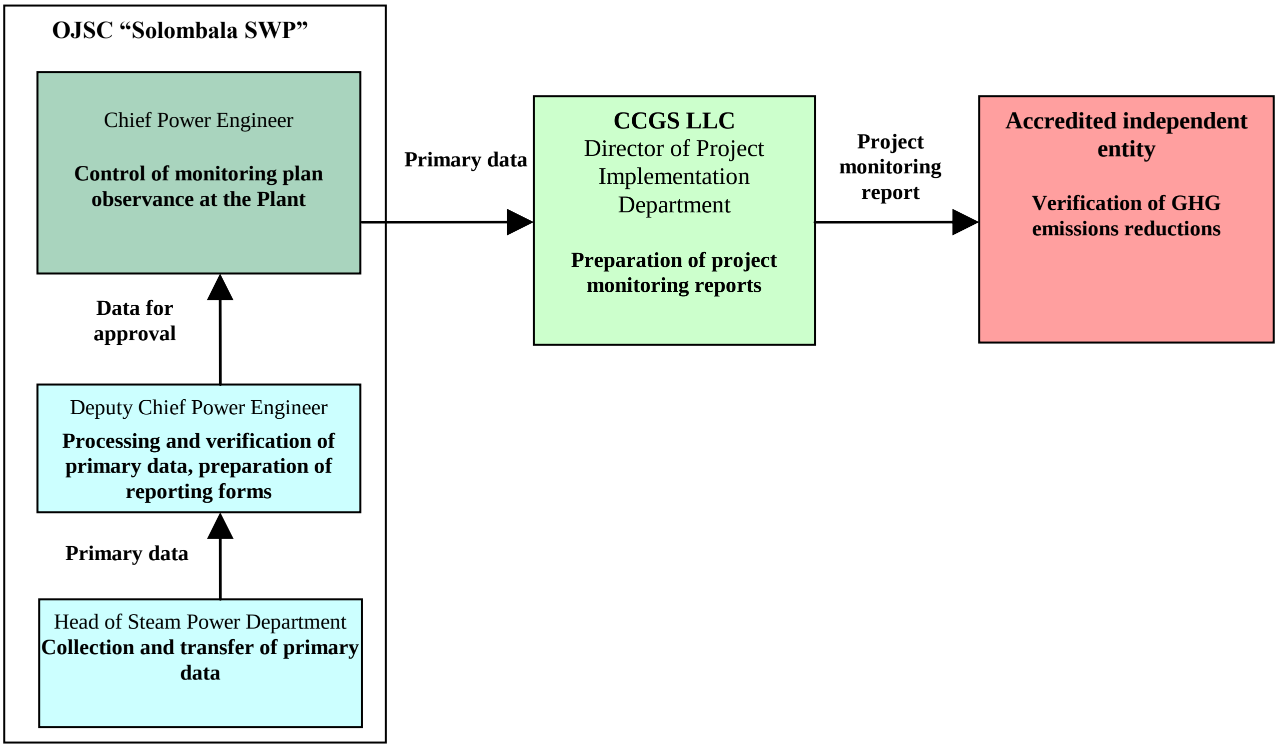

Fig. D.4-2. Collection and transfer of monitoring information

D.5. Name of person(s)/entity(ies) establishing the monitoring plan:

The monitoring plan was developed by CCGS LLC

Contact person: Egor Ershov

E-mail: e.ershov@ccgs.ru

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions and formulae used in the estimation:

The project emissions over the year *y* are determined as follows:

$$PE_y = \frac{100 \cdot HS_{BBH,y}}{\eta_{BBH}} \cdot \left(EF_{CH4,BWW} \cdot GWP_{CH4} + EF_{N2O,BWW} \cdot GWP_{N2O} \right), \quad \text{(E.1-1)}$$

where $HS_{BBH,y}$ is the heat production in the new biofuel boiler house over the year *y*, GJ;

η_{BBH} is the efficiency factor of biofuel boilers of the new boiler house. In accordance with [R2]: η_{BBH} = 86.6%;

$EF_{CH4,BWW}$. is the CH_4 emission factor for BWW, tCH_4/TJ. In accordance with [R8]:

$EF_{CH4,BWW}$ = 0.030 tCH_4/TJ;

GWP_{CH4} is the global warming potential of CH_4, tCO_2e/tCH_4. In accordance with [R5]:

GWP_{CH4} = 21 tCO_2e/tCH_4;

$EF_{N2O,BWW}$ is the N_2O emission factor for BWW, tN_2O /TJ. In accordance with [R8]:

$EF_{N2O,BWW}$ = 0.004 tN_2O/TJ;

GWP_{N2O} is the global warming potential of N_2O, tCO_2e /tN_2O. In accordance with [R5]:

GWP_{N2O} = 310 tCO_2e/tN_2O.

Table E.1-1. GHG emissions under the project scenario, tCO_2e

Name	Reporting years					2008-2012
	2008	2009	2010	2011	2012	
CH_4 due to BWW combustion	144	108	134	213	213	813
N_2O due to BWW combustion	283	213	264	420	420	1 600
Total project GHG emissions	**427**	**322**	**398**	**633**	**633**	**2412**

E.2. Estimated leakage and formulae used in the estimation, if applicable:

Leakage is considered to be zero.

E.3. Sum of E.1. and E.2.:

Since leakage can be neglected then: E.1 + E.2 = E.1.

E.4. Estimated baseline emissions and formulae used in the estimation:

The baseline emissions over the year *y* are determined as follows:

$$BE_y = BE_{FO,y} + BE_{BWW,dump,y}, \quad \text{(E.4-1)}$$

where BE_y is the baseline emissions over the year *y*, tCO_2e;

$BE_{FO,y}$ is the CO_2 emissions from heavy fuel oil combustion in the old hot water boiler house under the baseline scenario over the year y, tCO_2e;

$BE_{BWW,dump,y}$ is the CH_4 emissions due to BWW decay at the dump under the baseline scenario over the year *y*, tCO_2e.

Emissions of CH_4 and N_2O due to fossil fuel combustion are considered to be negligibly small.

CO_2 emissions from heavy fuel oil combustion in the old boiler house for production of heat supplied to the industrial site No.2 under the baseline scenario over the year *y* are determined as follows:

$$BE_{FO,y} = \frac{100 \cdot HS_{BBH,y}}{\eta_{FO}} \cdot EF_{CO2,FO}, \qquad \text{(E.4-2)}$$

where $HS_{BBH,y}$ is the heat production in the new biofuel boiler house over the year *y*, GJ;

η_{FO} is the efficiency factor of heavy fuel oil boilers of the old hot water boiler house, %;

$EF_{CO2,FO}$ is the CO_2 emission factor for heavy fuel oil combustion, tCO_2e/GJ.

The efficiency factor of heavy fuel oil boilers according to [R7], Table 1, is assumed to be η_{FO} = 85%.

CO_2 emission factor for heavy fuel oil combustion according to [R8], Volume 2, Chapter 2, Table 2.2, is assumed to be $EF_{CO2,FO}$ = 0.0774 tCO_2e/GJ.

Data on heat production in the new biofuel boiler house are given in Table B.1-1.

Numerical estimation of prevented methane emissions from dumps due to anaerobic decay of wood wastes was made using the model "Calculation of CO_2-equivalent emission reductions from biomass prevented from stockpiling or taken from stockpiles" developed by BTG biomass technology group B.V. for the World Bank [R5]. The model is built on the First Order Decay method with experimental adjustment of a number of parameters for waste wood dumps.

CH_4 emissions from wood waste decay at dumps under the baseline scenario during the year *y* are determined as follows:

$$BE_{BWW,y} = \left(1 - w_{lignin,BWW}\right) \cdot k_{BWW} \cdot \frac{C^d_{BWW}}{100} \cdot \left(1 - \frac{M_{BWW}}{100}\right) \cdot a \cdot \zeta \cdot \left(1 - \frac{\varphi}{100}\right) \times$$
$$\times \left(1 - \zeta_{OX}\right) \cdot \frac{V_m}{100} \cdot \rho_{CH4} \cdot GWP_{CH4} \cdot \sum_{x=2001}^{x=y} \left(BWW_x \cdot e^{-k_{BWW} \cdot (y-x)}\right), \qquad \text{(E.4-3)}$$

where BWW_x is the baseline BWW disposed to dumps (combusted under the project) over the year *x*, t;

$w_{lignin,BWW}$ is the lignin fraction in C (carbon) for bark and wood wastes;

k_{BWW} is the decomposition rate constant for bark and wood wastes, $year^{-1}$;

C^d_{BWW} is the the organic carbon content in BWW on dry basis, %;

M_{BWW} is the moisture content of BWW, %;

a is the conversion factor for kg carbon to volume of biogas, m^3/kg carbon;

ζ is the generation factor;

φ is the percentage of the stockpile under aerobic conditions, %;

ζ_{OX} is the methane oxidation factor;

V_m is the methane concentration biogas, %;

ρ_{CH4} is the density of methane, kg/m^3;

GWP_{CH4} is the Global Warming Potential for methane, tCO_2e/tCH_4;

y is the year for which to calculate the CO_2-equivalent reduction, year;

x is the year in which fresh biomass is utilized instead of stockpiled, year.

$$BWW_x = \frac{100 \cdot HS_{BBH,x}}{\eta_{BBH} \cdot NCV_{BWW}}, \qquad (E.4\text{-}4)$$

where η_{BBH} is the efficiency factor of biofuel boilers of the new boiler house;

NCV_{BWW} is the net calorific value of BWW, GJ/t.

The efficiency factor of biofuel boilers of the new boiler house according to [R2] is assumed to be η_{BBH} = 86.6%.

Net calorific value of BWW according to [R2] is assumed to be NCV_{BWW} = 7.54 GJ/t.

Data on the quantity of stockpiled BWW under the baseline scenario (BWW combusted in the new boiler house) for the period from 2003 to 2012 are given in Table B.1-3.

Constant input values for methane emission reduction estimation in the given model are as follows:

1. *Lignin fraction in C (carbon).* For bark and wood wastes we assumed the default value recommended by [R5]: $w_{lignin,BWW}$ = 0.25.
2. *Decomposition rate constant*. For bark and wood wastes we assumed the default value recommended by [R5]: k_{BWW} = -ln(1/2)/15 = 0.0462 year^{-1}, where 15 is the recommended default value for half-period of wood, years.
3. *Organic carbon content on dry basis*. We assumed the default value recommended by [R5]: C^d_{BWW} = 53.6%;
4. *Moisture of wood wastes*. We assumed the default value [R5]: M_{BWW} = 50%;
5. *Conversion factor for kg carbon to volume of biogas*. We assumed the default value recommended by [R5]: a = 22.4/12 = 1.87 m^3/kg carbon, where 22.4 is the molar volume of gas at normal conditions, l/mol; 12 is the molar mass of C, g/mol.
6. *Generation factor*. We assumed the default value recommended by [R5]: ζ = 0.77.
7. *Percentage of the stockpile under aerobic conditions*. We assumed the default value recommended by [R5]: φ = 10%.
8. *Methane oxidation factor*. We assumed the default value recommended by [R5]: ζ_{OX} = 0.10.
9. *Methane concentration biogas*. The default value recommended by [R5] is: V_m = 60%, for the purpose of conservatism we assumed V_m = 50%.
10. *Density of methane*. According to [R10], Table 1, we assumed: ρ_{CH4} = 0.716 kg/m^3.
11. *Global Warming Potential for methane*. We assumed the default value recommended by [R5]: GWP_{CH4} = 21 tCO_2e/tCH_4.

12. *Year for which to calculate the CO_2-equivalent reduction.* We assumed: *y* = 2008-2012.
13. *Year in which fresh biomass is utilized instead of stockpiled*. We assumed: *x* = 2003-2012.

The baseline emission calculation results are given in Table E.4-1 and Annex 2-2.

Table E.4-1. GHG emissions under the baseline scenario, tCO_2e

Name	Reporting years					2008-2012
	2008	2009	2010	2011	2012	
CO_2 due to heavy fuel oil combustion	18 002	13 574	16 773	26 688	26 688	101 726
CH_4 due to decay of wood wastes at dumps	13 894	15 126	16 742	19 643	22 413	87 818
Total baseline GHG emissions	**31 896**	**28 701**	**33 514**	**46 331**	**49 102**	**189 545**

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

The results of GHG emission reduction estimation are given in Table E.5-1.

Table E.5-1. GHG emission reductions, tCO_2e

Name	Reporting years					2008-2012
	2008	2009	2010	2011	2012	
Total baseline GHG emission reductions	**31 469**	**28 379**	**33 117**	**45 699**	**48 469**	**187 132**

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	427	0	31 896	31 469
2009	322	0	28 701	28 379
2010	398	0	33 514	33 117
2011	633	0	46 331	45 699
2012	633	0	49 102	48 469
Total (tonnes of CO_2 equivalent)	2412	0	189 545	187 132

SECTION F. Environmental impacts

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

The environmental impact of the project was analysed in accordance with the laws and regulations of the Russian Federation within the framework of the design documentation development [R1]. The following conclusions were made:

- environmental impact of the project activity is within the permissible limits;
- additional impact on the air in terms of air pollutions is insignificant;
- project measures ensure against the danger of surface and subsurface water pollution and land contamination in the area where the boiler house is located;
- impact upon soil during operation of the boiler house is minimized.

The following approval documents were obtained:

- Positive review of the State Environmental Appraisal Committee No.520 dated July 26, 2002 for the preliminary design documentation, containing an executive summary and environmental justification;
- Positive review of the State Environmental Appraisal Committee No.658 dated September 23, 2002 for the design documentation, containing an executive summary and corrected specification of maximum permissible emissions.

Table F.1. Changes in pollutant emissions before and after the project implementation

Pollutants	**Pollutant emission volume, t/year**	
	Reduction in emissions	**Increase in emissions**
Carbon oxide (CO)	-	69.704
Nitrogen dioxide	13.665	-
Nitrogen oxide	2.125	-
Suspended matter	-	12.845
Benzpyrene	-	0.000178
Wood ash	-	42.739
Sulphur dioxide (SO_2)	228.754	-
Saturated hydrocarbons (C12-C19)	0.03574	-
Hydrogen sulphide	0.0001724	-
Heavy fuel oil ash	0.418	-
Total reduction for the plant	**119.709**	

The pollutant emission pattern from 2002 to 2004 shows that upon commissioning of the biofuel boiler house in 2003 sulphur dioxide has not been detected in the course of instrumental survey by accredited laboratory (SLAM MPR in Arkhangelsk Region), and apart from that emissions of nitrogen oxides decreased significantly. Emissions of some pollutants, on the other hand, increased. For example, emissions of suspended matter increased. This is due to the fact that the boiler house runs on wood wastes which causes higher ash content in emissions and it explains the increase in suspended matter content in emissions. The plant has a maximum permissible emissions standard, and an emission permit is in place. A specialized accredited laboratory carries out industrial environmental monitoring of pollutant emissions on an annual basis.

Apart from reduction in pollutant emissions, generated ash and slag wastes can be used in agriculture to improve soil fertility. An expert opinion was obtained which states the possibility and feasibility of using ash from the boiler house to improve soil fertility.

Environmental benefits from BWW-fired boiler house operation:

1. Significant reduction in pollutant emissions at the plant on the whole. Reduction in pollutant emissions amounts to over 100 tonnes per year;
2. Generated ash and slag wastes can be sold to local residents to be used in agriculture to improve soil fertility;
3. Operation of the boiler house enables the plant to stop disposing bark at the dump which improves environmental, sanitary and epidemiological situation in Arkhangelsk.

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

The project has a positive expert review of the State Environmental Expert Commission No.658 dated September 23, 2002.

The project does not have significant environmental impact. The level of environmental impact during operation and execution of works will be permissible, provided that the environmental protection measures are implemented; the sustainability of ecosystems will not be disturbed.

Besides the project reduces methane emissions due to decay of wood wastes at dumps, as well as to decrease in combustion of fossil fuel and therefore to reduction in pollutant and GHG emissions.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

Comments on the project were obtained from local and federal authorities in the form of positive opinions of state expert reviews, permits and favourable opinions:

- Act of acceptance of completed construction dated 16.12.2002;
- Opinion of the Head of the Northern District Administration of Arkhangelsk about the project dated 16.05.2005;
- Opinion of the Chief State Health Inspector of Arkhangelsk about the project dated 02.10.2001;
- Positive review of the State Environmental Appraisal Committee No.520 dated July 26, 2002 for the preliminary design documentation, containing an executive summary and environmental justification;
- Positive review of the State Environmental Appraisal Committee No.658 dated September 23, 2002 for the design documentation, containing an executive summary and corrected specification of maximum permissible emissions.

These documents confirm that the project complies with the requirements of technical regulations, industrial safety standards, environmental and sanitary requirements, and serves to improve the environment in the city, as well as brings social benefits.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Open Joint Stock Company “Solombala Sawmill And Woodworking Plant”
Street/P.O.Box:	Dobrolyubov st.
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State/Region:	
Postal code:	163012
Country:	Russian Federation
Phone:	+7 (8182) 678455
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E-mail:	sldk@sldk.ru
URL:	http://www.solombala.com/sldk/
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Trifonov
Middle name:	Ivanovich
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Annex 2

BASELINE INFORMATION

Annex 2-1. Calculation of prevented methane emissions from anaerobic decay of wood wastes at the dump

Calculation of CO_2-equivalent emission reduction from BWW prevented from stockpiling or taken from stockpiles

General input data		
Conversion factor organic carbon to biogas (a)	1,87	m^3 biogas/kg carbon
GWP CH_4	21	
Density methane	0,716	kg/m^3
Methane concentration biogas	50%	
Half-life biomass (tau)	15	year
Decomposition constant (k)	0,0462	$year^{-1}$
Generation factor (zeta)	0,77	
Methane oxidation factor	0,10	
Percentage of the stockpile under aerobic conditions	10%	

LEGEND
BWW - bark wood waste
db = dry basis
wb = wet basis
yellow cells = unprotected cells
red marks = comment field included

This spreadsheet model is based on the report:
"Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles",
Worldbank PCFplus research, August 2002
Spreadsheet model developed by:

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Biomass specific input data	Biomass from stockpile	Fresh	
Organic carbon content (db)	50,0%	53,6%	db
Moisture content	50%	50%	wb
Organic carbon content (wb)	25,0%	26,8%	wb
Lignin fraction of C	0,25	0,25	

Year	Fresh biomass prevented from stockpiling or taken from: Biomass from stockpile (ton$_w$)	Age of biomass (years)	Fresh (ton$_w$)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
				ton CO2-eq									
2003			31 509	2 566	2 450	2 340	2 234	2 133	2 037	1 945	1 857	1 773	1 693
2004			36 746		2 993	2 858	2 728	2 605	2 488	2 375	2 268	2 166	2 068
2005			33 798			2 753	2 628	2 510	2 396	2 288	2 185	2 086	1 992
2006			30 562				2 489	2 377	2 269	2 167	2 069	1 976	1 886
2007			28 763					2 342	2 237	2 136	2 039	1 947	1 859
2008			30 291						2 467	2 356	2 249	2 148	2 051
2009			22 841							1 860	1 776	1 696	1 619
2010			28 222								2 298	2 195	2 096
2011			44 906									3 657	3 492
2012			44 906										3 657
2013													
2014													
2015													
2016													
2017													
2018													
Total	**0**		**332 544**										
Total emission prevention				**2 566**	**5 443**	**7 950**	**10 080**	**11 967**	**13 894**	**15 126**	**16 742**	**19 643**	**22 413**
Cumulative total emission prevention				**2 566**	**8 009**	**15 959**	**26 039**	**38 006**	**51 900**	**67 026**	**83 768**	**103 411**	**125 824**

87 818

Annex 2-2. Calculation of cash flows of the investment project for two implementation options

Input data

Parameter	Unit	Value
Discount	%	20
Profit tax	%	35
Property tax	%	1,8
Service life	years	20
Price of heavy fuel oil	RUR/t	2000
Price of early emissions	RUR/tCO2e	90,0
Price of ERU	RUR/tCO2e	300,0
Heat supply	Gcal/year	60 000
Heavy fuel oil boiler efficiency		0,85
NCV of heavy fuel oil	Gcal/t	9,59
Fuel oil CO2 emission factor	kg CO2/GJ	77,4

Parameter	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Reduction in heavy fuel oil consumption	t		7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361	7 361

Total revenue from project implementation

Parameter	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Reduction in heavy fuel oil costs	thousand RUR		14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721	14 721

Capital investments

Parameter	Unit	2001
Capital expenditure	thousand RUR	**-58 000**

Depreciation

Parameter	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Depreciation charges	thousand RUR	0	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900	-2 900
Fixed assets value	thousand RUR	58 000	55 100	52 200	49 300	46 400	43 500	40 600	37 700	34 800	31 900	29 000	26 100	23 200	20 300	17 400	14 500	11 600	8 700	5 800	2 900

Taxes

Parameter	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Property tax	thousand RUR		-1 017,90	-965,70	-913,50	-861,30	-809,10	-756,90	-704,70	-652,50	-600,30	-548,10	-495,90	-443,70	-391,50	-339,30	-287,10	-234,90	-182,70	-130,50	-78,30
Profit tax	thousand RUR		-3 781,16	-3 799,43	-3 817,70	-3 835,97	-3 854,24	-3 872,51	-3 890,78	-3 909,05	-3 927,32	-3 945,59	-3 963,86	-3 982,13	-4 000,40	-4 018,67	-4 036,94	-4 055,21	-4 073,48	-4 091,75	-4 110,02

Economic parameters without sale of GHG emission reductions

Parameter	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Net cash flow	thousand RUR	-58 000	9 922	9 956	9 990	10 024	10 058	10 092	10 126	10 160	10 194	10 228	10 261	10 295	10 329	10 363	10 397	10 431	10 465	10 499	13 433
Accumulated cash flow	thousand RUR	-58 000	-48 078	-38 122	-28 132	-18 108	-8 050	2 042	12 168	22 327	32 521	42 748	53 010	63 305	73 635	83 998	94 395	104 826	115 291	125 790	139 223

NPV	thousand RUR	**-9 131**
IRR	**%**	**16,48%**

Economic parameters with sale of GHG emission reductions

Parameter	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Amount of GHG ERs	tCO2e		22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876	22876
Revenue from sale of GHG ERs	thousand RUR		2 059	2 059	2 059	2 059	2 059	2 059	6 863	6 863	6 863	6 863	6 863								
Net cash flow	thousand RUR	-58 000	11 981	12 015	12 049	12 083	12 117	12 151	16 988	17 022	17 056	17 090	17 124	10 295	10 329	10 363	10 397	10 431	10 465	10 499	13 433
Accumulated cash flow	thousand RUR	-58 000	-46 019	-34 004	-21 955	-9 873	2 244	14 395	31 383	48 406	65 462	82 552	99 676	109 972	120 301	130 664	141 062	151 493	161 958	172 457	185 890

NPV	thousand RUR	**4 590**
IRR	**%**	**21,69%**

Annex 3

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