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

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Annexes

SECTION A. General description of the small-scale project

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

Pellet Production from Sawmill Wastes at CJSC “Sawmill 25”, Arkhangelsk, the Russian Federation

Sectoral scope: Waste handling and disposal (13)[1].

Version: 2.1

Date: September 8, 2010

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

The aim of the project

The project is aimed at utilizing sawmill residues by pelletizing which will allow to reduce bark and wood wastes disposal to the dump and thus would cut down methane emissions. Pellets will be used as fuel mainly overseas.

Situation before the starting date of the project

Prior to the project implementation there was a big surplus of sawmill wastes at CJSC “Sawmill 25”. There was no demand for excessive wastes and therefore they had to be disposed to the dump. Generally, disposal of such unclaimed wastes to the dumps is common practice at all sawmills of the Arkhangelsk Region and it suits them. That is why one can find vast areas of bark and sawdust disposal sites in the neighborhood of any sawmill.

The baseline scenario

Under the baseline scenario the company would continue with the existing practice of disposal of excessive sawmill wastes to the dump. Anaerobic decomposition of wastes at the dump would have been accompanied by release of methane into atmosphere – a greenhouse gas with global warming potential of 21.

The project scenario

The project scenario involves setting up a plant for pellet production from sawmill residues at CJSC “Sawmill 25”. The feedstock and fuel for this plant are sawdust and bark-wood waste (BWW) generated at the Mill.

The initial rated plant capacity (first stage of the project) was 50 thousand tonnes of pellets per year. In May 2008 the output of products began. The investments into the plant totaled EUR 7 million. The main suppliers of the equipment were Andritz and Hekotek companies.

In February 2010 the rated output capacity of the plant (second stage of the project) increased up to 75 thousand tonnes of pellets per year by setting up an additional production line. This required additional investments in the amount of EUR 2.33 million.

Heat demand of the pellet production plant is met by the heat generators installed at the plant itself and by the mini-CHP plant, both of which are running on BWW only. Electricity is supplied from the mini-CHP plant operated by the Sawmill and/or from the external power grid.

Fuel pellet production will make it possible to reclaim up to 180 thousand tonnes of sawdust and BWW per year. Without the project these wastes would have been disposed to the dump causing methane emissions produced from anaerobic decay. The greenhouse gas emission reductions over 2008-2012 are estimated at 101.8 kt CO_2e.

[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

The project background

The Sawmill's management first came up with the idea of constructing a pellet production plant in 2004. At the stage of planning, the company's management took into consideration the potential revenues from selling greenhouse gas emission reductions that could be generated by this project. Therefore the project was planned as joint implementation (JI) project in accordance with Article 6 of the Kyoto Protocol. This issue was discussed with the Environmental Investment Centre as early as 2005 [R11] and in 2008 – with CCGS LLC, the company that was finally chosen as a partner for developing all necessary documentation and selling GHG emission reductions in the international market.

The first contract for procurement of equipment for a pellet production plant was signed on June 08, 2007 [R12] (the starting date of the project). Actual product output and generation of emission reductions began in May 2008 [R13]. Officially the construction and installation works under the project with achievement of rated plant capacity of 75 thousand tonnes of pellets per year were fully completed in February 2010.

The total required investments into the project amount to around EUR 9.33 million.

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)
Party A: Russian Federation (Host Party)	Legal entity A1: Closed Joint Stock Company "Sawmill 25"	No
Party B: One of the Parties of Annex B to Kyoto Protocol	Legal entity B1: To be determined upon approval of the project	No

CJSC "Sawmill 25" is a legal entity registered in the form of a closed joint stock company, operating in accordance with the current legislation of the Russian Federation and with the Articles of Association.

The core business of CJSC "Sawmill 25" is production of export kiln-dried timber products and pulpchips. The enterprise specializes in cutting spruce and pine. The products of the company are exported to Germany, the Netherland, Ireland, Egypt, the UK, France, Algeria and sold domestically. To date the overall cutting capacity is 1 100 000 m^3/year (on the assumption of double-shift operation).

Main production capacities of CJSC "Sawmill 25" are based in Maimaksa District of Arkhangelsk. The cutting capacity is 600 000 m^3 per year. Currently the site is operating in double shift.

Additional production facilities are located in Tsiglomen District of Arkhangelsk. The cutting capacity is 500 000 m^3 per year. Currently the site is operating in one shift (approx. 240 000 m^3 per year).

Being a processor of northern wood with high environmental value, CJSC "Sawmill 25" is aware of its responsibility for environment protection and sustainable use of natural resources. In its activity and in setting development priorities it takes into account the opinion of Green Peace and WWF and closely cooperates with these organizations. CJSC "Sawmill 25" is a member of the Association of Environmentally Responsible Timber Producers of Russia.

Special attention is paid to climate change problems, sustainable forest management and voluntary certification of products in accordance with international standards in order to exclude use of illegal wood.

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

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

Location of the project: Russia, Arkhangelsk, CJSC "Sawmill 25", Maimaksa Production Site.

Fig. A.4-1. Location of Arkhangelsk

Fig. A.4-2. Location of Maimaksa Production Site at the map of Arkhangelsk

A.4.1.1. Host Party(ies):

The Russian Federation

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

The Arkhangelsk Region

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

The town of Arkhangelsk

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

Arkhangelsk is a town in the north of Russia, the administrative center of the Arkhangelsk Region.

Population: 349.8 thousand people

Geographic coordinates: latitude: 64°34'N, longitude: 40°49'E.

Time zone: GMT +3:00.

The town is located in the delta of the Northern Dvina River, 40-45 km from the influx of the river into the White Sea, 1133 km north of Moscow.

The climate is subarctic, maritime with long winters and short cold summers. It is formed under the influence of the northern seas and the air masses moving from the Atlantics and is characterized by little solar radiation. The average temperature in January is -13°C, in July — +17°. The yearly level of precipitation is 529 mm.

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

Type III: Other project activities limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually (Decision 1/CMP.2, par. 28 (c)).

Category E: Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment.[2]

This category envisages measures aimed at preventing methane emissions from biomass or other organic wastes left to decay under clearly anaerobic conditions at solid waste disposal sites without methane utilization. The projects involve controlled combustion of methane, gasification, and mechanical/thermal treatment of waste. An example is the pelletization of wood particles.

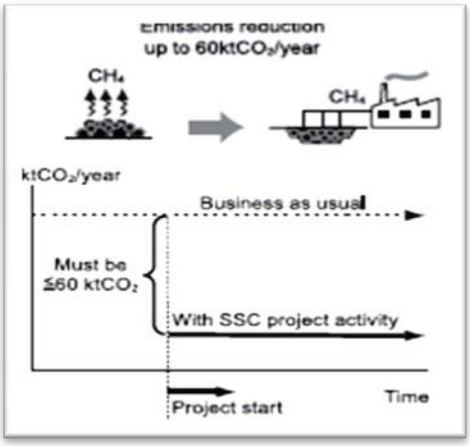

Fig. A.4-3. Type III.E

GHG emission reductions generated by the project are estimated at an average of 20 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.

[2] In accordance with the most recent list of SSC project categories approved by the Executive Board of the CDM, http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

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

The pellet production units are complete plants and ensure continuous manufacturing of saleable products (fuel wood pellets) provided that the rated operation conditions are satisfied. The equipment was supplied by Andritz and Hekotek companies. The first contract for procurement of equipment for the plant was signed on June 08, 2007.

The initial rated plant capacity (first stage of the project) was 50 thousand tonnes of pellets per year. The plant comprised two pellet production lines. Each line has the rated capacity of 25 thousand tonnes of pellets per year. In May 2008 the output of products began.

In February 2010 the rated output capacity of the plant (second stage of the project) increased up to 75 thousand tonnes of pellets per year by setting up the third production line.

The pellet production technology flow (Fig. A.4-4) consists of the following four stages:

1. Storage and preparation of feedstock;
2. Feedstock drying;
3. Additional crushing and pressing;
4. Packing and finished products shipment.

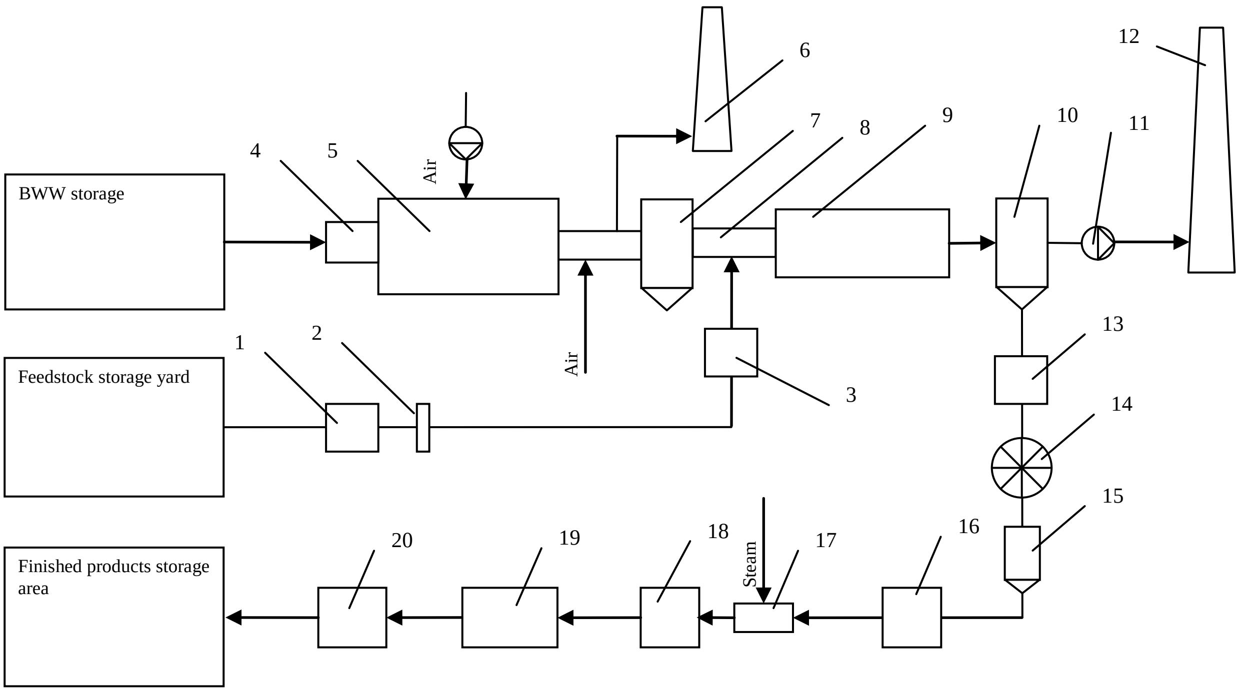

Fig. A.4-4. Schematic diagram of the pellet production process line

1- feedstock receiving bunker; 2- vibration screens; 3- proportioning bunker; 4- receiving hopper of heat generator; 5- combustion chamber; 6- chimney; 7- fly-ash collector; 8- mixing chamber; 9- drum drier; 10- dust collector; 11- smoke exhaust; 12- chimney; 13- bunker storage for dry sawdust; 14- hammer mill; 15- cyclone; 16- intermediate bunker; 17- conditioning device; 18- press; 19- cooler; 20- separator

Storage and preparation of feedstock

For continuous operation of a pellet plant it is necessary to have a four-week stock of sawdust. To this end a storage yard is arranged near the plant building. Sawdust from the storage yard is charged to the receiving bunker by a scoop loader. The feedstock from the bunker is sorted with the help of vibration screen, which separates large fractions, and then the feedstock is transported by a chain conveyor to the proportioning bunker of the drying lines. In order to ensure homogeneous composition of the feedstock and to exclude chocking-up the proportioning bunker is fitted with an electrically driven mixer. The wood feedstock from the bunker is fed by dosing screws to a mixing chamber located before the drum drier.

Feedstock drying

BWW from the fuel storage are charged to the receiving hopper of the heat generator by a scoop loader (Fig. A.4-5). Then fuel is fed by pushers to the fire-grate of the furnace chamber. Air is fed into the furnace by zones (primary and secondary air). Air is taken in from the workshop building by a rotary blower. The combustion wastes (fly ash) are removed from the furnace chamber by screws and transported to a moveable container (Fig. A.4-6).

The combustion products (hot flue gases) from the furnace chamber enter the flue duct where the gas temperature is reduced down to 500 ^{o}C due to supply of “cold” air. Thereafter the drying agent (gas-air mixture) is fed to the fly-ash collector. The flue duct which is supplying the drying agent to the ash collector is connected with an eight-meter high chimney, which is used when the heat generator is lit up and in case of emergency. When the heat generator starts to operate in normal mode, the chimney is disconnected from the flue duct by a hydraulically driven damper.

Fig. A.4-5. Heat generator

Fig. A.4-6. Fly-ash handling system

After being cleaned in the multicyclone the drying agent enters the mixing chamber where it picks up wet feedstock and transports it to the drum drier (Fig. A.4-7).

Fig. A.4-7. Drum drier

The dried feedstock is transported from the drying unit to the cyclone dust collector, where it is separated from the waste drying agent, which is fed to the 24-meter high chimney by the smoke exhaust.

Careful observance of the drying process conditions is crucial to ensure safety. For this purpose all control is computerized which helps to maintain the target sawdust moisture (10-12%) and to keep the record of the process flow.

Additional crushing and pressing

From the dust collector the sawdust is supplied to the dry sawdust storage bunker and further to the hammer mill, where it is ground to 1 mm fractions. After the mill the sawdust passes through a cyclone and with the help of a chain conveyor it is charged into the intermediate bunker. From the bunker with the help of a dosing unit the sawdust is fed to the conditioning unit where it is treated with the superheated steam and heated up to the temperature of 80°C, which facilitates the work of the press, improves the pellet quality and results in significant electricity savings.

In the press (Fig. A.4-8) sawdust is pressed through a matrix under high pressure and the finished pellets are fed by a chain conveyor and elevator to the cooler where the temperature of pellets is reduced down to the ambient temperature.

After being cooled the pellets are separated: the quality product is sent to the storage area and the off-grade product is returned to the beginning of the process flow.

The average output capacity of one pelletizing press is 3.5 tonnes of pellets per hour. Pellets moisture is less than 10%.

Fig. A.4-8. Pelletizing press

Packing and shipment of finished products

The wood pellet packing section includes:
- A big bag handling system with distribution and baling units with weighing elements;
- A system for baling of product in soft containers (baskets).

Big bags are shipped on wooden pallets with a help of an electric frame crane with lifting capacity of 1.5 tonnes.

Characteristic of big bags:

- diameter - 0.8 m;
- height – 1.82 m;
- volume – 0.6 m^3;
- lifting capacity – 0.75 t.

The two soft containers (baskets) with the holding capacity of 13 m^3 (8 t) each, installed on the vehicle deck, are loaded from the two bunkers with the total holding capacity of 140 m^3 (Fig. A.4-9). The operator connects the container to the bunker pipe from the platform fixed at the automobile deck. For ingress of motor vehicles the building has a 5.2 m wide thoroughfare.

Fig. A.4-9. Loading of pellets to the soft containers

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:

The project reductions of GHG emissions will be due to reduction of sawdust and BWW disposal to the dump where anaerobic decay takes place that leads to release of methane into the atmosphere.

It is unlikely that the project would have been implemented without the joint implementation mechanism, taking into account following circumstances:

- no GHG emission limits are set for Russian enterprises;
- financial profitability of the project without additional revenues from selling greenhouse gas emission reductions is not high enough.

In the absence of the project it could have been possible to avoid the follow risks:

- investment risks;
- production risks;
- commercial risks.

Investment risks are stipulated by the fact that actually more investments than planned could be necessary for the project implementation. It could take place due to designing mistakes, necessity to purchase additional equipment and perform unscheduled works, increase of equipment prices, installation work, adjustment and alignment, etc.

Investments into expansion and modernization of the core production, including introduction of state-of-the-art low-energy cutting and drying technologies could have ensured higher economic returns for the Sawmill at lower risks as compared with this project.

Production risks for Sawmill 25 are stipulated by:

- the risk of decrease of scheduled production volumes as a result of equipment downtime or its work with low capacity;
- the risk of increase of maintenance and repair work;
- the risk of production of granules which do not comply with the international standards.

In order to make the pellets competitive in the European market it is necessary to comply with a number of quality requirements. Each pellet consuming country has developed its own quality standard. In Germany these are DIN and DIN plus standards, in Austria – O-Norm, in Sweden – SS. These standards specify ash content, permissible factional content of bark and admixtures, and calorific value of pellets.

To comply with all these quality requirement it is necessary to strictly observe to the entire process chain of pellet production. And considering the fact that the equipment is 100% imported and fairly complicated, the foreign suppliers need to be consulted in order to solve various issues arising in the process of operation. This delays the entire problem solving process.

The Mill has never installed or operated such type of plants. The specialists of CJSC “Sawmill 25” encountered serious difficulties already at the stage of equipment installation and still continue to face challenges in the course of the plant operation.

Commercial risks are associated with sales of granules in the international market.

The main and only type of business for the enterprise is timber production. Wood pellets production was an absolutely new type of activity. Sawmill 25 has never been a fuel supplier to the international market and therefore there was a risk that it would not be able to occupy a new niche in this market. And as it was originally planned to supply pellets solely to international market, the risks were associated with the following:

- decrease of sales volumes due to reduction of demand for this production;
- landslide of prices for granules;
- toughening of competition.

Fairly high demand of pellets in Europe are being maintained by special biofuel subsidies. In case these subsidies are cancelled or reduced there is a risk that this demand would drop.

Thus, for instance, in 2006 the British government announced the shift of priorities towards using local raw materials as biofuel and thereby it slowed down the development of the industrial fuel pellet market.

In August 2006 Italy cut down the subsidies for “green electricity” which is generated by combustion of pellets produced from agricultural wastes, which challenged further growth of Italian energy producers’ demand for agro-pellets and agro-briquettes.

The most unpredictable factor of biofuel demand and price formation are weather conditions. Thus for instance in winter 2006-2007 warm weather in the Southern Europe led to some drastic consequences. Several biofuel producers in Austria and Germany found themselves on the verge of bankruptcy because the weather in Italy continued to be unusually warm till mid January and the warehouses of retail sellers were packed full with fuel.

European standards for wood pellets are very high. Without any experience of construction and operation of such sophisticated equipment there was a real risk that the required quality would not be achieved and therefore the product wouldn’t find its buyers or would be sold at a very low price.

Pellet plant of the Sawmill 25 is relatively small judging by production according to world criteria. Therefore competitive pellet plants of higher capacity (for instance, 500 000 tons of granules per year) will have advantage in the world market.

Accept risks associated with the sales of granules in the international market there were also risks associated with storage and transportation of granules as well as with force majeure.

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

	Years
Length of the crediting period	
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	1 604
2009	8 056
2010	18 579
2011	30 808
2012	42 732
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	101 779
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	20 356

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

In accordance with item 15 of the “Provisions for Joint Implementation Small-Scale Projects”, Version 03, JISC [R1], a small-scale joint implementation project can be viewed as a debundled component of a larger project, if there already is a (small-scale) joint implementation 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 has been made publicly available in accordance with paragraph 34 of the JI guidelines[3] within the previous 2 years; and
d) Whose project boundary is within 1 km of the project boundary of the proposed JI SSC project at the closest point.

[3] The Annex to Decision 9/CMP.1 referred to as JI guidelines.

It should be noted, that the large scale project "Wood waste-to-energy project at Sawmill-25 (Arkhangelsk)" was developed and published for comments in 2007 [4].

Proposed small-scale project "Pellet Production from Sawmill Wastes at CJSC "Sawmill 25" and the project "Wood waste-to-energy project at Sawmill-25 (Arkhangelsk)" are not the debundled components of a larger project because they do not meet in full to item 15 of the "Provisions for Joint Implementation Small-Scale Projects", Version 03, JISC (see Table A.4-1).

Table A.4-1. Project compliance to item 15 of the "Provisions for Joint Implementation Small-Scale Projects"

Conditions	Fulfillment of conditions (Yes/No)	Grounds
a) Which has the same project participants	No	The participants for wood waste-to-energy project are JSC "Sawmill 25" and Private company "CAMCO International". For pellet production project only first participant was determined: CJSC "Sawmill 25". The second participant will determined upon approval of the project.
b) Which applies the same technology/measure and pertains to the same project category	No	The technologies of waste-to-energy and pellet production are different.
c) Whose determination has been made publicly available in accordance with paragraph 34 of the JI guidelines within the previous 2 years	No	The wood waste-to-energy project was published at the UNFCCC website on February 22, 2007 http://ji.unfccc.int/JI_Projects/DB/YZXL9NJUWQPEABAQR5HZI652IXD6ZJ/PublicPDD/7QGCEK2I9BT7K8CQBA2XN7VG89GNRQ/view.html The pellet production project was published at the BVC website on June 17, 2010 http://www.bureau-veritas.ru/wps/wcm/connect/bv_ru/local/home/news/ghg-news-determination+sawmill+25?presentationtemplate=bv_master/news_full_story_presentation
d) Whose project boundary is within 1 km of the project boundary of the proposed JI SSC project at the closest point	Yes	Both projects are implemented partially on the same production site (Maimaksa)

[4] http://ji.unfccc.int/JI_Projects/DB/YZXL9NJUWQPEABAQR5HZI652IXD6ZJ/PublicPDD/7QGCEK2I9BT7K8CQBA2XN7VG89GNRQ/view.html

It should add also, that implementation of pellet production project has not been resulted in any decrease in waste-to-energy project activity as the BWW stockpile existed at the start of pellet production project was sufficient to provide the fuel for both activities.

Sawdust is used for pellet production only and normally could not be burned at the CHP.

A.5. Project approval by the Parties involved:

The letters of approval from the Parties will be received later.

SECTION B. Baseline

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

Choice of the approach to baseline setting

The PDD developer has chosen JI specific approach for baseline setting in accordance with paragraph 9 (a) of the "Guidance on criteria for baseline setting and monitoring", Version 02, JISC [R2].

The baseline has been established in accordance with Appendix B of the JI guidelines. Justification of the baseline has been provided in accordance with paragraph 23 through 29 of the "Guidance on criteria for baseline setting and monitoring".

The most plausible baseline scenario has been identified based on the analysis of alternatives of handling sawmill wastes that are used for pelletizing under the project. The choice of baseline has been justified taking into account Annex 1 to the "Guidance on criteria for baseline setting and monitoring".

To date the construction and installation works under the project were fully completed and right now the project is already generating physical reductions of GHG emissions. In this context it is reasonable to determine specific baseline parameters, which affect the expected level of GHG emission reductions up until 2012, taking into account available actual data on the pellet plant operation for 2008 and 2009.

All key data, factors and assumptions that affect GHG emission reductions are considered in a transparent and conservative manner.

Identification of plausible future scenarios and selection of the baseline scenario

The following alternatives of handling excessive sawmill wastes were identified:

Alternative 1: Continuation of the current situation;

Alternative 2: Use the wood wastes as a fuel for heat and power generation at the own energy sources;

Alternative 3: Use the wood wastes as the fuel for heat and power production at the Central CHP of Arkhangelsk city;

Alternative 4: Use the wood wastes as a feedstock for pulp and paper production;

Alternative 5: Use the wood wastes as a feedstock for hydrolyze plant;

Alternative 6: The project activity without the joint implementation mechanism.

Analysis of each alternative is given further below.

Alternative 1: Continuation of the current situation

This alternative implies continuation of the situation that had taken place prior to the project implementation. Excessive sawmill wastes generating at the Mill would be disposed to the dump.

This scenario is a business-as-usual for CJSC "Sawmill 25" and for other sawmills of the Arkhangelsk region too, and this practice is not in conflict with the applicable Russian law. There have been no problems with disposal of unclaimed wood wastes at the dump so far, and neither are such foreseen in the future.

This scenario does not require any investments on behalf of the enterprise and does not entail any additional expenses associated with construction and operation of an ancillary pellet production. This makes it possible to spend the investment resources on modernisation and expansion of the core plant's production capacities.

Without JI involvement the Alternative 1 can be considered as most plausible future scenario.

Alternative 2: Use the wood wastes as a fuel for heat and power generation at the own energy sources

This alternative was discarded because the enterprise already had its own heat and power sources: a boiler house in Tsiglomen and a mini-CHP in Maimaksa. All generating sources are running on wood wastes. When the boiler house was built in Tsiglomen and a mini-CHP – in Maimaksa the most effective ratio of heat and power generation was set. The enterprise fully covers its heat demand and partially meets its power demand. Thus, use of wood wastes as fuel for heat and power generation for its own energy sources was a settled issue as far back as 2005-2007.

Alternative 3: Use the wood wastes as the fuel for heat and power production at the Central CHP of Arkhangelsk city

Arkhangelsk has a central district heating system based on co-generation of heat and power. The center of energy supply is Arkhangelsk CHPP running on residual fuel oil. The boilers of the CHPP are designed for combustion of liquid fuels. Combustion of solid fuels (wood pellets) is technically impossible. Therefore this alternative was dismissed.

Alternative 4: Use the wood wastes as a feedstock for pulp and paper production

In the territory of Arkhangelsk city there are two major pulp and paper mills: Arkhangelsk PPM and Solombala PPM. The feedstock for these mills is process chips which are produced by cutting trunk timber. The requirements to the quality of chips (composition, shape, size, etc.) are fairly high. To use wood wastes (sawdust and bark) as a feedstock for pulping process is not technically possible. Therefore this alternative was dismissed.

Alternative 5: Use the wood wastes as a feedstock for hydrolyze plant;

Indeed, wood wastes can be used at hydrolysis plants as feedstock for alcohol production. Arkhangelsk hydrolysis plant (AHP) is located not far from Sawmill 25. However since 1995 alcohol production from wood was discontinued at AHP. The plant switched to alcohol production from molasses, the residue of beet sugar production, and then to alcohol production from sulphite liquors. Currently the plant is barely operational. Thus this alternative was also excluded from consideration.

Alternative 6: The project activity without the joint implementation mechanism

This alternative presupposes construction of a new pellet production plant and excessive sawmill waste generating at the Mill would be used as feedstock and technological fuel at the plant instead of disposal to the dump.

However the implementation of this alternative faces significant challenges (see the Investment Analysis in the Section B.2). Economic parameters of the project without additional revenues from selling GHG emission reductions would be unacceptably low. Construction and maintenance of pellet production is a fairly risky deal. Besides pellet marketing is not simple issue. Enter the international market is far not easy. Pellet selling in the domestic market is difficult because of dearness and unpopularity of this type of fuel in Russia.

It is unlikely that Alternative 6 could be implemented without the JI mechanism.

Thus on basis of the above analysis and taking into account investment analysis set forth below the Alternative 1 that implies continuation of the current situation was chosen as the most likely baseline scenario: excessive sawmill wastes would be disposed to the dump.

<u>Justification and description of the methodology for GHG emissions estimation under the baseline and the project scenarios</u>

At initial consideration the following emission sources were included in the project boundaries.

For baseline scenario:

- industrial wood waste dump, avoided (due to the project) emissions from anaerobic decay of sawmill waste;
- transportation of sawmill waste to the dump, combustion of fossil fuel.

For project scenario:

- suppliers of electricity for the pellet plant, combustion of fossil fuel;
- suppliers of heat for the pellet plant, combustion of biomass;
- transportation of wood waste to the pellet plant, ash to the dump and pellets to the buyers, combustion of fossil fuel.

Leakages which occur as a result of the project include CH_4 emissions from production, processing, storage, delivery and distribution of fossil fuel used by transport facilities and sawmill's energy sources.

Emission reductions

In the general case GHG emission reductions during the year *y* should be calculated as follow, t CO_2e:

$$ER_y = BE_y - PE_y - L_y, \quad (B.1\text{-}1)$$

where BE_y is the baseline GHG emissions during the year *y*, t CO_2e;

PE_y is the project GHG emissions during the year *y*, t CO_2e;

L_y is the leakages due to the project during the year *y*, t CO_2e.

Baseline emissions

In accordance with above denoted emission sources the baseline GHG emissions during the year *y* should be calculated as the sum of emissions from decay of sawmill waste (sawdust and BWW) plus emissions from fossil fuel consumption for transportation of sawmill waste to the dump, t CO_2e:

$$BE_y = BE_{sawdust,y} + BE_{BWW,y} + BE_{tr,y}, \quad (B.1\text{-}2)$$

where $BE_{sawdust,y}$ is the baseline CH_4 emissions from decay of sawdust at the dump during the year *y*, t CO_2e;

$BE_{BWW,y}$ is the baseline CH_4 emissions from decay of BWW at the dump during the year *y*, t CO_2e;

$BE_{tr,y}$ is the baseline CO_2 emissions[5] from transportation of sawmill waste to the dump during the year *y*, t CO_2.

The numerical values of $BE_{sawdust,y}$ and $BE_{BWW,y}$ are 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. for the World Bank [R4]. The model is built on the First Order Decay method with experimental specification of a number of parameters for waste wood dumps (See details in Section E.4).

In this model most of the parameters are constants and are determined once at the stage of the PDD preparation. The parameters variable from year to year are the values of reduction of sawdust and BWW disposal to the dump as a result of the project which are equivalent to the quantities of sawdust and BWW utilized as feedstock and fuel for pellet production.

[5] Emissions of CH_4 and N_2O from combustion of fossil fuel considered negligibly small as compared with CO_2 emissions and were neglected in development of the project.

The reduction of sawdust disposal to the dump as a result of the project during the year *x*, t:

$$W_{sawdust,x} = P_{pellet,x} \frac{100 - M_{pellet,x}}{100 - M_{sawdust}}, \quad \text{(B.1-3)}$$

where $P_{pellet,x}$ is the quantity of pellets produced during the year *x*, t;

$M_{pellet,x}$ is the average moisture content of pellets during the year *x*, %;

$M_{sawdust}$ - is the moisture content of sawdust, %.

The reduction of BWW disposal to the dump as a result of the project during the year *x*, t:

$$W_{BWW,x} = \frac{P_{pellet,x} \times SFC_{PP}}{NCV_{BWW}}, \quad \text{(B.1-4)}$$

where SFC_{PP} is the specific consumption of fuel for pellet production (for sawdust drying), GJ/t;

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

The specific net calorific value of BWW as-fired is calculated as follow:

$$NCV_{BWW} = NCV_{BWW}^{d} \times \frac{100 - M_{BWW}}{100} - 24.42 \times 10^{-3} \times M_{BWW}, \quad \text{(B.1-5)}$$

where NCV_{BWW}^{d} is the net calorific value of BWW on dry basis, GJ/t;

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

24.42×10^{-3} is the heat of evaporation for water per 1 % of evaporated water[6], GJ/(% t).

Values of $P_{pellet,x}$ and $M_{pellet,x}$ are subject to constant monitoring and for 2008 and 2009 were taken equal to actual data (See Table B.1-1). For the purpose of projections for the period 2010-2012 values of $P_{pellet,x}$ correspond with enterprise's plans and design data, $M_{pellet,x}$ is assumed constant over years and equal to average value for 2008 and 2009.

Specific consumption of fuel for pellet production SFC_{PP} was determined on basis of tests of the operating equipment during energy survey of the pellet production plant [R3] and assumed constant for the whole period 2008-2012.

Value of NCV_{BWW}^{d} was determined on the basis of reference data [R6] for fir bark.

M_{BWW} is considered as the constant parameter taken on default according to [R4].

In general the baseline CO_2 emissions from transportation of sawmill waste to the dump $BE_{tr,y}$ should be determined on basis of fuel consumption by transport vehicles taking into account distance from the sawmill to the dump, carrying capacity and specific fuel consumption of a vehicle, type of fuel and its CO_2 emission factor and/or others parameters.

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[6] Specific evaporation heat of water is 2 442 kJ/kg. Per 1 % of evaporated water this value is equal to 24.42 kJ/(%×kg) or 24.42×10^{-3} GJ/(%×t).

As explained below the baseline CO_2 emissions from transportation $BE_{tr,y}$ would be higher than the project CO_2 emissions from transportation $PE_{tr,y}$. For simplification and following conservative approach emissions related to transportation were excluded from consideration.

Finally, the baseline emissions include only CH_4 emissions from decay of sawdust and BWW at the dump, which are determined by amount of own sawmill's waste used for pellet production:

$$BE_y = BE_{sawdust,y} + BE_{BWW,y}. \quad \text{(B.1-6)}$$

Project emissions

According to initially specified emission sources the project GHG emissions during the year *y* should be calculated as the sum of emissions from fossil fuel consumption for electricity and heat supply to the pellet plant, and transportation of sawmill waste to the pellet plant, pellets to the buyers and ash to the dump, t CO_2e:

$$PE_y = PE_{el,y} + PE_{heat,y} + PE_{tr,y}, \quad \text{(B.1-7)}$$

where $PE_{el,y}$ is the project CO_2 emissions from electricity consumption by the pellet production plant during the year *y*, t CO_2;

$PE_{heat,y}$ is the project CO_2 emissions from heat supplied to the pellet production during the year *y*, t CO_2;

$PE_{tr,y}$ is the project CO_2 emissions from transportation of sawmill waste to the pellet plant, pellets to the buyers and ash to the dump during the year *y*, t CO_2.

Project emissions from electricity consumption by the pellet production plant during the year *y* are determined as follow, t CO_2:

$$PE_{el,y} = EC_{PP,y} \times EF_{el,y}, \quad \text{(B.1-8)}$$

where $EC_{PP,y}$ is the electricity consumption by the pellet production plant during the year *y*, MWh;

$EF_{el,y}$ is the CO_2 emission factor for electricity, t CO_2/MWh.

Value of $EC_{PP,y}$ is subject to constant monitoring and for 2008 and 2009 was taken equal to actual data (See Table B.1-1). For the purpose of projections for the period 2010-2012 values of $EC_{PP,y}$ were calculated on basis of specific electricity consumption per tonne of pellets produced, MWh:

$$EC_{PP,y} = P_{pellet,y} \times SEC_{PP,y}, \quad \text{(B.1-9)}$$

where $SEC_{PP,y}$ is the specific electricity consumption for pellet production during the year *y*, MWh/t.

Taking into account increase of pellet production together with observed and expected decrease of specific electricity consumption, the value of $SEC_{PP,y}$ for the period 2010-2012 was assumed constant and equal to its value for 2009.

Prior to commissioning of the pellet production plant, mini-CHP met only part of the enterprise's power demand. Therefore it can be rightfully assumed that electricity is supplied to the pellet production plant from external power grid:

$$EF_{el,y} = EF_{grid,y} \quad \text{(B.1-10)}$$

Value of $EF_{grid,y}$ was assumed as most conservative value for thermal power plants (TPP) of the Interconnected Power System (IPS) of North-West of Russia (see Annex 3). The IPS of North-West is an excessive power system. A TPP works in condensation cycle usually. It is assumed that increase of electricity consumption from the grid will occur due to TPPs of the IPS of North-West.

Project emissions from heat supplied to the pellet production during the year *y*, t CO_2:

$$PE_{heat,y} = PE_{heat,PP,y} + PE_{heat,CHP,y}, \quad \text{(B.1-11)}$$

where $PE_{heat,PP,y}$ is the GHG emissions from heat supplied to the pellet production needs from own heat generators during the year *y*, t CO_2;

$PE_{heat,CHP,y}$ is the GHG emissions from heat supplied to the pellet production needs from mini-CHP during the year *y*, t CO_2.

$$PE_{heat,PP,y} = W_{BWW,PP,y} \times NCV_{BWW} \times (EF_{CH4\_bio\_comb} \times GWP_{CH4} + EF_{N2O\_bio\_comb} \times GWP_{N2O}) \times 10^{-6} \quad \text{(B.1-12)}$$

$$PE_{heat,CHP,y} = W_{BWW,CHP,y} \times NCV_{BWW} \times (EF_{CH4\_bio\_comb} \times GWP_{CH4} + EF_{N2O\_bio\_comb} \times GWP_{N2O}) \times 10^{-6} \quad \text{(B.1-13)}$$

where $W_{BWW,PP,y}$ is the quantity of BWW fired at the pellet production plant, t;

$W_{BWW,CHP,y}$ is the quantity of BWW fired at the mini-CHP, t;

NCV_{BWW} is the net calorific value of BWW as-fired, GJ/t;

$EF_{CH4\_bio\_comb}$ is the CH_4 emission factor for biomass waste, kg CH4/TJ;

GWP_{CH4} is the global warming potential for CH_4, t CO2e/t CH4;

$EF_{N2O\_bio\_comb}$ is N_2O emission factor for biomass and waste, kg CH4/TJ;

GWP_{N2O} is the global warming potential for N_2O, t CO2e/t NO2.

The calculations show that the total annual emissions of CH_4 and N_2O, attributed to combustion of BWW at the mini-CHP for the heat needs of the pellet production plant, do not exceed 2000 tCO_2e/year and 1% of annual average baseline GHG emissions, therefore these are considered to be negligible and are excluded from consideration.

Thus:

$$PE_{heat,y} = PE_{heat,PP,y} = W_{BWW,PP,y} \times NCV_{BWW} \times (EF_{CH4\_bio\_comb} \times GWP_{CH4} + EF_{N2O\_bio\_comb} \times GWP_{N2O}) \times 10^{-6} \quad \text{(B.1-14)}$$

$$W_{BWW,PP,y} = \frac{P_{pellet,y} \times SFC_{PP}}{NCV_{BWW}}, \quad \text{(B.1-15)}$$

where $P_{pellet,y}$ is the quantity of pellets produced during the year *y*, t;

SFC_{PP} is the specific consumption of fuel for pellet production (for sawdust drying), GJ/t;

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

Project emissions from transportation of sawmill waste to the pellet plant, pellets to the buyers and ash to the dump during the year *y*, t CO_2:

$$PE_{tr,y} = PE_{tr,buyer,y} + PE_{tr,BWW,y} + PE_{tr,ash,y} + PE_{tr,sawdust,y} + PE_{tr,pellet,y}, \quad \text{(B.1-16)}$$

where $PE_{tr,buyer,y}$ - project emissions from pellets transportation to the buyers during the year *y*, t CO_2;

$PE_{tr,BWW,y}$ - project emissions from BWW transportation during the year *y*, t CO_2;

$PE_{tr,sawdust,y}$ - project emissions from sawdust transportation during the year *y*, t CO_2;

$PE_{tr,pellet,y}$ - project emissions from transportation pellet to the storage area during the year *y*, t CO_2;

Speaking about project CO_2 emissions from transportation pellets to the buyers it should be noted that all pellets produced by the Sawmill 25 are sold abroad. Pellets are delivered to overseas buyers by maritime transport. In accordance with the "IPCC Guidelines for the preparation of greenhouse gas (GHG) inventories" and the "UNFCCC reporting guidelines on annual inventories", emissions from international aviation and maritime transport (also known as international bunker fuel emissions) should be calculated as part of the national GHG inventories of Parties, but should be excluded from national totals and reported separately. These emissions are not subject to the limitation and reduction commitments of Annex I Parties under the Convention and the Kyoto Protocol[7].

Thus:

$$PE_{tr,y} = PE_{tr,BWW,y} + PE_{tr,ash,y} + PE_{tr,sawdust,y} + PE_{tr,pellet,y} \quad \text{(B.1-17)}$$

CO_2 emissions from transportation of BWW from the dump to the pellet production plant $PE_{tr,BWW,y}$ and from transportation of ash from the pellet production plant to the dump $PE_{tr,ash,y}$ were excluded from consideration due to their negligibility, since their total emissions do not exceed 2000 t CO_2/year and 1% of annual average baseline GHG emissions.

Thus:

$$PE_{tr,y} = PE_{tr,sawdust,y} + PE_{tr,pellet,y} \quad \text{(B.1-18)}$$

Project CO_2 emissions from transportation of sawmill waste to the pellet plant and pellets to the buyers are connected only with fuel consumed by transport facilities which operate only within national boundaries. In principal, these emissions can be determined like baseline emissions from transportation $BE_{tr,y}$. It is reasonably to determine which emissions from transport are lower: $PE_{tr,y}$ or $BE_{tr,y}$.

Sawdust demand of the pellet plant is completely covered by the wood wastes generated within Sawmill 25. Sawdust are supplied to the pellet production plant from the nearby sawmilling workshop. The haul distance from the waste generation workshop to the pellet plant is 0.12 km and from the pellet production plant to the pellets storage area at the port of shipment is 1.9 km, totally 2.02 km (See Fig. B.1-1).

Under the baseline sawdust from the waste generation workshops would be disposed to the dump, the haul distance is 2.4 km.

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[7] http://unfccc.int/methods_and_science/emissions_from_intl_transport/items/1057.php

Comparison of haul distances demonstrates rather higher fuel consumption for transportation under the baseline compared to the project. Besides it is obvious that average weight and volume of load transported is higher under the baseline than under the project.

Thus, it was concluded that $PE_{tr,y}$ are knowingly lower than $BE_{tr,y}$. On the ground of above said and for simplification it was decided to fully exclude emissions related with transport in both scenarios, it is conservative.

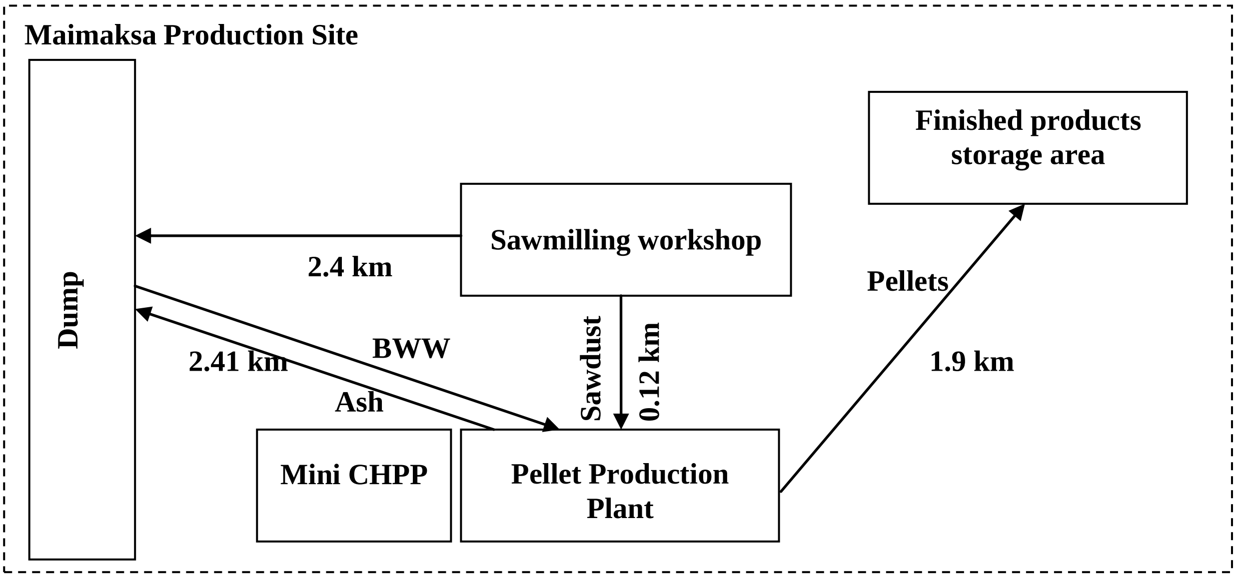

Fig. B.1-1. Distance between the Sawmill's facilities

Finally, the project emissions include GHG emissions associated with electricity consumption from the external power grid[8] and GHG emissions, attributed to combustion of BWW at pellet production plant:

$$PE_y = PE_{el,y} + PE_{heat,PP,y} \quad \text{(B.1-19)}$$

Leakages

Generally leakages which occur as a result of the project include fugitive CH_4 emissions from production, processing, storage, delivery and distribution of fossil fuel used by transport facilities which operate within national boundaries and sawmill's energy sources.

So long as emissions from transport were reasonably excluded and sawmill's energy source operate entirely on biomass, leakages are considered equal to zero.

<u>Application of the approach chosen</u>

All necessary parameters for baseline and project scenarios were determined following the foregoing methodology taking into account actual data for 2008 and 2009.

Data on performance of the pellet plant for the period 2008-2012 are given in Table B.1-1. Key constant parameters are described in the tabular format below.

[8] If the sawmill meets all of its electricity needs entirely by biomass combustion and ceases to purchase electricity from the outside then the GHG emissions under the project will become equal to zero.

Table B.1-1. Projection of the pellet production plant performance till 2012 (for 2008 and 2009 actual data used)

Name	Designation	Unit	Justification	2008	2009	2010	2011	2012	2008-2012
Pellet production	$P_{pellet,x}$	t	Enterprise's plan	16 748	45 395	70 000	75 000	75 000	**282 143**
Moisture content of pellets	$M_{pellet,x}$	%	On the basis of factual data	7.81	6.84	7.32	7.32	7.32	**-**
Moisture content of BWW	M_{BWW}	%	Assumed on default according to [R4]	50	50	50	50	50	**-**
Moisture content of sawdust	$M_{sawdust}$	%	Assumed on default according to [R4]	50	50	50	50	50	**-**
Sawdust consumption	$W_{sawdust,x}$	t	$W_{sawdust,x} = P_{pellet,x} \frac{100 - M_{pellet,x}}{100 - M_{sawdust}}$	30 881	84 584	129 751	139 019	139 019	**523 254**
Specific consumption of fuel per 1 tonne of pellets produced	SFC_{PP}	GJ/ t of pellets	Test data [R3]	3.976	3.976	3.976	3.976	3.976	**-**
Net calorific value of BWW on dry basis	NCV^{d}_{BWW}	GJ/t	Assumed according to [R6]	19.33	19.33	19.33	19.33	19.33	-
Net calorific value of BWW as-fired	NCV_{BWW}	GJ/t	$NCV_{BWW} = NCV^{d}_{BWW} \times \frac{100 - M_{BWW}}{100} - 24.42 \times 10^{-3} \times M_{BWW}$	8.44	8.44	8.44	8.44	8.44	**-**
BWW consumption	$W_{BWW,x}$	t	$W_{BWW,x} = \frac{P_{pellet,x} \times SFC_{PP}}{NCV_{BWW}}$	7 886	21 375	32 961	35 315	35 315	**132 852**
Specific electricity consumption	$SEC_{PP,y}$	MWh/ t of pellets	On the basis of factual data	0.136	0.110	0.110	0.110	0.110	**-**
Electricity consumption	$EC_{PP,y}$	MWh	$EC_{PP,y} = P_{pellet,y} \times SEC_{PP}$	2 284	4 987	7 690	8 239	8 239	**31 440**

Data/Parameter	SFC_{PP}
Data unit	GJ/t
Description	Specific consumption of fuel for pellet production
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Report "Energy Survey of the Main Equipment of the Pellet Production Plant with a view to Determining its Technical, Economic and Environmental Performance Parameters" Energy Center of ASTU, Arkhangelsk, 2008. [R3]
Value of data applied (for ex ante calculations/determinations)	3.976
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Specific fuel consumption was determined with the help of tests on the operating equipment during energy survey of the pellet production plant
QA/QC procedures (to be) applied	The equipment used for energy survey is regularly calibrated in accordance with the approved schedule and procedure for calibration of instrumentation and control equipment
Any comment	-

Data/Parameter	$SEC_{PP,y}$
Data unit	MWh/t
Description	Specific electricity consumption for pellet production
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Actual data for 2008 and 2009
Value of data applied (for ex ante calculations/determinations)	0.136 for 2008; 0.110 for 2009-2012
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Electricity consumption is measured by electric meters at the pellet production plant.
QA/QC procedures (to be) applied	Electric meters are calibrated regularly in accordance with the approved schedule and procedure for calibration of instrumentation and control equipment
Any comment	Parameter is used for estimation only

Data/Parameter	$EF_{grid,y}$
Data unit	t CO_2/MWh
Description	CO_2 emission factor for grid electricity
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Emission factors for Thermal Power Plants (TPPs) of the Interconnected Power System (IPS) of North-West of Russia for the period 2005-2007
Value of data applied (for ex ante calculations/determinations)	0.609
Justification of the choice of data or description of measurement methods and	Value of $EF_{grid,y}$ was assumed as most conservative value for TPPs of the IPS of North-West (see Annex 3)

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

Data/Parameter	NCV_{BWW}^{d}
Data unit	GJ/t
Description	Net calorific value of BWW on dry basis
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	S.I.Golovkov, I.F.Koperin, V.I.Naidyonov. Wood Wastes-to-Energy. – M.: Forest Industry, 1987. p. 23. [R6].
Value of data applied (for ex ante calculations/determinations)	19.33
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data for specific calorific value of fir bark
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	$M_{pellet,x}$
Data unit	%
Description	Average moisture content of pellets over the year *x*
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Laboratory of CJSC “Sawmill25”
Value of data applied (for ex ante calculations/determinations)	7.81 for 2008; 6.84 for 2009; 7.32 for 2010-2012
Justification of the choice of data or description of measurement methods and procedures (to be) applied	For 2008 and 2009 measured data; for 2010-2012 average value for 2008-2009. The moisture content is measured by analyzer at the pellet production plant.
QA/QC procedures (to be) applied	The moisture content measurement equipment is calibrated regularly in accordance with the approved schedule and procedure for calibration of instrumentation and control equipment
Any comment	Parameter is subject to monitoring. Fixed values assumed for estimation only

Data/Parameter	M_{BWW}
Data unit	%
Description	Moisture content of BWW
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
Value of data applied (for ex ante	50

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	Determined on the basis of reference data
Any comment	-

Data/Parameter	$M_{sawdust}$
Data unit	%
Description	Moisture content of sawdust
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	$w_{lignin,WW}$
Data unit	-
Description	Lignin fraction of carbon for wood waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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 on the basis of reference data
Any comment	-

Data/Parameter	k_{WW}
Data unit	$year^{-1}$
Description	Decomposition rate constant for the wood waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]

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	Formula evaluation: $k_{WW} = -\ln(1/2)/15$
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	15 is the recommended default value for half-life of wood, year

Data/Parameter	C_{WW}^{d}
Data unit	%
Description	Organic carbon content in the wood waste on dry basis
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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
QA/QC procedures (to be) applied	Determined on the basis of reference data
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	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
Value of data applied (for ex ante calculations/determinations)	1.87
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Formula evaluation: $a = 22.4/12$
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	22.4 is molar volume of gas at normal conditions, l/mol; 12 is molar mass of C, g/mol.

Data/Parameter	ζ
Data unit	-
Description	Generation factor
Time of determination/monitoring	Determined once at the stage of the PDD preparation

Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	φ
Data unit	%
Description	Percentage of the stockpile under aerobic conditions
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	ζ_{OX}
Data unit	-
Description	Methane oxidation factor
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	V_m
Data unit	%
Description	Methane concentration biogas
Time of	Determined once at the stage of the PDD preparation

determination/monitoring	
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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 is 60% To calculate adopted more conservative value - 50%
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	ρ_{CH4}
Data unit	kg/m^3
Description	Density of methane
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
Value of data applied (for ex ante calculations/determinations)	0.714
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Formula evaluation: $\rho_{CH4} = 16/22.4$
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	16 is molar mass of CH_4, g/mol; 22.4 is molar volume of gas at normal conditions, l/mol

Data/Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4
Description	Global warming potential of methane
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	GWP_{N2O}
Data unit	t CO_2e/t N_2O

Description	Global warming potential for nitrous oxide
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	IPCC Fourth Assessment Report: Climate Change 2007: Working Group I: The Physical Science Basis [R10]
Value of data applied (for ex ante calculations/determinations)	310
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 on the basis of reference data
Any comment	-

Data/Parameter	$EF_{CH4\_bio\_comb}$
Data unit	kg CH_4/TJ
Description	CH_4 emission factor for biomass waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy. [R9]
Value of data applied (for ex ante calculations/determinations)	30
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 on the basis of reference data
Any comment	-

Data/Parameter	$EF_{N2O\_bio\_comb}$
Data unit	kg N_2O/TJ
Description	N_2O emission factor for biomass waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy. [R9]
Value of data applied (for ex ante calculations/determinations)	4
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 on the basis of 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 defined in the paragraph 2 (a) of the Annex I to the "Guidance on criteria for baseline setting and monitoring", Version 02, JISC [R2], has been chosen to demonstrate that the SSC project provides reductions in emissions by sources that are additional to any that would otherwise occur.

Within the bounds of the approach chosen the additionality has been demonstrated using the Analysis of the Project Alternatives, the Investment Analysis and the Common Practice Analysis.

The Analysis of the Project Alternatives

The following alternatives of handling excessive sawmill wastes were identified:

Alternative 1: Continuation of the current situation;

Alternative 2: The project activity without the joint implementation mechanism.

Detailed analysis of the project alternatives is given in Section B.1. In summary Alternative 1 that implies continuation of the current situation was chosen as the most likely baseline scenario for excessive sawmill waste which would be disposed to the dump.

The Investment Analysis

Economic parameters of the project were compared for the two options:

(a) without selling GHG emission reductions;

(b) with selling GHG emission reductions.

The capital investments to the project total EUR 9.33 million including bank loan of EUR 7.00 million.

The selling price for emission reduction unit (ERU) generated during 2008-2012 was assumed equal to 15 EUR/t CO_2e, and for the period 2013-2020 it was assumed equal to 7.5 EUR/t CO_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:

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

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 30 Eurobonds with maturity date in 2030. In the first five months of 2007 (before starting date of the project) the rate of return on Russia 30 Eurobonds was at the level of 5.7÷5.8% 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 of a new product and its market promotion then the recommended risk premium is between 13% and 15%. Other risk premiums are altogether estimated at the level of 5%.

Following the conservative approach, the final discount rate was assumed at 20%. This roughly matches up with the hurdle rate of return on investments into timber production which is the core business for CJSC "Sawmill 25".

[9] http://www.bizeducation.ru/library/fin/invest/sinadsky.htm

[10] http://www.veb.ru/ru/analytics/review

The results of NPV and IRR calculation for the two implementation options are given in Table B.2-1 below and in Annex 2-3. As it is seen, implementation of the project without selling GHG emission reductions shows negative NPV and IRR below 20%, whereas additional revenues from selling emission reductions improve the project attractiveness: NPV = EUR 1 685 487, IRR = 32.1 > 20%.

Table B.2-1. Comparison NPV and IRR

Name	Unit	Without selling emission reductions	With selling emission reductions
NPV	EUR	-390 796	1 685 487
IRR	%	17.2%	32.1%

The analysis of the project sensitivity to variation of the main parameters was made (see Table B.2-2). Due to the revenues from selling GHG emission reductions the project becomes less sensitive to risks.

Table B.2-2. The sensitivity analysis

Name	Unit	Project without JI	Project as JI
1) Increase of investments by 10%			
NPV	EUR	-929 431	1 146 852
IRR	%	14.1%	27.2%
2) Decrease of investments by 10%			
NPV	EUR	147 838	2 224 121
IRR	%	21.2%	38.8%
3) Increase of production costs by 10%			
NPV	EUR	-1 849 715	226 568
IRR	%	7.7%	21.4%
4) Decrease of production costs by 10%			
NPV	EUR	1 044 456	3 120 739
IRR	%	28.4%	46.3%
5) Overproduction by 10%			
NPV	EUR	638 212	2 714 495
IRR	%	24.8%	40.9%
6) Underproduction by 10%			
NPV	EUR	-1 332 682	743 601
IRR	%	10.7%	25.1%
7) Increase of product price by 10%			
NPV	EUR	1 554 886	3 631 168
IRR	%	33.2%	52.8%
8) Decrease of product price by 10%			
NPV	EUR	-2 379 320	-303 037
IRR	%	4.6%	18.1%
9) Increase of operation time to 20 years			
NPV	EUR	-387 118	1 689 165
IRR	%	17.4%	31.6%
10) Decrease of operation time to 10 years			
NPV	EUR	-644 161	1 097 108
IRR	%	13.9%	30.5%

As the sensitivity analysis shows, without sale of GHG emission reductions (Project without JI) only four options have an IRR> 20 % and are economically attractive, whereas with sale of GHG emission reductions (Project as JI) nine options have an IRR> 20 % and are economically viable.

Taking into account the low investment attractiveness of the project the management of Sawmill 25 from the very beginning considered the possibility of financing the plant construction through sale of greenhouse gas emission reductions using the mechanisms of the Kyoto Protocol.

The Common Practice Analysis

The common practice of excessive BWW handling at sawmills in Russia on the whole and the Arkhangelsk region in particular is disposal of BWW to the dumps.

At the time when Sawmill 25 decided to implement the project there wasn't a single pellet production plant in the Arkhangelsk Region.

Proceeding from the above, the GHG emission reductions generated by the project are additional to those that might have otherwise occurred.

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

Fig. B.3-1 shows the main components and boundaries of the project. This scheme also shows main flows of energy and wood waste.

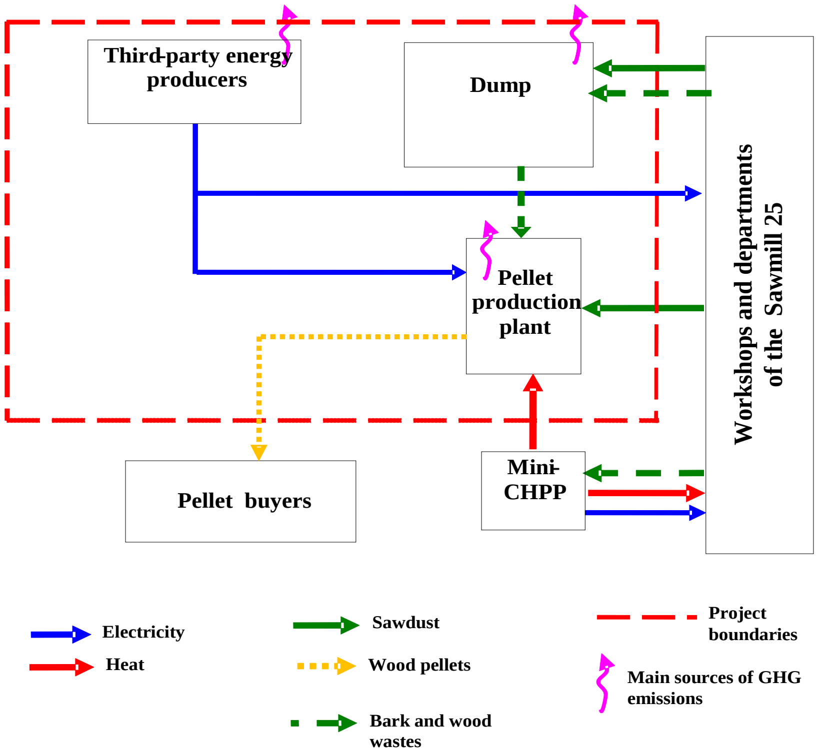

Fig. B.3-1. Main components and project boundaries

Table B.3-1 shows which gases and sources are included in and which are excluded from the project boundaries.

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

	Source	Gas	Inc./ Excl.	Justification/Explanation
Baseline	Industrial wood waste dump, avoided (due to the project) emissions from anaerobic decay of sawmill waste	CO_2	Excl.	Considered equal to zero
		CH_4	**Incl.**	**Main emission source**
		N_2O	Excl.	Considered negligibly small
	Transportation of sawmill waste to the dump, combustion of diesel fuel	CO_2	Excl.	Considered small and is offset by project emissions from transportation of sawmill waste to the pellet plant
		CH_4	Excl.	Considered negligibly small
		N_2O	Excl.	Considered negligibly small
Project activity	Third-party suppliers of electricity, combustion of fossil fuel	**CO_2**	**Incl.**	**Main emission source**
		CH_4	Excl.	Considered negligibly small
		N_2O	Excl.	Considered negligibly small
	Transportation of waste to the pellet plant, pellets to the buyers, ash to the dump, combustion of diesel fuel	CO_2	Excl.	Considered small and is completely offset by baseline emissions from transportation of sawmill waste to the dump. Basic fuel consumption for pellet transportation to the buyers connected with bunker fuel which is not considered in national GHG inventory and JI projects.
		CH_4	Excl.	Considered negligibly small
		N_2O	Excl.	Considered negligibly small
	Mini-CHP. Heat supply to the pellet production plant. Combustion of bark and wood wastes.	CO_2	Excl.	Considered climate neutral.
		CH_4	Excl.	Considered negligibly small
		N_2O	Excl.	Considered negligibly small
	Pellet production plant. Heat generators for sawdust drying. Combustion of bark and wood wastes.	CO_2	Excl.	Considered climate neutral.
		CH_4	**Incl.**	**Main emission source**
		N_2O	**Incl.**	**Main emission source**

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

The date of baseline setting: May 5, 2010

The baseline was developed by: CCGS LLC (CCGS LLC is not the project participant indicated in Annex 1 of the PDD)

Contact person: Vladimir Dyachkov

E-mail: v.dyachkov@ccgs.ru

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

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

June 08, 2007 (the first contract for procurement of equipment for a pellet production plant was signed)

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

15 years/180 months

C.3. Length of the crediting period:

4.58 years/55 months (from the 21st of May 2008 till the 31st of December 2012).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The PDD developer has chosen JI specific approach for monitoring in accordance with paragraph 9 (a) of the “Guidance on criteria for baseline setting and monitoring”, Version 02, JISC [R2].

All data (to be recorded in any case) required for estimation of GHG emission reductions are collected in compliance with the highest sectoral standards and best practice of fuel and energy monitoring and environmental impact assessment.

Emission reductions

The GHG emission reductions during the year *y* are calculated as the difference between the baseline GHG emissions and the project GHG emissions, t CO_2e:

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

where BE_y is the baseline GHG emissions during the year *y*, t CO_2;

PE_y is the project GHG emissions during the year *y*, t CO_2e.

Project emissions

The project emissions are associated with electricity consumption from the external power grid and from heat supplied to the pellet production needs from own heat generators during the year *y*, t CO_2e:

$$PE_y = PE_{el,y} + PE_{heat,PP,y}, \quad (D.1\text{-}2)$$

where $PE_{el,y}$ is the project GHG emissions from electricity consumption by the pellet production plant during the year *y*, t CO_2.

$PE_{heat,PP,y}$ is the project GHG emissions from heat supplied to the pellet production needs from own heat generators during the year *y*, t CO_2e.

$$PE_{el,y} = EC_{PP,y} \times EF_{grid,y}, \quad (D.1\text{-}3)$$

where $EC_{PP,y}$ is the electricity consumption by the pellet production plant during the year *y* (<u>this value is subject to monitoring</u>), MWh;

$EF_{grid,y}$ is the CO_2 emission factor for grid electricity, t CO_2/MWh.

Value of $EF_{grid,y}$ was assumed as most conservative value for TPPs of the Interconnected Power System of North-West (see Annex 3). $EF_{grid,y}$ =0.609 t CO_2/MWh.

$$PE_{heat,PP,y} = W_{BWW,PP,y} \times NCV_{BWW} \times (EF_{CH4\_bio\_comb} \times GWP_{CH4} + EF_{N2O\_bio\_comb} \times GWP_{N2O}) \times 10^{-6} \quad (D.1\text{-}4)$$

where $W_{BWW,PP,y}$ is the quantity of BWW fired at the pellet production plant during the year *y*, t;

NCV_{BWW} is the net calorific value of BWW as-fired, GJ/t;

$EF_{CH4\_bio\_comb}$ is the CH_4 emission factor for biomass waste, kg CH_4/TJ;

GWP_{CH4} is the global warming potential for CH_4, t CO_2 e/t CH_4;

$EF_{N2O\_bio\_comb}$ is N_2O emission factor for biomass and waste, kg CH_4/TJ;

GWP_{N2O} is the global warming potential for N_2O, t CO_2 e/t NO_2.

$$W_{BWW,PP,y} = \frac{P_{pellet,y} \times SFC_{PP}}{NCV_{BWW}}, \qquad \text{(D.1-5)}$$

where $P_{pellet,y}$ is the quantity of pellets produced during the year *y*, t;

SFC_{PP} is the specific consumption of fuel for pellet production, GJ/t;

$$NCV_{BWW} = NCV_{BWW}^{d} \times \frac{100 - M_{BWW}}{100} - 24.42 \times 10^{-3} \times M_{BWW}, \qquad \text{(D.1-6)}$$

where NCV_{BWW}^{d} is the net calorific value of BWW on dry basis, GJ/t;

24.42×10^{-3} is the heat of evaporation for water per 1 % of evaporated water[11], GJ/(% t);

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

Baseline emissions

The baseline GHG emissions during the year *y* are calculated as the sum of emissions from decay of sawdust and BWW, t CO_2e:

$$BE_{y} = BE_{sawdust,y} + BE_{BWW,y}, \qquad \text{(D.1-7)}$$

where $BE_{sawdust,y}$ is the baseline CH_4 emissions from decay of sawdust at the dump during the year *y*, t CO_2e;

$BE_{BWW,y}$ is the baseline CH_4 emissions from decay of BWW at the dump during the year *y*, t CO_2e.

The numerical values of $BE_{sawdust,y}$ and $BE_{BWW,y}$ are 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 [R4].

$$BE_{sawdust,y} = \left(1 - w_{lignin,WW}\right) \times k_{WW} \times \frac{C_{WW}^{d}}{100} \times \left(1 - \frac{M_{sawdust}}{100}\right) \times a \times \zeta \times \left(1 - \frac{\varphi}{100}\right) \times \times \left(1 - \zeta_{OX}\right) \times \frac{V_m}{100} \times \rho_{CH4} \times GWP_{CH4} \times \sum_{x=2008}^{x=y} \left(W_{sawdust,x} \times e^{-k_{WW} \times (y-x)}\right) \qquad \text{(D.1-8)}$$

$$BE_{BWW,y} = \left(1 - w_{lignin,WW}\right) \times k_{WW} \times \frac{C_{WW}^{d}}{100} \times \left(1 - \frac{M_{BWW}}{100}\right) \times a \times \zeta \times \left(1 - \frac{\varphi}{100}\right) \times \times \left(1 - \zeta_{OX}\right) \times \frac{V_m}{100} \times \rho_{CH4} \times GWP_{CH4} \times \sum_{x=2008}^{x=y} \left(W_{BWW,x} \times e^{-k_{WW} \times (z+(y-x))}\right) \qquad \text{(D.1-9)}$$

where $W_{sawdust,x}$ is the reduction of sawdust disposal to the dump as a result of the project which is equivalent to the quantity of sawdust utilized as feedstock for pellet production during the year *x*, t;

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[11] Specific evaporation heat of water is 2 442 kJ/kg. Per 1 % of evaporated water this value is equal to 24.42 kJ/(%×kg) or 24.42×10^{-3} GJ/(%×t).

$W_{BWW,x}$ is the reduction of BWW disposal to the dump as a result of the project which is equivalent to the quantity of BWW utilized as fuel at the pellet plant during the year *x*, t;

$M_{sawdust}$ is the moisture content of sawdust, %;

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

$w_{lignin,WW}$ is the lignin fraction of C (carbon) for wood wastes[12];

k_{WW} is the decomposition rate constant for wood wastes, year^{-1};

C_{WW}^{d} is the organic carbon content in wood wastes on dry basis, %;

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 biogas, %;

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

GWP_{CH4} is the global warming potential of methane, t CO_2e/t CH_4;

z is the age of biomass taken from the stockpile and utilised, year;

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.

The reduction of sawdust disposal to the dump as a result of the project during the year *x*, t:

$$W_{sawdust,x}^{d} = P_{pellet,x} \frac{100 - M_{pellet,x}}{100 - M_{sawdust,x}}, \qquad \text{(D.1-10)}$$

where $P_{pellet,x}$ is the quantity of pellets produced during the year *x* (this value is subject to monitoring), t;

$M_{pellet,x}$ is the average moisture content of pellets during the year *x* (this value is subject to monitoring), %.

$M_{sawdust}$ is the moisture content of sawdust, %;

[12] Hereinafter the term “wood waste (WW)” includes both sawdust and BWW.

The reduction of BWW disposal to the dump as a result of the project during the year *x*, t:

$$W_{BWW,x} = \frac{P_{pellet,x} \times SFC_{PP}}{NCV_{BWW}}, \tag{D.1-11}$$

where SFC_{PP} is the specific consumption of fuel for pellet production, GJ/t;

NCV_{BWW} is the specific net calorific value of BWW as-fired, GJ/t.

The algorithm for calculation of the actual generated emission reductions is shown in Fig. D.1-1.

All in all, three parameters are subject to direct monitoring, including:

1. Electricity consumption by the pellet production plant, $EC_{PP,y}$, MWh.
2. Pellet production quantity, $P_{pellet,x}$, t;
3. Moisture content of pellets, $M_{pellet,x}$, %;

The location of the monitoring points is shown in Fig. D.1-2.

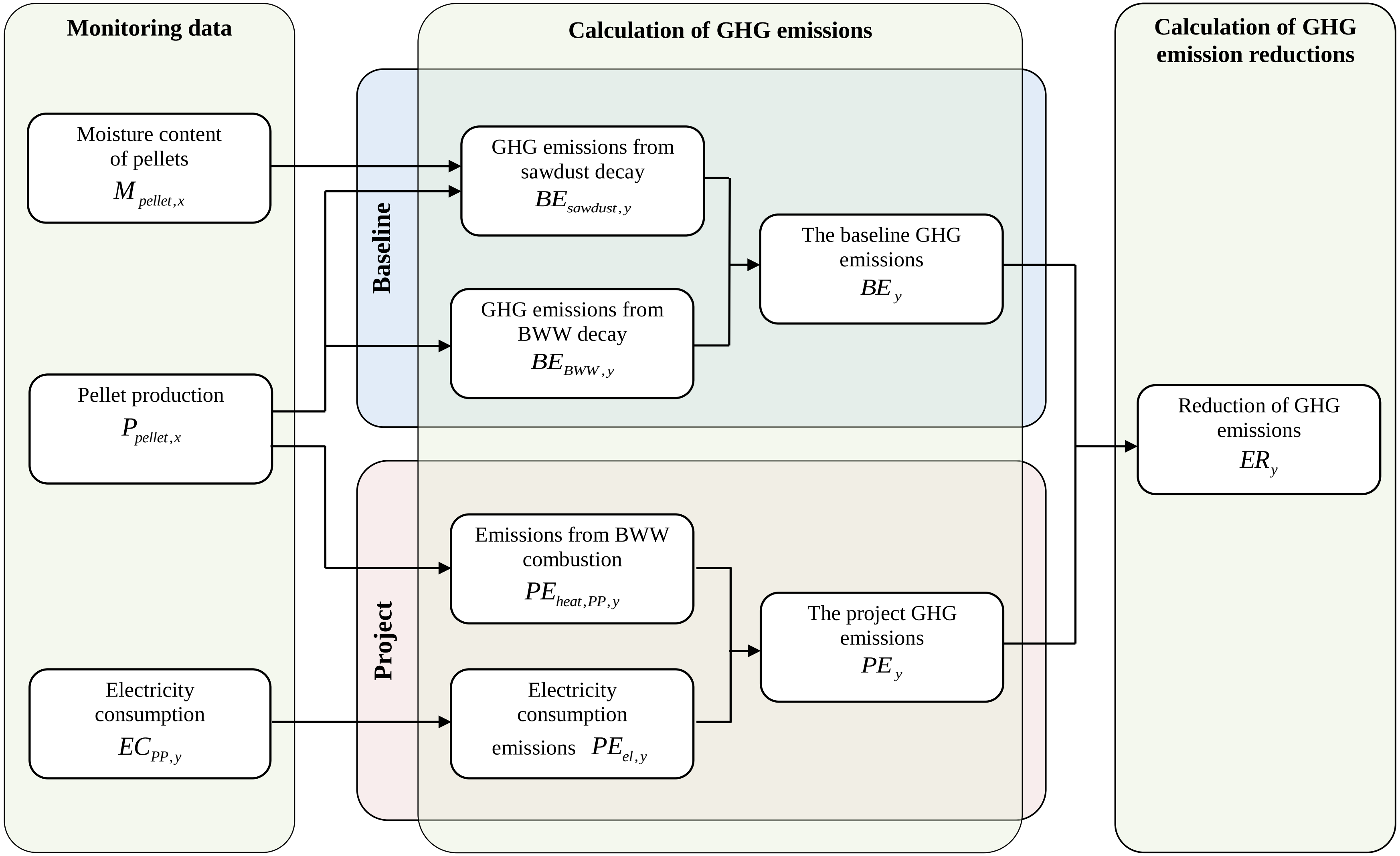

Fig. D.1-1. The algorithm for calculation of the actual generated emission reductions

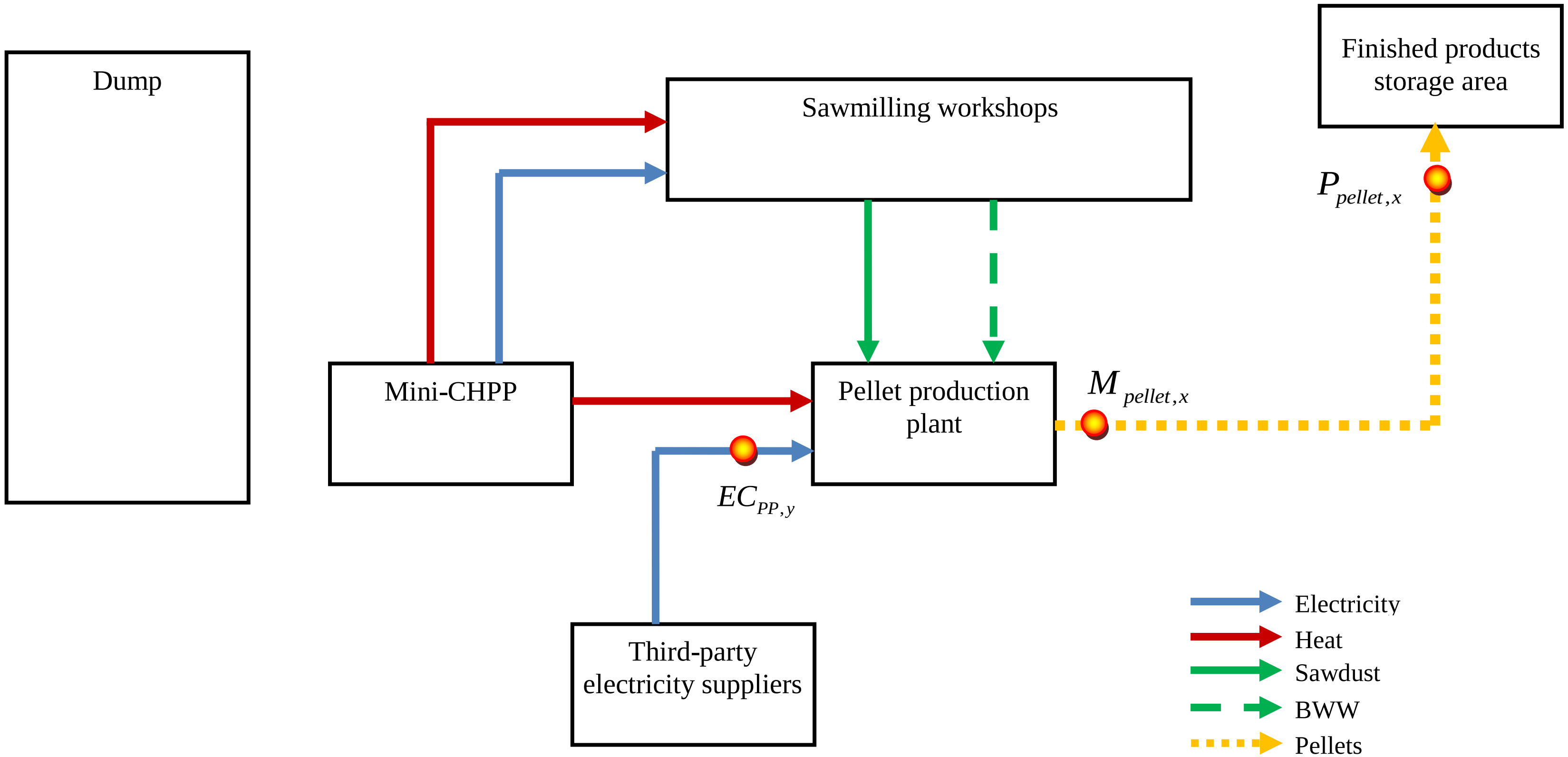

Fig. D.1-2. Location of monitoring points

D.2. Data to be monitored:

The data and parameters subject to monitoring during the crediting period:

Data/Parameter	$EC_{PP,y}$
Data unit	MWh
Description	Electricity consumption by the pellet production plant during the year *y*
Time of determination/monitoring	Continuously
Source of data (to be) used	The Department of the Chief Power Engineer of CJSC "Sawmill 25"
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Electricity consumption is measured by electric meters at the pellet production plant.
QA/QC procedures (to be) applied	Electric meters are calibrated regularly in accordance with the approved schedule and procedure for calibration of instrumentation and control equipment
Any comment	Data are archived electronically and on paper

Data/Parameter	$P_{pellet,x}$
Data unit	t
Description	Quantity of pellets produced during the year *x*
Time of determination/monitoring	Continuously
Source of data (to be) used	Production Department of CJSC "Sawmill25"
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The quantity of pellets produced is measured by weighing at the finished products storage area.
QA/QC procedures (to be) applied	The weighs are calibrated regularly, in accordance with the approved procedure for calibration of instrumentation and control equipment. The results of control weighing at ports of destination are used for cross-checking
Any comment	Data are archived electronically and on paper

Data/Parameter	$M_{pellet,x}$
Data unit	%
Description	Average moisture content of pellets over the year *x*
Time of determination/monitoring	6 times per day
Source of data (to be) used	Laboratory of CJSC "Sawmill25"
Value of data applied (for ex ante calculations/determinations)	-

Justification of the choice of data or description of measurement methods and procedures (to be) applied	The moisture content is measured by analyzer at the pellet production plant.
QA/QC procedures (to be) applied	The moisture content measurement equipment is calibrated regularly in accordance with the approved schedule and procedure for calibration of instrumentation and control equipment
Any comment	Data are archived electronically and on paper

Data and parameters assumed as constants for the crediting period:

Data/Parameter	$EF_{grid,y}$
Data unit	t CO_2/MWh
Description	CO_2 emission factor for grid electricity
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Emission factors for Thermal Power Plants (TPPs) of the Interconnected Power System (IPS) of North-West of Russia
Value of data applied (for ex ante calculations/determinations)	0.609
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Value of $EF_{grid,y}$ was assumed as most conservative value for TPPs of the IPS of North-West (see Annex 3)
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	SFC_{PP}
Data unit	GJ/t
Description	Specific consumption of fuel for pellet production
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Report “Energy Survey of the Main Equipment of the Pellet Production Plant with a view to Determining its Technical, Economic and Environmental Performance Parameters” Energy Center of ASTU, Arkhangelsk, 2008. [R3]
Value of data applied (for ex ante calculations/determinations)	3.976
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Specific fuel consumption was determined with the help of tests of the operating equipment during energy survey of the pellet production plant. To calculate adopted more conservative value from range given in report [R3].
QA/QC procedures (to be) applied	The equipment used for energy survey is regularly calibrated in accordance with the approved schedule and procedure for calibration of instrumentation and control equipment
Any comment	-

Data/Parameter	NCV^{d}_{BWW}
Data unit	GJ/t
Description	Net calorific value of BWW on dry basis
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	S.I.Golovkov, I.F.Koperin, V.I.Naidyonov. Wood Wastes-to-Energy. – M.: Forest Industry, 1987. p. 23. [R6]
Value of data applied (for ex ante calculations/determinations)	19.33
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data for specific calorific value of fir bark
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	M_{BWW}
Data unit	%
Description	Moisture content of BWW
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	$M_{sawdust}$
Data unit	%
Description	Moisture content of sawdust
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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
QA/QC procedures (to be) applied	Determined on the basis of reference data

Any comment	-

Data/Parameter	$w_{lignin,WW}$
Data unit	-
Description	Lignin fraction of carbon for wood waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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 on the basis of reference data
Any comment	-

Data/Parameter	k_{WW}
Data unit	$year^{-1}$
Description	Decomposition rate constant for the wood waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Formula evaluation: $k_{WW} = -\ln(1/2)/15$
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	15 is the recommended default value for half-life of wood, year

Data/Parameter	C_{WW}^{d}
Data unit	%
Description	Organic carbon content in the wood waste on dry basis
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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
QA/QC procedures (to be) applied	Determined on the basis of reference data

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	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
Value of data applied (for ex ante calculations/determinations)	1.87
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Formula evaluation: $a = 22.4/12$
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	22.4 is molar volume of gas at normal conditions, l/mol; 12 is molar mass of C, g/mol.

Data/Parameter	ζ
Data unit	-
Description	Generation factor
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	φ
Data unit	%
Description	Percentage of the stockpile under aerobic conditions
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data

Any comment	-
Data/Parameter	ζ_{OX}
Data unit	-
Description	Methane oxidation factor
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	V_m
Data unit	%
Description	Methane concentration biogas
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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 is 60% To calculate adopted more conservative value - 50%
QA/QC procedures (to be) applied	Determined on the basis of reference data
Any comment	-

Data/Parameter	ρ_{CH4}
Data unit	kg/m^3
Description	Density of methane
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
Value of data applied (for ex ante calculations/determinations)	0.714
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Formula evaluation: $\rho_{CH4} = 16/22.4$
QA/QC procedures (to be) applied	Determined on the basis of reference data

Any comment	16 is molar mass of CH_4, g/mol; 22.4 is molar volume of gas at normal conditions, l/mol

Data/Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4
Description	Global warming potential of methane
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002. [R4]
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	Determined on the basis of reference data
Any comment	-

Data/Parameter	GWP_{N2O}
Data unit	t CO_2e/t N_2O
Description	Global warming potential of N_2O
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	IPCC Fourth Assessment Report: Climate Change 2007: Working Group I: The Physical Science Basis [R10]
Value of data applied (for ex ante calculations/determinations)	310
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 on the basis of reference data
Any comment	-

Data/Parameter	$EF_{CH4\_bio\_comb}$
Data unit	kg of CH_4/TJ
Description	CH_4 emission factor for biomass waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy. [R9]
Value of data applied (for ex ante calculations/determinations)	30
Justification of the choice of data or description of	Recommended default value

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

Data/Parameter	$EF_{N2O\_bio\_comb}$
Data unit	kg of N_2O/TJ
Description	N_2O emission factor for biomass waste
Time of determination/monitoring	Determined once at the stage of the PDD preparation
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy. [R9]
Value of data applied (for ex ante calculations/determinations)	4
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 on the basis of reference data

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

Parameter	Uncertainty level of data (high/medium/low)	QA/QC procedures planned for these data, or why such procedures are necessary
Electricity consumption	Low	The electricity meters are regularly, once every eight years, checked by Federal State Institution “Standardization and Metrology Center” of Arkhangelsk pursuant to the requirements of standard technical documentation and in accordance with the schedule and procedure for checking instrumentation and control equipment adopted at the plant.
Pellet production quantity	Low	The weighs are regularly, once every six month, calibrated with the approved schedule and procedure for calibration of instrumentation and control equipment. In case the main weighs installed at the finished products shipment point, are out of order, weighing can be done in smaller portions with the help of the weighs installed at the pellet production plant. Besides the results of control weighing at ports of destination are used for cross-checking.
Moisture content of pellets	Low	The equipment is calibrated regularly in accordance with the requirements of standard technical documentation and approved schedule and procedure for calibration of instrumentation and control equipment.

Actions taken during calibration period or breakdown of instruments

The measuring instruments shall be calibrated during scheduled shutdowns of the equipment. If necessary, the removed measuring instrument is replaced with a gaged back-up instrument. Operation of the equipment without measuring instruments is not allowed.

Shall any instrument fail, the respective parameters are to be monitored with a help of a duplicate instrument or, if such is not available, the failed instrument is to be replaced with a gaged back-up instrument.

Cross-check

Initial check of the monitoring report is carried out by the Director of the Project Implementation Department of CCGS LLC or, on his instructions, by other specialist of the said Department who is not directly related to preparation of this report.

The additional cross-check is made by the Director of the Project Development Department of CCGS LLC or, on his instructions, by other specialist of this Department.

As soon as all comments made by the Project Development Department are incorporated or resolved the monitoring report is submitted for internal verification to the enterprise where the project is implemented. Primary data and GHG emission reduction calculations are checked at the enterprise.

Test verifications

Regularly, at least once a year, the specialists of CCGS LLC shall carry out test verification with a view to checking out 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:

Transferring of information

Original request for primary GHG emission reductions monitoring data is made by the Director of the Project Implementation Department of CCGS LLC to the CJSC "Sawmill 25" in Arkhangelsk to the Financial Director, who in his turn gives instructions to the enterprise to collect the requested data. The enterprise has specific persons (a working group) that responsible for collection, control and transfer of monitoring data. The responsibility of these persons is specified in corresponding orders.

The information collected at the enterprise is transferred to the Financial Director, who in his turn transfers it to the Director of the Project Implementation Department of CCGS LLC. All information is transferred by e-mail.

On the basis of the received data the Department of Project Implementation of CCGS LLC prepares a GHG emission reduction 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 are incorporated or resolved the monitoring report is submitted for verification to the enterprise where the project is implemented. At CCGS LLC the procedure for verification of the monitoring reports are laid down in "Regulations on quality check and control of GHG emission reduction project design documents (PDD) and monitoring reports at CCGS LLC".

After the report is verified and amended as necessary, the Director of the Project Implementation Department of CCGS LLC informs the Financial Director about preliminary monitoring results and, if there are no comments on his part, the General Director of CCGS LLC takes the final decision to submit the monitoring report for verification to an independent expert organization.

Registration and collection of monitoring data

Registration and collection of data required for calculation of GHG emission reductions are carried out in accordance with the metering points scheme shown in Fig D.1-2.

The information required for calculation of GHG emission reductions as a result of the project is collected in accordance with the resources monitoring procedure adopted at the enterprise.

Fig. D.4-1 shows how collection and submission of information required for implementation of the monitoring plan is organised.

The procedure for data registration, monitoring and storage, and also responsible persons are shown in Table D.4-1.

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

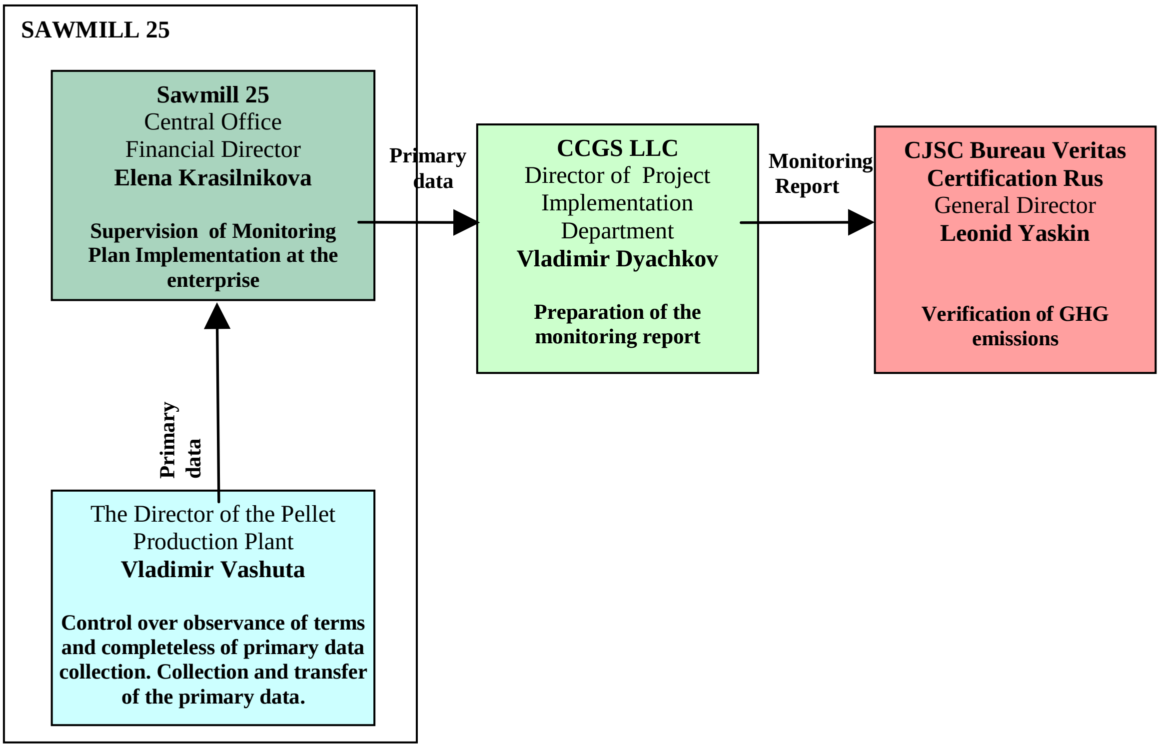

Fig. D.4-1. Organization of monitoring information collection and submission

Table D.4-1. Monitoring procedures

Monitored parameter	Procedures for registration, monitoring, recording and storage of data (including daily monitoring)	Person responsible for monitoring
Electricity consumption	1. The electricity consumption for auxiliary needs of the pellet production plant is constantly measured with the help of electric meters. 2. The readings of electric meters are displayed on the monitors of the pelletizing unit operator and the Director of the pellet production plant, printed on paper and stored in the computer memory. 3. Data are also daily recorded by the operator in daily logs at the control board of the pelletizing unit. 4. Electricity consumption data will be stored in the archive of the pellet production plant in electronic form and on paper for at least two years after the end of the crediting period or after the last transfer of ERUs under the project.	The Head of the Electrical Shop
Pellet production quantity	1. The quantity of produced pellets is measured by weighs installed at the finished products storage area. 2. The weighs readings are recorded by the operator in special logs, and submitted on a daily basis to the Production Department, where they are entered into the electronic data base. 3. Pellet production data will be stored in the archive of the pellet production plant in electronic form and on paper for at least two years after the end of the crediting period or after the last transfer of ERUs under the project.	The Head of the Production Department
Moisture content of pellets	1. Moisture content of pellets is determined 6 times per day by tests at a special section of the production laboratory of CJSC “Sawmill 25”. 2. The test results are recorded by operators in the working logs and then transferred to the electronic data base of the pellet production plant. 3. Moisture content data will be stored in the archive of the pellet production plant in electronic form and on paper for at least two years after the end of the crediting period or after the last transfer of ERUs under the project.	The Director of the Pellet Production Plant

Troubleshooting and emergency procedures

If any non-compliance of the measuring processes with the standards specified in design documentation is identified, the situation is analyzed, alternative monitoring and measuring procedures are developed for the period of non-compliance as well as corrective actions are taken that allow to remedy any identified non-compliance.

Shall any instrument fail, the respective parameters are to be monitored with a help of a duplicate instrument or, if such is not available, the failed instrument is to be replaced with a gauged back-up instrument.

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

The monitoring plan was developed by: CCGS LLC. (CCGS LLC is not the project participant as indicated in Annex 1 to the PDD).

The contact person: Vladimir Dyachkov

E-mail: v.dyachkov@ccgs.ru

SECTION E. Estimation of greenhouse gas emission reductions

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

The GHG emissions under the project are due to electricity consumption from the external power grid and from heat supplied to the pellet production needs from own heat generators during the year *y*, t CO_2e/year:

$$PE_y = PE_{el,y} + PE_{heat,PP,y}, \quad \text{(E.1-1)}$$

where $PE_{el,y}$ is the GHG emissions from electricity consumption by the pellet production plant during the year *y*, t CO_2;

$PE_{heat,PP,y}$ is the GHG emissions from heat supplied to the pellet production needs from own heat generators during the year *y*, t CO_2e.

$$PE_{el,y} = EC_{PP,y} \times EF_{grid,y}, \quad \text{(E.1-2)}$$

where $EC_{PP,y}$ is the electricity consumption by the pellet production plant during the year *y*, MWh. See Section B.1, Table B.1-1;

$EF_{grid,y}$ is the CO_2 emission factor for grid electricity, t CO_2/MWh. Value of $EF_{grid,y}$ was assumed as most conservative value for TPPs of the Interconnected Power System of North-West (see Annex 3). $EF_{grid,y}$ =0.609 t CO_2/MWh.

$$EC_{PP,y} = P_{pellet,y} \times SEC_{PP,y}, \quad \text{(E.1-3)}$$

where $P_{pellet,y}$ is the quantity of pellets produced during the year *y*, t;

$SEC_{PP,y}$ is the specific electricity consumption for pellet production during the year *y*, MWh/t.

$$PE_{heat,PP,y} = W_{BWW,PP,y} \times NCV_{BWW} \times (EF_{CH4\_bio\_comb} \times GWP_{CH4} + EF_{N2O\_bio\_comb} \times GWP_{N2O}) \times 10^{-6} \quad \text{(E.1-4)}$$

where $W_{BWW,PP,y}$ is the quantity of BWW fired at the pellet production plant during the year *y*, t;

NCV_{BWW} is the net calorific value of BWW as-fired, GJ/t;

$EF_{CH4\_bio\_comb}$ is the CH4 emission factor for biomass waste, according to [R9] $EF_{CH4\_bio\_comb}$ = 30 kg CH4/TJ;

GWP_{CH4} is the global warming potential for CH4, according to [R4] GWP_{CH4} =21 t CO2/t CH4;

$EF_{N2O\_bio\_comb}$ is N_2O emission factor for biomass and waste, according to [R9] $EF_{N2O\_bio\_comb}$ = 4 kg CH4/TJ;

GWP_{N2O} is the global warming potential for N_2O, according to [R10] GWP_{N2O} = 310 t CO_2/t NO_2.

$$W_{BWW,PP,y} = \frac{P_{pellet,y} \times SFC_{PP}}{NCV_{BWW}}, \quad \text{(E.1-5)}$$

where SFC_{PP} is the specific consumption of fuel for pellet production, GJ/t.

$$NCV_{BWW} = NCV_{BWW}^{d} \times \frac{100 - M_{BWW}}{100} - 24.42 \times 10^{-3} \times M_{BWW}, \quad \text{(E.1-6)}$$

where NCV_{BWW}^{d} is the net calorific value of BWW on dry basis, GJ/t;

24.42×10^{-3} is the heat of evaporation for water per 1 % of evaporated water, GJ/(% t);

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

Table E.1-1 below shows the results of calculations of the project emissions.

Table E.1-1. GHG emissions under the project, t CO_2e

Parameter	Reporting year					2008-2012
	2008	2009	2010	2011	2012	
Project GHG emissions	1 515	3 375	5 204	5 575	5 575	**21 245**

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

There are no leakages.

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

Since there are no leakages, then: E.1 + E.2 = E.1.

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

The baseline GHG emissions include methane emissions from the dump of Sawmill 25 avoided due to the project and are calculated as the sum of emissions from decay of sawdust and BWW during the year *y*, t CO_2e:

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

where $BE_{sawdust,y}$ is the baseline CH_4 emissions from decay of sawdust at the dump during the year *y* (under the project this sawdust is used in pellet production as feedstock), t CO_2e;

$BE_{BWW,y}$ is the baseline CH_4 emissions from decay of BWW at the dump during the year *y* (under the project BWW are used as fuel for the heat generators that produce heat for sawdust drying), t CO_2e.

The numerical estimations of avoided methane emissions from anaerobic decomposition of sawdust and BWW are 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 [R4]. The model is built on the First Order Decay method with experimental specification of a number of parameters for waste wood dumps.

$$BE_{sawdust,y} = \left(1 - w_{lignin,WW}\right) \times k_{WW} \times \frac{C_{WW}^{d}}{100} \times \left(1 - \frac{M_{sawdust}}{100}\right) \times a \times \zeta \times \left(1 - \frac{\varphi}{100}\right) \times \\ \times \left(1 - \zeta_{OX}\right) \times \frac{V_m}{100} \times \rho_{CH4} \times GWP_{CH4} \times \sum_{x=2008}^{x=y} \left(W_{sawdust,x} \times e^{-k_{WW} \times (y-x)}\right) \quad \text{(E.4-2)}$$

$$BE_{BWW,y} = \left(1 - w_{lignin,WW}\right) \times k_{WW} \times \frac{C_{WW}^{d}}{100} \times \left(1 - \frac{M_{BWW}}{100}\right) \times a \times \zeta \times \left(1 - \frac{\varphi}{100}\right) \times \\ \times \left(1 - \zeta_{OX}\right) \times \frac{V_m}{100} \times \rho_{CH4} \times GWP_{CH4} \times \sum_{x=2008}^{x=y} \left(W_{BWW,x} \times e^{-k_{WW} \times (z+(y-x))}\right) \quad \text{(E.4-3)}$$

where $W_{sawdust,x}$ is the reduction of sawdust disposal to the dump as a result of the project which is equivalent to the quantity of sawdust utilized as feedstock for pellet production (the amount of fresh biomass utilized) during the year *x*, t;

$W_{BWW,x}$ is the reduction of BWW disposal to the dump as a result of the project which is equivalent to the quantity of BWW utilized as fuel at the pellet plant during the year *x*, t;

$M_{sawdust}$ is the moisture content of sawdust, %;

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

$w_{lignin,WW}$ is the lignin fraction of C (carbon) for wood wastes;

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

C_{WW}^{d} is the organic carbon content in wood wastes on dry basis, %;

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 biogas, %;

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

GWP_{CH4} is the global warming potential of methane, t CO_2e/t CH_4;

z is the age of biomass taken from the stockpile and utilised;

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.

The following values of input parameters were used in the model taking into account recommendations in [R4]:

1. *Amount of biomass utilized.* The available data on reduction of sawdust and BWW disposal to the dump under the project, $W_{sawdust,x}$ and $W_{BWW,x}$ respectively, for the period from 2008 till 2012 were put into the model. See data in Section B.1, Table B.1-1;
2. *Moisture content.* For sawdust and BWW the recommended default value was adopted $M_{sawdust}$ = 50%; M_{BWW} = 50%;
3. *Lignin fraction of C.* The recommended default value was adopted: $w_{lignin,WW}$ = 0.25;
4. *Decomposition rate constant*. The recommended default value was adopted: k_{WW} = –ln(1/2)/15 = 0.0462 year^{-1}, where 15 is the recommended default value for half-life of wood, years;
5. *Organic carbon content on dry basis.* The recommended default value was adopted: C_{WW}^{d} = 53.6%;
6. *Conversion factor from kg carbon to landfill gas quantity*. The adopted recommended default value: a = 22.4/12 = 1.87 m^3/kg carbon, where 22.4 is molar volume of gas under normal conditions, l/mol; 12 is molar mass of C, g/mol;
7. *Generation factor*. The adopted recommended default value: ζ = 0.77;
8. *Percentage of the stockpile under aerobic conditions.* The adopted recommended default value: φ = 10%;
9. *Methane oxidation factor.* The adopted recommended default value: ζ_{OX} = 0.10;
10. *Methane concentration biogas*. The recommended default value: V_m = 60%. The adopted value: V_m = 50% (more conservative);
11. *Density of methane.* The adopted value: ρ_{CH4} = 16/22.4 = 0.714 kg/m^3, where 16 is molar mass of CH_4, g/mol;
12. *Global warning potential of methane.* The adopted recommended default value: GWP_{CH4} = 21 t CO_2e/t CH_4;
13. *Age of biomass taken from the stockpile and utilised*. The adopted value: *z*=1 year for 2008, *z*=2 years for 2009, *z*=3 years for 2010, *z*=4 years for 2011, *z*=5 years for 2012;
14. *Year for which to calculate the CO_2-equivalent reduction.* Years of the crediting period: *y* = 2008-2012;
15. *Year in which fresh biomass is utilized instead of stockpiled. x* = 2008-2012.

The results of calculation of the baseline GHG emissions are given in Table E.4-1 and in Annexes 2-1, 2-2.

Table E.4-1. The baseline GHG emissions, t CO_2e

Name	Reporting years					2008-2012
	2008	2009	2010	2011	2012	
Baseline GHG emissions, total including	3 120	11 431	23 783	36 383	48 307	**123 023**
Emissions from sawdust decomposition	2 508	9 264	19 384	29 799	39 743	100 698
Emissions from BWW decomposition	612	2 167	4 399	6 585	8 564	22 326

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

Table E.5-1. Reduction of GHG emissions, tCO_2e

Name	Reporting years					2008-2012
	2008	**2009**	**2010**	**2011**	**2012**	
Total GHG emission reductions	1 604	8 056	18 579	30 808	42 732	**101 779**

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	1 515	0	3 120	**1 604**
2009	3 375	0	11 431	**8 056**
2010	5 204	0	23 783	**18 579**
2011	5 575	0	36 383	**30 808**
2012	5 575	0	48 307	**42 732**
Total (tonnes of CO_2 equivalent)	21 245	0	123 023	**101 779**

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:

In accordance with the requirements of ph. 4.2. of Construction Standards and Rules (SNiP) 11-01-95 “Instructions for the procedures for development, agreement, approval and composition of design documentation for construction of plants, buildings and structures” [R7] the environmental impact assessment of the project was carried out.

The impact of the pellet production plant upon the land, land usage conditions and geological environment

The impact of the project construction upon the territory and geological environment is represented by condemnation of land for the project construction, terrain variation due to construction and leveling works, increase of load upon the foundation soil which now has to bear the weight of various structures, variation of hydrogeological characteristics and diversion of surface run-off.

The master plan allows for the most rational usage of land allocated for construction of the pellet production plant and for reduction of the land demand of the construction project owing to a more close-together lay-out of the building and roads:

1. Territory zoning by function,
2. Lay-out of the production building in accordance with the technological production flow diagram of the sawmill,
3. Block layout of main and auxiliary production facilities, which improves economic performance of the project and reduced the territory occupied by the project.

Land conservation during construction and cleanup activities

Construction management of the project envisaged environmental protection measures, which included soil rehabilitation at the construction site, prevention of natural resources wastage, prevention of discharges into the soil and water and emissions into the atmosphere during construction.

Construction was organized in two stages:

1. Preparation stage: geodesic survey of foundation elevations; construction of temporary buildings, structures and facilities for the workers; electric supply of the construction site; clearing of the territory from vegetation, demolition of the existing buildings and dismantling of the existing foundations.
2. Main stage: civil engineering and special works related to the project.

The construction management plan involved a number of measures aimed at mitigation of environmental impact upon soil during construction period:

1. When construction materials were delivered to the construction site it was prohibited to organize storage areas in the adjacent territories. For this purpose the construction materials, items and structures were packaged before shipment.
2. Motor vehicles moved along the existing roads and along the routes of the designed access roads. Access ways to the construction site were constantly cleared from dirt, garbage, and dust.
3. The construction debris was removed after completion of construction; leveling works and site improvement were carried out.

Site improvement includes construction of in-site and out-site motor roads with hard surface. The areas free from buildings and stockpiling were planted with vegetation. The main type of landscaping is lawns.

Land conservation during operation of the production facility

To prevent soil pollution and degradation during the project operation the following actions are envisaged on the site of the designed plant and in the adjacent territories:

1. Minimizing the level and intensity of pollutant emissions and subsequent pollution of surface run-off and soil.

2. Elevation planning of the territory allows for a drainage system connected to the existing storm run-off treatment facilities.

3. Organized collection of production and consumption wastes, compliance with the requirements to their temporary storage on the enterprise's site and adherence to transportation specifications, regular cleaning of the enterprise's territory.

Justification of the sanitary protection zone

In accordance with the classification of SanPiN 2.2.1/2.1.1.1200-03 "Sanitary-Protection Zones and Sanitary Classification of Enterprises, Structures and Other Facilities" [R8], the newly designed sawmill production falls under class IV of wood working enterprises with a sanitary protection zone of 100 m.

The calculation of maximum ground level concentrations of pollutants in reference points on the border of the 100-meter sanitary protection zone of the wood working production shows that the permissible concentration level for any of the pollutants is not exceeded.

Thus the 100-meter sanitary protection zone of the enterprise established according to [R8] is sufficient and it does not need to be expanded.

Production effluents are not generated in the process of pellet production.

The estimation of pollutant emissions in atmosphere from project activity

The pollutant emissions norms are agreed with local authorities. Current (annual) monitoring of environmental impact of the enterprise is carried out by an independent environmental service – the Center for Laboratory Analysis and Technical Measurements.

Every year 2-tp (air) [R14] reporting form is drawn up and shows information on actual emissions and allowed emissions for Maimaksa production site (see Table F.1-1).

Table F.1-1. Pollutant emissions in atmosphere in 2009, t

Name	Allowed emissions	Actual emissions
Pollutant emissions, total	2374.841	723.631

As seen from the Table F.1-1 actual emissions not exceed allowed emissions.

Thus, it can be argued that the project activity not lead to exceeding the allowed emissions.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide 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 does not have significant impact upon the environment, which is confirmed by the following official documents:

- Positive opinion of expert commission of the State environmental expertise of the Department on technological and environmental supervision in the Arkhangelsk region, No. 66 issued on 01.02.2006;
- Sanitary-and-epidemiologic positive opinion of the Territorial department of the Federal Agency for Inspection in the Sphere of Customer Rights Protection and Human Welfare No. 29.01.02.522.T.000371.12.05 issued on 26.12.2005;
- Sanitary-and-epidemiologic expertise of the Federal state health care institution “Centre of Hygiene and Epidemiology in Arkhangelsk Region”, No. 1302/557 issued on 14.12.2005;
- Positive opinion of the State expertise of the Department of architecture and urban development of Arkhangelsk region No.29-1-4-0356-07 issued on 4.04.2008;
- Permit on Air Pollutant Emissions No.11-28/01-22 dd.18/03/2010 valid till 19.03.2012.

SECTION G. Stakeholders' comments

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

Comments on behalf of local and federal authorities were received in the form of positive opinions regarding the project activity from the state expert examinations and permits for the project implementation:

- Positive opinion of expert commission of the State environmental expertise of the Department on technological and environmental supervision in the Arkhangelsk region, No. 66 issued on 01.02.2006;
- Sanitary-and-epidemiologic positive opinion of the Territorial department of the Federal Agency for Inspection in the Sphere of Customer Rights Protection and Human Welfare No. 29.01.02.522.T.000371.12.05 issued on 26.12.2005;
- Sanitary-and-epidemiologic expertise of the Federal state health care institution "Centre of Hygiene and Epidemiology in Arkhangelsk Region", No. 1302/557 issued on 14.12.2005;
- Positive opinion of the State expertise of the Department of architecture and urban development of Arkhangelsk region No.29-1-4-0356-07 issued on 4.04.2008.
- Positive opinion of Interregional registration department of State Inspection for Road Traffic Safety of Department of internal affairs of Arkhangelsk No. 14/23798 issued on 18.11.2005;
- Positive opinion of Department of roads and bridges of Mayor's office of Arkhangelsk No. 1720/169-13 issued on 01.11.2005;
- Positive opinion of the administration of Maimaksa territorial area No. 1123/365 issued on 21.12.2005;
- Positive opinion of Department of water resources in the Arkhangelsk region and Nenets Autonomous Area of Water resources department of Dvinsko-Pechorsky basin No. A-20/168 issued on 20.02.2006;
- Positive opinion of Municipal Unitary Enterprise "Arhkomhoz" No. 01-06/714 issued on 08.11.2005;
- Positive opinion of the branch "Arkhangelsk town heat network" of OJSC "AGK" No. 05-01/1925 issued on 29.11.2005;
- Positive opinion of the branch "Arkhangelsk power network" of OJSC "Arhenergo" No. 10-30/149 issued on 24.01.2006;
- Positive opinion of Arkhangelsk branch of OJSC "Arkhnagelskoblgas" No. 4/2237 issued on 11.11.2005.

It was confirmed in the aforementioned documents that the design documentation complies with the technical regulations, industrial safety, environmental and health requirements.

REFERENCES

[R1] Provisions For Joint Implementation Small-Scale Projects, Version 03, JISC

[R2] Guidance on criteria for baseline setting and monitoring, Version 02, JISC

[R3] Report "Energy Survey of the Main Equipment of the Pellet Production Plant with a view to Determining its Technical, Economic and Environmental Performance Parameters" Energy Center of ASTU, Arkhangelsk, 2008.

[R4] Methane and Nitrogen Oxide Emissions from Biomass Waste Stockpiles, PCFplus Research, World Bank, August 2002.

[R5] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Vol.1. General Guidelines./ Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004.

[R6] S.I.Golovkov, I.F.Koperin, V.I.Naidyonov. Wood Wastes-to-Energy. – M.: Forest Industry, 1987.

[R7] Construction Standards and Rules (SNiP) 11-01-95 "Instructions for the procedures for development, agreement, approval and composition of design documentation for construction of plants, buildings and structures".

[R8] Sanitary Rules and Norms (SanPiN) 2.2.1/2.1.1.1200-03 "Sanitary-Protection Zones and Sanitary Classification of Enterprises, Structures and Other Facilities".

[R9] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy

[R10] IPCC Fourth Assessment Report: Climate Change 2007: Working Group I: The Physical Science Basis.

[R11] The Minutes Of Deliberations between local non-profit organization "Environmental Investment Center" and CJSC "Sawmill-25" regarding implementation of project aimed, dated 21/04/2005.

[R12] Contract No643 dd.08/06/2007 "Procurement of equipment for a pellet production plant from sawmill wastes".

[R13] Order No329 dd.21/05/2008 On the checking of preparedness to commissioning of wood pellet production shop

[R14] Reporting form 2-tp (air) "Data on Atmospheric Air" for Maimaksa production site of Sawmill 25.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Represented by:	
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Salutation:	Mrs.
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Annex 2

BASELINE INFORMATION

Annex 2-1. Estimated GHG emissions from anaerobic decomposition of sawdust at the dump under the baseline scenario (under the project the said sawdust is used as feedstock for pellet production)

Calculation of CO_2-equivalent emission reduction from sawdust 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	0,714	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

db = dry basis
wb = wet basis
yellow cells = unprotected cells
red marks = comment field included

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

Year	Fresh biomass prevented from stockpiling or taken from			Year				
	Biomass from stockpile (ton_w)	Age of biomass (years)	Fresh (ton_w)	2008	2009	2010	2011	2012
				ton CO2-eq				
2008			30 881	2 508	2 395	2 287	2 183	2 085
2009			84 584		6 869	6 559	6 263	5 980
2010			129 751			10 538	10 062	9 607
2011			139 019				11 290	10 781
2012			139 019					11 290
Total	**0**		**523 254**					
Total emission prevention				**2 508**	**9 264**	**19 384**	**29 799**	**39 743**
Cumulative total emission prevention				**2 508**	**11 772**	**31 156**	**60 954**	**100 698**

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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Annex 2-2. Estimated GHG emissions from anaerobic decomposition of BWW at the dump under the baseline scenario (under the project the said BWW is used as fuel for feedstock drying process)

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

BWW - bark wood waste

General input data		
Conversion factor organic carbon to biogas (a)	1,87	m^3 biogas/kg carbon
GWP CH_4	21	
Density methane	0,714	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

db = dry basis
wb = wet basis
yellow cells = unprotected cells
red marks = comment field included

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

Year	Fresh biomass prevented from stockpiling or taken from			Year				
	Biomass from stockpile (ton_w)	Age of biomass (years)	Fresh (ton_w)	2008	2009	2010	2011	2012
				ton CO2-eq				
2008	7 886	1		612	584	558	532	508
2009	21 375	2			1 583	1 511	1 443	1 378
2010	32 961	3				2 330	2 225	2 125
2011	35 315	4					2 384	2 276
2012	35 315	5						2 276
Total	**132 852**		**0**					
Total emission prevention				**612**	**2 167**	**4 399**	**6 585**	**8 564**
Cumulative total emission prevention				**612**	**2 778**	**7 177**	**13 762**	**22 326**

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

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Annex 2-3. Calculation of cash flows of the investment project for the two implementation options

Unified social tax and accident and occupational disease insurance contributions	26,20%
Property tax	2,20%
Profit tax	24,00%
Rate of discounting	20,00%

		1	2	3	4	5	6	7	8	9	10	11	12	13
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
OPERATING ACTIVITY, EUR														
Revenues from sale	**0**	**2 000 000**	**4 500 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**	**6 750 000**
Sales volume	0	20 000	45 000	67 500	67 500	67 500	67 500	67 500	67 500	67 500	67 500	67 500	67 500	67 500
Price of product	0	100	100	100	100	100	100	100	100	100	100	100	100	100
Production costs	**0**	**-1 498 952**	**-3 349 477**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**	**-4 963 650**
Standing costs		64 132	121 132	121 132	121 132	121 132	121 132	121 132	121 132	121 132	121 132	121 132	121 132	121 132
Salaries		*50 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*	*100 000*
Land lease		*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*	*1 200*
Machinery insurance		*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*	*5 932*
Services (communications, security services, sudit, etc.)		*4 500*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*	*9 000*
Other		*2 500*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*	*5 000*
Variable costs	0	1 434 820	3 228 345	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518	4 842 518
Steam consumption		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Electricity consumption		*147 700*	*332 325*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*	*498 488*
Consumables and lubricants		*47 200*	*106 200*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*	*159 300*
Water supply and effluents		*2 000*	*4 500*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*	*6 750*
Repair and construction works		*10 000*	*22 500*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*	*33 750*
Packaging, rent of containers		*120 000*	*270 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*	*405 000*
Support shops		*96 800*	*217 800*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*	*326 700*
Freight		*1 000 000*	*2 250 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*	*3 375 000*
Customs dues		*11 120*	*25 020*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*	*37 530*
Tax payments	**0**	**-144 413**	**-178 304**	**-189 263**	**-177 054**	**-164 845**	**-152 636**	**-140 426**	**-128 217**	**-116 008**	**-103 799**	**-91 590**	**-79 381**	**-67 171**
Property tax		-131 313	-152 104	-163 063	-150 854	-138 645	-126 436	-114 226	-102 017	-89 808	-77 599	-65 390	-53 181	-40 971
Uniform social tax	0	-13 100	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200	-26 200
Balance-sheet value, total	**5 799 335**	**6 138 179**	**7 689 432**	**7 134 471**	**6 579 510**	**6 024 549**	**5 469 588**	**4 914 627**	**4 359 666**	**3 804 705**	**3 249 744**	**2 694 783**	**2 139 821**	**1 584 860**
Depreciation charges, total	**0**	**-211 661**	**-423 323**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**	**-554 961**
Balance-sheet value 1 phase	5 799 335	6 138 179	5 714 856	5 291 533	4 868 211	4 444 888	4 021 565	3 598 243	3 174 920	2 751 597	2 328 275	1 904 952	1 481 629	1 058 307
Depreciation charges 1 phase		-211 661	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323	-423 323
Palance-sheet value 2 phase			1 974 576	1 842 938	1 711 299	1 579 661	1 448 023	1 316 384	1 184 746	1 053 107	921 469	789 831	658 192	526 554
Depreciation charges 2 phase				-131 638	-131 638	-131 638	-131 638	-131 638	-131 638	-131 638	-131 638	-131 638	-131 638	-131 638
Taxable profit	**-34 152**	**-321 277**	**192 951**	**790 895**	**907 886**	**1 025 087**	**1 078 754**	**1 090 963**	**1 103 172**	**1 115 381**	**1 127 590**	**1 139 800**	**1 152 009**	**1 164 218**
Profit tax	0	0	-46 308	-189 815	-217 893	-246 021	-258 901	-261 831	-264 761	-267 692	-270 622	-273 552	-276 482	-279 412
Net profit	**-34 152**	**-321 277**	**146 643**	**601 081**	**689 993**	**779 066**	**819 853**	**829 132**	**838 411**	**847 690**	**856 969**	**866 248**	**875 527**	**884 806**
Operating activity balance	**0**	**356 635**	**925 911**	**1 407 273**	**1 391 404**	**1 375 485**	**1 374 814**	**1 384 093**	**1 393 372**	**1 402 651**	**1 411 930**	**1 421 209**	**1 430 488**	**1 439 767**
Operating activity balance on an accrual basis	**0**	**356 635**	**1 282 546**	**2 689 819**	**4 081 223**	**5 456 708**	**6 831 522**	**8 215 615**	**9 608 987**	**11 011 638**	**12 423 568**	**13 844 777**	**15 275 265**	**16 715 031**

Annex 2-3. Calculation of cash flows of the investment project for the two implementation options (ending)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
INVESTMENT ACTIVITY, EUR														
Capital expenditure	-5 799 335	-550 505	-1 974 576											
VAT	-650 160		-355 424											
VAT refund		650 160		355 424										
Investment activity balance	**-6 449 495**	**99 655**	**-2 330 000**	**355 424**										
FINANCIAL ACTIVITY, EUR														
Loan	6 449 495	550 505												
Repayment of loan		-291 667	-1 750 000	-1 750 000	-1 750 000	-1 458 334								
Debt servicing	-22 000	-1 000	-1 000	-1 000	-1 000	0								
Interest on loan	-12 152	-465 251	-354 946	-250 231	-145 450	-41 458								
Financial activity balance	**6 415 343**	**-207 413**	**-2 105 946**	**-2 001 231**	**-1 896 450**	**-1 499 792**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ECONOMIC PERFORMANCE WITHOUT SELLING GHG EMISSION REDUCTIONS														
Common balance	**-34 152**	**248 878**	**-3 510 035**	**-238 534**	**-505 046**	**-124 307**	**1 374 814**	**1 384 093**	**1 393 372**	**1 402 651**	**1 411 930**	**1 421 209**	**1 430 488**	**3 024 627**
Net present value (NPV)	**-390 796**													
Internal rate of return (IRR)	17,2%													
ECONOMIC PERFORMANCE WITH SELLING GHG EMISSION REDUCTIONS														
Revenues from sale of GHG emission reductions	**0**	**45 856**	**170 375**	**369 829**	**585 593**	**791 665**	**493 674**	**587 097**	**676 302**	**761 478**	**842 807**	**920 464**	**994 614**	**1 065 415**
GHG emission reductions		3 057	11 358	24 655	39 040	52 778	65 823	78 280	90 174	101 530	112 374	122 729	132 615	142 055
Value of reductions		15	15	15	15	15	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Common balance	**-34 152**	**294 733**	**-3 339 660**	**131 295**	**80 548**	**667 358**	**1 868 488**	**1 971 190**	**2 069 673**	**2 164 128**	**2 254 737**	**2 341 673**	**2 425 102**	**4 090 043**
Net present value (NPV)	**1 685 487**													
Internal rate of return (IRR)	32,1%													

Annex 3

Emission factors for TPPs of the Interconnected Power System of North-West of Russia

Plant	2005		2006		2007	
	EF_{grid}, t CO_2/MWh	Electricity, GWh	EF_{grid}, t CO_2/MWh	Electricity, GWh	EF_{grid}, t CO_2/MWh	Electricity, GWh
Kirishskaya TPP	0.572	5660	**0.609**	6911	0.567	6259
Pechorskaya TPP	0.535	2994	0.539	3274	0.536	3446
Pskovskaya TPP	0.544	1377	0.538	1776	0.539	1628