Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Valdivia biomass power plant.
Scale of the project activity	1. x Large-scale 2. ☐ Small-scale
Version number of the PDD	Version 3
Completion date of the PDD	01/08/2019
Project participants	CELULOSA ARAUCO Y CONSTITUCION S.A.
Host Party	CHILE
Applied methodologies and standardized baselines	ACM0006 (Version 14.0), "Consolidated methodology for electricity and heat generation from biomass residues".
Sectoral scopes	Scope 1
Estimated amount of annual average GHG emission reductions	77,973 CERs.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The proposed project activity consists in the construction of a new 550,000[1] (ADt/year)[2] pulp mill with 61 MW maximum surplus electric power capacity to the grid. This new pulp mill will function as a new grid-connected biomass power plant and is located in the XIV Region of Chile. The surplus electric power capacity of the mill is a result of the following initiatives:

- The installation of a high capacity biomass power boiler designed for electric power generation.
- The construction of a more efficient pulp mill, capable of generating surplus electric power to the grid.

The project activity is designed to use black liquor[3] and biomass from forest operations (bark and sawdust) for power cogeneration in the new pulp mill facility. The project activity is presented by Celulosa Arauco y Constitución S.A. (from now on, Arauco), a leading forestry and pulp-producing company in Chile.

Though modern pulp mills tend to be self-sufficient in terms of heat and electric power generation, the Valdivia pulp mill was deliberately designed to generate a considerable amount of surplus power to the grid. This power surplus is generated by burning black liquor in the recovery boiler and biomass from forest operations from own- and third-party sources in a power boiler, both inside the pulp mill facility. All the biomass consumed by the project activity is generated from sustainable forest operations[4]. The additional electric power generation capacity of the pulp mill is a result of particular modifications of the mill that enable it to generate additional power to the grid. Such capacity would have not been available to the grid with a more conventional business as usual pulp mill design. The reduction in greenhouse gas emissions is therefore accomplished through the displacement of energy from the SIC grid by the carbon neutral surplus electric power generation of the new biomass power plant. An additional reduction of greenhouse gases is also accomplished by the more efficient use of the additional biomass from forest operations used by the proposed project, which is burned efficiently in the project plant instead of being dumped in piles for natural decay or burned in the open air in an uncontrolled manner.

Considering the higher cost of building a pulp mill with surplus electric power capacity, the decision of building such power plant relied on the possibility of not relying on the SIC grid for electric power, on selling excess power to the grid, on supplying electric power to other mills within the Arauco Group and on the potential benefits from being a CDM project activity.

The proposed project activity will assist Chile's sustainable growth by providing electricity to the SIC grid through biomass power generation, which is a clean and renewable energy source. The project proponent believes that biomass power generation constitutes a sustainable source of power generation that brings clear advantages to mitigate global warming. By using the available natural resources in a more efficient way, the Valdivia CDM project activity helps to promote the development of renewable energy sources in Chile, in particular the use of biomass generated as a by-product of the forestry industry, which has a significant potential in the country. The proposed project is a good example to demonstrate the viability of electricity generation as a source of revenue not only to the pulp industry, but also to all forest-related industries. It is worthy to highlight, however,

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[1] The Valdivia pulp mill was designed to produce on average 1,800 ADt/d of bleach pulp from pine and 1,980 ADt/d of bleached pulp from eucalyptus. With 354 operating days per year and with 70% of the time planned with pine and 30% planned with euca the yearly - combined production would be 656,316 ADt/y. However, the pulp mill has an environmental permit to limit the plant to operate below the 550,000 (ADt/y), which was granted after the main equipment and the turbo generators were purchased.

[2] ADt stands for "Air Dry ton".

[3] Black liquor is an organic by-product of the pulp production Kraft cycle and falls under the category of *biomass residue*, according to the "Clarifications of definitions of biomass and consideration of changes in carbon pools due to a CDM project activity", Annex 8, of 20th Executive Board meeting report and the "Biomass residue" definition provided in page Nº2 of the ACM0006 (Version) baseline methodology used for this project activity.

[4] All the wood used to generate pulp and energy (heat and power) comes from exotic plantations of Radiata Pine and Eucalyptus. The forestlands are closely supervised by CONAF and must be managed in a sustainable way by law.

that very few pulp mills in Chile have this additional power generation capacity, making the Valdivia biomass power plant quite unique and particular in its type.

The proposed project activity is consistent with the decision taken by Arauco a few years ago of improving the energy efficiency of its industrial facilities, while at the same time reducing the GHG emissions. To accomplish this goal, Arauco has used the benefits of the CDM, as can be seen in the other CDM projects activities registered by Arauco[5], all based on the same principles of sustainable development, energy efficiency and use of renewable energy. In this context, the technological improvement associated to the proposed project activity must be recognized as an initiative that goes beyond the common practice of the pulp industry in Chile.

A.2. Location of project activity

The host country is Chile. The proposed project activity is located in the XIV Region of Valdivia, commune of San José de la Mariquina, in the province of Valdivia. It is located in km 788 of the 5-Sur highway in the Rucao sector. The Valdivia Region can be directly accessed from Santiago through the 5-Sur or Panamericana Sur highway.

The Valdivia Region holds 6.3% of the total Chilean population of 15 million inhabitants. Approximately 61% of the total population in the Region is urban, while the reminder 39% is rural. Its economy relies basically on agriculture and the growth of native forests. The salmon industry and the tourist activity are also important in this region, due to the weather conditions and natural resource present in this part of the country.

Figure 1: Geographical location of the Valdivia biomass power plant project activity

This new pulp mill will function as a new grid-connected biomass power plant and is located in the XIV Region of Chile as indicated following:

[5] By the date this PDD was written, Arauco counted with the following registered CDM} project activities: the "Trupan Biomass Power Plant in Chile", the "Nueva Aldea Biomass Power Plant Phase 1" and the "Nueva Aldea Biomass Power Plant Phase 2".

Figure 2: Valdivia biomass power plant overview

A.3. Technologies/measures

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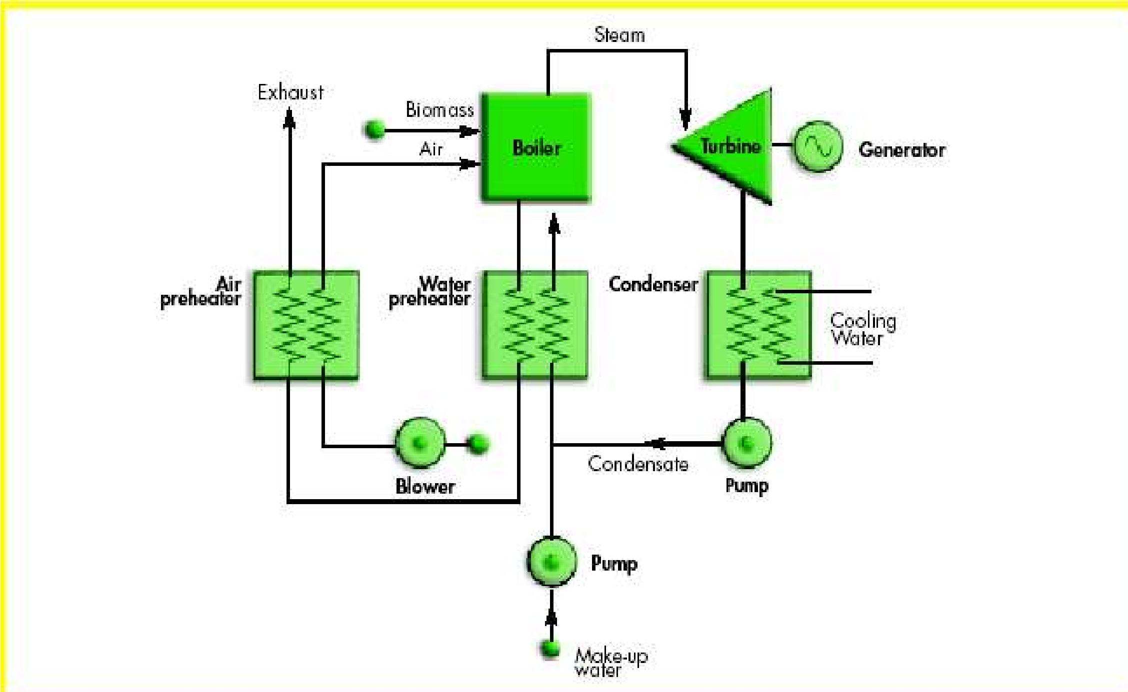
The predominant technology in all parts of the world today for generating megawatt (MW) levels of electricity from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in a boiler to generate steam, which is then expanded through a turbine. The steam-Rankine technology is a mature technology, having been introduced into commercial use about 100 years ago. Most steam cycle plants are located at industrial sites, where the waste heat from the steam turbine is recovered and used for meeting industrial-process heat needs. Such combined heat and power (CHP), or cogeneration systems provide greater levels of energy services per unit of biomass consumed than systems that generate electric power only.

The steam-Rankine cycle involves heating pressurized water, with the resulting steam expanding to drive a turbine-generator, and then condensing back to water for partial or full recycling to the boiler. A heat exchanger is used in some cases to recover heat from flue gases to preheat combustion air, and a deaerator must be used to remove dissolved oxygen from water before it enters the boiler.

Steam turbines are designed as either “backpressure” or “condensing” turbines. CHP applications typically employ backpressure turbines, wherein steam expands to a pressure that is still substantially above ambient pressure. It leaves the turbine still as a vapor and is sent to satisfy industrial heating needs, where it condenses back to water. It is then partially or fully returned to the boiler. Alternatively, if process steam demands can be met using only a portion of the available steam, a condensing extraction steam turbine (CEST) might be used. This design includes the capability for some steam to be extracted at one or more points along the expansion path for meeting process needs (figure 3). Steam that is not extracted continues to expand to sub-atmospheric pressures, thereby increasing the amount of electricity generated per unit of steam compared to the backpressure turbine. The non-extracted steam is converted back to liquid water in a condenser that utilizes ambient air and/or a cold water source as the coolant.

Figure 3: Schematic diagram of a biomass-fired steam-Rankine cycle for cogeneration using a condensing-extraction steam turbine.



Source: Williams & Larson, 1993 apud Kartha & Larson, 2000, p. 101.

Since the Valdivia biomass power plant was built in conjunction with the Valdivia pulp mill, the best way to outline and describe the equipment related to the project activity is to describe how the pulp mill would have been designed if it would have maintained the conventional business as usual design, without additional electric power generation capacity. These changes are outlined in the table below:

Table 1: Detailed description of the Valdivia biomass power plant project activity

Department	Changes
Recovery Boiler	• The recovery boiler would have been designed for the same amount of black liquor to be burned, however the liquor concentration would have been chosen lower, at 72% instead of 74%. • The high-pressure steam data would have been lower, 61 bar(a) 450ºC instead of 85 bar(a) 485ºC. Higher steam data results in a higher investment cost and higher maintenance costs. Lower steam pressure also means less power consumption for the feed water pumps. • The feed water temperature would have been reduced from 135ºC to 125ºC. This would give a smaller and cheaper boiler economizer. The only reason to have a high feed water temperature is to be able to generate more power.
Bark Boiler	• The bark boiler would have generated saturated steam instead of high pressure steam. • The maximum capacity of the bark boiler would have been similar, however the biomass capacity would have been lower. Boiler biomass

	capacity inclusive fuel preparation is extremely more expensive than oil capacity.
Boiler water systems	• The feed water tank would have had the same size, but would have been designed for a lower pressure. • The large heat exchanger to cool the process condensate could be reduced in size, the capacity could be reduced from 8 MW/ºC temperature difference to about 6 MW/ºC.
Drier	• Drier input capacity 65,00 t/h., output capacity 46,00 t/h. and water evaporation 19,00 t/h. • Drier surface of 382 m² (active drying zone with hot air flowing through) • Total connected electrical load 675,00 kW. Average electrical consumption is approx. 70% of the connected electrical load.
Steam Distribution	• The steam is primarily consumed in two pressures, medium pressure (MP) and low pressure (LP). The middle pressure level should be the same also in the baseline case, but the lower pressure level would have been selected somewhat higher, 5.0 bar (a) instead of 4.5 bar (a). This would have resulted in less expensive equipment by the consumers, especially the evaporation plant and the drying machine would have needed less heat transfer surface. • The low-pressure steam distribution pipes would have been somewhat smaller in size (i.e. less steam carries the same energy).
Turbogenerators	• The real mill is equipped with two 70 MW turbogenerators, one backpressure machine and one condensing machine. Both have extractions to the middle and low-pressure systems. In the alternative pulp mill, there would have been no condensing turbine, but two backpressure units. • The size of the turbogenerators would have been smaller, about 2 x 45 MW. • In the baseline pulp mill alternative, as there would have not been a condensing machine, there would not have been any condenser cooling water system. The size of the cooling tower would have also been considerably reduced. Possible excess of steam would have been blown off as low-pressure steam and not condensed.
Evaporator Plant	• The number of effects would have been reduced from 6 to 5. This would have reduced the investment cost. • The outlet concentration would have been reduced from 74% to 72%. This would have resulted in a cheaper plant. • The warm water temperature of 50ºC from the surface condenser would have been reduced to 45ºC to reduce the condenser surface.
Drying Machines	• The drying machines of the real pulp mill are equipped with an expensive shoe press. One main reason for the shoe press is the reduced steam consumption in the dryer, to give more excess steam for condensing power generation. If the electrical power generation had been reduced, the shoe press would have not been economically justified and would have not been installed. A system without a shoe press would demand a somewhat larger dryer, but the higher low-pressure steam would have resulted in a small dryer.
Fibre Line	• The hot water temperature would have been reduced from 90ºC to 85ºC, which would reduce the costs for the heat recovery surface somewhat.
Electrical Systems	• As a result of the lower generation capacity of the baseline pulp mill alternative, it would have been chosen a lower distribution voltage: 13.2KV instead of 15KV. • The total capacity of the electrical system would have been reduced in the alternative case. The capacity of the transformer against the external grid would have been reduced, though still allowing the mill to run without the turbogenerators. • The number of variable speed drives would have been reduced.

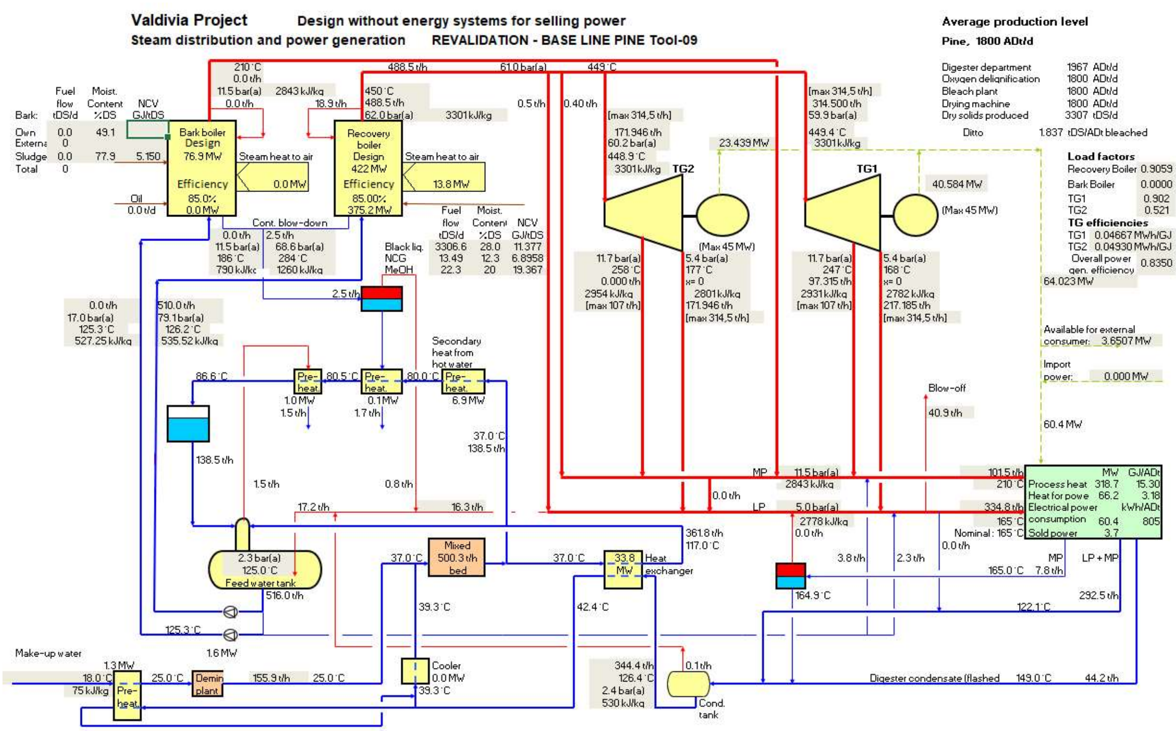
The alternative business-as-usual (BAU) pulp mill (or reference mill) would have had the same capacity as the real mill (with the implementation of the CDM project activity) and would have

contemplated the installation of a power and recovery boilers dimensioned to generate the exact same amount of pulp per year, assuming self-sufficiency in thermal and electric power generation[6]. The BAU pulp mill alternative would have contemplated the installation of the latest and most modern equipment in the pulp industry, as the real pulp mill currently does. The differences highlighted above are exclusively derived from the on-site additional electric power generation capacity of the pulp mill design that includes the proposed CDM project activity.

The following diagrams below show the energy / mass balances of the conventional BAU pulp mill and the project pulp mill. These diagrams (and energy / mass flow calculations) will be used later in this PDD to calculate some parameters, which are required to calculate the emission reductions of this project activity.

<u>Valdivia pulp mill configuration without electric power generation capacity</u>

Baseline scenario for pine campaign



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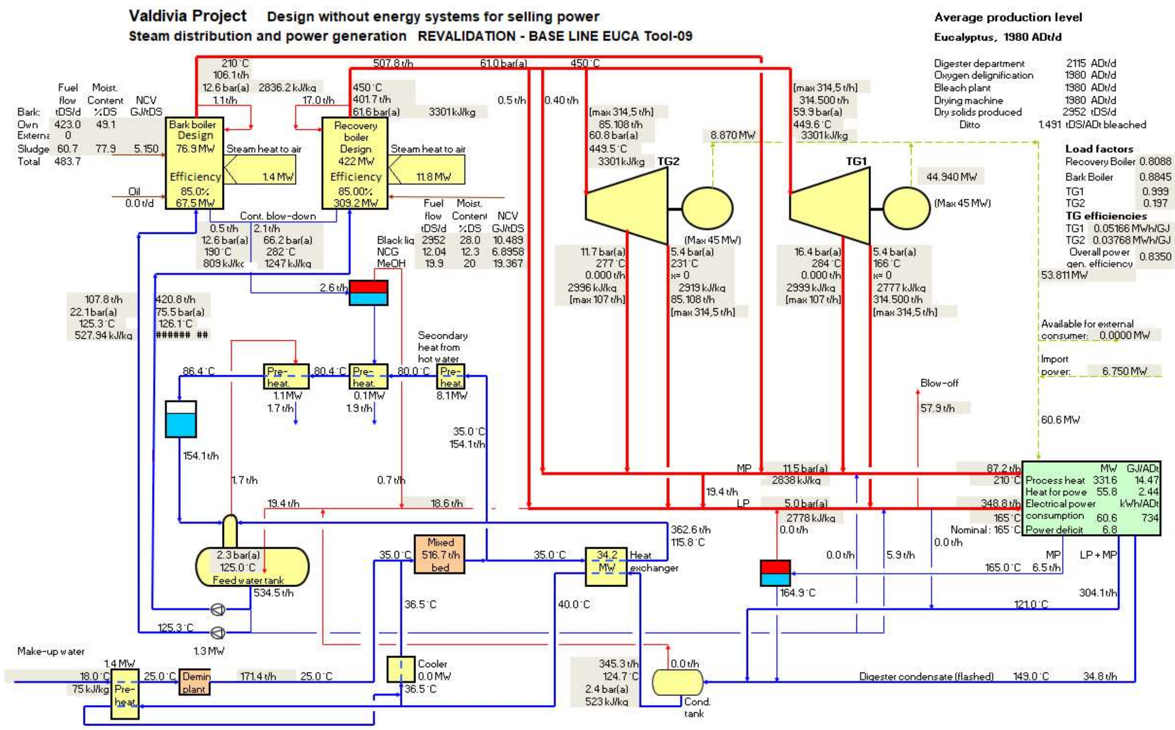
6 See explanation below the baseline energy / mass balances.

BASELINE SCENARIO FOR EUCA CAMPAIGN

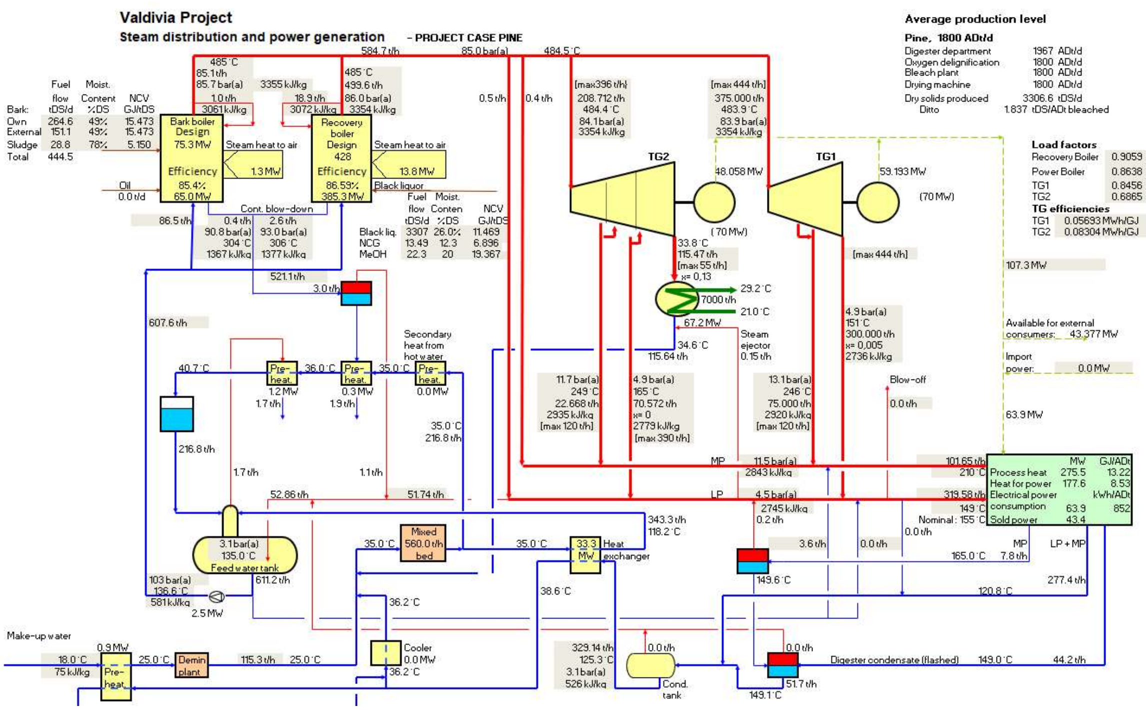


As can be seen above, the Valdivia pulp mill is designed to produce two types of pulp <u>alternatively</u>, from Pine (long fiber pulp) or from Eucalyptus (short fiber pulp). In the first case, the mill is capable of producing all the electric power for internal consumption, however in the second case, the mill is not able to do so and must marginally rely on the grid for power purposes. This happens because under a conventional pulp mill design, the Kraft cycle for Eucalyptus does not produce enough black liquor to generate all the electric power required by the mill. This shortcoming is a characteristic of a conventional pulp mill design, since other modern pulp mills recently built in Chile also present a small power deficit when they produce pulp from Eucalyptus. It is foreseen for this second crediting period, based on previous monitoring periods that the Valdivia pulp mill will produce pulp from Eucalyptus 30% of the time, leaving the remaining 70% of the time devoted exclusively to Pine pulp production, so the baseline design would still be almost self-sufficient in electric power generation during the year.

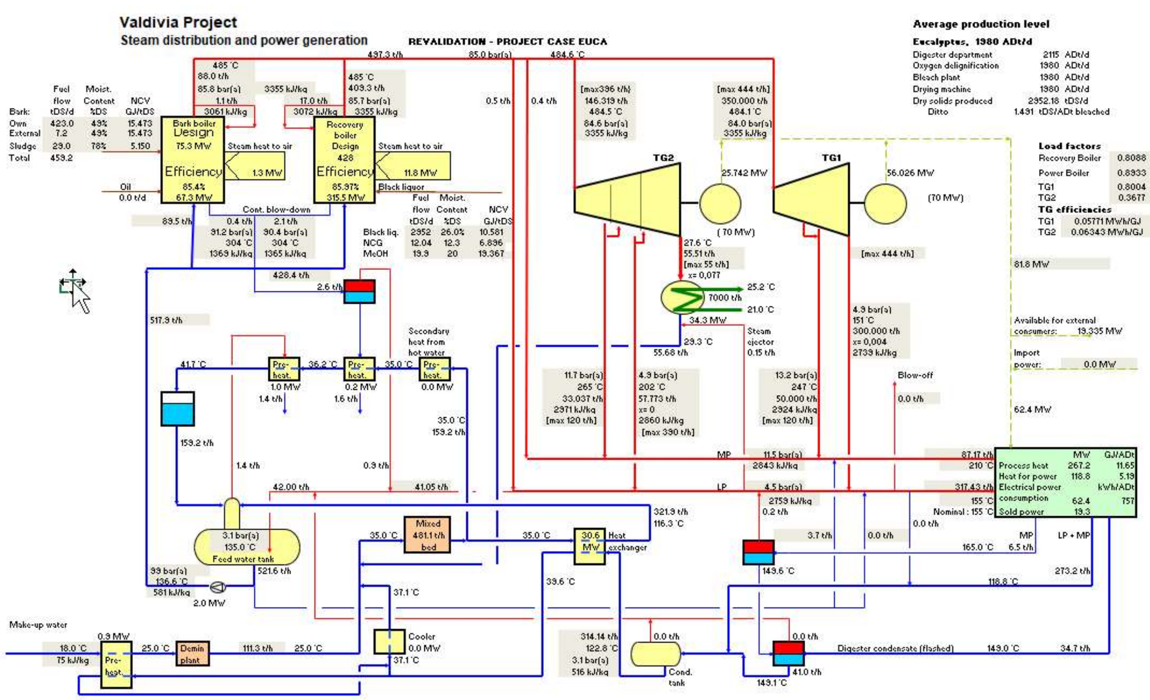
Despite the above and for conservative reasons, it will be assumed that the baseline pulp mill would have been completely self-sufficient in electric power generation.

Valdivia pulp mill configuration with electric power generation capacity.

Project case under pine campaign (average production without restricted production)

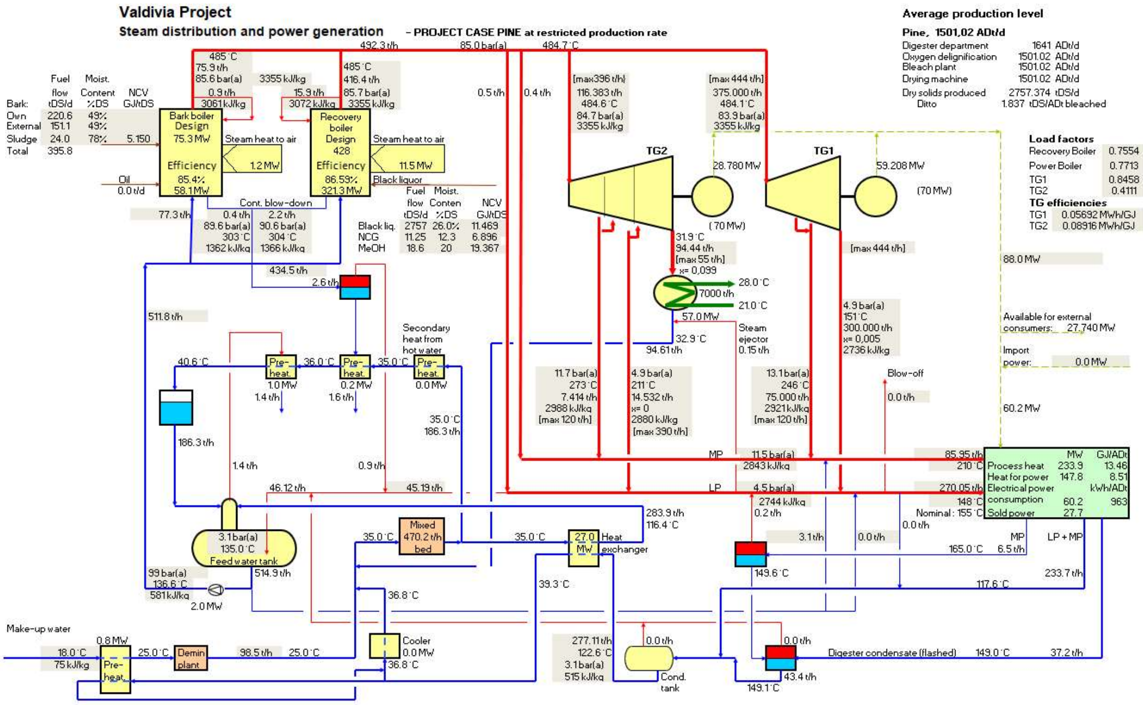


Project case under euca campaign (average production without restricted production)

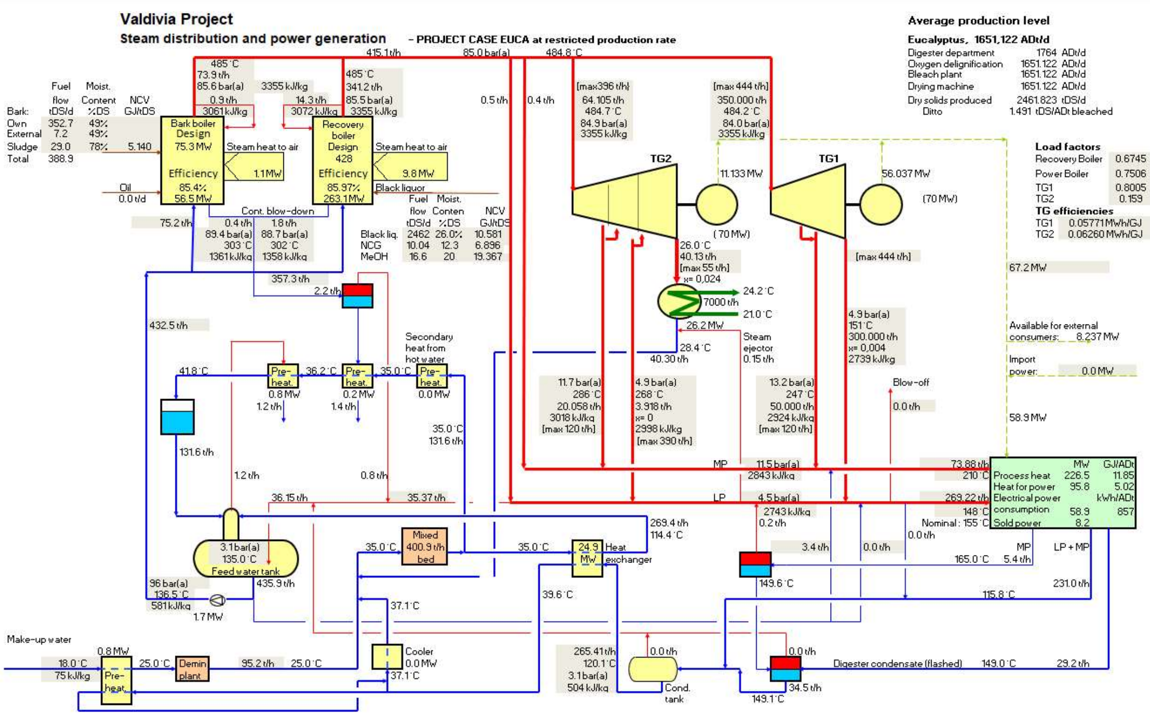


Valdivia pulp mill configuration with electric power generation capacity.

Project case under pine campaign (average production WITH restricted pulp production to 550,000 ADt/yr)



Project case under euca campaign (average production WITH restricted pulp production to 550,000 ADt/yr)



A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile	Celulosa Arauco y Constitución S.A..	No.
United Kingdom of Great Britain and Northern Ireland.	Celulosa Arauco y Constitución S.A.	No.

A.5. Public funding of project activity

The financial plans for the proposed project activity did not involve public funding. The investment made in the Valdivia biomass power plant was financed with Arauco's own resources.

A.6. History of the project activity

The Project participant confirms that the proposed CDM project activity is registered as a CDM project activity, but it was not included as a component project activity (CPA) in a registered CDM programme of activities (PoA).

A.7. Debundling

Not applicable.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference of methodologies and standardized baseline

The name of the approved baseline methodology applied to the proposed project activity is:

ACM0006 (Version 14.0), "Consolidated methodology, electricity and heat generation from biomass".

The proposed project activity also relies on the application of the latest versions of the following methodological tools (referenced in the methodology ACM0006 (Version 14.0)).

"TOOL07: Tool to calculate the emission factor for an electricity system (Version 07.0)".

"TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (Version 03.0)".

"TOOL09: Determining baseline efficiency of thermal or electric energy generation systems (Version 02.0)".

"TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)".

"TOOL16: Project and leakage emissions from biomass (Version 04.0)

Since this PDD is designed to revalidate the crediting period of the Valdivia biomass power plant CDM project activity, the document also relies on the last versions of the following procedures/tools:

"TOOL11Assessment of the validity of the original/current baseline and update the baseline at the renewal of a crediting period (Version 03.0.1)".

"TOOL12: Project and leakage emissions from transportation of freight (Version 01.1.0)".

B.2. Applicability of methodologies and standardized baselines

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The Valdivia biomass power plant project activity is a biomass cogeneration power plant that generates electricity and thermal energy from renewable energy sources.

Paragraph 48 of the Marrakesh Accords stipulates that:

"In choosing a baseline methodology for a project activity, project participants shall select from among the following approaches the one deemed most appropriate for the project activity taking into account any guidance by the executive board, and justify the appropriateness of their choice:

a) Existing actual or historical emissions, as applicable; or,
b) Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;
c) The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 percent of their category.

Since the project activity will serve to reduce emissions from existing emission sources and that biomass is not normally used to generate surplus electric power to the grid, approach a) seems to be the applicable option in selecting the baseline scenario for Valdivia project activity.

According to the chosen baseline methodology, the Valdivia Power Plant fully complies with the applicability criteria:

- The proposed project activity includes the installation of a new power generation plant at a site where currently no power generation occurs. Therefore it is a "power greenfield" project.

Further requirements are also fulfilled by the proposed project activity:

No other biomass types than biomass residues are used in the project plant and these biomass residues are the predominant fuel used in the project plant: The Valdivia power plant will use black liquor from its pulping process and forest residues (bark and sawdust) from its own- and third-party forest operations. Some fossil fuel can be co-fired for operational reasons (i.e. biomass from forest operations is too wet in winter) and to a limited extent, to enhance the economic performance of the power plant.

Fossil fuel may be co-fired in the project plant. However, the amount of fossil fuels co-fired does not exceed 80% of the total fuel fired on an energy basis: As will be shown in the subsequent sections for this PDD some fossil fuels may be co-fired due to operational reasons (e.g. start-up operations, shut down operations) and to a limited extent, to enhance the economic performance of the plant.

For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project does not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in the process: The biomass generated in the Valdivia pulp mill is

absolutely determined by the processing capacity of the pulp mill. The mill was designed for a pulp production capacity of 656,316[7] (ADt/y). This production level was used for the reference and project plants informed in the original PDD. However, and as it was informed in previous section of this document the mill got an environmental permit which limited its pulp production to 550,000[8] (ADt/y).

The biomass used at the project facility should not be stored for more than one year: The black liquor is a by-product of the Kraft cycle and is normally burned in a dedicated boiler (the recovery boiler) to recover and recycle the inorganic compounds required in the pulping process. For that reason, it is not stored in the pulp mill. The biomass used in the power boiler (bark and sawdust) is stored in a dedicated place in the Valdivia pulp mill site. However, the storage time of that biomass is not higher than one week approximately (total biomass/consumption rate).

The biomass residues used by the project facility are not obtained from chemically processed biomass (e.g. through esterification, fermentation, hydrolysis, pyrolysis, bio- or chemical-degradation, etc.) prior to combustion. Moreover, the preparation of biomass-derived fuel does not involve significant energy quantities, except from transportation or mechanical treatment so as not to cause significant GHG emissions.

No fuel switch activities are considered part of the proposed project activity.

No biogas is considered as part of the project activity in power and/or heat generation.

No dedicated energy biomass plantations are considered part of the proposed project activity.

The methodology is only applicable if the most plausible baseline scenario, as identified per the "Selection of the baseline scenario and demonstration of additionality" section hereunder, is:

- For power generation: Scenario P2 to P7, or a combination of any of those scenarios.
- For the generation: Scenarios H2 to H7, or a combination of any of those scenarios.

When using biomass residues, the alternative scenarios of the biomass residues in the absence of the project activity shall be determined following the guidance in the methodological tool "Project and leakage emissions from biomass":

- For biomass residues use: Scenarios B1 to B4, or any combination of those scenarios.

In addition to the alternative scenarios included in the methodological tool "Project and leakage emissions from biomass", the alternative scenarios shall include:

B5: The biomass residues are used for power or heat generation at the project site in new and/or existing plants.

[7] The design production capacity is 656,316 ADt/y determined as follows: 1,800(ADt/y)*70%+ 1,980(ADt/y)*30%, where the former value corresponds to the pulp production under pine and the second under euca campaign. From 354 days of normal operation 70% of the time the plant operated under pine campaign and 30% under euca campaign.

[8] This is informed in the original PDD on page 2 and corresponds to the environmental permit, which cap the pulp production below the 550,000 (ADt/y).

B.3. Project boundary, sources and greenhouse gases (GHGs)

	Source	GHGs	Included?	Justification/Explanation
Baseline scenario	Electricity and heat generation	CO_2	Included	Main emission source. It must be noticed though, that the project activity does not claim emission reductions due to heat displacement. Heat generation is not influenced by the project activity and in the cogeneration facility it is accomplished using renewable, carbon neutral biomass residues.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Uncontrolled burning or decay of surplus biomass residues	CO_2	Excluded	All biomass used in the project activity come from renewable sources. It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included	Surplus biomass (mix of sawdust and bark) if not used for power generation is normally left in piles for uncontrolled burning or natural decay.
		N_2O	Excluded	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources [a].
Project scenario	On-site fossil fuel consumption	CO_2	Included	This emission source is considered by the Project Participant.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be small [b].
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small [b].
	Off-site transportation of biomass.	CO_2	Included	This emission source is considered by the Project Participant.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be small [b].
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small [b].
	Combustion of biomass for electricity and heat.	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included	This emission source must be included if CH_4 emission from uncontrolled burning or decay of biomass residues in the baseline scenario are included.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small [b].

a. Note that the emission factors for CH_4 and N_2O emissions from uncontrolled burning or decay of dumped biomass residues are highly uncertain and depend on many site-specific factors. Quantification is difficult and may increase transaction costs significantly. Note also that CH_4 and N_2O emissions from the natural decay or uncontrolled burning are in some cases (e.g. natural decay of forest residues) not anthropogenic sources of emission included in Annex A of the Kyoto Protocol and should not be included in the calculation of baseline emissions pursuant to paragraph 44 of the modalities and procedures for the CDM.

b. CH_4 and N_2O emission factors depend significantly on the technology (e.g. vehicle type) and may be difficult to determine for project participants. Exclusion of this emission source is not a conservative assumption; however, it appears reasonable, since CH_4 and N_2O from on-site use of fossil fuels and transportation are expected to be very small compared to overall emission reductions, and since it simplifies the determination of emission reductions significantly.

B.4. Establishment and description of baseline scenario

According to the ACM0006 (Version 14.0), the Project Participant shall identify the most plausible baseline scenario and demonstrate additionality using the steps outlined in the section of the methodology: “Selection of the baseline scenario and demonstration of additionality”.

Step 1: Identification of alternative scenarios.

Sub-step 1a requires the project participant to define alternative scenarios to the proposed CDM project activity.

According to ACM0006 (Version 14.0), Project Participant should identify realistic and credible alternative scenarios that are available to Project Participants that can provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity and that have been implemented previously or are currently underway in the relevant geographical area. It is also recommended that the relevant geographical area should include preferable ten facilities (or projects) that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity. In case less than ten facilities (or projects) are found in the region/host country, the geographical area may be expanded accordingly.

The relevant geographical area for the CDM project activity is the host country Chile with more than ten projects similar and comparable to this project activity without considering the implementation of the CDM project activity. These facilities correspond mostly to alternative scenarios for surplus electric power generation.

The alternative scenarios should specify:

- How electric power would be generated in the absence of the CDM project activity;
- How heat would be generated in the absence of the CDM project activity;
- If the project activity generates mechanical power through steam turbines (s): how the mechanical power would be generated in the absence of the CDM project activity; and
- What would happen to the biomass residues in the absence of the project activity?

Table 3: How electric power would be generated in the absence of the CDM project activity

Scenario	Scenario description	Feasibility in the context of the proposed project activity
P1:	The proposed project activity not undertaken as a CDM project activity.	Yes.
P2:	The **continuation** of power generation in existing power plant at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the starting date of the project activity	No. There was no power plant at the project site before the implementation of the project activity. Power was obtained from the grid.
P3	The **continuation** of power generation in existing power plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the starting date of the project activity.	No. There was no existing power plant at the project site before the implementation of the project activity. Power was obtained from the grid.

P4:	The **retrofitting** of an existing power plant at the project site. The retrofitting may or may not include a change in fuel mix.	No. There was no power plant at the project site before the implementation of the project activity. Power was obtained from the grid.
P5:	The installation of a **new** power plant at the project site different from those installed under the project activity.	Yes.
P6	The generation of power in **specific off-site** plants, excluding the power grid.	No. There was no existing captive power plant at the project site.
P7	The generation of power in the **power grid.**	Yes. This was the situation before the implementation of the project activity. This is also the situation in conventional Sawmill/Plywood mill boiler.

According to the above, the feasible baseline scenarios for power generation would be: P1, P5, and P7

Table 4: How heat would be generated in the absence of the CDM project activity

Scenario	Scenario description	Feasibility in the context of the proposed project activity
H1	The proposed project activity not undertaken as a CDM project activity.	Yes.
H2	The continuation of heat generation in existing plants at the project site. The existing plants would operate at the **same conditions** (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the project activity.	No. There was no power plant at the project site before the implementation of the project activity.
H3	The continuation of heat generation in existing plants at the project site. The existing plants would operate **with different** conditions from those observed in the most recent three years prior to the project activity	No. There was no existing power plant at the project site before the implementation of the project activity.
H4	The retrofitting of existing plants at the project site. The retrofitting may or may not include a change in fuel mix.	No. There was no power plant at the project site before the implementation of the project activity.
H5	The installation of new plants at the project site different from those installed under the project activity.	Yes.
H6	The generation of heat in specific off-site plants	No. External heat sources are not available in Chile on a normal basis. It was not available in the context of the project activity.
H7	The production of heat from district heating	No. External heat sources are not available in Chile on a normal basis. It was not available in the context of the project activity.

According to the above, the feasible baseline scenarios for heat generation would be: H1and H5.

Table 5: How the mechanical power would be generated in the absence of the CDM project activity

Scenario	Scenario description	Feasibility in the context of the proposed project activity

M1	The proposed project activity not undertaken as a CDM project activity	No. Since mechanical power would not be generated in the absence of the project activity
M2	If applicable, the continuation of mechanical power generation from the same steam turbines in existing plants at the project site.	No. There was no mechanical power generation at the project site before the implementation of the project activity.
M3	The installation of new steam turbines at the project site.	No. Since mechanical power would not be generated in the absence of the project activity
M4	If applicable, the continuation of mechanical power generation from electrical motors in existing plants at the project site.	No. There was no mechanical power generation at the project site before the implementation of the project activity.
M5	The installation of new electrical motors at the project site.	No. Since mechanical power would not be generated in the absence of the project activity

Table 6: What would happen to the biomass residues in the absence of the project activity?

Scenario	Scenario description	Feasibility in the context of the proposed project activity
B1:	The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.	Yes.
B2:	The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.	No. The biomass residues are normally used for heat and power generation in pulp mills. As a result, this baseline is not applicable in this case.
B3:	The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes.	Yes.
B4:	The biomass residues are used for energy or non energy applications, or the primary source of the biomass residues and/or their fate cannot be clearly identified.	Biomass used for energy: No. The generation of biofuels using forestry biomass residues (sawdust and bark) is not developed at an industrial scale in Chile (and in the world) to date. Biomass used for non-energy applications: No. The biomass residues used for energy generation purposes are not the same as the biomass residues used for feedstock for pulp and paper production. Primary source of biomass residues and/or their fate cannot be clearly identified: No. Though there is a market for biomass residues in the region, considerable surplus still remains which is not commercialized, but disposed in piles or burned in the open air. For this reason, this baseline is not really applicable for the biomass types considered under this project activity

B5:	The biomass residues are used for power or heat generation at the project site in new and/or existing plants.	Yes.

According to the above, the feasible baseline scenarios would be: B1 or B3 and B5.

As previously mentioned, the project activity consists in a new pulp mill equipped with 2 x 70 MW gross generation capacity with 61 MW maximum of surplus electric power capacity to the grid. The surplus electric power capacity of the mill is a result of the following initiatives:

- The installation of a high capacity biomass power boiler designed for electric power generation.
- The construction of a more efficient pulp mill, capable of generating surplus electric power to the grid.

To achieve this, the project activity is designed to use different biomass residues types for power cogeneration in the new pulp mill facility.

Biomass residues type[9]:

- Black liquor.
- Methanol (MeOH).
- Concentrated Non Condensable Gases (CNCG). This is a residual gas from the pulping process.

Biomass from industrial and forestry operations (sawdust and bark):

- Sludge from on-site industrial operations.
- Mix of sawdust and bark from on-site industrial operations.
- Mix of sawdust and bark from off-site industrial operations.
- Mix of sawdust and bark from off-site forest operations.

In the following tables different project alternatives are presented as plausible baseline scenarios for this project plant. In each option, it is mentioned the feasibility of becoming the baseline scenario for the project activity and also it is addressed what would happen to any difference in power generation between each alternative and the project plant, in the absence of the project activity.

1.1 Conventional self-sufficient pulp mill, without surplus power generation capacity.
This is the standard practice in the pulp industry in Chile and in the world. The technology for these pulp mills is proven and fully developed. Under this alternative, the pulp mill would be self-sufficient in heat and electric power generation and would have to rely on the external grid for start-ups and other contingencies. Technical assumptions: Under this scenario, design maximum heat generation capacity, load factor, energy efficiencies, fuel mixes and equipment configuration correspond to the ones considered under baseline scenario of the project activity. Technical specifications are presented as follows: Equipment configuration:

[9] As Black liquor, Methanol and CNCG are also biomass residues types generated in the Kraft pulping process. However, Methanol and CNCGs represent less than 2% of the total energy contribution of the biomass fuels used in the power plant.

- Two backpressure heat engines.
- Heat generator #1 (Recovery boiler).
- Heat generator #2 (Power boiler)

Installed capacities:

- Heat generator #1 (Recovery boiler): Design maximum heat generation capacity of 422MW[10] with a max high-pressure steam flow of 314.5 (t/h) to backpressure heat engine TG1 and a max high-pressure steam flow of 314.5 (t/h) to the backpressure heat engine TG2.
- Heat generator #2 (Power boiler):75.3MW
- Back-pressure heat engine: (max 45MW)
- Back-pressure heat engine: (max 45MW)

Load factor:

- Heat generator #1 (Recovery boiler): 0.9059 (pine) and 0.8088 (euca) determined as: (average value) / (Design value)
- Heat generator #2 (Power boiler):   0.0 (pine) and 0,8958 (euca) determined as: (average value) / (Design value)
- Heat engine TG1 (Backpressure): 69.461 % (31.257MWproduced / 45 MW installed $_{\text{capacity}}$) for pine and 46.84 % (21.078MW_{produced} / 45 $MW_{\text{installed capacity}}$) for euca.
- Heat engine TG2 (Back-pressure): 76.733% (34.530MW_{produced} / 45$MW_{\text{installed capacity}}$) for pine and 74.688% (33.609MW_{produced} / 45$MW_{\text{installed capacity}}$) for euca.

(See note below additional information about how the actual power generation and design capacity of the turbo generators were determined).

Efficiency:

- Overall efficiency: 83.5% for pine and 83.5% for euca.
- Heat generator #1 (Recovery boiler) (based on NCV-dry basis): 85.0% for pine and 85.0% for euca.
- Heat generator #2 (Power boiler) (based on NCV-dry basis): 85,0%
- Heat engine (Backpressure TG1): Pine 0.04630 (MWh/GJ) and Euca 0.04561 (MWh/GJ).
- Heat engine (Backpressure TG2): Pine 0.05232 (MWh/GJ) and Euca 0.05222 (MWh/GJ).

Fuel mixes:

Recovery boiler:

- Black-liquor (from pine pulp): 819,474(tDS/y) determined as [3,307 (tDS/d) * 354d]*70%.
- Black-liquor (from euca pulp): 106(tDS/y) determined as [2,952 (tDS/d) * 354d]*30%.
- CNCGs: (at pine pulp) 3,342.8(tDS/y) determined as [13.49(tDs/d) * 354d]*70%
- CNCGs: (at euca pulp) 1,278.6(tDS/y) determined as [12.04(tDs/d) * 354d]*30%
- MeOH: (at pine pulp) 5,525(tDS/y) determined as   [22.3(tDS/d) * 354d]*70%
- MeOH: (at euca pulp) 21,133.8 (tDS/y) determined as   [19.9(tDS/d) * 354d]*30%

Power boiler:

[10] Data obtained from the energy and mass balance informed in this PDD.

- Sludge (under euca campaign):6,446.3 (tDS/y) determined as [60.7(tDs/d) * 354d]*30%
- Sawdust and bark from on-site industrial Ops 44,922 (tDS/y) determined as [423(tDs/d) * 354d]*30%.

The Project Participant informs that figures above informed are obtained from the diagram of the baseline energy and mass balance presented in this PDD, and carried out specifically for this alternative configuration.

Notes:
The actual power generation of the TGs (#1 and #2) for the baseline case has been established considering the following:

- The actual power generation must be the same as the power consumption as the baseline mill would be, according to the definition informed in the registered PDD a self-sufficient pulp mill, without surplus power generation to the grid.
- The pulp mill was designed to produce 1,800 ADt/d of bleached pulp from pine and 1,980 ADt/d of bleached pulp from eucalyptus. With 354 operating days/y and with 70% of the time planned with pine and 30% eucalyptus the yearly combined production would be 656,316 ADt/a. This means that 11 days per year allocated for planned maintenance stop for all departments and equipment in the mill including turbo generators.
- In the diagrams of the baseline case energy and mass balance informed in this PDD show an average power consumption of 64.023 MW (TG1: 40.584 MW + TG2: 23.439MW) at pine campaigns and 53.81 MW (TG1: 8.870 MW + TG2: 44.940 MW) at euca campaigns. During pine campaigns the power generation is higher than the power demand at 60.4 MW, and at euca campaigns the power generation is lower than the power consumption. As an average, the mill will have a theoretical small surplus of power generation.
- The power generation in each of the TGs (#1 and #2) is calculated using the following parameters: a) the steam pressure in and out; b) the steam temperature in; c) steam flows in and out at the different levels; d) an overall efficiency at 83.5% as per Tool 09 “Determining the baseline efficiency of thermal electric generation systems” (version 02.0); e) thermodynamic laws and behaviour of commercial steam turbines.

The design capacity of the TGs (#1 and #2) has been established considering the following:

The total installed power generation capacity is 90 MW (45MW + 45MW) in the baseline case. The difference between the design capacity and the average required capacity results is in the pine case 25.98MW (90MW – 64.023 MW) and in the eucalyptus case 36.19MW (90MW – 53.81MW).

a) The main reasons behind the 25.98MW/36.19 MW difference between utilized and installed capacity are due to the following considerations: The mill is operating at

restricted pulp production of 550,000 (ADt/yr) due to the actual environmental permit which was granted after the main equipment and the turbo generator were purchased.
b) Margin to make sure that the TGs based on predicted values are not too small at the real plant operation,
c) As the energy and mass balance was performed under average conditions of the pulp mill a margin shall be contemplated for seasonal variations in power consumption,
d) Normally the pulp mill operated above average conditions for long periods of time, therefore additional capacity shall be contemplated to cope with this operational condition,
e) To give sufficient catch-up capacity for unplanned maintenance stops,
f) To give sufficient power generation capacity with one turbo generator to make possible a controlled shutdown or controlled reduction of production at a failure of one of the Turbo generators.

TGs are with exactly the same size as they idea is to minimize the negative consequences of failure of one TG and to be able to have common spares for the generator and the rest of 13.2 kV system.

Power generation: Power would be generated in the cogeneration plant inside the pulp mill, but only to the extent of supplying the pulp mill's internal power requirements. Since no surplus power would be generated, in the absence of the proposed project activity, the surplus would have to be generated by power plants in the grid.

The applicable baseline scenario for power would be:

- The power required by the pulp mill: P5
- The power required would be obtained from the power grid: P7 (only for start-ups and other contingencies).

Heat generation: All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.

The applicable baseline scenario for heat generation would be: H5

Biomass residues: The same amount of black liquor and a lower amount of biomass from forest operations (sawdust and bark) would be used as fuel in this case, compared to the amounts used in the project plant, respectively. In the absence of the proposed project activity, the unused biomass residues from forest operations would be burned in the open-air or left in piles to natural decay.

The applicable baseline scenarios for biomass types would be:

Recovery boiler:

1) Black liquor:B5
2) Methanol:B5
3) CNCG:B5

Power boiler:

1. Sludge from off-site industrial operations:B5
2. Mix of sawdust and bark from on-site industrial operations:B5
3. Mix of sawdust and bark from off-site industrial operations:B1
4. Mix of sawdust and bark from off-site forest operations:B1

1.2 Conventional self-sufficient pulp mill, with a conventional fossil fuel power unit as a back-up.

This alternative is similar to the previous one, in that the pulp mill would generate its own power internally, but would back its power requirements with a dedicated gas / diesel power unit. This alternative has three advantages over the previous one: first, it provides electric power back-up, which can be used under contingencies (i.e. plant stops and maintenances); second, it is a good business, since the low price of a used / new fossil fuel power back-up units can be rapidly repaid solely on the basis of the firm power revenues (i.e. the unit does not have to operate to repay the investment, just be available for dispatch in the grid); third, it can generate surplus power to the grid when the spot price of electricity is sufficiently high. Arauco has actually implemented this solution in its Arauco mill, where it installed a 25 MW, dual fuel Frame 5 (Horcones power plant) nearby the industrial facility.

Technical assumptions:

This option is similar to the previous one with the distinction that a conventional fossil fuel power unit would be contemplated as back-up.

Power generation: Power would be generated in the cogeneration plant inside the pulp mill, but only to the extent of supplying the pulp mill's internal power requirements. Additional power could be occasionally generated with the fossil fuel unit, particularly during pulp-mill maintenance and start-up operations or when the price of electricity is high. As a result, in the absence of the proposed project activity, a significant fraction of the surplus power generated by the project plant would still have to be generated by power plants in the grid.

The applicable baseline scenario for power would be:

- The power required by the pulp mill would be obtained from the power grid: P7
- The surplus of electric power to the grid: P5 and P7 (part of surplus power generated by project plant would be also generated by grid-connected plants, since the surplus power generation would depend on the spot price level).

Heat generation: All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.

The applicable baseline scenario for heat generation would be: H5

Biomass residues: The same amount of black liquor and a lower amount of biomass from forest operations (sawdust and bark) would be used as fuel in this case, compared to the amounts used in the project plant, respectively. In the absence of the proposed project activity, the unused biomass residues from forest operations would be burned in the open-air or left in piles to natural decay.

The applicable baseline scenarios for biomass types would be:

Heat generator #1 (Recovery boiler):

1) Black liquor: B5
2) Methanol:B5
3) CNCG:B5

Heat generator #2 (Power boiler):

1) Sludge from off-site industrial operations:B5
2) Mix of sawdust and bark from on-site industrial operations:B5
3) Mix of sawdust and bark from off-site industrial operations:B1
4) Mix of sawdust and bark from off-site forest operations:B1

1.3 Pulp mill designed to generate additional electric power at a lower efficiency or at a later stage, not undertaken as a CDM project activity.

As the proposed project activity, this is also a possible alternative, however from the project proponent's point of view, such undertaking would not constitute the usual practice in the relevant industry either. It would face similar barriers as the proposed project activity (i.e. become a visible player in the power industry) and therefore, would most likely not happen without the incentives of the CDM. In addition, since the more sophisticated pulp mill would generate additional power mainly based on black liquor, transforming a conventional pulp mill into a net power exporter (on black liquor) at a later stage would be prohibitively expensive[11]. Similarly, a less efficient power producing pulp mill would have slightly lower investment cost than the more efficient counterpart, and would certainly not be able to generate as much surplus electric power as the more efficient mill. This would make the project less attractive from a financial point of view and therefore less viable and likely to happen.

Technical assumptions:

Under this scenario installed capacities, load factors, energy efficiencies, fuel mixes and efficiencies values (i.e. heat engine and heat generator) would be lower than those contemplated in the project activity. This would mean that this alternative would still have generated on-site electric power generation but would generate less surplus power to the grid.

Equipment configuration:

- One back pressure heat engine TG1
- One condensing wih extractions heat engine TG2
- Heat generator #1 (Recovery boiler).
- Heat generator #2 (Power boiler).

Installed capacities:

- Heat generator #1 (Recovery boiler): Design maximum heat generation capacity of 422 MW.
- Heat generator #2 (Power boiler): Design maximum heat generation capacity 75.3 MW
- Back-pressure heat engine #1: 65MW
- Back-pressure heat engine #2: 65MW

Load factor:

- Heat generator #1 (Recovery boiler): 0.7554 (pine) and 0.6745 (euca) determined as: (average value) / (Design value)
- Heat generator #2 (Power boiler): 0.7713 (pine) and 0.7506 (euca) determined as: (average value) / (Design value)
- Heat engine TG1 (Backpressure): 76.49 % (pine) and 72.73 % (euca)
- Heat engine condensing with extractions TG2: 45.66% (pine) and 18.67% (euca).

[11] It would imply major changes in key process equipment of the pulp mill. Please see Table 1 in section A.4.3 of this PDD.

Efficiency:

- Heat generator #1(based on NCV-dry basis): 86.59% for pine and 85.97% for euca.
- Heat generator #2(based on NCV-dry basis): 85.4%
- Heat engine (Backpressure TG1): 0.04868(MWh/GJ) (pine) and 0.04959 (MWh/GJ) (euca).
- Heat engine (Condensing with extractions9 TG2: P0.08958 (MWh/GJ) at pine and 0.06593 (MWh/GJ) at euca.

Fuel mixes:

Heat generator #1 (Recovery boiler):

- Black-liquor (from pine pulp): 634,386(tDS/y) determined as [2,757 (tDS/d) * 354d]*65%.
- Black-liquor (from euca pulp): 305,042(tDS/y) determined as [2,462 (tDS/d) * 354d]*35%.
- CNCGs: (at pine pulp) 2,589(tDS/y) determined as [11.25(tDs/d) * 354d]*65%
- CNCGs: (at euca pulp) 1,244(tDS/y) determined as [10.04(tDs/d) * 354d]*35%
- MeOH: (at pine pulp) 4,280 (tDS/y) determined as [18.6(tDS/d) * 354d]*65%
- MeOH: (at euca pulp) 2,057 (tDS/y) determined as [16.61(tDS/d) * 354d]*35%

Heat generator #2 (Power boiler):

- Sludge (during pine campaign):5,522 (tDS/y) determined as [24.0(tDs/d) * 354d]*65%
- Sludge (during euca campaign):3,593 (tDS/y) determined as [29.0(tDs/d) * 354d]*35%
- Sawdust and bark from on-site industrial Ops (during pine campaign). 50,737 (tDS/y) determined as [220.5(tDs/d) * 354d]*65% (under pine campaign):
- Sawdust and bark from on-site industrial Ops (during euca campaign). 43,700 (tDS/y) determined as [352.7(tDs/d) * 354d]*65%
- Sawdust and bark from off-site industrial Ops (during pine campaign). 34,768 (tDS/y) determined as [151.1(tDs/d) * 354d]*65%.
- Sawdust and bark from off-site industrial Ops (during euca campaign). 892 (tDS/y) determined as [7.2(tDs/d) * 354d]*35%.

The Project Participant informs that figures presented above were taken from the diagram of the energy / mass balance carried out specifically for this alternative configuration. Compared to the project case this project scenario would have generated less surplus electricity to the grid.

Power generation: Power would be generated in the cogeneration plant inside the pulp mill. This power capacity would be enough to serve the pulp mill's internal power requirements and would allow for some electricity exports to the grid. Since the surplus power capacity of the pulp mill in this case would be lower than the surplus power capacity of the project mill, in the absence of the proposed project activity the difference would have to be generated in power plants in the grid.

The applicable baseline scenario for power would be:

- The power required by the pulp mill and a fraction of the surplus power to the grid contemplated under the project activity: P5
- The remaining power required would be obtained from the power grid: P7

Heat generation: All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.

The applicable baseline scenario for heat generation would be:H5
<u>Biomass residues:</u> The same amount of black liquor and a lower amount of biomass from forest operations (sawdust and bark) would be used as fuel in this case, compared to the amounts used in the project plant, respectively. In the absence of the proposed project activity, the unused biomass residues from forest operations would be burned in the open-air or left in piles to natural decay. Heat generator #1 (Recovery boiler): 1) Black liquor: B5 2) Methanol:B5 3) CNCG:B5 Heat generator #2 (Power boiler): 4) Sludge from off-site industrial operations:B5 5) Mix of sawdust and bark from on-site industrial operations:B5 6) Mix of sawdust and bark from off-site industrial operations:B1 7) Mix of sawdust and bark from off-site forest operations:B1

1.4 Conventional pulp mill, but with surplus power generation capacity based on other type of biomass (i.e.: sawdust and bark).
In the pulp industry it is usual to have a relatively small bark boiler to supply thermal energy to the pulp mill for start-ups and / or as a supplementary steam source unit. However, installing a larger high-pressure bark boiler to generate surplus electric power to the grid is not part of the business as usual practice in the pulp industry. Such project would face similar barriers as the proposed project activity and, as the previous alternative, would not to happen without the incentives of the CDM either.
<u>Power generation:</u> Power would be generated in the cogeneration plant inside the pulp mill. A lower surplus power generation capacity compared to the one of the project plant would be available to the grid. The reason for the lower surplus capacity is because it is more convenient to produce additional power using the same amount of black liquor (determined by the pulp generating capacity of the pulp mill) rather than from biomass from forest operations (sawdust and bark). This last option would require considerable amounts of additional biomass, which would have to be transported from far away sawmills, increasing the power generation costs. According to this, the difference between the surplus power capacity of the project plant and this plant would have to be generated by power plants in the grid.
<u>Heat generation:</u> All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.
<u>Biomass residues:</u> The same amount of black liquor as the one used in the project plant would be used as fuel in the cogeneration plant inside the pulp mill. The amount of biomass residues from forest operations used in this case compared to the ones used in the project plant would depend on the surplus electric power capacity of this alternative pulp mill.

As can be seen, all the conventional options presented above are plausible, credible and realistic. Most of them correspond to the BAU practice in the relevant industry. Some of them have been even implemented by Arauco and other players in the pulp industry in Chile. They fully comply with the current Chilean environmental regulation, since once the relevant permits are obtained from the corresponding authorities (CONAMA, COREMA, SNS, etc.), they do not face additional restrictions.

Considering the business as usual practice in the pulp industry and the level of feasibility and conservativeness the alternative project must have to be chosen as the baseline scenario, the alternative that most likely and conservatively reflects how the surplus electric power would have been generated and the additional biomass would have been used if the proposed project activity had not been implemented, is the construction of a conventional pulp mill without surplus electric power generation capacity. Under this scenario, the additional electric power would have been generated in the grid and the additional biomass from forest operations would have been dumped or left in piles for natural decay and not used for electric power generation.

According to the ACM0006 (Version 14.0), when defining plausible and credible alternative scenarios for biomass usage, biomass residues should be separately identified for different categories, covering the whole amount of biomass residues supposed to be used in the project activity during the crediting period, and consistently with the alternative scenarios selected for power (P) and heat generation (H).

B1: The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.

Black liquor, CNCG and methanol: These biomass types are normally used for heat and power generation in pulp mills. As a result, this baseline is not applicable in this case.

Biomass residues (mix of sawdust and bark) from on-site and off-site industrial operations: This type of biomass residues are normally used as fuel to generate heat for wood drying in Sawmills and presses, and drying in the Panel board industries. However, a considerable surplus of this type of biomass residues remains unused in the region; the additional biomass consumed by the proposed project activity would most likely be left in piles for natural (aerobic) decomposition. As a result, this baseline is applicable in this case.

Sludge from on-site industrial operations: This is a solid waste generated in the pulp production process, which is an industrial activity. In the absence of the project activity, sludge would be fully combusted in a low pressure boiler for heat generation. As a result, this baseline is not applicable in this case.

Mix of sawdust and bark from forest operations: As a current practice in Chile, residues from harvesting, pruning and thinning operations are mostly left in piles to natural decay. The additional biomass consumed by the project activity would most likely left in piles for natural decay. As a result, this baseline is applicable in this case.

B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.

Black liquor, CNCG and methanol: These biomass types are normally used for heat and power generation in pulp mills. As a result, this baseline is not applicable in this case.

Mix of sawdust and bark from on-site and off-site industrial operations: This type of biomass residues are normally used as fuel to generate heat (i.e. for wood drying) in sawmills and Panel board industries. Considering landfills are so far away from the project plant that is uneconomical to transport and dispose these residues in this way. As a result, this baseline is not applicable in this case.

Sludge from on-site industrial operations: In the absence of the proposed project activity, this residue would be either fully combusted in a low pressure boiler for heat generation or would be dumped in a dedicated land field. As a result, this baseline is not applicable in this case.

Mix of sawdust and bark from forest operations: Biomass residues from harvesting, pruning and thinning operations are mostly left in piles to natural (aerobic) decay. As a result, this baseline is not applicable in this case.

B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes.

Black liquor, CNCG and methanol: These biomass types are normally used for heat and power generation in pulp mills. As a result, this baseline is not applicable in this case.

Mix of sawdust and bark from on-site and off-site industrial operations: In the absence of the proposed project activity part of this biomass would be combusted in a conventional low pressure boiler for heat generation purpose. Since a considerable surplus of this type of biomass residue remains unused in the region, the additional biomass consumed by the proposed project activity would most likely be left in piles for natural decay, and in some particular cases, the biomass would be burned in the open-air in an uncontrolled manner. As a result, this baseline is applicable in this case.

Sludge from on-site industrial operations: In the absence of the proposed project activity, this residue would be fully combusted in a low pressure boiler for heat generation purpose. As a result, this baseline is not applicable in this case.

Mix of sawdust and bark from forest operations: Biomass residues from harvesting, pruning and thinning operations are mostly left in piles to natural decay. Only in some particular cases, the biomass would be burned in the open-air in and uncontrolled manner. As a result, this baseline is applicable in this case.

B4: The biomass residues are used for energy or non-energy applications, or the primary source of the biomass residues and/or their fate cannot be clearly identified.

Biomass residues used for energy applications:

This option is not available to the proposed project activity. In this case, the technology required to generate for instance, biofuels using forest biomass residues (mix of sawdust and bark) is not developed at an industrial scale in Chile (and in the world) to date. As a result, this baseline scenario is not applicable to any of the biomass types involved in the project activity.

Black liquor, CNCG and methanol: These biomass types are normally used for heat and power generation in pulp mills. As a result, this baseline is not applicable in this case.

Non-energy applications:

The biomass residues used for energy generation purposes are not the same as the biomass residues used for feedstock in the process of pulp and paper industry. Although these biomass residues could be used as fertilizers, they must be previously stabilized. As a result, this baseline scenario is not a likely or realistic baseline scenario for these biomass residues types.

Primary source of the biomass residues and/or their fate cannot be clearly identified:

Though there is a market for biomass residues in the region, a considerable surplus still remains. This surplus of biomass residues is not commercialized, but disposed in piles or burned in the open air. For this reason, this baseline is not really applicable for the biomass types considered under this project activity.

B5: The biomass residues are used for power or heat generation at the project site in new and /or existing plants.

Black liquor, CNCG and methanol: These biomass types are normally used for heat and power generation in the same pulp mill facilities where they are generated and not in other facilities. As a result, this baseline is applicable in this case.

Mix of sawdust and bark from industrial operations: Considering the surplus amount of biomass residues available in the region, the additional biomass consumed by the proposed project activity would most likely be left in piles for natural decay (aerobic). As a result, this baseline scenario is applicable in this case.

Sludge from on-site industrial operations: In the absence of the proposed project activity, this residue would be either fully combusted in a low pressure boiler for heat generation purpose. As a result, this baseline is applicable in this case.

Mix of sawdust and bark from forest operations: Biomass residues from harvesting, pruning and thinning operations are mostly left in piles to natural decay. This type of biomass is the least available/most costly biomass residue to be consumed. As a result, this baseline is not applicable in this case.

Considering the analysis above, the baseline scenarios for the biomass residues can be established as follows:

Recovery boiler:

Biomass residues category n	Biomass residue type	Biomass residues source	Biomass residues fate in the absence of the Project activity	Biomass residues use in project scenario	Biomass residues quantity (tDS)[12]
1	Black liquor	On-site production.	The biomass residues are used for power and heat generation at the project site (B5).	Heat and power generation.	944,727[13]
2	CNCG	On-site production.	The biomass residues are used for power and heat generation at the project site (B5).	Heat and power generation.	6,372[14]
3	Methanol	On-site production.	The biomass residues are used for power and heat generation at the project (B5).	Heat and power generation.	3,875[15]

Power boiler:

Biomass residues category n	Biomass residue type	Biomass residues source	Biomass residues fate in the absence of the Project activity	Biomass residues use in project scenario	Biomass residues quantity (tonnes)

[12] Biomass flows are obtained from the energy and mass balance with the environmental restriction, which limits the pulp production to 550,000 ADt/yr. Note that this environmental permit was granted after the main equipment and the turbo generator were purchased. Biomass flows are expressed in (tDS) stands for "tonnes of dry solids".

[13] This is the annualized flow of black liquor (tDS/d) from pine and euca (2,757.4tDS/d *248d +2,461.8tDS/d*106d) under restricted pulp production 550,000 ADt/yr.

[14] This is the annualized flow of CNCG (11.3 tDS/d + 10.0tDS/d) under pine and pulp production, respectively.

[15] This is the annualized flow of Methanol (18.6 tDS/d + 16.6tDS/d) under pine and euca pulp production, respectively

4	Sludge from industrial operations.	On-site production.	The biomass residues are used for power or heat generation at the project site (B5).	Heat generation.	9,027
5	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass residues are used for power or heat generation at the project site (B5).	Heat generation.	85,706
6	Mix of sawdust and bark from industrial operations.	On-site production	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.	6,546
7	Mix of sawdust and bark from industrial operations.	Off-site production	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.	38,207
8	Mix of sawdust and bark from forestry operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.	0

As can be seen from table above, all biomass residues types would be used for heat and power generation in the baseline scenario.

Project scenarios for biogas use

The proposed project activity does not imply the generation of wastewater from biomass treatment under anaerobic conditions. Therefore, no biogas is generated.

Sub-step 1b requires assessing the consistency with mandatory applicable laws and regulations

For each project scenario, it is established its compliance with the current mandatory and applicable laws and regulations in Chile.

Consistency of project scenarios for power generation

Scenario	Consistency with mandatory laws and regulation in Chile	Yes/No
P1	Once the corresponding permits are obtained from the national authorities, this project scenario is consistent with the mandatory laws and regulations in Chile. Currently, there are other similar projects that operate in Chile (as registered CDM projects), without restriction.	Yes.
P5	Once the corresponding permits are obtained from the national authorities, this project scenario is consistent with the mandatory laws and regulations in Chile.	Yes.
P7	This project scenario is consistent with the mandatory laws and regulations in Chile.	Yes.

According to the above, the project scenarios: P1, P5 and P7 would be in compliance with the mandatory laws and regulations in Chile.

Scenario	Consistency with mandatory laws and regulation in Chile	Yes/No
H1	Once the corresponding permits are obtained from the national authorities, this project scenario is consistent with the mandatory laws and regulations in Chile. Currently, there are other similar projects that operate in Chile (as registered CDM projects), without restriction.	Yes.
H5	Once the corresponding permits are obtained from the national authorities, this project scenario is consistent with the mandatory laws and regulations in Chile.	Yes.

According to the above, the project scenarios: H1and H5 would be in compliance with the mandatory laws and regulations in Chile.

Consistency of project scenarios for biomass use

Scenario	Consistency with mandatory laws and regulation in Chile	Yes/No
B1	This is part of the normal practice in the forest industry in Chile. It is consistent with the mandatory laws and regulations in Chile.	Yes.
B3	This is part of the normal practice in the forest industry in Chile. It is consistent with the mandatory laws and regulations in Chile.	Yes.
B5	This is part of the normal practice in the forest industry in Chile. It is consistent with the mandatory laws and regulations in Chile.	Yes.

According to the above, the project scenario: B1 and B3 and B5 would be in compliance with the mandatory laws and regulations in Chile.

Step 2: Barrier analysis.

Sub-step 2a requires the identification of a set of barriers that would prevent the implementation of alternative scenarios.

The Valdivia biomass power plant project activity faces barriers that:

a) Prevent the implementation of this type of proposed project activity; and
b) Do not prevent the implementation of at least one of the alternatives presented in Step 1.

These barriers will be presented and analyzed below.

Barriers that prevent a wide spread implementation of this activity

Investment barriers: The higher investment risk results from the added operational complexity of operating a pulp mill as a power plant connected to the grid. Being part of the grid and the corresponding dispatch center (CDEC-SIC) implies additional risks. For example, any power contingency (i.e. black out) in the system may translate into an economic penalty to the owner of the cogeneration power plant, even if the problem was not related to the operation of the power plant itself[16]. To date, Arauco has paid around US$ 130,000 in fines to the authority. It must be noted however, that the original amounts were -on average- 7 times higher. In each case, Arauco has had to appeal to the corresponding national authority.

Technological barriers: Though Arauco is a relevant player in the pulp industry in Chile, the Valdivia pulp mill does present some particular features that make the plant special and different from the BAU pulp mill. This is due to the fact that the Valdivia pulp mill was specially designed to generate

[16] Normally, the penalty is proportional to the owner's total generation capacity in the system. Some penalizations that have been applied to Arauco can be found in RE 1433, pages 13-14, RE 809, page 16 and RE 1114 pages 13-14.

additional electric power, which implies some modifications and technology improvements over the conventional mill that are not standard in the pulp mill industry in Chile[17]. A pulp mill with surplus electric power generation capacity must deal with the following technical issues:

- The project mill has more equipment. This inherently increases the overall risk of failure, the maintenance costs and the downtime of the project mill during the year compared to a simpler and more conventional mill.

- The more energy-efficient pulp mill requires skilled and trained labor in order to operate the mill in a way that both the pulp production and power generation are optimized. It requires qualified personal that know how to coordinate the pulp production program and at the same time comply with the dispatch program of the CDEC-SIC. These types of skills are not readily available in the host country, since no other company but Arauco has pulp mills that behave as grid-connected power units[18]. This results in a “trial-and-error” learning process, which is costly (i.e. the Dispatch Center severely penalizes power companies with lower power revenues if they fail to deliver full power when instructed to do so) and lengthy.

- From a design point of view, a pulp mill with surplus electric power capacity to the grid tends to work with higher steam data (i.e. 85 bar and 480ªC). To generate this type of steam, the recovery boiler must be equipped with a super heater that works with a higher temperature (650ºC) compared to the one in a mill with no additional power generation capacity. As a result of the higher temperature, the sulfur and potassium present in the flue gases, melt and adhere to the exterior of the boiler tubes, causing corrosion and fouling problems. This increases the maintenance costs and downtime of the mill during the year. Supporting evidence that confirms the above can be found in publicly available studies[19] of the pulp industry.

- In some cases, the surplus power generation of a pulp mill compromises / interferes with the normal operation of the pulping processes. For example, in the Valdivia pulp mill case, the condensing turbogenerator is equipped with cooling towers that use pulp mill water as a coolant. Sometimes, at high power generation loads, the temperature of the water that exits the cooling towers (after condensing the steam that comes from the condensing turbine) increases to the point that it becomes insufficient to cool down other processes at the mill. To compensate this, additional (cool) water must be pumped to the mill, overloading the capacity of the pumps that supply fresh water to the mill. When this situation happens, the plant is forced to reduce its surplus power generation to the grid, in order to avoid risking the pulp production process. If this situation happens during a peak power demand period, the plant may be penalized on its future power revenues by the Dispatch center for non-compliance with the dispatch program.

It must also be noted that much of the engineering and innovations required to build these types of mills must be subcontracted abroad, usually from northern European countries (Finland and Sweden), which are leaders in energy efficiency and renewable (biomass) energy generation technologies. That is clearly in line with the CDM postulates.

<u>Barriers due to the prevailing practice:</u> The Valdivia pulp mill is <u>the first pulp mill in Chile</u> to be designed with the deliberate purpose to maximize the electric power generation surplus to the grid. As previously stated, big-scale surplus electric power generation in a pulp mill does not constitute the normal practice in the pulp mill industry.

By the time the Valdivia project was built there was no other player in the pulp industry in Chile that had a pulp mill like the Valdivia pulp mill. No other pulp mill in Chile operated with such a high-pressure steam data (85 bar, 480°C) and was able to generate such a considerable amount of

[17] “Not standard” is used here to indicate that the pulp mill has additional electric power generation capacity to the grid. For more details about how exactly the project mill departs from the standard pulp mill design, please revisit section A.4.3, Table 1 of this PDD.
[18] This can be easily verified, looking at the list of power plants connected to the SIC I Appendix 4 of this PDD.
[19] Please see: Fredrik Bruno. 2001. Thermochemical aspect on chloride corrosion in Kraft recovery boilers. Corrosion 2001. Paper N° 04126. Available at: http://www.nace.org/nacestore/assets/ConferencePapers/2001/01426.pdf.

surplus power to the grid (61 MW). Still today, there is no other pulp mill in Chile (including registered CDM project activities) capable of generating such a surplus of electric power to the grid. This statement can be easily checked looking at the type of power plants that are grid-connected to the SIC system.

Cultural barriers: Arauco's culture in the forestry-related industries is very much influenced by the commodities: wood-products and pulp markets, which differ from the culture in the electric power sector. Unlike forestry products, electric power cannot be stored in order to speculate on price. The Power Purchase Agreements require different negotiation skills, which are not the core competences of Arauco management. For instance, when signing a long-term electricity contract, the PPA, the seller must be confident enough that it will be able to supply the contracted power at a reasonable cost.

This barrier can be substantiated by considering that the Project Proponent only has 30% of its available power capacity engaged in long-term power sale contracts. The usual standard in the power sector in Chile is higher than 60%.

Barriers to entry to the electric power industry: Most of the above paragraphs have dealt with barriers related to the Pulp mill industry. However, the proposed project also faces barriers in the electric power industry; some of them are mentioned and discussed below:

Unlike some developed countries in which biomass cogeneration receives favorable treatment and incentives (i.e. Finland, Germany, Sweden, etc.), in Chile, when a cogeneration system is not operational due to maintenance, the developer of cogenerated electricity needs to purchase electricity from the grid. A similar situation happens in case of a technical problem, even if it means stopping the cogeneration plant for just 15 minutes (the minimum period in which the electric distributors measure the peak power consumption). In that case, if the cogeneration facility registers peak power consumption during peak power time, the consuming plant not only has to pay for the electricity (MWh) consumed during this period, but also for the maximum power demand (MW) for the entire billing period. Moreover, while the billing period is monthly, the billing peak demand remains at the maximum demand for 12 months at a time. Thus, if the cogeneration facility is not operational even for a short period of time a year, the industrial customer must pay the demand charge all year long. This is described in CDEC-SIC Internal Regulation, Article 118, page 47.

On the same lines, the lack of special regulations for cogeneration facilities translates in exigencies, as those mentioned in the RM 40, page 21, which establish the operational conditions under low-frequency conditions of the grid. The current regulation does not allow power generators to disconnect their facilities from the grid (island operation) in case of an imminent risk of blackout and therefore, prevents the cogeneration facility to protect the production line from a possible power outage. This situation generates instability in the production process and increases the downtime of the production facility due to the additional startup operations.

The coordination with other generating / distribution / transmission companies also constitutes another barrier for cogeneration power plants such as the Valdivia biomass power plant. To be able to sell electric power to the SIC grid and obtain the benefits of a power generating company, Arauco must be part of the CDEC-SIC, the Dispatch Center of the SIC grid. This constitute an operational barrier, since the cogeneration power plant needs to comply with both internal and external energy requirements, compared to pure power plants units in the system, which only need to coordinate with external CDEC instructions. This duality represents a higher operational complexity for the owner of the cogeneration facility, who cannot tune the power plant to exclusively maximize the return on electric power generation assets.

An argument that reinforces and complements the barrier mentioned above, refers to the fact that in the SIC system, the non-conventional renewable energy technologies represent less than 5% of the total energy generated in the system. In addition, the electric power industry is highly concentrated,

with mainly four power companies concentrating over 60% of the total energy generated in the SIC grid. The low share of non-conventional renewable energy technologies, the high leverage of conventional power generators and the insufficient incentives for renewable sources in the electric law make these barriers structural and relatively permanent for prospective non-conventional energy producers and current players such as Arauco.

The coordination with sub-distribution, distribution and transmission companies also become more complicated when an industrial facility not only consumes power from the grid but also injects power to the grid. Sometimes the system to which the cogeneration plant must connect is not capable of handling the additional power injected by the power plant. This implies additional investments (reinforcement of sub-transmission lines and new protection systems), which in some occasions can translate into additional (and costly) startups delays[20].

Despite the regulatory authorities have recently incorporated[21] some measures to promote the use of non-conventional renewable energy sources, the RM17 of 2004 introduced a new algorithm for the firm power calculation for self-power generating companies. This new algorithm introduced a new penalization factor that lowered the firm power for these power producers, which is not present in the calculation of the firm power of conventional power producers. This measure negatively affects biomass cogeneration facilities such as the Valdivia biomass power plant, given that the cogeneration facility falls under this power plant category.

At a more macro level, the current regulatory incentives are not enough to make the use of renewable sources more prevalent in Chile. As a result:

- There is a lack of awareness of the multiple benefits of decentralized energy and therefore, the considerable potential to develop micro power plants in the south of the country remains to be exploited. According to several studies, Chile has considerable electric power generation potential in small-hydraulic, wind and biomass renewable sources.
- Regulations for the electric sector are mostly oriented around centralized large-scale and conventional power generation.
- Relatively low price for electricity (node price) does not make the development of non-conventional energy sources economically feasible.
- Unlike some more developed countries, the current initiatives that have been implemented by the government to promote non-conventional renewable energy initiatives do not reflect all the positive externalities related to these technologies. As a result, they are not very attractive from a financial perspective and so, are still not competitive compared to other conventional technologies.

Finally, in order to address the extent to which the barriers presented above are "prohibitive considering the fact that the project has been in operation since 2004", the Project Proponent would like to mention the following:

1. The various stated barriers are deemed prohibitive by the Project Proponent because there are no other non-integrated bleached Kraft pulp mills in Chile (except for the Valdivia pulp mill by Arauco, which is a registered CDM project activity) that uses a high-pressure recovery boiler, that is capable of generating such a surplus amount of power to the grid (40 to 60 MW) and that operates as a power plant in the grid. From this perspective, the Valdivia pulp mill falls under the category of "first of a kind" project. Step 4 of the "Tool for the demonstration and assessment of additionality Version 03" further ratifies this, since according to the Common Practice Analysis, there are no other pulp mills in Chile other that the Nueva Aldea pulp mill capable of supplying a considerable surplus power to the grid.

[20] Given that these additional costs are very hard to anticipate and estimate, they are seldom considered as part of the investment and accounted for in the financial evaluation ex-ante.
[21] Short Law I in March 2004 and Short Law II in May 2005.

According to Step 4 of the additionality tool, this test complements the barrier analysis in this case and ratifies the case of additionality for the Valdivia project activity.

To further illustrate how prohibitive these barriers are, the Project Proponent would like to present an example. During September 2004 the main competitor of Arauco in Chile built a new pulp mill line in the VIII Region of the country. This new pulp mill line had a similar capacity to the Valdivia's pulp mill capacity and incorporated the latest technology available in the pulp industry (it was built according to the BAT, Best Available Technology in the pulp industry). Nevertheless, the new pulp mill used a lower steam data boiler and was not capable of even generating all the power required by the new pulp mill line itself. The new pulp mill line had to rely on the grid to source all its power requirements. Other pulp mills in Chile also share the same situation and are not capable of generating all the power they require, making them dependent on the grid. This case, however, is a good example since it is a more recent pulp mill than the Valdivia pulp mill.

2. The reason for which the Valdivia biomass power plant had been operating despite the prohibitive nature of the stated barriers is because the project biomass power plant is an intrinsic part of the Valdivia pulp mill and therefore must operate if the pulp mill operates. The Valdivia pulp mill is a non-integrated Kraft pulp mill that uses the Kraft cycle technology to produce bleached pulp. Under the Kraft cycle, the biomass power plant must burn all the black liquor to generate the heat and power required by the pulping process (e.g. for wood cooking in the wood digesters) and be able to recover the chemicals used in the cooking process in the wood digesters. According to this, once the project pulp mill was built, the Project Proponent had no other option rather than to operate the biomass power plant, with or without the registration of the project in the CDM, unless the Project Proponent decided not to operate the pulp mill. In other words, the operation of the new biomass power plant was determined by the operation of the pulp mill rather than by the nature of the barriers faced by the associated CDM project activity.

The CDM would alleviate the identified barriers in the following way:

The approval and registration of the Valdivia biomass power plant as a CDM activity would report significant benefits to the Valdivia pulp mill. However, these benefits will not only circumscribe to the project activity itself, but also to Arauco for overcoming the associated barriers to carry the proposed project to final completion, and to any other company in Chile who decides to follow Arauco's lead in biomass cogeneration in the future.

The main areas in which the CDM would alleviate the identified barriers are mentioned below:

- The project will unquestionably reduce anthropogenic greenhouse emissions by generating electric power via a clean energy source. This demonstrates the constant environmental improvement policy of Arauco and positions the company as an "environmental friendly" company not only in the Chilean context, but also in the international context. This is quite relevant to Arauco since approximately 60% of the company's consolidated annual sales come from exports to countries that have a high consciousness about the environment and the usage of sustainable technologies. The registration of this project by the CDM would acknowledge Arauco's effort by using high-end environmental-friendly technology and would give the company a competitive edge in this field.

- The financial benefit derived from the sale of CERs to Annex I countries is also a strong incentive to develop CDM project activities for Arauco. The additional investment related to a biomass electric power generation capacity is about 1 to 2 MMUS$ per installed MW (depending on the project context), which is significant. The barriers that must be overcome to implement such projects are not minor either and in the long run would translate into a higher operational risk exposure and ultimately into additional costs. The revenue that would come from the sale of the CERs would contribute to mitigate these extra costs associated to these

projects. It could also contribute to make CDM biomass cogeneration projects more attractive for Arauco as well as for other companies that could use these clean technologies in the future.

- The CDM is a new mechanism that has the potential to promote in an economically efficient way the usage of clean technology. However, given that the system is still at its beginnings, the transaction costs for developing new project activities are still very high. This makes it very difficult for small companies to use the mechanism to develop new CDM projects. By registering the proposed project activity, it will become easier for other grid-connected renewable energy project to be implemented in the country, as they will benefit from Arauco's CDM experience. The investment in new power units in Chile has been low in the last years. In particular, the investment in new hydro and other renewable units has become less attractive compared to other fossil-fuel options under the current electric industry perspectives. The CDM registration of the proposed project activity would open a new funding possibility for grid-connected renewable energy projects, which are not economically viable under the currently prevailing conditions. Chile has considerable renewable energy potential. It has a world-class forest industry, which can provide abundant biomass fuel for energy generation; it has abundant undeveloped hydroelectric resources in the south and has significant geothermal resources in the central and south part of the country, which has not been exploited at all. From this perspective, the CDM registration of the Valdivia biomass power plant would be a positive and powerful signal to potential investors of renewable energy sources in the country.

- Finally, Chile has shown a sound management of its economic policy in the last 20 years, a fact for which it is now recognized as one of the most attractive countries to do business with in Latin America. With the recent approval of free-trade agreements with USA and the European Union, Chile has a very open and world-integrated economy, which relies heavily on its exports (approximately 50% of its GNP). That makes the Chilean economy very sensitive to external shocks and currency fluctuations. Because of this, the CDM provides an interesting way to mitigate the effects of inflation and exchange rate fluctuation, by opening a new hard-currency cash flow stream possibility that can be used to finance new investment possibilities and to improve their financial performance by curbing the financial risk exposure.

The identified barriers would not prevent the implementation of at least one of the baseline scenario alternatives:

It can be easily shown that none of the barriers mentioned above would prevent the wide implementation of most of the conventional project alternatives mentioned in Step 1, and particularly, of the proposed baseline project scenario.

<u>Investment barriers:</u> Since the proposed baseline scenario for the Valdivia biomass power plant project activity would have used a conventional (business as usual) pulp mill configuration, the facility would have been self-sufficient in thermal and electric power generation and would have not generated additional electric power to the grid. Therefore, there would have been no additional operational risks and the project risk would have not differed from that of the conventional mill in the corresponding industry.

Investment barriers would not prevent other conventional baseline case scenarios either, such as to generate electric power by using fossil fuels. As was mentioned before, the project proponent has implemented these solutions in other of its pulp mill facilities.

<u>Technological barriers:</u> The same argument mentioned above applies in this case, since in a conventional pulp mill, there are no additional technological barriers other than the ones normally found in the corresponding industries.

The technological barriers for a conventional power generation alternative would also be minor, since there are plenty of companies and brokers that provide new / used power generation equipment, spares and technical support at competitive prices today.

Barriers due to the prevailing practice: The proposed baseline case scenario, as well as each of the other conventional power generation alternatives presented in Step 1 constitutes the common practice in the corresponding industries.

Cultural barriers: There would be no cultural issues with the proposed baseline project scenario or with any of the BAU / conventional alternatives presented in Step 1. There are no barriers in the pulp industry that would prevent the utilization of alternative fossil fuel power units for electric power generation other than the ones that could be found in the corresponding industry. Though the installation of a small power plant nearby a pulp mill would imply entering into the power generation business, the operation and administration of such power facility could be done with independence of the pulp mill operation.

Barriers to entry to the electric power industry: Given that the proposed baseline scenario would not contemplate additional electric power generation capacity, the coordination for power injection with the CDEC-SIC and the transmission, distribution and power companies would not be required, so none of the barriers mentioned before for the project activity would apply. The only coordination the power plant would require would be that of any normal client with the electric system, which would be part of the business as usual practice. As for the conventional power generation baseline options, these barriers would exist, however, given the nature of the more conventional power generation alternative, they would be less restrictive.

It must be noted that most of the barriers and low incentives for renewable energy sources presented in this section have been addressed and ratified by the OECD Environmental Performance Review study for Chile, published early in 2005[22].

Given that the identified barriers do compromise the viability of the proposed project activity and do not significantly affect the baseline or the other project activity alternatives, the proposed project activity presents a clear case for additionality from a barrier perspective analysis.

Sub-step 2b requires the project participant to eliminate the alternative scenarios which are prevented by the identified barriers.

This is done in the table below for all the feasible power, heat generation and biomass use baseline scenarios.

Baseline assessment for Power generation:

Scenario	Barriers that prevent the implementation of the alternative scenarios	Likely baseline candidate?
P1	• Investment barriers. • Technological barriers. • Barriers due to the prevailing practice. • Cultural barriers. • Regulatory barriers.	No.
P5	None.	Yes.
P7	None. The Project Participant would like to note that this project option is the common practice of the pulp mill industry in Chile and the geographical region.	No.

[22] See pages 19, 59, 63 and 65.

Baseline assessment for Heat generation:

Scenario	Barriers that prevent the implementation of the alternative scenarios	Likely baseline candidate?
H1	• Investment barriers. • Technological barriers. • Barriers due to the prevailing practice. • Cultural barriers. • Regulatory barriers.	No.
H5	This project option would not face barriers and is consistent with the common practice of the Pulp and Paper industry in Chile and the relevant geographical region.	Yes

Baseline assessment for Biomass usage:

Scenario	Barriers that prevent the implementation of the alternative scenarios	Likely baseline candidate?
B1	This project option would not face barriers and is consistent with the common practice of the Pulp and Paper industry in Chile and the relevant geographical region.	
B3	This project option would not face barriers and is consistent with the common practice of the Pulp and Paper industry in Chile and the relevant geographical region.	
B5	This project option would not face barriers and is consistent with the common practice of the Pulp and Paper industry in Chile and the relevant geographical region.	Yes

As can be seen, the likely baseline project options for power generation, heat generation and biomass use are the following:

Baseline scenario options for power generation

Scenarios	Scenario description
P5	The installation of a **new** power plant at the project site different from those installed under the project activity.
P7	The generation of power from the grid.

Baseline scenario options for heat generation

Scenarios	Scenario description
H5	The installation of a **new** power plant at the project site different from those installed under the project activity.

Baseline scenario options for biomass use

Scenarios	Scenario description	
B5	The biomass residues are used for power or heat generation at the project site in new and/or existing plants.	

B1	The biomass residues are dumped or left to decay mainly under aerobic conditions.

According to the baseline analysis described above, a combination of baseline scenarios that would qualify as a likely baseline candidate for the proposed project activity is provided below:

Baseline scenarios for power, heat generation and biomass usage, relevant for the project activity				
P5 and P7	The installation of new plants at the project site different from those installed under the project activity. The generation of power in the grid.			
H5	The installation of new plants at the project site different from those installed under the project activity.			
Biomass types consumed in the Heat generator #1 (Recovery Boiler)				
Biomass residues category n	**Biomass residues type**	**Biomass residues source**	**Biomass residues fate in the absence of the project activity.**	**Biomass residues use in project scenario.**
1	Black liquor	On-site production.	The biomass residues are used for power and heat generation at the project site (B5).	Heat and power generation.
2	Methanol	On-site production.	The biomass residues are used for power and heat generation at the project (B5).	Heat and power generation.
3	CNCG	On-site production.	The biomass residues are used for power and heat generation at the project site (B5).	Heat and power generation.

Biomass types consumed in the Heat generator #2 (Power boiler)				
Biomass residues category (k)	**Biomass residue type**	**Biomass residues source**	**Biomass residues fate in the absence of the Project activity**	**Biomass residues use in project scenario**
4	Sludge from industrial operations.	On-site production.	The biomass residues are used for power or heat generation at the project site (B5).	Heat generation.
5	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass residues are used for power or heat generation at the project site (B5).	Heat generation.
6	Mix of sawdust and bark from industrial operations.	Off-site production.	The biomass residues are used for power or heat generation at the project site (B1).	Power generation.
7	Mix of sawdust and bark from industrial operations.	Off-site production	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.

8	Mix of sawdust and bark from forestry operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.

This baseline scenario would be translated into the alternative (baseline) project Option 1, presented in section B5 of this PDD, consisting in a conventional self-sufficient pulp mill, without surplus power generation capacity.

Step 3: Investment analysis

Not chosen.

According to ACM0006 (Version 14.0), if there is only one alternative scenario that is not prevented by any barrier, and if this alternative is not the project activity and the CDM does alleviate the barriers identified for the proposed project activity, the Project Participant must now proceed to Step 4.

Step 4: Common practice analysis,

Arauco initiatives:

Arauco is the only company who has developed biomass cogeneration to the point to become a relevant net energy generator in the SIC. Though Arauco has implemented some previous biomass cogeneration initiatives, the only biomass cogeneration initiative that is relatively comparable to the Valdivia biomass power plant project activity is the Constitución mill. Nevertheless, as will be shown, there are clear distinctions that make the proposed project activity different from the Constitución case.

The Constitución mill: The Constitución mill is a small mill that was designed to produce unbleached Kraft pulp from radiata pine. However, the original design contemplated the possibility of installing a bleaching department and a paper-manufacturing department at a later stage, so the mill was designed to generate additional heat to support these areas. Since these initiatives never materialized, Arauco decided to use the extra heat generation capacity of the mill to generate additional electric power to the grid. Despite the concept is similar to the one used by the proposed project activity, the following differences must be noted:

- The scale of the additional power generation capacity is smaller compared to the one of the proposed project activities (15 MW versus 61 MW). The Constitution mill design (recovery boiler, evaporators, presses, etc.) did not contemplate additional power generation capacity to the grid.

- The surplus power generation capacity of the Constitución mill is a result of a change in the type of product the mill was supposed to produce (from a more power intensive to a less power intensive product type) rather than a deliberate purpose to generate power to the grid. For this reason, the Constitución mill does not reflect the common practice of the pulp mill industry in terms of energy generation.

Other Arauco cogeneration initiatives rely heavily on fossil fuels or are significantly smaller in scale therefore are not comparable to the proposed project activity.

Other company's initiatives:

There are no other pulp mills in Chile that have been deliberately designed to generate surplus electric power to the grid without considering the benefits of the CDM.

A similar cogeneration initiative by another relevant player in the pulp mill industry in Chile includes a biomass (bark) power boiler (150 tvap/hr at 60 bar) that is currently being installed inside a pulp mill facility site. This initiative is mainly oriented towards the generation of steam for a future wood product mill that will be installed near the pulp mill area. It will also provide additional steam to increase the electric generation capacity inside the pulp mill to make it (and other company's interconnected pulp mills in the region) self-sufficient in electric power generation.

As was previously mentioned, today it is a common practice in the pulp industry not to rely in external electric power sources, but to generate all power internally. Older pulp mills were less energy efficient (both in energy consumption and generation capacity) so they were not necessarily self-sufficient in electric power generation. Another distinction that needs to be mentioned, is that this cogeneration initiative differs from the proposed project activity in that the latter implies a modification in equipment that is key to the pulp production (i.e. recovery boiler) and not just to an isolated piece of equipment (an additional power boiler).

The rest of the biomass cogeneration initiatives in Chile are definitely not comparable to the proposed project activity, since they are significantly smaller scale than the Valdivia biomass power plant (e.g. <50 tvap/hr, saturated or near saturated steam at 45 bar, <10 MW, etc.).

Analysis of similar options observed in Chile

Other biomass cogeneration initiatives have been presented and discussed in the preceding section. From the project proponent's point of view, these initiatives present clear differences that make the proposed project activity particular and unique in its type. However, even in the case these cogeneration initiatives were considered similar to the proposed project activity, biomass cogeneration would still not be the common practice in any of the industries in which the proposed project activity is involved:

Electric power industry: The following table shows the biomass power generation situation in the SIC grid and in Chile:

		2002	2003	2004	2005	2006
Total power generation in Chile	(GWh)	42,636	45,409	48,970	50,937	53,916
Total biomass power generation in Chile	(GWh)	374	429	649	516	423
Biomass power generation / total power generation in Chile	(%)	0.9%	0.9%	1.3%	1.0%	0.8%
Nº of biomass power plants in the SIC (and in Chile)	(Number)	4	5	7	8	8
Total Number of power plants in the SIC	(Number)	54	56	60	67	70

Source: 2003 to 2006 CDEC-SIC Annual Reports.
Note: Biomass power generation includes all types of biomass. 2006 includes 2 Arauco registered CDM biomass project activities.

From the table above, it is possible to see the extremely low share of biomass-generated power compared to the total power generation in Chile. Furthermore, the table above does not consider some still non-registered (2) CDM projects from Arauco, one of which is the Valdivia power plant. In other words, in the last years there has not been any other new biomass power plant added to the SIC, other than the ones built by Arauco under the CDM.

Pulp industry: Though cogeneration is widely used in the pulp industry, and therefore part of the business as usual practice, only modern pulp mills tend to be self-sufficient in thermal and electric power generation. In these mills, all internal thermal and electric power requirements are served by burning black liquor in the recovery boiler (not biomass from forestry operations), which is part of the Kraft process. In some cases, a biomass (bark) power boiler to supplement internal thermal and

electric power generation is also considered a normal practice. However, it is not the common practice in Chile (or in the world) that a pulp mill becomes a net electric power exporter to the grid to which it is connected. Even today there are examples of new pulp mills in Chile that are not self-sufficient in electric power generation, and must import electric power from the grid on a normal basis.

Other related industries: Sawmills, plywood mills and MDF panel board industry: In all of these industries only low pressure and / or saturated steam is required for their internal processes. These plants are not designed to operate with high-pressure steam, so on-site power generation is not considered a normal practice, even for internal power consumption.

According to the analysis above, the following conclusions can be drawn:

- The Valdivia biomass power plant project is the first of its type in Chile. Comparable initiatives are not observed in other pulp mill facilities in Chile[23].
- Similar biomass cogeneration projects in related industries (i.e. Sawmills, plywood mills and MDF wood panel mills) are equally unique, and therefore, not observed as conventional initiatives either.

For these reasons, the Valdivia biomass power plant project activity is not considered to be part of the common practice in the relevant (and comparable) industry (ies), and therefore considered additional from a common practice perspective analysis.

B.5. Demonstration of additionality

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Revalidation of the baseline for Valdivia Biomass Power Plant project activity

Considering that this PDD corresponds to the first renewal of the Valdivia Biomass Power Plant crediting period, the Project Participant will follow the CDM project standard (Version 02.0).

To do so, the Project Participant will include in this section of the PDD the application of the tool “Assessment of the original/current baseline and to update the baseline at the renewal of a crediting period Version 03.0.1)”.

The tool above requires two steps to be followed. Each of them will be presented below:

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies.

As can be seen from the baseline analysis previously presented, the current baseline for electricity (P5 and P7), heat (H5) and biomass use (B5 and B1) complies with all relevant mandatory national and/or sectorial policies which have come into effect after the submission of the Valdivia Biomass Power Plant for validation. In particular:

Electricity:

The installation of a new power plant at the project site different from those installed under the project activity (P5). There have been no new regulations or policies that prevent the Pulp and

[23] The only other comparable initiative is the Nueva Aldea Phase 2 power plant by Arauco, which has been registered as a CDM project activity.

Paper industry in Chile and geographical area, from installing a self-sufficient pulp mill in electric power generation, without surplus power to the grid, since the date in which the proposed project activity was submitted for validation.

The sourcing of electric power from the grid (P7). Since no surplus power would be generated, in the absence of the proposed project activity, the surplus would have to be generated by power plants in the grid. There have been no new regulations or policies that prevent the Pulp and Paper industry in Chile or other forest industrial facilities from obtaining electric power from the grid, since the date in which the proposed project activity was submitted for validation.

Heat:

The installation of a new power plant at the project site different from those installed under the project activity (H5). As in the previous case, there have been no new regulations or policies that prevent the Pulp and Paper industry in Chile and geographical area from generating heat using biomass residues, since the date in which the proposed project activity was submitted for validation.

Biomass use:

The biomass residues are used for power or heat generation at the project site in new and/or existing plants (B5). There have been no new regulations or policies that prevent the Pulp and Paper industry in Chile and geographical area the normally used of biomass residues for heat and power generation in pulp mills, since the date in which the proposed project activity was submitted for validation.

The natural decay or uncontrolled burning of unused biomass residues (B1). There have been no new regulations or policies that prevent the dumping or the uncontrolled burning of biomass residues in the open air, since the date in which the proposed project activity was submitted for validation.

Step 1.2: Assess impact of circumstances

The current circumstances at the date of requesting crediting period renewal have change to some extend to those that prevailed at the date of sending the proposed project activity to validation.

The changes that the energy sector has experienced in recent years have been significant. At general level, the integration of very low-cost renewable energies, such as solar and wind, has contributed to transform energy matrices in many countries.

In Chile, solar and wind energy took quickly place them as the most relevant sources among new projects, given their low costs, Chile 's natural conditions and a regulatory framework and favorable bidding. About the latter, the energy tender done in 2017 for 2,200 GWh/y was 100% renewable energy with an average awarded price of 32.5[24] USD/MWh. Two tenders were done previously. One in 2016 and the other in 2015. The tenders done in 2016 for 12,430 GWh/y, the average awarded average price was 47.6 MWh/y and the one done in 2015 for 1,200 GWh/y, the average awarded price was 79.3 USD/MW, which demonstrates the clear downward trend in the energy prices.

In recent years there has been a significant increase in installed capacity, especially solar and wind renewable projects of large generators, which contemplates large solar and wind megaprojects, displacing biomass and mini-hydraulics projects.

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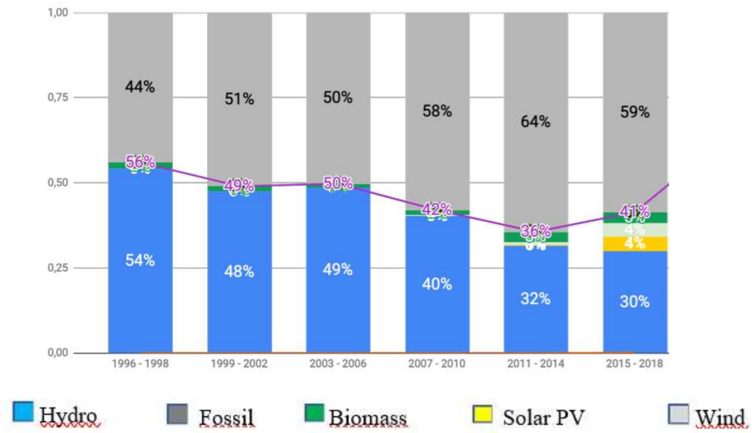
[24] See https://www.cne.cl/prensa/prensa-2017/11-noviembre-2017/valor-de-la-energia-mas-bajo-en-la-historia-de-las-licitaciones-en-chile/

Electricity generation in Chile period (1996 – 2018)

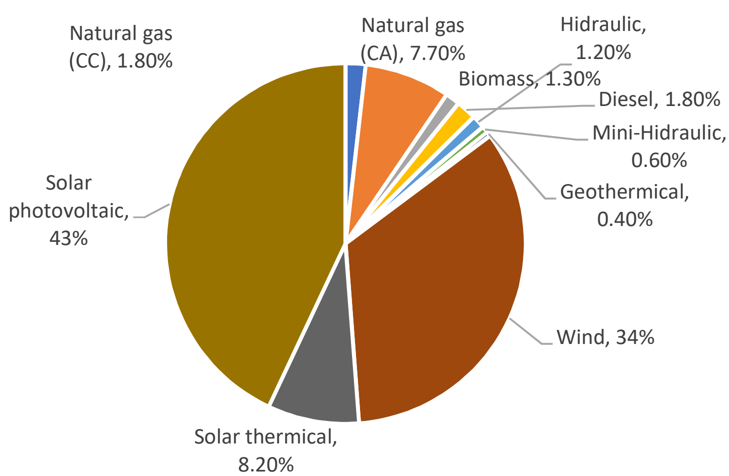


Source: Data 1996 – 2017: Average data based on public information, CNE

According to the graph, the participation in biomass technologies has remained unchanged in recent years. This is partly due to downward trend in the energy electric prices (see above), and it should be noted that biomass generation technologies compete with solar and wind generation technologies, which have no fuel and supply costs.

According to the CNE[25] the distribution of the total investment according to technology, based on the information provided by the developers, and considering the projects under construction and under study is shown below:

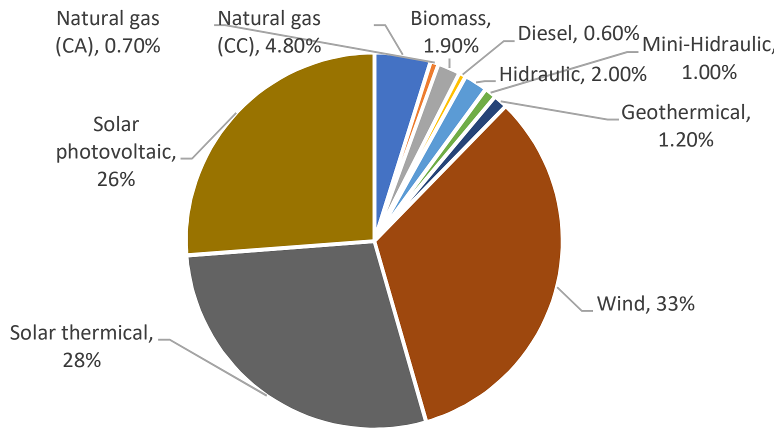
Distribution of the total investment of projects under construction and study per technology generation



Source, CNE (National Commission of Energy)

[25] Refer to https://www.cne.cl/wp-content/uploads/2019/03/Res.-Ext.-N%C2%B0-207-Informe-costos-de-generaci%C3%B3n-2019.pdf page 32, Figure 1: Distribution of the total investment of projects under construction and study per technology generation.

Distribution of the total capacity of projects under construction and study per technology generation.



Source, CNE (National Commission of Energy)

Based on investment and installed capacity informed above, the CNE (National Commission of energy) [26] determined the average unit cost of investment for a photovoltaic solar project is US $ 1,138 per KW installed, while for a wind one it is US $ 1,361. In contrast, the unit cost of biomass thermoelectric plants resulted to be US $ 2,056 per KW installed.

At sectorial level the internal and electric power generation for internal consumption is part of the BAU in the Pulp and Paper industry and therefore, conventional self-sufficient pulp mill, without surplus power generation capacity is the standard practice in the pulp mill industry in Chile and geographical area.

In conclusion, Chile´s natural conditions, downward trend in the energy prices and decrease in the investment cost for wind and solar technologies and regulatory framework have been promoting the increase in the installed capacity of solar and wind projects leaving the installed capacity of biomass technology without variations in recent years.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) is the most likely scenario for the crediting period for which renewal is requested.

This assessment is not applicable; since in the case of the proposed project activity the equipment that would have been used in the baseline scenario does not exist. This equipment did not exist at the date the project activity was started.

Step 1.4: Assessment of the validity of the data and parameters

All monitored parameters have been updated according to the new monitoring methodology of the ACM0006 (Version 14.0).

<u>Step 2: Update the current baseline and the data and parameters</u>

Step 2.1: Update the current baseline

This version of the PDD considers a fully updated baseline based on the latest approved version of the methodology applicable to the project activity.

[26] Please refer to, https://www.cne.cl/wp-content/uploads/2019/03/Res.-Ext.-N%C2%B0-207-Informe-costos-de-generaci%C3%B3n-2019.pdf, page 35, Table 8: Investment costs (USD/KW).

Step 2.2: Update the data and parameters

All data and parameters determined at the start of the first crediting period for Valdivia Biomass Power Plant project have been updated according to the new monitoring methodology of the ACM0006 (Version 14.0).

The new emission reduction calculation for the second and third crediting period of this project activity fully considers all the parameter updates and latest default factors from the IPCC mentioned above. This calculation is in full compliance with the monitoring plan of the latest approved version of the baseline methodology applicable to the project activity.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

The proposed project activity consists in the construction of a new grid-connected biomass power plant (a Greenfield project), which is a result of the implementation of two CDM project initiatives in a new pulp mill facility. Both CDM project initiatives are aimed at making the new pulp mill a net power exporter to the grid. The two project initiatives are described below:

1. The installation of a biomass (sawdust and bark) power boiler in a new pulp mill that generates high-pressure steam used to cogenerate surplus power to the grid. The biomass boiler that would have been installed in a baseline situation would have had a lower biomass firing capacity and would have generated saturated (low pressure) steam, not suitable to cogenerate electric power in the mill.

2. The construction of a new pulp mill with a high electric power efficiency, so as to make it a net power exporter to the grid. The higher efficiency is possible due to the installation of a high steam pressure of the recovery boiler and two high-capacity turbo generators. As in the previous initiative, these efficiency improvements allow the pulp mill to cogenerate surplus power to the grid, but in this case, without increasing the amount of biomass (black liquor, dry basis) that would be fired in the recovery boiler in a baseline scenario.

Both CDM project initiatives were implemented at the same time, during the construction phase of the new pulp mill facility. The two project initiatives share the same turbo generators, through which heat is obtained (extractions) and power is generated (generator). The new pulp mill facility is a cogeneration power plant.

According to ACM0006 (Version 14.0), the Project Participant was requested to provide the following information:

<u>For each plant generating power and /or heat that has been operated at the project site within the most resent three years prior to the start of the project activity:</u>	
The type and capacity of the heat generator (s):	There were no heat and/or power plants operating at the project site before the implementation of the project activity.
The type and quantities of fuels which have been used in the heat generator (s):	Not applicable, see the answer above.
The type and capacity of the heat engine (s):	Not applicable, see the answer above.
Whether the equipment continues operations after the start of the project activity:	Not applicable, see the answer above.
<u>For each plant generating power and /or heat installed under the project activity:</u>	

The type and capacity of the heat generator (s) [27]:	Recovery boiler: 428MW Power boiler: 75.3MW
The type and quantities of fuels used in the heat generator (s)[28]:	Recovery Boiler: • Biomass residues (black liquor) for heat and electricity generation: 1,132,977(tDS) • Biomass residues (Methanol)for heat and electricity generation: 7,639 (tDS) • Biomass residues (CNCG) for heat and electricity generation: 4,621 (tDS) • Fuel Oil: 1,891[29](ton/y) • Diesel: 0.0(ton/y) • LPG: 0.0(ton/y) • Natural Gas:0.0(ton/y) Power boiler: • Sludge from on-site production for heat generation: 10,216(BDt[30]/y). • Mix of sawdust and bark from on-site production from industrial operations for heat generation: 110,490(BDt/y). • Mix of sawdust and bark from off-site production from industrial operations for heat generation: 38,207(BDt/y). • Mix of sawdust and bark from forest operations for electric power generation: 0.0(BDt/y). • Diesel: 0.0 (ton/y). • Fuel Oil: 778(ton/y) and/or alternatively Diesel and/or LPG.
The type and capacity of the heat engines and direct heat extractions:	Backpressure with extractions turbine (TG1)[31]: • Capacity of the heat engine: 70[32]MW • Capacity of inlet steam: 444 (ton/h) high-pressure steams flow. Capacity of the extraction N°1: 120 (ton/h) medium pressure flow. • Capacity of the extraction N°2: 444(ton/h) low-pressure steam flow. Backpressure with extractions turbine (TG2)[33]: • Capacity of the heat engine: 70[34]MW • Capacity of inlet steam: 396 (ton/h) of high-pressure flow. • Capacity of the extraction N°1: 120(ton/h) medium pressure flow.

[27] Both capacities informed are obtained from the project energy and mass balance informed in this PDD, under average operational conditions without restricted production.

28 These types of biomass amount were determined from the project energy/mass balance, under average operational conditions of the pulp mill without restricted production rate.

[29] Fuel oil consumption of 1,891 tons of fuel oil tit is consumed when the plant is selling surplus power to the grid. The PP will monitor all the fossil fuel consumption used to generate additional electric power to the grid.

[30] BDt stands for "Bone-dry ton" and means 100% dry biomass.

[31] The capacity of the heat engine and the direct heat extractions were determined from the project case energy/mass balance informed in this PDD (without restricted production rate), performed under average operational conditions of the pulp mill.

[32] Max power generation capacity of TG1 obtained from the project case energy / mass balance informed in this PDD.

[33] The capacity of the heat engine and the direct heat extractions from the project case energy/mass balance informed in this PDD (without restricted production rate), performed under average operational conditions of the pulp mill.

[34] Power generation capacity TG2 from the project energy / mass balance informed in this PDD (without restricted production rate).

	• Capacity of the extraction N°2: 390(ton/h) low-pressure steam.

For each plant generating power and /or heat that would be installed in the absence of the project activity:	
The type and capacity of the plant:	
The type and capacity of heat generator (s) [35]:	Recovery boiler: 422MW Power boiler:76.9[36] MW
The type and capacity of the heat engine (s) and electric power generator (s):	Two backpressure heat engines: Backpressure with extractions turbine (TG1): • Capacity of the heat engine: 45[37](MW) • Capacity of inlet steam: 314.5(ton/h) high-pressure steams flow. • Capacity of the extraction N°1:53 (ton/h) medium pressure steam flow. • Capacity of the extraction N°2:314.5 (ton/h) low-pressure steam flow. Backpressure with extractions turbine (TG2): • Capacity of the heat engine: 45[38](MW) • Capacity of inlet steam: 314.5 (ton/h) high-pressure steam flow. • Capacity of the extraction N°1:53 (ton/h) medium pressure steam flow Capacity of the extraction N°1: 314.5 (ton/h) low-pressure steam flow.
The types and quantities of fuels which would be used in each heat generator:	Recovery boiler: • Black liquor: for heat and electricity generation: 1,132,977[39] (tDS) • Methanol: for heat and electricity generation: 7,639 [40](tDS) • CNCG: for heat and electricity generation: 4,621 [41](tDS) • Fuel Oil: [42](ton/y). • Diesel: 0.0[43](ton/y). • LPG: 0.0[44](kg/y). • Natural Gas: 0.0[45](ton/y). Power boiler:

[35] Both capacities are from the baseline energy and mass balance diagram informed in this PDD (without restricted production rate).
[36] Informed in the energy and mass balance (with restricted production rate).
[37] Power generation capacity of TG1 determined from the baseline energy / mass balance presented in this PDD.
[38] Power generation capacity of TG2 determined from the baseline energy / mass balance presented in this PDD.
[39] Annualized weighted average flow of black liquor (3,307 tDS/d * 248d +2,952*106d). Black liquor average flows (dry basis) results from the energy/mass balances under euca and pine campaign informed in the PDD.
[40] This is the annualized flow of Methanol (22.3 tDS/d *248d +19.9*106d). Methanol´s average flow (dry basis) results from the energy/mass balances under pine and euca campaign presented in the PDD, under average operational conditions of the pulp mill.
[41] This is the annualized flow of CNCG (13.5 tDS/d * 248 +12.04 tDS/d * 106d). CNCG´s average flow (dry basis) results from the energy/mass balances under pine and euca campaign presented in the PDD, under average operational conditions of the pulp mill.
[42] Fossil fuels (Fuel oil) determined as average amount of black-liquor (under restricted production rate) consumed in the RB.
[43] Determined based on data monitored directly from the project plant.
[44] Determined based on data monitored directly from the project plant.
[45] Determined based on data monitored directly from the project plant.

	• Sludge from on-site production for heat generation: 6,446 (BDt/y)[46]. • Mix of sawdust and bark from on-site production from industrial operations for heat generation: 44,922(BDt/y). • Mix of sawdust and bark from off-site production from industrial operations for power generation: 0.0(BDt/y). • Mix of sawdust and bark from forest operations for electric power generation**:** 0.0(BDt/y). • Fuel Oil: 0.0 (ton/y)[47] and/or Diesel and/or LPG (ton/y).
The average amounts of electricity and heat import from off-site sources that would happen in the absence of the project activity on a yearly basis and the forecast for the project scenario:	
Average amount of electricity and heat import from off-site sources in the absence of the project activity:	Electricity imports: 2,000 (MWh/y). The most likely and conservatively scenario that reflects how the electric power would have been generated in the absence of the project activity is a self-sufficient pulp mill in thermal and electric power generation. The Project Participant would like to note that only under particular circumstances (general stoppage, star-ups) the project activity will be sourced from the grid. Heat imports: 0 (GJ/y). The baseline plant would be self-sufficient in heat generation. External heat sources (such as, heat generation in specific off-site plants and heat production from district heating) would not be available in the context of the baseline scenario.
Average amount of electricity and heat import from off-site sources under the project activity:	Electricity imports: 2,000 (MWh/y). This project activity is a net electric power exported to the grid to which it is connected and therefore, only under particular circumstances the project activity might be sourced from the grid. Heat imports: 0(GJ/y). The situation would not be different from the baseline scenario; therefore, the project plant would be self-sufficient in heat generation.

[46] BDt stands for "Bone-dry ton" and means 100% dry biomass.

[47] In this case, the estimate fuel oil that would be consumed in the baseline would be nil as biomass moisture content would be reduced due to biomass drier impact considerations. For conservative reasons and to simplify emission calculations the project participant contemplates for project emission calculations, the total amount of fuel oil consumed in the power boiler.

Equations used to calculate emissions reductions

The net emission reductions of the proposed project activity are calculated through equation 1 of the ACM0006 (Version 14.0):

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	=	Emissions reductions in year y (tCO_2e/y)
BE_y	=	Baseline emissions in year y (tCO_2e/y)
PE_y	=	Project emissions in year y (tCO_2e/y)
LE_y	=	Leakage emissions in year y (tCO_2e/y)

Baseline Emissions

Baseline emissions are calculated based on the most plausible baseline scenario identified in the section "Selection of the baseline scenario and demonstration of additionally" of this PDD. This calculation is performed taking into account how power and heat would be generated and how the biomass residues would be used in the absence of the project activity. In addition and following the baseline methodology ACM0006 (Version 14.0), the Project Participant must adopt in this calculation a conservative approach considering biomass residues as a priority (to fossil fuels) for the generation of power and heat.

Considering the above, baseline emissions for the proposed project activity are calculated through the equation 2 of the ACM0006 (Version 14.0):

$$BE_y = EL_{BL,GR,y} * EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} * EF_{FF,y,f} + EL_{BL,FF/GR,y} * \min(EF_{EG,GR,y}, EF_{EG,FF,y}) + BE_{BR,y}$$

Where:

BE_y	=	Baseline emissions in year y (tCO_2).
$EL_{BL,GR,y}$	=	Baseline minimum electricity generation in the grid in year y (MWh).
$EF_{EG,GR,Y}$	=	Grid emission factor in year y (tCO_2/MWh).
$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year y (GJ).
$EF_{FF,,y,f}$	=	CO_2 emission factor for fossil fuel type f in year y (tCO_2/GJ).
$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity generation in the grid or on-site in year y (MWh).
$EF_{EG,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y (tCO_2/MWh).
$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year y (tCO_2e).
y	=	Year of the crediting period.
f	=	Fossil fuel type.

The Project Participant will use the algorithm presented in the ACM0006 (Version 14.0) to calculate the baseline emissions.

- Step 1: determine the biomass availability, generation and capacity constraints, efficiencies and power emission factors;
- Step 2: Determine the minimum baseline electricity generation in the grid;
- Step 3: Determine the baseline biomass-based heat and power generation;

- Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and
  the corresponding electricity generation;
- Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues;
- Step 6: Calculate baseline emissions.

In the following section, the Project Participant will present an explanation of the methodological choices and the equations considered to calculate the baseline emissions of the proposed project activity.

<u>Step 1:</u> Determine biomass availability, generation and capacity constraints, efficiencies and power emission factors in the baseline

Proceed to step 1.1 to determine total baseline process heat generation

According to ACM0006 (Version 14.0), the amount of process heat refers to the heat utilized to meet process heat demand of industrial mills in the baseline ($HC_{BL,y}$).[48]

The process heat demand that would be generated in the baseline in year y ($HC_{BL,y}$) is determined as the difference of the enthalpy of the process heat (steam) supplied to the process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators.

The respective enthalpies will be determined based on the mass flows, the temperatures and, in case of superheat steam, the pressure. Steam tables and/or appropriate thermodynamic equations will be used to calculate the enthalpy as a function of temperature and pressure. The process heat will be calculated net of any parasitic heat used for drying of the biomass residues.

Proceed to step 1.2 to determine total baseline electricity generation

The amount of electricity that would be generated in the baseline scenario is calculated using equation 3 of the ACM0006 (Version 14.0):

$$EL_{BL,y} = EL_{PJ,gross,y} + EL_{PJ,imp,y} - EL_{PJ,aux,y}$$

Where:

$EL_{BL,y}$	=	Baseline electricity generation in year y (MWh).
$EL_{PJ,gross,y}$	=	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y (MWh).
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year y (MWh).
$EL_{PJ,aux,y}$	=	Total auxiliary electricity consumption required for the operation of the power plant at the project site in year y (MWh).
y	=	Year of the crediting period.

According to ACM0006 (Version 14.0), total auxiliary electricity consumption ($EL_{PJ,aux,y}$) shall include all the electricity required for the operation of equipment related to the following activities:

[48] Process heat demand in the baseline scenario will not change compare to the process heat demand in the real project plant. The differences between both scenarios would be exclusively derived from the on-site electric power generation capacity attributable to this CDM project activity (Refer to Section A.3.Technologies and/or measures, energy/mass balance diagrams of this PDD).

This is the additional electric power consumption due to the project activity is derived from the installation of the equipment that enables the project pulp mill to generate additional power. The installation of a higher biomass capacity power boiler in the project mill, compared to the one that would have been installed in a baseline pulp mill, ash treatment, cooling towers, turbine plant.

Proceed to step 1.3 to determine baseline capacity of the electricity generation

According to the baseline methodology ACM0006 (Version 14.0), the Project Participant should determine the total capacity of electric power generation available in the baseline scenario using equation 4 below:

$$CAP_{EG,total,y} = LOC_y * \left[\sum_i (CAP_{EG,CG,i} * LFC_{EG,CG,i}) + \sum_j (CAP_{EG,PO,j} * LFC_{EG,PO,j}) \right]$$

$CAP_{EG,total,y}$	=	Baseline electricity generation capacity in year y (MWh/y).
$CAP_{EG,CG,I}$	=	Baseline electricity generation capacity of heat engine i (MW).
$CAP_{EG,PO,j}$	=	Baseline electricity generation capacity of heat engine j (MW)
$LFC_{EG,CG,i}$	=	Baseline load factor of heat engine i (ratio).
$LFC_{EG,PO,j}$	=	Baseline load factor of heat engine j (ratio).
LOCy	=	Length of the operational campaign in year y (hour)
i	=	Cogeneration-type heat engine in the baseline scenario.
j	=	Power-only-type heat engine in the baseline scenario.
y	=	Year of the crediting period.

The Project Participant would like to note that in the baseline scenario there would be two cogeneration-type heat engines and no power-only-type heat engine. The corresponding load factors for both heat engines will be chosen according to the common practice of the Pulp Industry.

Proceed to step 1.4 to determine the baseline availability of biomass residues

According to the baseline methodology ACM0006 (Version 14.0), the Project Participant should determine the baseline availability of biomass based on the monitored amounts of biomass residues used for power and/or heat generation for which (B4) is the most plausible baseline scenario ($BR_{B4,ny}$).

In the baseline scenario, there would be two heat generators a recovery and a power boiler and each of them would be used the following types of biomass residues for heat and power generation. These are listed as follows:

Recovery boiler:

1) Black liquor
2) Methanol
3) CNCG

Power boiler:

1) Sludge from industrial operations.
2) Mix of sawdust and bark from on-site industrial operations.
3) Mix of sawdust and bark from off-site industrial operations.
4) Mix of sawdust and bark from forestry operations.

The Project Participant would like to note that all the biomass residues types and total amount would be consumed exclusively in the recovery and power boiler.

Proceed to step 1.5 to determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines.

Efficiencies of heat generator:

According to the ACM0006 (Version 14.0), the Project Participant should calculate the efficiencies of heat generators using one of the following options:

- Option 1: Default values. Use Option F in the latest approved version of “Tool to determine the baseline efficiency of thermal or electric energy generation systems (Version 02)”.
- Option 2: Manufacturer´s data.
- Option 3: Only applicable to heat generators and heat engines that were operated at the project site for at least three calendar years prior the date of submission of the PDD.

Considering that the project activity is a Greenfield power generation project (i.e. no previous operational history), the Project Participant will use Option 1 to calculate the biomass-based heat generation efficiency of the single heat generator that would be part of the baseline.

The default value suggested by the ACM0006 (Version 14.0) for the losses linked to the electricity generator group (i.e turbine/engine, cuplings and electricity generator), $GGL_{default}$, is 5%).

The Project Participant will use the options described above for both heat generators and heat engines that would operate in the baseline.

The heat-to-power ratio of cogeneration-type heat engines (e.g. backpressure and heat-extraction steam turbines) should be calculated as follows.

Considering that the project activity is a Greenfield power generation project (i.e. no previous operational history), the Project Participant will use Case 2 to calculate the heat-to-power ration as per the design conditions of the plant, for the configuration identified as baseline scenario in the “Selection of the baseline scenario and demonstration of additionality”. The Project Participant will use the information provided by the consultant for baseline pulp mill design.

Proceed to step 1.6 to determine the emission factor of on-site electricity generation with fossil fuels.

This assessment is not applicable. There is no fossil fuel-based power generation identified as part of the baseline scenario. As a result, the Project Participant will do:

$$EF_{EG,FF,y} = EF_{EG,GR,y}$$

Where:

$EF_{EF,FF,y}$ = CO_2 emission factor for electricity generation with fossil fuels at the Project site in the baseline in year y (tCO_2 / MWh)

$EF_{EG,GR,y}$ = CO_2 emission factor of the fossil fuel type that would be used for power generation at the project site in the baseline (tCO_2 / GJ)

Proceed to step 1.7 to determine the emission factor of grid electricity generation

According to the ACM0006 (Version 14.0) the Project participant will be determined the emission factor of the grid electricity generation as the combined margin CO_2 emission factor for the grid to which the project activity is connected in year y.

This parameter will be calculated using the "Tool to calculate the emission factor for an electricity system" (Version 07.0.0). According to this Tool the following steps shall be followed:

Step 1: Identify the relevant electricity systems.

The tool establishes that the Project Participant should use the electricity grid to which the project activity is connected to and provide evidence there are no significant transmission constraints.

The project activity is connected to the "Sistema Eléctrico Nacional" [49](SEN). The SEN is composed by the transmission lines and the interconnected power plants that operate from "Arica" in the North (XV Region), to "Isla Grande de Chiloé" in the South (X Region). The SEN is the largest of the 3 existing transmission systems in Chile, accounting for about 99,3% [50] of the power generation capacity of the country. Additionally, note that this system has no interconnection with any other transmission system in Chile or in the region.

According to the criteria indicated in the tool for establishing the presence of significant transmission constraints, the project participant verified that none of the conditions are satisfied in the case of the SEN system. In particular, the Project Participant verified that there are no transmission constraints proving that the following criteria is met:

a) The transmission line is operated at 75% or less of its rated capacity during 90% or more of the hours of the most recent year for which information is available (at least one year data is required) using the algorithm below:

    a. For every hour of the year check whether the transmission line is operated at 75 per cent or less of its rated capacity.
    b. Each hour of the year when the transmission line was operated at 75 per cent or less of its rated capacity should be counted as zero.
    c. Each hour of the year when the transmission line was operated at 75 per cent or more of its rated capacity should be counted as one.
    d. There is no transmission constraint if the total sum is less than ten percent of the hours of the year.

According to the article N° 80 of the law " Servicios Eléctricos Generales" [51], annually, this law mandates the "Coordinador Eléctrico Nacional" (CEN)[52] shall prepare and make publicly available in his website the expected technical available capacity of the dedicated transmission systems of the SEN for the next years. This study is presented during the validation process as evidence to support that in there is no transmission constrains in the transmission system in the coming years.

The absence of significant transmission constraints in the transmission systems can be further substantiated by the Short Law N° 1 (March, 2004). This law mandates transmission companies to assess their transmission systems every four years and make all the necessary investments in order to secure the quality and safety of the transmission service.

49 The English translation for this would be "Central Interconnected System"
50 http://energiaabierta.cl/visualizaciones/capacidad-instalada/
51 The English translation for this would be "Central Interconnected System"
52 The English translation for this would be "National electrical coordinator"

<u>Step 2:</u> Choose whether to include off-grid power plants in the project electricity system (optional).

This is not applicable in this case, since no off-grid power plants would have been identified so far.

<u>Step 3:</u> Select a method to determine the operating margin (OM).

The "Tool to calculate the emission factor for an electricity system" offers four options to calculate the Operating Margin emission factor:

a) Simple OM,
b) Simple Adjusted OM
c) Dispatch Data Analysis OM
d) Average OM

Considering the characteristics of the SIC system (e.g. low-cost/must run power generation) and availability of information, the Project Participant will choose <u>option b) to calculate the Operating Margin (OM).</u>

The Simple Adjusted OM method is a variation of the simple OM, where the power plants/units (including imports) are separated in low-cost/must run power sources (k) and other power sources (m). As under <u>Option A</u> of the simple OM, it is calculated based on the net electricity generation of each power unit and the emission factor for each power units, as follows:

$$EF_{grid,OM-adj,y} = (1-\lambda_y)\cdot\frac{\sum_m EG_{m,y}\cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y\cdot\frac{\sum_k EG_{k,y}\cdot EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

Where:

$EF_{grid,OM-adj,y}$	=	Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh).
□	=	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y.
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
$EG_{k,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit k in year y (MWh).
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh).
$EF_{EL,k,y}$		CO_2 emission factor of power unit k in year y (tCO_2/MWh).
m	=	All grid power units serving the grid in year y except low-cost/must run power units.
k	=	All low-cost/must-run grid power units serving the grid in year y.
y	=	The relevant year as per the data vintage chosen in Step 3.

The procedures for determining the λ, are stated in equation N°9 of the "Tool to calculate the emission factor for an electricity system" (Version 04.0.0) and therefore, will be not presented in this section.

According to the baseline methodology, it is possible to calculate the Operating Margin (OM) using data vintages for year(s) y:

Ex-ante option: The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required, or

Ex-post option: The emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

The Project Proponent will use the *Ex-ante option* to calculate the OM; that is, the OM will be calculated once at the validation stage. As a result, no monitoring and recalculation of the emissions factor during the crediting period is required.

Step 4: Calculate the operating margin emission factor according to the selected method.

For the calculation of the operating margin, the Project Proponent will use:

- Option A to calculate the $EF_{grid,OM\text{-}adj,y}$: Use information based on the net electricity generation and a CO_2 emission factor for each power unit.

For the determination of the emission factor of each power unit m, $EF_{EL,m,y}$ the Project Proponent will choose:

- Option A1: Use information based on fuel consumption and electricity generation for each power unit m.

Note that in this case, the information that is directly available from the Dispatch Centre is the net generation of each power unit m and the corresponding fossil fuel consumption rate.

Step 5: Calculate the Build Margin (BM) emission factor.

In terms of data vintage, the Project Participant will choose Option 2:

- For the first crediting period, the Build Margin (BM) emission factor shall be updated annually, ex-post, including those units build up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units build up to the latest year for which information is available.

- For the second crediting period, the Build Margin (BM) emission factor shall be calculated *ex ante*, as previously described in Option 1.

- For the third crediting period, the Build Margin (BM) emission factor calculated for the second crediting period should be used.

The calculations are shown in section B.6.3. step 1.7 of this PDD. Additionally, further background information on ex ante calculation can be found in Appendix 4 of this PDD.

Step 6: Calculate the combined margin emissions factor.

In this case, the combined margin emission factor is calculated according to the following option:

Weighted average calculation:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh).
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y (tCO_2/MWh).
W_{OM}	=	Weighting of operating margin emission factor (%).
W_{BM}	=	Weighting of build margin emission factor (%).

According to the guidance provided by the tool for calculating the grid emission factor, in this case the Project Participant will use the following default values for W_{OM} and W_{BM}:

Defaults values for the second and third crediting periods.	Weights
W_{OM}	0.25
W_{BM}	0.75

The values for W_{OM} and W_{BM} applied by the project participant will be fixed for a crediting period and may be revised at the renewable of the (third) crediting period.

The calculations are shown in section B.6.3.step 1.7 of this PDD. Additionally, further background information on ex ante calculation can be found in Appendix 4 of this PDD.

Proceed to step 2 to determine the minimum baseline electricity generation in the grid

According to the baseline methodology ACM0006 (Version 14.0), the parameter EL $_{BL,GR,y}$ corresponds to the baseline minimum electricity that would be generated in the grid in the baseline:

$$EL_{BL,GR,y} = \max[0, EL_{BL,y} - CAP_{EG,total,y}]$$

Where:

El $_{BL,GR,y}$	=	Baseline minimum electricity generation in the grid in year y (MWh)
EL $_{BL,y}$	=	Baseline electricity generation in year y (MWh)
CAP $_{Eg,total,y}$	=	Baseline electricity generation capacity in year y (MWh)
y	=	Year of the crediting period

<u>Step 3:</u> Determine the baseline biomass-based heat and power generation

Proceed to step 3.1 to determine the baseline biomass-based heat generation

According to the general principles suggested by the ACM0006 (Version 14.0), the Project Participant will contemplate in the calculation of the baseline biomass-based heat generation the following project-specific conditions:

- The Project Participant will prioritize the use of biomass for which scenario (B5) that has been identified as the baseline scenario ($BR_{B5,n,y}$) over the use of any fossil fuels, and will monitor the corresponding amount of heat ($HG_{BL,BR,y}$,) that would be generated.

- According to the energy and mass balance of the baseline scenario (refer to section A.3 of this PDD), there would be a recovery and power boiler for heat generation purpose. These heat

generators will run on the following biomass residues types for which the baseline scenario (B5) has been identified:

Recovery boiler:

1) Black liquor (B5)
2) Methanol (B5)
3) CNCG (B5)

Power boiler:

1) Sludge from industrial operations (B5).
2) Mix of sawdust and bark from on-site industrial operations (B5).
3) Mix of sawdust and bark from off-site industrial operations (B1).
4) Mix of sawdust and bark from forestry operations (B1).

The Project Participant would like to note that biomass residues types (black liquor, methanol and CNCG) can only be consumed in the recovery boiler. Biomass residues types (sludge and mix of sawdust and bark) can only be consumed in the power boiler.

According to the ACM0006 (Version 14.0), the Project Participant shall identify the fossil fuel type and amount required due to technical constraint of the heat generator. The fossil fuel amount will be added to the parameter $FF_{BL,HG,y,f}$. and the corresponding heat generation in the monitoring of the parameter $HG_{BL,BR,y}$..

Fossil fuel consumption in the recovery boiler:

- In the baseline scenario, the recovery boiler would have included the possibility of co-firing some fossil fuels due to technical constraints. Hence, the Project Participant will define the type of fossil fuel and the amount based on plant´s consumption in previous monitoring periods.

  Fossil fuel(s) types:
  1) Fuel Oil,
  2) Diesel,
  3) Natural Gas
  4) LPG
  5) Other fossil fuels.

These fossil fuels are consumed due to operational reasons, such as start-ups conditions which are defined in term of pulp mill production.

Fossil fuel co-fired per unit of combusted biomass due to technical constraints:

Considering the above, the average fossil fuel amount co-fired in previous monitoring periods:

- Fuel Oil: 13,915(ton/y)[53]
- Diesel: 0.0(ton/y)
- Natural Gas: 0.0(ton/y)
- LPG: 0.0(ton/y)

[53] The boiler does allow some use of fossil fuels for start-up operations, to generate power when the mill is not capable of generating enough power for its own consumption. Since these two situations are not related to the implementation of the proposed project activity, as they would occur with or without the implementation of the project activity, fossil fuel amount is contemplated as part of the baseline case.

Fossil fuel consumption in the power boiler:

- Fuel Oil: 1,001[54](ton/y)
- Diesel: 0.0(ton/y)
- Natural Gas: 0.0(ton/y)
- LPG: 0.0(ton/y)

The Project Participant would like to note the following:

- Diesel and LPG consumption are estimated to be nil, based on measurements conducted in past monitoring period where Fuel Oil was preferred as an alternative due to economic reasons. However, these might change in the future.
- Natural gas consumption is estimated to be nil due since Argentina no longer export natural gas to Chile. However, in the future the situation might change and expected natural gas supply from Argentina.

According to the ACM0006 (Version 14.0), these fossil fuels amounts will be accounted for in the parameter $FF_{BL,HG,y,f}$ and the corresponding heat generation considered in the monitoring of the parameter ($HG_{BL,BR,y}$).

Allocation of biomass residues and fossil fuels:

According to the baseline scenario ACM0006 (Version 14.0), the Project Participant should calculate the amount of heat generated with biomass residues based on the allocation rules established above using the following equation:

$$HG_{BL,BR,y} = \sum_h \sum_n (BR_{B5,n,h,y} * NCV_{BR,n,y} * \eta_{BL,HG,BR,h})$$

Subject to the following conditions:

The biomass residues used in each heat generator should not exceed the total amount of biomass residues available. This is stated in equation 15:

$$\sum_h \sum_n BR_{B5,n,h,y} = \sum_n BR_{B4,n,y}$$

The heat generation in each heat generator should not exceed the total capacity of the heat generator.

This is stated in equation 16:

$$\sum_n (BR_{B5,n,h,y} * NCV_{BR,n,y} * \eta_{BL,HG,BR,h}) \leq LOC_y * CAP_{HG,h} * LFC_{HFG,h}$$

Where:

[54] Monitored amount of fuel consumed in the power boiler due to operational problems, such as trips and start ups.

$HG_{BL,BR,y}$	=	Baseline biomass heat generation in year y (GJ)
$BR_{B5,n,h,y}$	=	Quantity of biomass residues of category n used in heat generator h in year y with baseline scenario B5 (tone on dry-basis)
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tone on dry-basis).
$\eta_{BL,HG,BR,h}$	=	Baseline biomass-based heat generation efficiency of heat generator h (ratio).
$BR_{B4,n,y}$	=	Quantity of biomass residues of category n used in the project. activity in year y for which the baseline scenario is B4: (tone on dry-basis).
LOCy	=	Length of the operational campaign in year y (hour).
$CAP_{HG,h}$	=	Baseline capacity of heat generator h (GJ/h).
$LFC_{HG,h}$	=	Baseline load factor of heat generator h (ratio).
y	=	Year of the crediting period.
h	=	Heat generator in the baseline scenario.

Proceed to step 3.2 to determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction.

According to ACM0006 (Version 14.0), it is assumed that cogeneration of process heat and power using biomass-based heat ($HG_{BL,BR,y}$) is prioritized over the use of fossil fuels for the generation of process heat and power.

According to the general principles suggested by the ACM0006 (Version 14.0), the Project Participant will allocate the biomass-based heat to the heat engines identified in the baseline scenario. In order to do that the Project Participant will follow the procedure bellow:

- In the case of this project activity, the list of heat engines identified in the baseline scenario for which heat and power can be cogenerated are[55]:

  1. Back-pressure turbines with capacity (TG1) 45MW
  2. Back pressure turbine with capacity (TG1) 45MW

The Project Participant would like to note that heat and power can be cogenerated in both heat engines.

<u>Allocation of biomass-based heat $HG_{BL,BR,y}$.</u>

Considering the above, the Project Participant will allocate the maximum amount of heat to the heat engines identified that would operate in the baseline scenario. In doing so, the following principles should be adhered to:

- In the case of the project activity, the baseline scenario considers two back pressures heat engines in which heat can technically be allocated so as to maximize the cogeneration of process heat.
- Heat engines are both equally efficient, so heat is allocated equally.

With this allocation the Project Participant will determine the amount of electricity and process heat that would be cogenerated in the baseline scenario.

[55] These values are obtained from the baseline case energy/mass balance presented in this PDD, performed based on average operational conditions of the pulp mill.

The amount of electricity that would be cogenerated in the baseline scenario is determined by equation 17 as follows:

$$EL_{BL,BR,CG,y} = \frac{1}{3.6} * \sum_i \left(\frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} * HG_{BL,BR,CG,y,i} \right)$$

The amount of process heat that would be cogenerated in the baseline scenario is determined by equation 18 as follows:

$$HC_{BL,BR,CG,y} = \sum_i \left(\frac{HPR_{BL,i}}{(HPR_{BL,i} + 1 + GGL_{default})} * HG_{BL,BR,CG,y,i} \right)$$

Subject to,

1. The biomass-based heat used in cogeneration mode should not exceed to total biomass-based heat generated. This is stated in equation 19 as follows:

$$\sum_i HG_{BL,BR,CG,y,i} \leq HG_{BL,y}$$

2. The process heat co-generated should not exceed the total process heat demand. This is stated in equation 20 as follows:

$$HC_{BL,BR,CG,y} \leq HC_{BL,y}$$

3. The electricity generation in each heat engine should not exceed the total capacity of the heat engine. This is stated in equation 21 as follows:

$$(\eta_{BL,EG,CG,i} * HG_{BL,BR,CG,y,i}) \leq LOC_y * CAP_{EG,CG,i} * LFC_{EG,CG,i}$$

Where:

$EL_{BL,BR,CG,y}$	=	Baseline biomass-based cogenerated electricity in year y (MWh).
$\eta_{BL,EG,CG,y}$	=	Baseline electricity generation efficiency of heat engine i (MWh/GJ).
$HG_{BL,BR,CG,y,I}$	=	Baseline biomass-based heat used in heat engine I in year y (GJ).
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat cogenerated in year y (GJ).
$HPR_{BL,I}$	=	Baseline heat-to-power ration of the heat engine i (ratio).
$GGL_{default}$	=	The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. Set at 0.05) (ratio).
$HG_{BL,BR,y}$	=	Baseline biomass-based heat generation in year y (GJ).
$HC_{BL,y}$	=	Baseline process heat generation in year y (GJ).
LOC_y	=	Length of the operational campaign in year y (hour).
$CAP_{EG,CG,I}$	=	Baseline electricity generation capacity of heat engine i (MW).
$LFC_{EG,CG,I}$	=	Baseline load factor of heat engine i (ratio).
i	=	Cogeneration-type heat engine in the baseline scenario.

Y = Year of the crediting period.

According to the ACM0006 (version 14.0), the next step to be followed depends on the outcomes of the calculations above. The methodology states there are four possible cases:

Case 3.2.4

In this case, there would be biomass-based heat in the baseline that could still be used and process heat demand to be met. It is assumed then that this balance of biomass-based heat would be extracted from the heat header and used to meet the process heat demand without cogeneration of power. The latter is reflected as follows:

$$HG_{BL,BR,y} > \sum_i HG_{BL,BR,CG,y,i}$$

And

$$HC_{BL,y} > HC_{BL,BR,CG,y}$$

According to the ACM0006 (Version 14.0), there are three possible outcomes that can happen and the Project Participant presents the most likely outcome:

Case 3.2.4.3

In this case, the balance of biomass-based heat (right-hand side of the equation) is greater than the remaining demand for process heat (left side of the equation). This is stated as follows:

$$HC_{BL,y} - HC_{BL,BR,CG,y} < \frac{h_{LOW,y}}{h_{HIGH,y}} * (HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i})$$

Then the balance of heat produced with biomass is greater than the balance of process heat demand, which means that there is still some biomass-based heat to be used after the demand for process heat was met. It is assumed then that this heat would be used to generate electricity in power-only mode i.e. without cogeneration of process heat.

In order to estimate the baseline parameters that result, the project participant should make the following definitions:

$$HG_{balance,BR,PO,y} = (HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i}) - \frac{h_{HIGH,y}}{h_{LOW,y}} * (HC_{BL,y} - HC_{BL,BR,CG,y})$$

$$EL_{balance,PO,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$$

Proceed to Step 3.3 to determine the baseline biomass-based electricity generated in power–only mode.

Proceed to step 3.3 to determine the baseline biomass-based electricity generated in power only mode.

If power-only type heat engines, i.e. heat engines that produce only electricity without cogeneration of process heat, have been identified in the baseline scenario, it is assumed that the balance of heat produced using biomass residues, if any, would be used in power-only mode.

According to this, equations 22, 23 and 24 apply:

$$EL_{BL,BR,PO,y} = \sum_i (HG_{BL,BR,PO,y,j} * \eta_{BL,EG,PO,j})$$

Subject to:

$\sum_i HG_{BL,BR,PO,y,j} \leq HG_{balance,BR,PO,y}$ The biomass-based heat used in the heat engines should not exceed the biomass-based heat balance.

$(HG_{BL,BR,PO,y,j} * \eta_{BL,EG,PO,j}) \leq LOC_y * CAP_{EG,PO,j} * LGC_{EG,PO,j}$ The electricity generation in each heat engine should not exceed the total capacity of the heat engine.

Where:

$EL_{BL,BR,PO,y}$ = Baseline biomass-based electricity (power-only) in year y (MWh).
$HG_{BL,BR,PO,y,j}$ = Baseline biomass-based heat used in heat engine j in year y (GJ).
$\eta_{BL,EG,PO,j}$ = Average electric power generation efficiency of heat engine j (MWh/GJ).
$HG_{balance,BR,PO,y}$ = Baseline biomass-based heat balance after cogeneration in year y (GJ).
LOC_y = Length of the operational campaign in year y (hours/yr).
$CAP_{EG,PO,j}$ = Baseline electricity generation capacity of heat engine j (GJ/hr).
$LFC_{EG,PO,j}$ = Baseline load factor of heat generator j (ratio).

According to the design of the baseline scenario, the most likely outcome from the equations above is case 3.3.1. As a result, the following equation applies:

$$EL_{balance,PO,y} \geq EL_{BL,BR,PO,y}$$

This means that the amount of electricity generated on-site in the baseline is equal or less than the amount of electricity generated in the project scenario. In that case, the following definitions must be made:

$$EL_{BL,FF/GR,y} = EL_{balance,PO,y} - EL_{BL,BR,PO,y}$$

$$EL_{PJ,offset,y} = 0$$

$$FF_{BL,HG,y,f} = 0$$ [56]

[56] Note that according to step 3.1, some fossil fuels must be used in the baseline due to technical constraints. According to the methodology, this amount of fossil fuel must be considered (added) to this parameter. As a result, this parameter will most likely be small, but not zero. This will be fully illustrated in the ex-ante emission reduction calculation section of this PDD.

Proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

<u>Step 5</u>: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

According to ACM0006 (Version 14.0) the emissions should be determined separately for biomass residues categories for which scenarios B1 and B3 (aerobic decay or uncontrolled burning) apply, and for biomass residues categories for which scenario B2 (anaerobic decay) apply, using equation 35 as follows:

$$BE_{BR,y} = BE_{BR,B1/B3,y} + BE_{BR,B2,y}$$

Where:

$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year y (tCO_{2e})
$BR_{B1/B3,n,y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (tCO_2).
$BE_{BR,B2,y}$	=	Baseline emissions due to anaerobic decay of biomass residues in year y (tCO_2).

In the case of the project activity, the Project Participant will consider the baseline emissions due to uncontrolled burning or decay of biomass residues, only determined for those categories for biomass residues for which (B1), (B2) or (B3) have been identified as the most plausible baseline scenario. From this equation stated above is simplified to the following:

$$BE_{BR,y} = BE_{BR,B1/B3,y}$$

Proceed to step 5.1 to determine $BE_{BR,B1/B3,y}$

According to the ACM0006 (Version 14.0), in cases where the most likely scenario for the use of biomass residues is that the residues would be dumped or left to decay under mainly aerobic conditions (B1), or burnt in an uncontrolled manner without utilizing them for energy purposes (B3), the corresponding baseline emissions must be calculated assuming that the biomass residues would be burnt in an uncontrolled manner. Therefore, the baseline emissions are calculated using equation 36 of the ACM0006 (Version 14.0):

$$BE_{BR,B1/B3,y} = GWP_{CH4} * \sum_{n} BR_{B1/B3,n,y} * NCV_{BR,n,y} * EF_{BR,n,y}$$

Where:

$BE_{BR,B1/B3,y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (tCO_2).
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period (tCO_2/tCH_4).
$BR_{B1/B3,n,y}$	=	Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B1: or B3: (tones on dry-basis)
$NCV_{B1/B3,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tone on dry-basis).

$EF_{BR,n,y}$	=	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year y (tCH_4/GJ).
n	=	Biomass residue category.

Proceed to step 5.2 to determine $BE_{BR,B2,y}$

This assessment is not applicable, since no biomass residues would be dumped under clearly anaerobic conditions (B2) in the baseline scenario.

<u>Step 6:</u> Calculate baseline emissions (BE_y)

Baseline emissions are calculated using the equation 2 stated in the methodology ACM0006 (Version 14.0).

<u>Calculate project emissions (PE_y)</u>

Project emissions for this project activity are calculated using equation 37 of the ACM0006 (Version 14.0):

$$PE_y = PE_{FF,y} + PE_{GR1,y} + PE_{GR2,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} + PE_{BG2,y} + PE_{BC,y}$$

Where:

PE_y	=	Project emissions in year y (tCO_2).
$PE_{FF,y}$	=	Emissions during the year y due to fossil fuel consumption at the project site (tCO_2).
$PE_{GR1,y}$	=	Emissions during the year y due to grid electricity imports to the project site (tCO_2).
$PE_{GR2,y}$	=	Emissions due to a reduction in electricity generation at the project site as compared to the baseline scenario in year y (tCO_2).
$PE_{TR,y}$	=	Emissions during the year y due to transport of the biomass residues to the project plant (tCO_2).
$PE_{BR,y}$	=	Emissions from the combustion of biomass residues during the year y (tCO_2e).
$PE_{WW,y}$	=	Emissions from wastewater generated from the treatment of biomass residues in year y (tCO_2e).
$PE_{BG2,y}$	=	Emissions from the production of biogas in year y (tCO_2e).
$PE_{BC,y}$ in	=	Project emissions associated with the cultivation of land to produce biomass year y (tCO_2).

In view of the particular circumstances of this project activity, the following simplifications apply to equation 37 previously presented:

- In this case, the amount of electricity generation on-site in the baseline would not exceed the amount of electricity generated in the project activity scenario as a result, associated project emissions are considered zero (PE_{GR2} =0).
- The project activity will not imply anaerobic treatment of waste water generated from the treatment of biomass residues as a result, associated project emissions from waste water treatment are considered zero ($PE_{WW,y}$ = 0).

- The project activity will not imply the production of biogas as a result, associate project emissions are considered zero (PE_{BG2} =0).
- The project activity will not imply the cultivation of land to produce biomass ($PE_{BC,y}$ =0).

Considering the above simplifications, the equation 37 of the ACM0006 (Version 14.0) results as follows:

$$PE_y = PE_{FF,y} + PE_{GR1,y} + PE_{TR,y} + PE_{BR,y}$$

Determination of PE $_{FF,y}$

According to the ACM0006 (Version 14.0), the Project Participant shall use the last version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02). According to this tool and considering the availability of information in the country in which the project activity is implemented, the Project Participant will use the following approach for determining CO_2 emissions:

$$PE_{FC,j,y} = \sum_i (FC_{i,j,y} * COEF_{i,y})$$

Where:

$PE_{FC,j,y}$	=	CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/y).
$FC_{i,j,y}$	=	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/y).
$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit);
i	=	are the fuel types combusted in process j during the year y.

The CO_2 emission coefficient $COEF_{i,y}$ will be calculated using Approach B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02), which consists in calculating the coefficient based on the net calorific value and CO_2 emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} * EF_{CO2,i,y}$$

Where:

$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit).
$NCV_{i,y}$	=	Weighted average net calorific value of the fuel type i in year y (tCO_2/GJ).
$EF_{CO2,i,y}$	=	Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ).
i	=	Fuel types combusted in process j during the year y.

For weight average net calorific values ($NCV_{i,y}$) and weight average CO_2 emission factors ($EF_{CO2,i,y}$) of fossil fuels type i, the Project Participant will use IPCC default values for the emission reduction calculation registered in this PDD. Subsequently monitoring periods, the Project Participant may use

other sources, in accordance with the guidance of the monitoring methodology ACM0006 (Version 14.0) and the corresponding tool.

For fossil fuels type i density, the Project Participant will use reliable and documented National Energy Statistics (National Energy Commission, energy balance).

Project emissions will be determined for the following combustion processes j:

a) Emissions from on-site fossil fuel consumption for the generation of electric power and heat:

It must be noted that virtually all the emissions attributed to this source, will correspond to fossil fuel consumption in the power boiler and (eventually) the recovery boiler.

Fossil fuel consumption in the recovery boiler: Under normal operational conditions, fossil fuels are not used to generate additional power in the recovery boiler, since it disturbs the recovery process of the inorganic chemicals used in the pulping process (i.e. loss of chemicals through the flue gases of the recovery boiler) and because it is uneconomic, since the recovery boiler is not designed to burn fossil fuel to generate steam in an efficient way. However, the boiler does allow some use of fossil fuels for start-up operations, to generate power when the mill is not capable of generating enough power for its own consumption and to generate additional power to the grid under a high energy marginal price condition.

Since the first two situations are not related to the implementation of the proposed project activity, as they would occur with or without the implementation of the project activity, fossil fuel consumption will be considered as a project emission source only when the plant is generating surplus power to the grid and is not in a start-up operation. That means that fossil fuel consumption will be accounted as a project emission source only when the plant is burning fossil fuel to generate additional power to the grid. Under that condition, the project will consider all the fossil fuel used to increase the electric power output of the plant as a project emission source.

Fossil fuel consumption in the power boiler: In this case, fossil fuels are used for start-up operations, during winter when the biomass residues from forest operations are too wet and also, to increase the electric power output of the plant. Since the power boiler used in the project activity has a higher biomass firing capacity than the one that would have been used in the baseline case scenario, the fossil fuel consumption related to the project activity will be the one:

1. Used to burn the additional biomass related to the project activity.
2. Used to increase the generation of surplus power to the grid.

To account for the first project emission source, the project proponent originally informed to use the specific consumption factor that considers historic fossil fuel consumption per unit of additional biomass consumed in the Valdivia power boiler under normal operation conditions (i.e. start-up operations, when biomass is too wet, etc.). However, the estimate amount of fuel oil consumed in the baseline would be nil due to drier impact on biomass moisture content. Therefore, for monitoring simplicity the project participant will contemplate in project emission calculation the whole amount of fossil fuel used to burn the total biomass in the power boiler.

To account for the second project emission source, the project proponent will monitor all the additional fossil fuel consumption used to generate additional electric power to the grid. It must be noted that as in the previous case, fossil fuel consumption will only be considered as a project emission source when the pulp mill is generating surplus power to the grid. Under that condition, the project will consider all the fossil fuel used to increase the electric power output of the plant as a project emission source.

b) Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power and heat:

In the case of this project activity, emissions will correspond to fossil fuel amount required for the operation of auxiliary equipment related to the preparation, storage and on-site transportation of biomass residues from wood handling to the power boiler area, attributable to this project activity.

Determination of PE $_{GRI,y}$

This project activity includes the possibility to imported electricity from the grid to the project site. Considering this project activity is designed to generate surplus of electricity to the grid, only under some particular circumstances (such as, start-up operations, maintenance periods and other exceptional circumstances), it might be required to import a certain amount of electric power from the grid. In such situations, this parameter will be monitored and the corresponding emissions will be accounted for as project emissions, and calculated using equation 38 of the ACM0006 (Version 14.0):

$$PE_{GR1,y} = EF_{EG,GR,y} * EL_{PJ,imp,y}$$

Where:

$PE_{GR1,y}$ = Emissions during the year y due to grid electricity imports to the project site (tCO_2).

$EL_{PJ,imp,y}$ = Project electricity imports from the grid in year y (MWh).

$EF_{EG,GR,y}$ = Grid emission factor in year y (tCO_2/MWh).

Determination of PE $_{TR,y}$

This project activity contemplates the use of additional biomass residues from industrial and forest operations sourced from third party providers. Since the transportation of such biomass to the plant is done by vehicles (e.g. heavy trucks) the Project Participant will use the latest version of the tool “Project and leakage emissions from transportation of freight” (Version 01.1.0) to determine the emissions from transportation of freight to the project plant.

According to this tool the Project Participant should document in this PDD which type of freight transportation will occur under the project activity including for each transportation activity the following information:

- The origin and destination of the freight: In the case of this project activity, the Project Participant will document the origin and destination of freight based on previous monitoring period, based on available information at the validation stage, under the title: “Documentation of freight transportation activities under the project activity” (See Appendix 5 of this PDD). In the case new origins of freight are used by this project activity, the Project Participant will contemplate them in the monitoring stage and therefore, registered in the Monitoring Report.
- The type (s) of freight that is planned to be transported: In the case of this project activity, the Project Participant will contemplate to transport one type of freight: Mix of sawdust and bark from industrial and forestry operations.
- The planned number of trips and/or the planned quantity of freight that should be transported shall be documented in this PDD: As a reasonable estimate, the Project Participant considers the quantity of freight transported based on measurements conducted in previous monitoring periods.

In this case, the Project Participant will choose Option B to calculate PETR,y., according to the latest version of the tool "Project and leakage emissions from transportation of freight. Under this option, the Project Participant shall monitor separately for each freight transportation activity *f* the following data in order to estimate the project emissions:

- The quantity of freight transported (FRf,m).
- The origin and destination of the freight transported and the road distance between the origin and the destination (Df,m);
- The vehicle class used. This tool defines two vehicle classes based on their gross vehicle mass. Light vehicles with GVM being less or equal to 26 tonnes; and heavy vehicles with GVM being higher than 26 tonnes. In the case of this project activity, heavy vehicles with GVM being higher than 26 tons will be used for freight transportation to the plant.

Project emissions related to this source will only be accounted for the (additional) consumption of biomass residues (mix of sawdust and bark) from industrial and forest operations from third party providers attributable to electric power generation of the project activity. The way in which the quantity of (additional) biomass residues is calculated is described in section B.6.3 Ex-ant calculation of emission reductions.

$$\sum_{f} D_{f,m} \cdot FR_{f,m} \cdot EF_{CO_2,f} \cdot 10^{-6}$$

Where:

PETR,y = Project emissions from transportation of freight monitoring period m (tCO2).

Df,m = Return trip road distance between the origin and destination of freight transportation activity f in monitoring period m (km).

FRf,m = Total mass of freight transported in freight transportation activity *f* (gCO2/t km).

EFCO2,f = Default CO2 emission factor for freight transportation activity *f* (g CO2/t km).

f = Freight transportation activities in the project activity in monitoring period m.

Determination of PE BR,y

Since the Project Participants decided to include emissions due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$) in the calculation of the baseline emissions, then emissions from the combustion of biomass residues in the power boiler shall be included and calculated using equation 40 of the ACM0006 (Version 14.0):

$$PE_{BR,y} = GWP_{CH4} * EF_{CH4,BR} * \sum_{k} BR_{PJ,n,y} * NCV_{BR,n,y}$$

Where:

PEBR,y = Emissions from the combustion of biomass residues during the year y (tCO2e).

GWPCH4 = Global Warming Potential of methane valid for the commitment period (tCO2/tCH4).

EFCH4,BR = CH4 emission factor for the combustion of biomass residues in the project plant (tCH4/GJ).

BRPJ,n,y = Quantity of biomass residues of category n used in the project activity in year y (tonnes on dry-basis).

NCVBR,n,y = Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis).

According to the baseline methodology ACM0006 (Version 14.0), the Project Participant may either conduct measurements at the plant site or use IPCC default values, as provided in Table 4 of this methodology. In this project activity, the Project Participant decided to use IPCC default values in accordance with the ACM0006 (Version 14.0) monitoring methodology.

Leakage emissions

According to the ACM0006 (Version 14.0), where the most likely baseline scenarios for which potential leakage is relevant is B4 the Project Participants shall demonstrate that the use of biomass does not result in increased fossil fuel consumption elsewhere.

To assess possible leakage emissions for the categories of biomass residues whose baseline scenario has been identified as B4 the Project Participant shall calculate leakage emissions as follows:

$$LE_{BR,y} = \sum_{n} BR_{PJ,n} x\, NCV_{n,y}$$

Where:

$LE_{BR,y}$ = Leakage emissions in year y (tCO_2).

$EF_{CO2,LE}$ = CO_2 emissions factor of the most carbon intensive fossil fuel used in the country (tCO_2/GJ).

$BR_{PJ,n,y}$ = Quantity of biomass residues used in the project site and included in the project boundary in year y (tonnes on dry-basis).

$NCV_{,n,y}$ = Net calorific value of biomass residue of category n in year y (GJ/tonne on dry basis).

n = Categories of biomass residues for which B5 has been identified as the alternative scenario.

y = Year of the crediting period.

In this case, the leakage emissions are not relevant as this project activity will contemplates the utilization of biomass residues for which the most likely (applicable) baseline scenario would be for heat generation purpose (B5), dumped or left to decay under mainly aerobic conditions (B1), and in some particular cases biomass burnt in an uncontrolled manner without utilizing them for energy purposes (B3).

Supply / Demand situation in Valdivia power plant influence area
(Estimation for year 2017)

Biomass residues generation

Biomass from industrial operations	(m^3st/yr)	4,132,348

Biomass residues demand

Demand from industrial operations	**(m^3st/yr)**	2,267,306

Sources: Infor official bulletins and studies.

Valdivia power plant surplus index
(estimation for year 2017)

This index was calculated using criteria "L2" of the ACM0006

Industrial Biomass residues supply / Industrial Biomass residues consumption	1.8226

Supply / Demand situation in Valdivia power plant influence area
(Estimation for year 2016)

Biomass residues generation

Biomass from industrial operations	(m^3st/yr)	4,424,209

Biomass residues demand

Demand from industrial operations	**(m^3st/yr)**	2,494,139

Sources: Infor official bulletins and studies.

Valdivia power plant surplus index
(estimation for year 2016)

This index was calculated using criteria "L2" of the ACM0006

Industrial Biomass residues supply / Industrial Biomass residues consumption	1.7738

Default values

In this section, the Project Participant will provide the default values used in the emission reduction calculations of this project activity.

According to step 1.5 of the methodology ACM0006 (Version 14.0), the Project Participant shall provide the default values of the efficiencies of heat generators and heat engines available in the baseline to be used in the emission reduction calculation.

In the baseline case of this project activity, there would be two heat generators (recovery and power boiler) available in the baseline and two back-pressure heat engines. From the options presented only Option 1: "Default values should be chosen" is applicable, in this case. Subsequently, this option automatically refers to Option F: "Use a default value" of the latest tool Determining the baseline efficiency of thermal or electric energy generation systems" at the date of revalidation of this project activity.

Default value types	Name	Unit	Value[57]	Justification/comment
Heat efficiency of the recovery boiler (heat generator)	$\eta_{BL,HG,BR,RB}$	(%)	85.0%	This value was available under option F, Appendix. Default efficiency factors, Table 1. Default efficiency for thermal applications of the latest approved version of the "Tool to determine the baseline efficiency of thermal or electric energy generation systems" at the date of the validation of the project activity.

[57] Values informed in above table results from the baseline energy/mass balance presented in this PDD, performed under average operational conditions of the pulp mill. Most of the supporting evidence has not been included in this PDD; however, detailed evidence of the calculations will be fully available at the validation stage of this project activity.

				As a result, the Project Participant will use the default efficiency value stated in the Tool09 "Determining the baseline efficiency of thermal or electric energy generation systems" version 02.0.
Heat efficiency of the power boiler (heat generator)	$\eta_{BL,HG,BR,PB}$	(%)	85.0%	This value was available under option F, Appendix. Default efficiency factors, Table 1. Default efficiency for thermal applications of the latest approved version of the Tool09: "Determine the baseline efficiency of thermal or electric energy generation systems" (version 02.0) at the date of the validation of the project activity. As a result, the Project Participant will use the default efficiency value stated in the Tool09 "Determining the baseline efficiency of thermal or electric energy generation systems" version 02.0.
Baseline electricity generation efficiency of heat engine i (TG1)	$\eta_{BL,HG,BR,}$	(MW/GJ)	0.04667 under pine pulp prod. 0.05166 under euca pulp prod.	These parameters were determined considering the overall efficiency of 83.5% in accordance with Tool 09 "Determining the baseline efficiency of thermal or electric energy generation systems" (version 02.0), Option F: Use default value, Appendix. "Default efficiency factors", Table 2. "Default efficiency for grid connected power plants".
Baseline electricity generation efficiency of heat engine i (TG2)	$\eta_{BL,HG,BR,}$	(MW/GJ)	0.04930 under pine pulp prod. 0.03768 under euca pulp prod.	These parameters were determined considering the overall efficiency of 83.5% in accordance with Tool 09 "Determining the baseline efficiency of thermal or electric energy generation systems" (version 02.0), Option F: Use default value, Appendix. "Default efficiency factors", Table 2. "Default efficiency for grid connected power plants.
Baseline heat-to-power ratio of heat engine i (TG1)	$HPR_{BL,i}$	(Number)	4.935 under pine pulp production. 4.361 under euca pulp production.	Chosen according to Case 2, efficiency of heat engines, Step 1.5 of the ACM0006 (Version 14.0). The Project Participant obtained this parameter from the design study of the baseline pulp mill.
Baseline heat-to-power ratio of heat engine i (TG2)	$HPR_{BL,i}$	(Number)	4.616 under pine pulp production. 6.358 under euca pulp production.	Chosen according to Case 2, efficiency of heat engines, Step 1.5 of the ACM0006 (Version 14.0). The Project Participant obtained this parameter from the design study of the baseline pulp mill.
Losses linked to the electricity generation group	$GGL_{default}$	(%)	5	Default value suggested by the ACM0006 (Version 14.0) in step 1.5.

B.6.2. Data and parameters fixed ex ante

<u>Data and parameters not monitored for ACM0006 (Version 14.0)</u>

Notes:

The values of the parameters for the reference plant design for the baseline scenario of the PDD submitted for the renewal of the crediting period differ from the values stated in the revised registered PDD (ver.10, dated 15 October 2015) for the first crediting period. This is due to the fact that the revised registered PDD were performed under Maximum Continues rates (MCR) conditions of the pulp mill. In the new methodology ACM0006 (14.0) it can be understood that balances for average conditions should be used and presented. In this PDD submitted for the renewal of the crediting period, the balances were updated considering average values of the measured parameters on the actual performance of the plant, which results to be more representative of monitored data. This fact needs to be considered when comparing energy and mass balances of registered revised PDD (ver.10, dated 15 October 2015) with the PDD submitted for the renewable of the crediting period.

Data /Parameter table 10

Data / Parameter	$\mathbf{CAP_{HG,h}}$
Unit	(GJ/h)
Description	**$\mathbf{CAP_{HG,h}}$= Baseline capacity of heat generator h (GJ/h)**
Source of data	Reference plant design parameters.
Value(s) applied	Recovery boiler (heat generator): Baseline capacity 1,879 (GJ/h) under euca pulp production and 1,677 (GJ/h) under pine pulp production. Power boiler (heat generator): Baseline capacity 301 (GJ/h) under euca campaign. Under pine campaigned the power boiler would not operate (see additional comments bellow).
Choice of data or Measurement methods and procedures	This parameter reflects the design maximum heat generation capacity (in GJ/h) of the baseline heat generator h based on the installed capacity of the heat generator. <u>Heat generator (Recovery boiler) under euca and pine campaigns:</u> The value 1,879 (GJ/h) corresponds to the baseline capacity of the heat generator "recovery boiler" <u>under euca pulp production</u>, determined as the heat output [422 MW * 3.6 (GJ/MW)/80.88%]. Where: • The 422 MW corresponds to the design capacity of the recovery boiler, This is consistent with the design value used in the baseline energy and mass balance of this PDD. • The 80.88% corresponds to the baseline load factor of the recovery boiler under euca pulp production. Refer to the parameter $LFC_{HG,h.}$ The value 1,677 (GJ/h) corresponds to the baseline capacity of the heat generator "recovery boiler" <u>under pine pulp production</u>, determined as the heat output [422 MW * 3.6 (GJ/MW)/90.59%]. Where: • The value 90.59% corresponds to the baseline load factor of the recovery boiler under pine pulp production. Refer to the parameter $LFC_{HG,h.}$ The PP would like to clarify: - As fuel oil is only used at start-up when black liquor load is lower than 50% the Fuel oil firing as nothing to do with the recovery boiler capacity and/or the load factor.

	- It has been assumed that the efficiency is the same for all of the fuels fired in the recovery boiler, which is reasonable to assume. Heat generator (Power boiler) under euca and pine campaigns: The 313 (GJ/h) corresponds to the baseline capacity of the heat generator "power boiler" under euca pulp production, determined as the heat output [76.9 MW * 3.6 (GJ/MW)/88.42%]. Where: • The 76.9 MW corresponds to the design capacity of the power boiler, specified by manufacture. This value is consistent with the design value used in the baseline energy and mass balance of this PDD. • The value 88.42% corresponds to the baseline load factor of the power boiler under euca pulp production. Refer to the parameter $LFC_{HG,h.}$ The boiler is not in operation at pine campaign.
Purpose of data	---
Additional comment	According to ACM0006 (Version 14.0), this parameter refers to biomass heat generator, not fossil fuel heat generator. (*) Under a conventional pulp mill design, Kraft cycle for pine the mill would be self-sufficient in term of energy (heat and electricity) using the recovery boiler only. The Kraft cycle for Eucalyptus does not produce enough black liquor to generate all the electric power required by the mill. This shortcoming is a characteristic of a conventional pulp mill design, since other modern pulp mills recently built in Chile also present a small power deficit when they produce pulp from Eucalyptus

Data /Parameter table 11

Data / Parameter	$\mathbf{CAP_{EG,CG,i}}$ $\mathbf{CAP_{EG,PO,j}}$
Unit	MW
Description	$CAP_{EG,CG,i}$= Baseline electricity generation capacity of heat engine i (MW) $CAP_{EG,PO,j}$= Baseline electricity generation capacity of heat engine i (MW)
Source of data	On-site measurement of reference plant design parameters.
Value(s) applied	$CAP_{EG,CG,i}$ = Two backpressures units of 45MW (TG1) and 45MW (TG2) $CAP_{EG,PO,j}$: = 0 (MW). In the baseline pulp mill, there would be no power-only heat engines.
Choice of data or Measurement methods and procedures	This parameter reflects the design maximum electricity generation capacity (in MW) of the baseline heat engines i and j. It is based on the installed capacity of the heat engines. The applied values were obtained from the pulp mill plant design for the baseline, performed by reputed consultants in the Pulp and Paper industry. The design capacity of the turbo generators has been established considering the following: The actual power generation of the TGs (#1 and #2) for the baseline case has been established considering the following: The actual power generation must be the same as the power consumption as the baseline mill would be, according to the definition informed in the registered PDD a self-sufficient pulp mill, without surplus power generation to the grid. The Valdivia pulp mill was designed to produce on average 1,800 ADt/d of bleach pulp from pine and 1,980 ADt/d of bleached pulp from eucalyptus. With 354 operating days per year and with 70% of the time planned with pine and 30% planned with euca the yearly -combined production would be 656,316 ADt/y. However, the pulp mill has an environmental permit to limit the plant to operate below the 550,000 (ADt/y), which was granted after the main equipment and the turbo generators were purchased.

	The baseline diagrams of the energy and mass balance informed in the PDD show an average power consumption of 64.023 MW (TG1: 40.584 MW + TG2: 23.439 MW) at pine campaigns and 53.811MW (TG1: 44.94 MW + TG2: 8.87 MW) at euca campaigns. Note that under pine campaigns, the power generation shall be higher than the power demand, but under euca campaigns the power generation shall be lower than the power consumption. As an average, the mill will have a theoretical small surplus of power generation. The power generation in each of the Turbo generators (#1 and #2) was determined based on following parameters: a) the steam pressure in and out, b) the steam temperature in, c) steam flows in and out at the different levels, d) an overall efficiency at 83.5% as per Tool 09 "Determining the baseline efficiency of thermal electric generation systems" (version 02.0), e) thermodynamic laws and behaviour of commercial steam turbines. The design capacity of the TGs (#1 and #2) has been established considering the following: i) TGs are with exactly the same size as they idea is to minimize the negative consequences of failure of one TG and to be able to have common spare parts for the generator and the rest of 13.2 kV system. ii) The total installed power generation capacity is 90 MW (45MW + 45MW) in the baseline case. The difference between the design capacity and the average required capacity results is in the pine case 25.98 MW (90MW – 64.023 MW) and in the eucalyptus case 36.19 MW (90MW – 53.81MW). iii) The main reasons behind the 25.98MW/35.19MW difference between utilized and installed capacity is due to the following considerations: a) The Turbo generators have been selected on the big side to make sure that they can handle an increase in pulp production above the mill design, which is quite common within the pulp industry. b) Margin to make sure that the TGs based on predicted values are not too small at the real plant operation, c) As the energy and mass balance was performed under average conditions of the pulp mill a margin shall be contemplated for seasonal variations in power consumption, d) Normally the pulp mill operated above average conditions for long periods of time, therefore additional capacity shall be contemplated to cope with this operational condition, e) To give sufficient catch-up capacity for unplanned maintenance stops, f) To give sufficient power generation capacity with one turbo generator to make possible a controlled shutdown or controlled reduction of production at a failure of one of the Turbo generators.
Purpose of data	Baseline emission calculations.
Additional comment	Refer to the baseline case energy and mass balance presented in this PDD. In addition, Third party memo prepared by reputed consultant from the pulp industry is provided during revalidation stage as evidence to support.

Data / Parameter table 12

Data / Parameter	$LFC_{HG,RB}$
Unit	Ratio
Description	Baseline load factor of heat generator recovery boiler (RB) (ratio)
Source of data	Reference plant design parameters.
Value(s) applied	Recovery boiler (heat generator): 0.906 under pine pulp production; 0.809 under euca pulp production.

Choice of data or Measurement methods and procedures	This parameter reflects the maximum load factor (i.e. the ratio between the actual heat generation of the heat generator and its design maximum heat generation along one year of operation) of the baseline heat generator h, taking into account downtime due to maintenance, seasonal operational patterns, and any other technical constraints. Load **factor 0.906** under pine campaign is determined as the ratio between average pulp production **3,307 (tDs/d)** and the load design 3,650 (tDS/d) of the recovery boiler. Similarly, the load factor **0.809** under euca campaign is determined as the ratio between the average **2,952 tDS/d** and design load of 3,650 tDS/d of recovery boiler. The 3,307 tDS/d and 2,952 tDS/d flows correspond to the average load (tons of dry solids per day) of black-liquor under pine and euca pulp production, respectively. Note that informed values of the black liquor quantities have been specified for the pulping process by the suppliers of the actual pulp mill. These values are used in the baseline energy and mass balances performed on average operational production. The load design of recovery boiler capacity is defined as 3,650 tDS/d which gives a load factor of 90,6% at pine campaigns which is in line with the normal practice, 90–92%, within the pulp and paper industry. At euca campaigns the load factor will be less or 80,88%. The reason for this is that the specific solids generation at pulp production from euca is much lower than for pine. (tDS/d) stands as" tonnes of dry solids per day", in this case of black liquor.
Purpose of data	---
Additional comment	Refer to the baseline case energy/mass balance stated in this PDD. Also a technical memo is presented during the validation process as evidence to support the load design values used in the baseline scenario.

Data / Parameter table 12

Data / Parameter	$LFC_{HG,PB}$
Unit	Ratio
Description	Baseline load factor of heat generator power boiler (PB) (ratio)
Source of data	Reference plant design parameters.
Value(s) applied	Power boiler (heat generator): 0.884 under euca pulp production.

Choice of data or Measurement methods and procedures	This parameter reflects the maximum load factor (i.e. the ratio between the actual heat generation of the heat generator and its design maximum heat generation along one year of operation) of the baseline heat generator h, taking into account downtime due to maintenance, seasonal operational patterns, and any other technical constraints. Load factor of 0.884 is determined as the ratio between the average steam flow 106.1 (t/h) and the design steam flow of 120 (t/h). This ratio is in line with normal practice within the pulp and paper industry. The steam flow 106.1(t/h) corresponds to the average load of steam generated under euca campaign, obtained from the average energy and mass balance performed under average operational conditions. The steam flow 120 (t/h) corresponds to the load design selected for the power boiler, The load design of power boiler capacity is defined as 120 t/h, which gives a load factor of 88.4% under euca campaign, which is in line with the normal practice in the pulp and paper industry. Note that for pine campaign, the power boiler would not be in operation and so the load factor would be zero, as biomass consumption in the power boiler would not be required, as the pulp mill would be self-sufficient with the recovery boiler.
Purpose of data	----
Additional comment	Refer to the baseline case energy/mass balance stated in this PDD. In addition, a technical memo is presented during the validation process as evidence to support the load design values used in the baseline scenario.

Data / Parameter table 13

Data / Parameter	$HPR_{BL,i}$
Unit	Ratio
Description	Baseline heat-to-power ratio of the heat engine i (ratio)
Source of data	On-site measurements or reference plant design parameters.
Value(s) applied	Pulp production / $HPR_{BL,TG1}$ / $HPR_{BL,TG2}$: Euca: 4.361 / 6.358 Pine: 4.935 / 4.616
Choice of data or Measurement methods and procedures	In the case of this project activity, this parameter was determined as per the design conditions of the plant, for the baseline case scenario. The values informed above results from ratio: [(1) Quantity of process heat extracted from the heat engine i, year y (GJ/y) / (2) the Quantity of electricity generated in heat engine i, year y (MWh/y).] where: (1) Quantity of process heat extracted from the heat engine i determined as: Average steam flows and their corresponding enthalpies, used to determine the above parameter, obtained from the baseline energy and mass balance of this PDD, performed on average operational conditions of the pulp mill. (2) Quantity of electricity generated in heat engine i determined as follows: The gross power generation of the heat engine (MW) times the annual operational hours, obtained from the baseline case energy and mass balance of this PDD, performed on average operational conditions of the pulp mill. Detailed calculation can be seen in the emission reduction calculations spreadsheet provided at the validation stage.
Purpose of data	Baseline emission calculations.
Additional comment	The project activity is a greenfield project and therefore, the Project Participant chose case 2 described under step 1.5 to determine the $HPR_{BL,i}$ of both heat engines identified in the baseline scenario. Refer to the baseline energy and mass balance presented in this PDD. In addition, third party memo prepared by reputed consultant from the pulp industry is provided during revalidation stage as evidence to support.

Values applied (table within "Value(s) applied"):

Pulp production	$HPR_{BL,TG1}$	$HPR_{BL,TG2}$
Euca	4.361	6.358
Pine	4.935	4.616

Data / Parameter table 14

Data / Parameter	$LFC_{EG,CG,i}$ $LFC_{EG,CG,j}$
Unit	ratio
Description	$LFC_{EG,CG,i}$ =Baseline load factor of heat engine i (ratio) $LFC_{EG,CG,j}$ =Baseline load factor of heat engine j (ratio)
Source of data	Reference plant design parameters.

Value(s) applied	In the baseline pulp mill there would be no condensing-type heat engines, but two backpressures heat engines: <u>Under pine pulp production:</u> LFC $_{EG,CG,TG1}$= 90.19% (40.58MW produced / 45MW installed) LFC $_{EG,CG,TG2}$= 52.09% (23.44MW produced / 45MW installed) <u>Under euca pulp production:</u> LFC $_{EG,CG,TG1}$= 99.87% (44.94MW produced / 45MW installed) LFC $_{EG,CG,TG2}$= 19.71% (8.87MW produced / 45MW installed) The values informed corresponds to each heat engine´s load factor under pine and euca pulp production, obtained from the baseline case energy and mass balance informed in this PDD, performed under average operational conditions of the pulp mill. Note that informed values are rounded to two decimal.
Choice of data or Measurement methods and procedures	This parameter reflects the maximum load factor (i.e. the ratio between the actual power generation and their design maximum power generation along one year of operation) of the baseline heat engine i or j. The values should take into account downtime due to maintenance, seasonal operational patterns, and any other technical constraints. In this case, the baseline load factor was determined as the ratio between the (actual power generation) and its (design maximum power generation) for the baseline situation along one year of operation. Design and average power generation of TGs (#1 and #2) informed in the baseline energy and mass balance can be seen in “Baseline electricity generation capacity of heat engine”.
Purpose of data	Baseline emission calculations.
Additional comment	A technical memo prepared by third party consultant is presented during the validation process as evidence to support the baseline load factors values used in the baseline scenario.

Table / Parameter table 19

Data / Parameter	GWP_{CH4}
Unit	(tCO_2e/tCH_4)
Description	Global Warming Potential of methane valid for the commitment period (tCO_2/tCH_4)
Source of data	IPCC
Value(s) applied	25. Shall be updated according to any future COP/MOP decisions.
Choice of data or Measurement methods and procedures	Until the next COP/MOP decision, it is the accepted value for emission reduction calculations in CDM project activities.
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	Additional electric power consumption of the project mill
Unit	(GWh/time unit)
Description	This is the additional electric power consumption of the project pulp mill with surplus power capacity generation to the grid with respect to a baseline pulp mill, which does not have surplus electric power capacity to the grid. This marginal higher power consumption is derived from the installation of the equipment that enables the project pulp mill to generate additional power (for example: the installation of a higher biomass capacity power boiler in the project mill, compared to the one that would have been installed in a baseline pulp mill).
Source of data	Project and baseline case energy / mass balances for the Valdivia mill.
Value(s) applied	Constant 4.71[58]% % of the total energy consumed by the pulp mill in the project scenario.
Choice of data or Measurement methods and procedures	The value was obtained from the difference between the project and baseline cases energy / mass balances of the project mill. Since the energy / mass balances of the project mill are a good representation of the behaviour of the real mill, the calculation was deemed appropriate and realistic (i.e. the higher the electric power consumption of the pulp mill, the higher the additional electric power consumption of the associated power plant).
Purpose of data	Baseline emission calculations.
Additional comment	The direct monitoring of this parameter is not possible, since it would require simulating the power consumption of a mill without surplus power generation capacity to the grid, given the production level of the project mill.

[58] Determine as the additional internal power consumption (3.0MW) divided by the total internal power consumption of the project plant (63.5MW). For detailed calculation refer to emission reduction calculation spread sheet, under data sheet.

Data / Parameter table 26

Data / Parameter	$EF_{BR,n,y}$
Unit	tCH_4/GJ
Description	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year y (tCH_4/GJ).
Source of data	Conduct measurements.
Value(s) applied	The project participant measured once at the start of the project activity rather than use default methane emission factors provided by the baseline methodology. The results of the measurements performed by the type of biomass residues is presented as follows: Biomass types consumed in the Power boiler:

Biomass residues category n	Biomass residues type.	Biomass residues source.	CH4 factor for biomass uncontrolled burning ($KgCH_4/TJ$).	Conservativeness factor (%).	Adjusted CH4 default factor.
5	Mix of sawdust and bark from industrial operations.	On-site production.	930 +/- 167	0.94	874.20
6	Mix of sawdust and bark from industrial operations.	On-site production.	930 +/- 167	0.94	874.20
7	Mix of sawdust and bark from industrial operations.	Off-site production	930 +/- 167	0.94	874.20
8	Mix sawdust and bark from forest operations.	Off-site production.	114 +/- 114	0.82	93.48

Choice of data or Measurement methods and procedures	The Project Participant measured ones at the start of the project activity. The methane emission factor shall be performed for each type of biomass consumed in the power boiler, because of the implementation of the project activity.
Purpose of data	For the purpose of ex-ante emission reductions calculations presented in section B.6.3
Additional comment	Note that differences between IPCC default values and measurements conducted are mainly due to the compactness level of the biomass residues burned. In the case of biomass mix (sawdust and bark) from industrial operations, it was densely packed allowing for very little oxygen in the combustion process, which led to high methane emission factors. In the case of biomass mix (sawdust and bark) from forest operations, since these are mainly branches these allow for plenty of oxygen during the combustion process, which led to much lower methane emission factors.

Table / Parameter table 28

Data / Parameter	$EF_{CH4,BR}$
Unit	tCH_4/GJ
Description	CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ)
Source of data	On-site measurements or default values, as provided in Table 4.

<table>
<tr><td>Value(s) applied</td><td>The project participant uses a default methane emission factor provided by the baseline methodology.

<u>Biomass types consumed in the Power boiler:</u>

<table>
<tr><th>Biomass residues category n</th><th>Biomass residues type.</th><th>Biomass residues source.</th><th>CH4 factor for biomass controlled burning ($KgCH_4/TJ$).</th><th>Conservativeness factor (%).</th><th>Adjusted CH4 default factor.</th></tr>
<tr><td>4</td><td>Sludge from industrial operations.</td><td>On-site production.</td><td>30.0</td><td>1.37</td><td>41.1</td></tr>
<tr><td>5</td><td>Mix of sawdust and bark from industrial operations.</td><td>On-site production.</td><td>30.0</td><td>1.37</td><td>41.1</td></tr>
<tr><td>6</td><td>Mix of sawdust and bark from industrial operations.</td><td>On-site production.</td><td>30.0</td><td>1.37</td><td>41.1</td></tr>
<tr><td>7</td><td>Mix of sawdust and bark from industrial operations.</td><td>Off-site production</td><td>30.0</td><td>1.37</td><td>41.1</td></tr>
<tr><td>8</td><td>Mix sawdust and bark from forest operations.</td><td>Off-site production.</td><td>30.0</td><td>1.37</td><td>41.1</td></tr>
</table></td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>Not applicable, since default values will be used in this case.</td></tr>
<tr><td>Purpose of data</td><td>For the purpose of ex-ante emission reductions calculations presented in section B.6.3</td></tr>
<tr><td>Additional comment</td><td>Note that on-site CH_4 emissions will only be accounted for biomass controlled burning in the power boiler, and not in the recovery boiler. In the first case, additional biomass are burned to generate power due to the project activity, while in the second, the same amount of biomasses (black-liquor, methanol and CNCGs) are burned more efficiently to generate power, so no incremental CH4 emissions are generated due to the project activity implementation.</td></tr>
</table>

<u>Data and parameters not monitored for the Tool “Project and leakage emissions from transportation of freight (Version 01.1.0)”.</u>

<table>
<tr><td>Data / Parameter:</td><td>$\mathbf{EF_{CO2,f}}$</td></tr>
<tr><td>Unit</td><td>g CO_2 / t km</td></tr>
<tr><td>Description</td><td>Default CO_2 emission factor for freight transportation activity f.</td></tr>
<tr><td>Source of data</td><td>
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>Emission factor was obtained from empirical data from European vehicles.</td><td>Light vehicles</td></tr>
</table></td></tr>
</table>

	Emission factor has been derived from based on custom design transient speed-time-gradient drive cycle (adapted from the international FIGE cycle), vehicle dimensional data, mathematical analysis of loading scenarios, and dynamic modelling based on engine power profiles, which, in turn, are a function of gross vehicle mass (GVM), load factor, speed/acceleration profiles and road gradient. The following assumptions on key parameters have been made: an average driving speed of 30 km/h, an average gradient of 15, and a load factor attained when biomass is transported were assumed.	Heavy vehicles
Value(s) applied	**Vehicle class**	**Emission factor (g CO_2 / t km)**
	Light vehicles	245
	Heavy vehicles	129
Choice of data or Measurement methods and procedures	---	
Purpose of data	Project emissions calculation from transportation of freight.	
Additional comment	Applicable to Option B of the Tool “Project and leakage emissions from transportation of freight” (Version 01.1.0).	

Non- monitored parameters from the “Tool to calculate the emission factor for an electricity system (Version 07.0)”:

Data / Parameter:	**$EF_{grid,CM,y}$**
Unit	(tCO_2/MWh)
Description	CO_2 emission factor for grid electricity during year y.
Source of data	The project participant will use the latest version of the “Tool to calculate the emission factor for electricity system (version 04.0.0)”
Value(s) applied	The applied value is: 0.5125(tCO_2/MWh). The Build margin (BM), in this case 0.4278(tCO_2/MWh) will remain fixed for the second and third crediting periods. The Operating margin (OM), in this case, 0.7665(tCO_2/MWh) will remain fixed for the second and third crediting period.
Measurement methods and procedures	Arauco Bioenergia S.A. is responsible for performing the calculations to determine the grid emission factor according to the “Tool to calculate the emission factor for electricity system (Version 07.0)”.
Monitoring frequency	Annually
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	$EF_{grid\ OM,y}$
Unit	(tCO_2/MWh)
Description	Simple adjusted operating margin CO2 emission factor in year y.
Source of data	CDEC-SIC Dispatch Centre reports. Ministry of Energy reports. IPCC lower values.
Value(s) applied	Generation weight average Operating Margin: 0.7665(tCO_2/MWh). This is determined s ex-ante option, which considers the last 3-years data available. (See Appendix 4 of this PDD)
Choice of data or Measurement methods and procedures	The Operating Margin is calculated according to the last version of the “Tool to calculate the emission factor for an electricity system”, which must be used in this case.
Monitoring frequency	The Project Proponent will use the Ex-ante option to calculate the OM; that is, the OM will be calculated once at the validation stage. As a result, no monitoring and recalculation of the emissions factor during the crediting period is required.
QA/QC procedures	---
Purpose of data	Baseline and project emission calculations.
Additional comment	In this case, since the ex-ante option is chosen, this emission factor is determined once at the validation stage, thus no monitoring and recalculation of this emission factor during the crediting period is required.

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	CO_2 Build Margin emission factor of the grid.
Source of data	CDEC-SIC Dispatch Centre reports. Ministry of Energy reports. IPCC lower calorific values.
Value(s) applied	The Build Margin (BM) will remain fixed for the second and third crediting periods. The value informed corresponds to 2017 BM which used the latest available data at the moment of this revalidation. 0.4278(tCO_2/MWh) (This will remain fixed for the second crediting period)
Choice of data or Measurement methods and procedures	Arauco Bioenergía S.A. will be responsible for performing the calculations to determine the grid emission factor, according to the “Tool to calculate the emission factor for electricity system (Version 07.0)”. All information required for the calculation of this emission factor is provided in Appendix 4 of this PDD.
Purpose of data	For purpose of ex ante calculation of emission reductions in section B.6.3.
Additional comment	---

B.6.3. Ex ante calculation of emission reductions

Notes:

1. According to the ACM0006 (Version 14.0), the way in which the emission reduction calculation is carried out can present several variations depending on the operational behaviour of the project plant. As a result, the Project Participant will present the emission reduction calculation of the proposed project activity using past monitoring data (electricity generated/consumed, biomass residues types and corresponding amount)

2. In some cases where it is required, the Project Participant will use design parameters, of the baseline and project plants to perform emission calculations. In other cases, the Project Participant will use the average energy/mass balance[59] from which emission calculations draw some information. These calculations, then, shall be considered only as a reference, as long as the project plant behaves as expected.

3. Following on what was described in paragraphs above, in case the operational of the project plant departs from the probable scenario, the Project Participant will apply the ACM0006 (Version 14.0) and follow all the indications and guidelines provided by the methodology.

4. Note that differences in baseline and project emission calculations included in tables below are due to the fact that all calculations are done directly in excel spread sheets, which implies a decimal precision that is not carried over onto word formatted tables because decimals are truncated and rounded down. Therefore, exact resulting values can be viewed directly in emission reduction calculation spread sheet.

Calculation of Baseline Emissions (BEy)

Emissions due Baseline electricity generation

Proceed to Step 1.1 to determine total baseline process heat generation.

According to the ACM0006 (Version 14.0) process heat amount that would be generated in the baseline in year y ($HC_{BL,y}$) shall be determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. From the energy/mass balance of the project plant, the process heat calculation is determined as follows:

	No restricted production			With restricted production to 550,000 ADt/yr		
Pulp type production:	Pine	Euca	Total	Pine	Euca	Total
1) Process heat enthalpy.	1,311	1,237	2,548(GJ/hr)	1,112	1,053	2,165
2) Feed and make up-water, boiler blow-down and condensate enthalpy.	203	181	360(GJ/hr)	167	149	316 (GJ/hr)

[59] In the new methodology ACM0006 (14.0) it can be understood that balances for average conditions should be used and presented. Regarding the latter, the revalidation energy and mass balances of the project and baseline case diagrams were performed under average operational conditions of the pulp mill. However, the project and baseline cases energy/mass balances diagrams presented in the registered PDD (ver.9, 15/07/2015) were performed under Maximum Continues rates (MCR) conditions of the pulp mill. This fact needs to be considered when comparing energy and mass balances. The MCR definition is the supplier guaranteed or otherwise given maximum continues load on the equipment or to the complete mill. Note that in some cases the design and MCR not necessarily need to be the same as MCR is based on a balance and the design is the selected capacity.

3) Operational hours per year	2,549	5,947	8,496 hrs.	5,947	2,549	8,496

Calculations:

			Without restricted production rate.[60]	With restricted production rate.[61]
4) Baseline process heat generation (pine pulp production)	$HC_{BL,y}$	[(1) - (2)]*(3)	6,594,403(GJ/y)	5,624,324(GJ/y)
5) Baseline process heat generation (euca pulp production)	$HC_{BL,y}$	[(1) - (2)]*(3)	2,692,026(GJ/y)	2,306,013(GJ/y)
6) Total baseline process heat generation	$HC_{BL,y}$	(5) + (6)	9,286,429(GJ/y)	7,930,337(GJ/y)

Proceed to step 1.2 to determine total baseline electricity generation.

According measurements performed by Project Participants in previous monitoring periods, using equation 3 of the ACM0006 (Version 14.0), the baseline electricity generation in the grid is calculated as follows:

Data:

		Without restricted production.	With restricted production rate.
(1) Gross quantity of electricity generated.	$EL_{PJ,gross,y}$	846,253 (MWh)	694,485(MWh)
(2) Project electricity imports from the grid.	$EL_{PJ,imp.y}$	2,812 [62](MWh)	2,812(MWh)
(3) Total auxiliary electricity consumption required for the operation of the power plants.	$EL_{PJ,aux,y}$	25,403 (MWh)	25,403(MWh)

Calculations:

			Design production capacity.	With restricted production rate.
(4) Baseline electricity generation capacity in year y	$EL_{BL,y}$	**[(1) + (2) - (3)]**	**823,662(MWh)**	**671,894(MWh)**

Proceed to step 1.3 to determine baseline capacity of electricity generation.

According to the baseline plant design there would be two cogeneration-type heat engines and no power-only-type heat engine. The calculation is done using equation 4 as follows:

Data:

[60] Resulted from project case energy/mass balance diagram performed under average operational conditions of the pulp mill (without restricted production rate).

[61] The average production capacity of the pulp mill results in 656,316 (ADt/yr). However, the pulp production of the mill has being restricted as per environmental permission, which caps the production to 550,000 (ADt/yr). Note that this permission was granted after the main equipment and the turbo generators were purchased. The project case energy and mass balance at restricted production rate was available at validation stage.

[62] Data monitored directly from past monitored periods of this project activity.

Pulp type production:		Pine	Euca
(1) Baseline electricity generation capacity of heat engine TG1	$CAP_{EG,CG,1}$	45(MW)	
(2) Baseline electricity generation capacity of heat engine TG2	$CAP_{EG,CG,2}$	45(MW)	

		Pine	Euca
(3) Baseline load factor of heat engine TG1	$LFC_{EG,CG,1}$	90.19%	99.87%
(5) Baseline load factor of heat engine TG2	$LFC_{EG,CG,2}$	52.09%	19.71%
(6) Length of the operational campaign in year y	LOC_y	5,947(h/y)	2,549(h/y)

Calculations:

Pulp type production:		Pine	Euca
Baseline electricity generation in year y	[(1)*(3) + (2)*(4)]*(5)	353,561(MWh)	160,009(MWh)
Total Baseline electricity generation in year y	$\mathbf{CAP_{EG,total,i}}$	**517,909 (MWh/y)**	

Proceed to step 1.4 to determine the baseline availability of biomass residues.

The baseline scenario includes the use of biomass residues types for heat and power generation. According to measurements conducted in previous monitoring periods the amount of biomass residues per type that would be available in the baseline in year y ($BR_{B4,k,y}$) are the following:

Biomass types consumed in the Heat generator #1 (Recovery Boiler)				
Biomass residues category (n)	**Biomass residues type**	**Units**	**Parameter**	**Amounts**
1	Black liquor	(tDS/d)	$BR_{B4,1,y}$	Pine/ Euca : 3,307/2,952
		(tDS/y)		1,132,977
2	Methanol	(tDS/d)	$BR_{B4,2,y}$	Pine/Euca: 22.3/19.9
		(tDS/y)		7,640
3	CNCG	(tDS/d)	$BR_{B4,3,y}$	Pine/Euca: 13.5/12.0
		(tDS/y)		4,621

Source: Baseline energy and mass balances performed based on average operational conditions of the pulp mill (without restricted production rate)

Biomass types consumed in the Heat generator #2 (Power boiler)				
Biomass residues category (n)	**Biomass residue type**	**Units**	**Parameter**	**Amounts**
1	Sludge from industrial op.	(tDS/d)	$BR_{B4,4,y}$	0.0/60.7: Pine/Euca
		(tDS/y)		6,446
2	Mix of sawdust and bark from industrial op.	(tDS/d)	$BR_{B4,5,y}$	0.0/423.0 : Pine/Euca
		(tDS/y)		44,923

3	Mix of sawdust and bark from industrial op.	(tDS/d)	$BR_{B1,6,y}$	0/0:Pine/euca
		(tDS/y)		0
4	Mix of sawdust and bark from forestry op.	(tDS/d)	$BR_{B1,7,y}$	0/0:Pine/euca
		(tDS/y)		0

Source: Baseline energy and mass balances performed based on average operational conditions of the pulp mill (without restricted production rate)

The Project Participant would like to note the following:

- In the baseline scenario there would be two heat generator i.e. the recovery and power boiler. All the biomass residues above presented can be completely allocated to these heat generators.
- According to the normal (and modern) practice in the Pulp and Paper Industry, there is normally one fate for the biomass residues identified above: the co-generation of heat and power. This has already been addressed in previous sections of this PDD.
- The ratio (meth + CNCG)/ (total biomass residues) represents less than 2% of the total energy contribution of the biomass fuels used in the power plant.

Proceed to step 1.5 to determine the efficiencies of heat generators and efficiencies and heat to power ratio of heat engines.

1.5.1 Efficiencies of heat generators and heat engines in the baseline plant.

With regard to the efficiency of the recovery boiler in the baseline scenario the Project Participant will use the efficiency values informed in table below available under option F, Appendix. Default efficiency factors, Table 1. Default efficiency for thermal applications of the latest approved version of the Tool09 “Determine the baseline efficiency of thermal or electric energy generation systems” (version 02.0).

Heat generator in the baseline		Efficiency
Low pressure power boiler	$\eta_{BL,HG,BR,Power.boiler}$	85.0%
Recovery boiler	$\eta_{BL,HG,BR,Rec.boiler}$	85.0%

With regard to the efficiency of the cogeneration-type heat engine i identified in the baseline scenario informed in table below. This result of considering the overall efficiency of 83.5% in accordance with Tool 09 “Determining the baseline efficiency of thermal or electric energy generation systems” (version 02.0), Option F: Use default value, Appendix. “Default efficiency factors”, Table 2. “Default efficiency for grid connected power plants.

Heat engine in the baseline		**Value (MWh/GJ)**	
Pulp type production:		Pine	Euca
Cogeneration-type heat engine i (TG1)	$\eta_{BL,EG,CG,i}$	0.04666	0.05163
Cogeneration-type heat engine i (TG2)	$\eta_{BL,EG,CG,i}$	0.04929	0.03766

1.5.2 Heat-to-power ratio of heat engines in the baseline.

According to the ACM0006 (version 14.0), for heat engines without a minimum three-year operational history prior to the project activity the heat-to-power ration should be determined as per the design conditions of the plant, for the configuration identified as baseline scenario. Consequently, in this case the HPER was determined according to the baseline energy mass balance carried out by the consultant.

Heat engine in the baseline		Value	
Pulp type production:		Pine	Euca
Cogeneration-type heat engine i (TG1)	$HPR_{BL,i}$	4.935	4.361
Cogeneration-type heat engine i (TG2)	$HPR_{BL,i}$	4.616	6.358

Proceed to step 1.6 to determine the emission factor of on-site electricity generation with fossil fuels.

In this case no fossil fuel-based power generation was identified as part of the baseline scenario, as a result, according to ACM0006 (Version 14.0) the Project Participant will do:

$$EF_{EG,FF,y} = EF_{EG,GR,y}$$

The Project Participant would like to note that the fossil fuel consumed in the baseline scenario would only supply heat to process.

Proceed to step 1.7 to determination of the emission factor of grid electricity generation.

According to the ACM0006 (Version 14.0), the monitored parameter $EF_{EG,GR,y}$ should be determined as the combined margin CO_2 emission factor for the grid to which the project activity is connected in year y, calculated using the latest approved version of the “Tool to calculate the emission factor for an electricity system”. This calculation is presented below:

Data

1) Operating Margin (OM) (1)	$EF_{grid,OM,y}$	0.7665(tCO_2/MWh)
2) Build Margin (BM) (2)	$EF_{grid,BM,y}$	0.4278(tCO_2/MWh)
3) Weighting of Operating Margin	W_{OM}	25%
4) Weighting of Build margin	W_{BM}	75%

Notes:
(1) This is determined s ex-ante option, which considers the last 3-years data available.
(2) The Build Margin (BM) will remain fixed for the second and third crediting periods. The value informed corresponds to 2017 BM which used the latest available data at the moment of this revalidation

Calculations

5) Combined Margin calculation (CM)	$EF_{grid,CM,y}$	**(1)*(3) + (2)*(4)**	**0.5125(tCO_2/MWh)**

Proceed to step 2 to determine the minimum baseline electricity generation in the grid.

According to equations 13 of the ACM0006 (Version 14.0), baseline minimum electricity generation in the grid can be calculated as follows:

Data:

		Without restricted production rate.	With restricted production rate to 550,000 ADt/yr.
(1) Baseline electricity generation in year y.	$EL_{BL,y}$	823,662 (MWh)	671,894(MWh) [63]
(2) Baseline electricity generation capacity in year y.	$CAP_{EG,total,y}$	519,909(MWh)	517,909(MWh)[64]

Calculations:

			Without restricted production rate.	With restricted production rate.
(3) Minimum baseline electricity generation in the grid in year y.	$EL_{,BL,GR,y}$	Max [0,(1)-(2)]	305,754(MWh)	153,986(MWh)

Proceed to step 3 to determine the baseline biomass-based heat and power generation.

Proceed to step 3.1 to determine the baseline biomass-based heat generation.

According to the procedures established by the ACM0006 (Version 14.0):

1. There would be two heat generators (recovery and power boilers) that would use biomass residues in the baseline scenario.

2. Such recovery and power boilers would have consumed all the biomass residues for which the baseline scenario $BR_{B4,k,y}$ has been identified.

According to ACM0006 (Version 14.0), the Project Participant should clearly identify the type and quantity of fossil fuels required due to technical constraints and should be accounted in the total heat generation of the recovery and power boiler, and also considered in the baseline emission calculation of the project.

Recovery boiler	Units	Amount
Fuel Oil	(ton/y)	13,915
Diesel	(ton/y)	0
Natural gas	(ton/y)	0
LPG	(ton/y)	0

[63] The project activity is being restricted as per environmental permission, which caps the pulp production to 550,000 (ADt/y). The energy and mass balance at restricted rate was available at the validation stage.

[64] Source: Baseline energy and mass balances performed based on average operational conditions of the pulp mill (without restricted production rate).

Power boiler	Units	Amount
Fuel Oil	(ton/y)	1,001
Diesel	(ton/y)	0
Natural gas	(ton/y)	0
LPG	(ton/y)	0

In this case, the Project Participant will determine, according to equation N°14 of the ACM0006 (Version 14.0), the amount of heat generated with biomass residues, and shall comply with the following restrictions:

Restriction associated to equation 15:

- The biomass residues used in each generator should not exceed the total amount of biomass residues available.

Restriction associated to equation 16:

- The heat generation in each heat generator should not exceed the total capacity of the heat generator.

Determine the total biomass-based heat generated in the recovery boiler.

Considering the above, the calculation of the baseline biomass-based heat generation is calculated as follow:

Data:

Pulp production type		Pine	Euca
1) Black liquor.	$BR_{B4,1,y}$	819,475(tDS/y)	313,502(tDS/y)
2) Net calorific value of black liquor.	$NCV_{B4,1,y}$	11.38 (GJ/tDS)	10.49 (GJ/tDS)
3) Methanol.	$BR_{B4,2,y}$	5,526 (tDS/y)	2,114(tDS/y)
4) Net calorific value of Methanol.	$NCV_{B4,2,y}$	19.37 (GJ/tDS)	19.37(GJ/tDS)
5) CNCG.	$BR_{B4,3,y}$	3,343 (tDS/y)	1,279(tDS/y)
6) Net calorific value of CNCG.	$NCV_{B4,3,y}$	6.90 (GJ/tDS)	6.90 (GJ/tDS)
7) Baseline biomass-based heat generation efficiency of the RB.	$\eta_{BL,HG,BR,RB}$	85.0%	85.0%

Calculations:

8) Baseline biomass-based heat generation of the RB in year y (without FF)	$HG_{BL,BR,y}$	**[(1)*(2)+(3)*(4)+(5)*(6)]*(7)**	**10,872,306(GJ/y)**

Determine the total biomass-based heat generated in the Power boiler.

Data:

Pulp production type:		Euca
1) Sludge	$BR_{B4,1,y}$	6,446(BDt/y)
2) Net calorific value of sludge.	$NCV_{B4,1,y}$	5.15 (GJ/BDt)

3) Mix of sawdust and bark from on-site industrial op.	$BR_{B4,2,y}$	44,923 (BDt/y)
4) Net calorific value of the mix of sawdust and bark	$NCV_{B4,2,y}$	16.93(GJ/tDS)
5) Mix of sawdust and bark from off-site industrial op.	$BR_{B4,3,y}$	0.0 (BDt/y)
6) Net calorific value of mix of sawdust and bark.	$NCV_{B4,3,y}$	16.93(GJ/BDt)
7) Mix od sawdust and bark from forestry op.	$BR_{B4,3,y}$	0.0(BDt/y)
8) Net calorific value of mix of sawdust and bark.	$NCV_{B4,3,y}$	16.937(GJ/BDt)
9) Baseline biomass-based heat generation efficiency of the PB	$\eta_{BL,HG,BR,PB}$	85.0%

Note: Power boiler generation would not be required under pine campaigned as the pulp mill would be self - sufficient in term of heat and power generated by the recovery boiler.

10) Baseline biomass-based heat generation of the PB in year y (without FF)	**$HG_{BL,BR,y}$**	**[(1)*(2)+(3)*(4)+(5)*(6)+(7)*(8)]*(9)**	**619,043 (GJ/y)**

Determine the heat contribution due to fossil fuel consumption in the RB:

This is accomplished considering the total fossil fuels due to operational (technical) constraints:

Data:

Pulp production type:		Pine	Euca
1) Total Fuel Oil consumption due to operational reasons.	$FF_{BL,HG,y,}$	9,740 (ton/y)	4,174(ton/y)
2) Net calorific value of Fuel Oil.	NCV_{FO}	39.8(GJ/ton)	39.8(GJ/ton)
3) Total Diesel consumption due to operational reasons.	$FF_{BL,HG,y,}$	0(ton/y)	0(ton/y)
4) Net calorific value of Diesel.	NCV_{Diesel}	41.4(GJ/ton)	41.4(GJ/ton)
5) Total Natural Gas consumption due to operational reasons.	$FF_{BL,HG,y,}$	0(ton/y)	0(ton/y)
6) Net calorific value of Natural Gas.	NCV_{NG}	46.5(GJ/ton)	46.5(GJ/ton)
7) Total Liquid Petroleum Gas (LPG).	$FF_{BL,HG,y,}$	0(ton/y)	0(ton/y)
8) Net calorific value of LPG.	NCV_{LPG}	44.8(GJ/ton)	44.8(GJ/ton)
9) Baseline biomass-based heat generation efficiency of the RB.	$\eta_{BL,HG,BR,RB}$	85.0%	85.0%

Note that for baseline emissions the net calorific values of fossil fuels in above table are obtained from the 2006 IPCC Manual, Energy, table 1.2, lower boundary value.

Calculations:

10) Fossil fuel heat contribution in year y	**$HG_{BL,FF,y}$**	**[(1)*(2)+(3)*(4)+(5)*(6)+(7)*(8)]*(9)**	**489,655 (GJ/y)**

Determine the heat contribution due to fossil fuel consumption in the PB:

Data:

Pulp production type:		Pine	Euca
1) Total Fuel Oil consumption due to operational reasons.	$FF_{BL,HG,y,}$	0.0(ton/y)	1,001(ton/y)

2) Net calorific value of Fuel Oil.	NCV_{FO}	39.8(GJ/ton)	39.8(GJ/ton)
3) Total Diesel consumption due to operational reasons.	$FF_{BL,HG,y}$,	0.0(ton/y)	0.0(ton/y)
4) Net calorific value of Diesel.	NCV_{Diesel}	41.4	41.4(GJ/ton)
5) Total Natural Gas consumption due to ops reasons	$FF_{BL,HG,y,}$	0(ton/y)	0(ton/y)
6) Net calorific value of Natural Gas.	NCV_{NG}	46.5(GJ/ton)	46.5(GJ/ton)
7) Total Liquid Petroleum Gas (LPG).	$FF_{BL,HG,y,}$	0(ton/y)	0(ton/y)
8) Net calorific value of LPG.	NCV_{LPG}	44.8(GJ/ton)	44.8(GJ/ton)
9) Baseline biomass-based heat generation efficiency RB.	$\eta_{BL,HG,BR,RB}$	85.0%	85.0%

10) Fossil fuel heat contribution in year y	$HG_{BL,FF,y}$	**[(1)*(2)+(3)*(4)+(5)*(6)+(7)*(8)]*(9)**	**35,225(GJ/y)**

The Project participant would like to note:

In this case, the estimate amount of fuel oil consumed in the baseline would be nil due to drier impact on biomass moisture. This is conservative from project emission calculations as the total fuel oil consumed in the power boiler is contemplates as project emissions.

Determine the total biomass-based heat generation in the RB, including fossil fuel heat contribution:

Data:

1) Fossil fuels heat contribution in year y.	$HG_{BL,FF,y}$	489,655[65](GJ/y)
2) Baseline biomass-based heat generation of the RB in year y (without FF).	$HG_{BL,BR,y}$	10,872,306(GJ/y)

Calculations:

3) Baseline biomass-based heat generation of the power boiler in year y.	$HG_{BL,BR,y}$	(1) + (2)	11,361,961(GJ/y)

Determine the total biomass-based heat generation in the PB, including fossil fuel heat contribution:

Data:

1) Fossil fuels 'heat contribution in year y.	$HG_{BL,FF,y}$	35,225[66](GJ/y)
2) Baseline biomass-based heat generation of the PB in year y (without FF).	$HG_{BL,BR,y}$	619,043(GJ/y)

Calculations:

3) Baseline biomass-based heat generation of the power boiler in year y.	$HG_{BL,BR,y}$	(1) + (2)	654,268(GJ/y)

[65] According to ACM0006 (version 14.0), this corresponds to the heat generation from fossil fuel required due to technical constraint based on the efficiency of the heat generator and shall be added to the parameter $HG_{BL,BR,y}$..

[66] According to ACM0006 (version 14.0), this corresponds to the heat generation from fossil fuel required due to technical constraint based on the efficiency of the heat generator and shall be added to the parameter $HG_{BL,BR,y}$..

Proceed to calculate the heat generation capacity of the recovery and power boiler:

Determine the capacity of the RB:

The Project would like to note that the reference plant design parameters are used as source of data to determine the baseline capacity of the RB in the baseline scenario.

Data:

Pulp production type:		Pine	Euca
1) Length of the operational campaign in year y	LOC_y	5,947(h)	2,549(h)
2) Baseline capacity of heat generator h	$CAP_{HG,h}$	1,677[67](GJ/h)	1,879[68](GJ/h)
3) Baseline load factor of heat generator h.	$LFC_{HG,h}$	90.59[69]%	80.87[70]%

Calculations:

Pulp production type:		Pine	Euca	Total
4) Total capacity of heat generation of the recovery boiler	(1)*(2)*(3)	8,035,015(GJ)	2,837,291(GJ)	10,872,306(GJ/y)

Determine the capacity of the PB:

The Project would like to note that design parameters of the reference plant are used as source of data to determine the baseline capacity of the low-pressure power boiler in the baseline scenario.

Data:

Pulp production type:		Pine	Euca
1) Length of the operational campaign in year y	LOC_y	5,947(h)	2,549(h)
2) Baseline capacity of heat generator h	$CAP_{HG,h}$	n/a	313[71](GJ/h)
3) Baseline load factor of heat generator h.	$LFC_{HG,h}$	0	88.42[72]%

Calculations:

Pulp production type:		Pine	Euca	Total
4) Total capacity of heat generation of the power boiler	(1) * (2) * (3)	See note bellow (GJ)	769,469(GJ)	769,469(GJ/y)

Note: The power boiler would have generated saturate steam in the baseline under euca pulp production only and not being necessary to operate when the mill produce pulp with pine.

[67] Design maximum heat generation capacity of the recovery boiler determined as: [422MW/90.59%]* 3.6. See parameter description under section B.6.2 Parameters fixed ex-ante in this PDD and refer to the electricity baseline emission work-book.

[68] Design max heat generation capacity determined as: [422MW/80.87%]* 3.6. See parameter description under section B.6.2 Parameters fixed ex-ante in this PDD and refer to the electricity baseline emission work-book.

[69] This corresponds to the baseline load factor of the heat generator, in this case recovery boiler under pine campaign. See parameter description under section B.6.2 Parameters fixed ex-ante in this PDD and refer to the electricity baseline emission work-book.

[70] This corresponds to the baseline load factor of the heat generator, in this case recovery boiler under euca campaign. See parameter Description under section B.6.2 Parameters fixed ex-ante in this PDD and refer to the electricity baseline emission work-book.

[71] This corresponds to design max heat generation capacity determined as: [76.9MW*3.6/88.42%]. The 76,9 MW would be the baseline design capacity of the power boiler. See parameter description under Section B.6.2 Parameters fixed ex-ante in this PDD.

[72] This is the baseline load factor of the heat generator. It is determined as the ratio between the average steams of 106.1 t/h generated by the power boiler under euca campaign divided by the selected design steam load of 120 t/h of the power boiler.

Considering the above calculations, the restrictions 15 is met for both heat generators RB and PB, but the restriction 16 is met for the RB, but no longer met for the PB:

Restriction 15: All biomass residues types available in the baseline would be used in the heat generators (recovery and power boiler) available in the baseline.

Restriction 16: Check whether this heat generation not exceed the total capacity of the heat generator.

In this case, the biomass-based heat generation of the power boiler with the heat generation contribution of fossil fuels due to technical constraints result to be lower than the total capacity of heat generation of the power boiler.

As a result, the biomass-based heat generation of the PB in year y is calculated from equation 14 of the ACM0006.

Heat generator types	Restriction	Check
Recovery boiler	$\sum BR_{B5,n,h,y} * NCV_{BR,n,y} * h_{BL,HG,BR,RB} =< LOC_y * CAP_{HG,h} * LFC_{HG,h}$	The condition is met
Power boiler	$\sum BR_{B5,n,h,y} * NCV_{BR,n,y} * h_{BL,HG,BR,PB} =< LOC_y * CAP_{HG,h} * LFC_{HG,h}$	The condition is met

Proceed to step 3.2 to determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction.

In this case, there would be two heat engines available in the baseline scenario, as a result, all the biomass-based heat ($HG_{BL,BR,y}$) generated in the power and recovery boilers would be allocated to these heat engines.

According to the ACM0006 (Version 14.0), the biomass-based heat generation of electricity and process heat are determined using equations 17 and 18. Nevertheless, the calculation shall comply with the following restrictions:

Restriction associated to equation 19: The biomass-based heat used in cogeneration mode should not exceed the total biomass-based heat generated.

Data:

Pulp production type:		Pine	Euca	Total
1) Total biomass-based heat used in cogeneration mode.	$\sum HG_{BL,BR,CG,y,i}$	8,000,511	2,818,810	10,819,320(GJ/y)
2) Total biomass-based heat generation.	$HG_{BL,BR,y}$	8,377,774	2,984,187	11,361,961(GJ/y)

Calculations

Pulp production type:	Pine	Euca	Check
Condition associated to equation 19.	(1) < (2)	(1) < (2)	The conditions are met.

Restriction associated to equation 20: The process heat co-generated should not exceed the total process heat demand.

Data:

Pulp production type:		Pine	Euca	Total
1) The baseline biomass-based process heat cogenerated in year y	$HC_{BL,BR,CG,y}$	6,569,026	2,303,236	8,872,263 (GJ/yr)
2) Total biomass-based heat generated (heat demand)	$HC_{BL,y}$	6,594,403	2,692,026	9,286,429 (GJ/yr)

Calculations:

Pulp production type:	Pine	Euca	Check
3) Condition associated to equation 20	(1) < (2)	(3) < (2)	The condition are met.

Restriction associated to equation 21: The electricity generation in each heat engine should not exceed the total capacity of the heat engine. Since in the baseline there would be two co-generation-types heat engines i, the restriction is as follows:

Data:

Pulp production type:		Pine (MWh)	Euca (MWh)	Total
1) Electricity generation in the cogeneration-type heat engine i (TG2).	$\eta_{BL,EG,CG,i} * HG_{BL,BR,CG,y,i}$	139,396	22,608	162,004(MWh/yr)
2) Total capacity of the cogeneration-type heat engine.	$LOC_y * CAP_{EG,CG,i} * LFC_{EG,CG,i}$	139,396	22,608	162,004(MWh/yr)

Calculations:

3) Condition associated to equation 21	(1) = < (2)	The condition is met.

Data:

Pulp production type:		Pine (MWh)	Euca (MWh)	Total
(1) Electricity generation in the cogeneration-type heat engine i (TG1).	$\eta_{BL,EG,CG,i} * HG_{BL,BR,CG,y,i}$	241,361	114,543	355,904(MWh/yr)
(2) Total capacity of the cogeneration-type heat engine.	$LOC_y * CAP_{EG,CG,i} * LFC_{EG,CG,i}$	241,361	114,543	355,904(MW/yr)

Calculations:

(3) Condition associated to equation 21	(1) = < (2)	The condition is met.

Calculation of $EL_{BL,BR,CG,y}$ and $HC_{BL,BR,CG,y}$ (considering restrictions)

The baseline biomass-based cogenerated electricity and heat in year y is calculated using equation 17 and 18 as follows.

Data:

Pulp production type:		Pine (GJ)	Euca (GJ)
1) Heat-to-power ratio of the heat engine i (TG1)	$HPR_{BL,i}$	4.935	4.361
2) Baseline biomass-based heat generation in year y.	$HG_{BL,BR,CG,y,i}$	5,172,538	2,218,465
3) Default value for losses linked to the electricity generator group	$GGL_{Default}$	5%	5%

Calculations:

Pulp production type:		Pine	Euca	Total
4) Baseline biomass-based cogenerated electricity in TG1 in year y.	$EL_{BL,BR,CG,y}$	240,069	113,884	353,952
5) Baseline biomass-based cogenerated heat in year y.	$HC_{BL,BR,CG,y}$	4,265,078	1,787,985	6,053,063

Data:

Pulp production type:		Pine	Euca
1) Heat-to-power ratio of the heat engine i (TG2)	$HPR_{BL,i}$	4.616	6.358
2) Baseline biomass-based heat generation in year y.	$HG_{BL,BR,CG,y,i}$	2,827,972	600,345
3) Default value for losses linked to the electricity generator group	$GGL_{Default}$	5%	5%

Calculations:

Pulp production type:		Pine	Euca	Total
4) Baseline biomass-based cogenerated electricity in TG2 in year y.	$EL_{BL,BR,CG,y}$	138,631	22,511	161,142
5) Baseline biomass-based cogenerated heat in year y.	$HC_{BL,BR,CG,y}$	2,303,948	515,251	2,819,199

Total baseline biomass-based cogenerated electricity and heat in engines TG1 and TG2 in year y

		Total
Baseline biomass-based cogenerated electricity in year y	$EL_{BL,BR,CG,y}$	515,095(MWh/yr)
Baseline biomass-based cogenerated heat in year y (See note below)	$HC_{BL,BR,CG,y}$	8,872,263 (GJ/yr)

According to the ACM0006 (Version 14.0), the Project Participant shall follow the next step based on the outcome of the previous calculation outcome.

Pulp production type:		Pine	Euca	Total
Baseline biomass-based heat generation in year y	$HG_{BL,BR,y}$	8,377,774	3,638,455	12,016,229
Total baseline biomass-based heat used in heat engine i in year y.	$\sum HG_{BL,BR,CG,y,i}$	8,000,511	2,818,810	10,819,320

Baseline process heat generation in year y (demand)	$HC_{BL,y}$	6,594,403	2,692,026	9,286,429
The baseline biomass-based process heat cogenerated in year y.	$HC_{BL,BR,CG,y}$	6,569,026	2,303,236	8,872,263

Considering the above result Case 3.2.4 shall be followed:

This means that there would be biomass-based heat in the baseline that could still be used and process heat demand to be met. It is assumed that this balance of biomass-based heat would be extracted from the heat header and used to meet process heat demand without co-generation of power.

Data:

Total baseline biomass-based heat used in heat engine i in year y.	$\sum HG_{BL,BR,CG,y,i}$	10,819,320
Baseline biomass-based heat generation in year y.	$HG_{BL,BR,y}$	12,016,229
Specific enthalpy of the heat carrier at process heat demand side.	$h_{LOW\ (euca/pine)}$	3.3550
Specific enthalpy of the heat carrier at the heat generator side	$h_{HIGH(euca/pine)}$	2.7754
Total biomass-based heat generated (heat demand) in year y.	$HC_{BL,y}$	9,286,429
The baseline biomass-based process heat cogenerated in year y.	$HC_{BL,BR,CG,y}$	8,872,263

Calculations:

All process heat demand would be met with biomass-based heat.	$HC_{BL,y} - HC_{BL,BR,CG,y}$	414,167
The balance of biomass-based heat	$(h_{LOW}/h_{HIGH})*(HG_{BL,BR,y} - \sum HG_{BL,BR,CG,y})$	989,092

Calculation of the baseline biomass-based heat balance after cogeneration in year y, $HG_{balance,BR,PO,y}$:

$HG_{balance,BR,PO,y}$	$(HG_{BL,BR,y} - \sum HG_{BL,BR,CG,y,i}) < (h_{LOW}/h_{HIGH})*(HG_{BL,BR,y} - \sum HG_{BL,BR,CG,y})$	696,152(GJ/y)[73]

Therefore, sub-case 3.2.4.3 applies.

Calculation of the electricity in power-only mode assumed to be generated in the baseline in year y,

$EL_{balance,PO,y}$:

		Without restriction
Baseline electricity generation capacity in year y	$EL_{BL,y}$	823,662
Baseline minimum electricity generation in the grid in year y.	$EL_{BL,GR,y}$	305,754

73 The remained heat not used is a consequence of Valdivia pulp mill project was optimized as a pulp mill and not as a power plant. Consequently, the project activity design was a consequence from this philosophy. The excess of steam would not be used in the process as heat consumption is fixed for the selected process concept, and therefore would have to be discarded.

Baseline biomass-based co-generated electricity in year y.	$EL_{BL,BR,CG,y}$	515,095

Calculation:

$EL_{balance,PO,y}$	$EL_{BL,y}$ - $EL_{BL,GR,y}$- $EL_{BL,BR,CG,y}$	2,814(MWh/y)

With the above definitions and calculations, the Project Participant must proceed to step 3.3

Proceed to step 3.3 to determine the baseline-based electricity generated in power-only mode.

Since no heat engines that produce only electricity without cogeneration of process heat have been identified in the baseline scenario. The remained heat would not be used to generate electricity in power-only mode (i.e. without cogeneration of process heat) consequently; the baseline biomass-based electricity (power-only) in year y (MWh) would be zero.

			Pine	Euca	**Total**
Baseline biomass-based heat used in heat engine j	$HG_{BL,BR,PO,y,j}$	(MWh/yr)	0	0	0
Average electric power generation efficiency of heat engine j	$h_{BL,EG,PO,j}$	%	0	0	0
Baseline biomass-based electricity (power-only)	$EL_{BL,BR,PO,y}$	(MWh/yr)	0	0	0

Then

		Pine	Euca	**Total**
$EL_{balance,PO,y}$	(MWh/yr)	882	1,764	2,814
$EL_{BL,PR,PO,y}$	(MWh/yr)	0	0	0

With this outcome, the applicable case would be 3.3.1. This would imply the following definitions:

The baseline uncertain electricity generation in the grid or on-site in year y, ($EL_{BL,FFYGR,y}$) is:

Case 3.3.1

$EL_{BL,FF/GR,y}$	(MWh/yr)	2,814
$EL_{PJ,offset,y}$	(MWh/yr)	0
$FF_{BL,HG,y,f}$	(GJ/yr)	166,141

Notes: Includes fossil fuel consumption due to technical constraints under euca and pine campaigne.

Proceed to Step 5 to determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

Proceed to Step 5.1 to determine $BE_{BR,B1/B3,y}$

To calculate this emission source, it is necessary first to calculate the categories of biomass residues used as a result of the project activity. According to equation 36 the following calculation can be done:

Data:

Biomass residues attributable to project activity:

1) Mix of sawdust and bark from on-site industrial operations, electricity generation.	$BR_{PJ,6,y}$	6,546 (BDt/y)
2) Mix of sawdust and bark from off-site industrial operations, electricity generation.	$BR_{PJ,7,y}$	38,207(BDt/y)
3) Mix of sawdust and bark from forest operations, electricity generation.	$BR_{PJ,8,y}$	0.0(BDt/y)
4) Net calorific value of mix of sawdust and bark from off-site industrial operations.	$NCV_{BR,7,y}$	16.93(GJ/ton)
5) Net calorific value of mix of sawdust and bark from forest operations.	$NCV_{BR,7,y}$	16.93(GJ/ton)
6) Adjusted CH_4 factor for uncontrolled burning of mix of sawdust and bark from off-site industrial operations.	$EF_{BR,7,y}$	874.20(kgCH_4/TJ)
7) Adjusted CH_4 factor for uncontrolled burning of mix of sawdust and bark from forest operations.	$EF_{BR,8,y}$	93.48(kgCH_4/TJ)
8) CH_4 Global Warming Potential.	GWP	25(number)

Calculations:

9) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,y}$)	[(1)+(2)]*(4)*(6) * (8)]/10^6	16,559(tCO_2/y)
10) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,y}$)	[(3) * (5) * (7) * (8)]/10^6	0.0(tCO_2/y)
11) Emissions.		**16,559(tCO_2/y)**

Proceed to Step 5.2 to determine the $BE_{BR,B2,y}$

Since in the proposed project activity there are no biomass residues categories for which the baseline scenario is B2, this step is not applicable in this case.

Proceed to step6: Calculate baseline emissions

According to equation 2 of the ACM0006 (Version 14.0), the emission reductions due to electricity displacement can be calculated as follows:

Data:

		Without restricted production rate.	With restricted production rate
1) Baseline minimum electricity generation in the grid in year y.	$EL_{BL,GR,y}$	305,754(MWh)	153,986(MWh) (*)
2) Grid emission factor in year y.	$EF_{EG,GR,y}$	0.5125(tCO_2/MWh)	0.5125(tCO_2/MWh)
3) Baseline fossil fuel demand for process heat in year y.	$FF_{BL,HG,y,f}$	593,642 (GJ/y)	593,642(GJ/y)
4) CO_2 emission factor for fossil fuel type f in year y.	$EF_{FF,y,f}$	0.0788(tCO_2/GJ)	0.0788(tCO_2/GJ)
5) Baseline uncertain electricity generation in the grid or on-site in year y.	$EL_{BL,FF/GR,y}$	2,814(MWh)	2,814(MWh)
6) CO_2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y.	min($EF_{EG;GR;Y}$, $EF_{EG;FF;Y}$)	0.5125(tCO_2/MWh)	0.5125(tCO_2/MWh)

(*) The mill will operate at restricted pulp production of 550,000 (ADt/yr) due to the actual environmental permit which was granted after the main equipment and the turbo generator were purchased.

Calculations:

		Without Restricted production rate.	With Restricted production rate.(*)
7) Baseline emissions due to minimum grid electricity displacement.	(1) * (2)	156,696(tCO_2eq/y)	78,916(tCO_{2eq}/y)
8) Baseline emissions due to fossil fuel demand for process heat generation in year y.	(3) * (4)	46,779(tCO_2eq/y)	46,779(tCO_{2eq}/y)
9) Baseline emissions due to uncertain electricity generation in the grid in year y.	(5) * (6)	1,442(tCO_2eq/y)	1,442(tCO_{2eq}/y)
10) CH_4 emission savings.		11,389(tCO_2eq/y)	11,389(tCO_{2eq}/y)
11) Baseline emissions.		**216,306(tCO_2eq/y)**	**138,526(tCO_2eq/y)**

(*) The mill will operate at restricted pulp production of 550,000 (ADt/yr) due to the actual environmental permit which was granted after the main equipment and the turbo generator were purchased.

Project emissions

Considering the simplifications of equation 37 of the ACM0006 (Version 14.0) presented in the preceding section of the PDD, the project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GRI,y} + PE_{TR,y} + PE_{BR,y}$$

2.1 Determination of $PE_{FF,y}$

2.1.1 Emissions from fossil fuels consumptions due to technical constraints and heat generation.

– Fossil fuel consumption in the power boiler

The project participant estimates a total consumption of 2,523[74] tons of Fuel oil per year in the power boiler under normal operations. According to the above estimates, project emissions can be calculated as follows:

Data:

(1) Fuel Oil consumption due to operational reasons.	$FC_{FO,y}$	1,001(ton/y)
(2) Fuel Oil used to increase heat and/or power generation	$FC_{FO,y}$	1,522(ton/y)
(3) Fuel Oil net calorific value.	$NCV_{FO,y}$	41.70(GJ/ton)
(4) Fuel Oil CO_2 emission factor.	$EF_{FO,y}$	0.0788(tCO_2/GJ)

Calculations:

Total emission	[(1) + (2)] * (3) * (4)	8,290 (tCO_{2eq}/y)

Regarding to the average past fuel oil consumption in the recovery boiler, the estimates is 15,806[75] of fuel oil consumptions per year. From this 13,915 tons of fuel oil would be consumed in the baseline cases due to operational reasons, such as start-ups, trips. Average estimation of 1,891 tons of fuel oil will be consumed due to increase heat and/or power consumption, attributable to the project activity.

Data:

(1) Fuel Oil consumption due to operational reasons.	$FC_{FO,y}$	13,915(ton/y)
(2) (2) Fuel Oil used to increase heat and/or power generation	$FC_{FO,y}$	1,891(ton/y)
(3) Fuel Oil net calorific value.	$NCV_{FO,y}$	41.70(GJ/ton)
(4) Fuel Oil CO_2 emission factor.	$EF_{FO,y}$	0.0788(tCO_2/GJ)

Calculations:

Total emission	[(1) + (2)] * (3) * (4)	51,937(tCO_{2eq}/y)

It must be noticed that figures above are average past monitored fuel oil consumption and figures might suffer variations, depending on the operational situation of the pulp mill and the energy price condition in the grid system (i.e. fluctuation in the pulp production level and energy prices in the SIC).

Also, under no circumstances the amount of fuel oil used in the recovery boiler can possibly become the predominant fuel because the recovery boiler was not designed to operate with fossil fuels on a normal base operation.

– Fossil fuel consumption for processing biomass residues from forest operations:

There is no preparation of biomass residues in the mill as all biomass from industrial and/or forestry operations will be provided to the plant ready to be used.

2.1.2 Emissions from fossil fuel consumed due to biomass from forest transportation in the Plant site.

[74]Total monitored fuel oil consumed in the power boiler.

75 Total fuel oil consumed in the recovery boiler due to operational problems (such as trips and start-ups) and associated to selling surplus power to the grid.

– Fossil fuel consumption due to on-site transportation of biomass residues:

This emission source is generated by the front loaders and / or bulldozers used to transport the biomass from forest operations attributed to the project activity to the power boiler area. To calculate this fossil fuel amount, the project proponent will calculate the ratio of the biomass attributable to the project activity to the total biomass combusted in the power boiler,and will multiply this ratio by the total fossil fuel consumption related to on-site biomass from forest operations transportation.

The project participant estimates 139,487 (BDt/y) of biomass residues from industrial and forest operations consumed in the power boiler, of which 44,753 (BDt/y) are attributable[76] to the project activity. This indicates a fraction of 32.08% of attributable biomass associate to the project activity.

The project participant also estimates113 tons of diesel consumed by the front loaders or bulldozers in a year. According to this, the fossil fuel amount used for on-site biomass transportation due to the implementation of the project activity is 36.09 (ton/yr).

According to the above estimates, project emissions can be calculated as follows:

Data:

(1) Diesel consumption due to operational reasons.	$FC_{Diesel, y}$	36.09(ton/y)
(2) Diesel net calorific value.	$NCV_{,Diesel,y}$	43.30(GJ/ton)
(3) Diesel CO_2 emission factor.	$EF_{,Diesel,}$	0.0748(tCO_2/GJ)

Calculations:

Total emission	[(1)*(2)*(3)]	117(tCO_{2eq}/y)

Emissions from fossil fuel consumption at the project site

Emissions from fossil fuel consumption in the Power boiler.	$FC_{FO, Project Plant, y}$	8,290(ton/y)
Emissions from fossil fuel consumption in the Recovery boiler.	$FC_{FO Project Plant, y}$	51,937(ton/y)
Emissions from fossil fuel consumption due to on-site transportation of biomass.	$FC_{Dies9,579el, Project Site, y}$	117(ton/y)
Total emissions.	$PE_{FF,y}$	60,344 (tCO_2eq/y)

2.2 Determination of $PE_{GR1,y}$

– Emissions from electricity imported from the grid

Project electricity imports from the grid.	$EL_{PJ,imp,y}$	2,812(MWh/y)
Total emissions.	$PE_{GR1,y}$	1,441(tCO_2eq/y)

[76] Additional biomass only used for electric power generation will be attributable to the project activity. It is contemplated that biomass consumed to satisfy the process heat demand would be consumed any way in the absence of the project activity.

2.3 Determination of $PE_{GR2,y}$

Not applicable in this case.

2.4 Determination of $PE_{TR,y}$

The project activity includes the following categories of biomass residues:

- Category N°7: Mix of sawdust and bark from off-site industrial operations.
- Category N°8: Mix of sawdust and bark from forest operations.

Both categories of biomass residues listed above are transported by heavy trucks to the power plant. As a result, these are contemplated as project emissions due to transportation.

According to Option B of the tool "Project and leakage emissions from transportation of freight", the emissions related to this source can be calculated as follows:

Data:

1) Mix of sawdust and bark from off-site industrial operations, electricity generation.	$BR_{PJ,7,y}$	38,207(BDt/y)
2) Biomass residues (mix of sawdust and bark) from forest operations, electricity generation.	$BR_{PJ,8,y}$	0.0(BDt/y)[77]
3) Total mass of freight transported in freight transportation activity f.	$FR_{f,m}$ = [(1) + (2)]	38,207(BDt/y)
4) Return trip road distance between the origin and destination of freight transportation activity f.	$D_{f,m}$	57.4(km)x2
5) Weight average calculation. (See note below).	$\sum[D_{f,m} * FR_{f,m}]$	7,410,002
6) Default CO_2 emission factor for freight transportation activity f.	$EF_{CO2,f}$	129(gCO_2/t-km)

Calculations:

(14) Total emissions.		**$[(5) * (6)]/10^6$**	**956(tCO_2/y)**

The Project Participant would like to note the following:

The applied value corresponds to the simple average return distance of freight activities performed in previous monitoring period. Note that this is a reference value only as the weight average calculation will be used in project emission calculation. (See Appendix 5 of this PDD).

2.5 Determination of $PE_{BR,y}$: **Emissions from the combustion of biomass residues.**

According to equation 40 of the ACM0006 (Version 14.0), the Project Participant should consider the total quantity of biomass residues of categories consumed in the project activity as source of methane emissions. As a result, the project emissions related to this source can be calculated as follows:

[77] In the influence zone of the project activity it is expected a surplus of biomass residues from forest industrial operations at lower cost than biomass residues from forest operations. This drives the assumption that this project will not rely of biomass from forest operation at least in the coming years. However, this situation might change in the future.

Data:

1) Sludge from off-site industrial operations, heat generation.	$BR_{PJ,4,y}$	9,027(BDt/y)
2) Mix of sawdust and bark from on-site industrial operations, heat generation.	$BR_{PJ,5,y}$	85,706(BDt/y)
3) Mix of sawdust and bark from off-site industrial operations, heat generation	$BR_{PJ,6,y}$	6,546(BDt/y)
4) Mix of sawdust and bark from off-site industrial operations, electricity generation.	$BR_{PJ,7,y}$	38,207(BDt/y)
5) Mix of sawdust and bark from forest operations, electricity generation.	$BR_{PJ,8,y}$	0.0(BDt/y)
6) Net calorific value of sludge from off-site industrial operations.	$NCV_{BR,4,y}$	5.15(GJ/ton)
7) Net calorific value of mix of sawdust and bark from on-site industrial operations.	$NCV_{BR,5,y}$	16.93(GJ/ton)
8) Net calorific value of mix of sawdust and bark from off-site industrial operations.	$NCV_{BR,6,7,y}$	16.93(GJ/ton)
9) Net calorific value of mix of sawdust and bark from forest operations.	$NCV_{BR,8,y}$	16.93(GJ/ton)
10) Adjusted CH_4 emission factor for controlled burning, mix of sawdust and bark from forest operations.[(a)]	$EF_{CH4,BR}$	41.10(tCH_4/GJ)
11) Conservativeness factor		1.37(number)
12) CH_4 Global Warming Potential.	GWP	25(number)

Note: Both associate conservativeness factor 1.37 obtained from Table 5 of the ACM0006 (Version 14.0) and default value 30 kg/CH4/TJ obtained from Table 4: emission factor for combustion of biomass residues, ACM0006 (version 14.0.) are used to determine this value.

Calculations:

(14) Emissions	[(1)*(5)+(2)*(6)+(3)*(7)+(4)*(8)]*(9)*(10)*(11)	2,982(tCO_2eq/y)

2.6 Determination of $PE_{ww,y}$

Not applicable in this case.

Emissions from fossil fuel consumption at the project site	$PE_{FF,y}$	(tCO_2/y)	60,344
Emissions from electricity imported from the grid	$PE_{GR1,y}$	(tCO_2/y)	1,441
Emissions from electricity generated on-site	$PE_{GR2,y}$	(tCO_2/y)	0.0
Emissions from biomass transportation to the Power Plant	$PE_{TR,y}$	(tCO_2/y)	956
Emissions from the combustion of biomass residues in boiler	$PE_{BR,y}$	(tCO_2/y)	2,982
Emissions from biogas.	$PE_{ww,y}$	(tCO_2/y)	0.0
TOTAL PROJECT EMISSIONS		**(tCO_2eq/y)**	**65,723**

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions	Project emissions	Leakage	Emission reductions
	(t CO_2e)	(t CO_2e)	(t CO_2e)	(t CO_2e)
2016	107,772	49,292	0	58,480
2017	143,696	65,723	0	77,973
2018	143,696	65,723	0	77,973
2019	143,696	65,723	0	77,973
2020	143,696	65,723	0	77,973
2021	143,696	65,723	0	77,973
2022	143,696	65,723	0	77,973
2023	35,924	16,431	0	19,493
Total	1,005,873	460,060	0	545,813
Total number of crediting years	**7 years**			
Annual average over the crediting period	143,696	65,723	0	77,973

Note: The Project Participant informs that the starting date of the second crediting period is April 1st, 2016 and therefore end the crediting period in March 31st, 2023.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter table 20

Data / Parameter	Biomass residues categories and quantities used in the CDM project activity.
Unit	Type: bagasse, rice husks, empty fruit branches, etc. Source: produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, etc. Fate (in the absence of the project activity): scenarios B. Quantity: tonnes on dry-basis.
Description	The biomass quantities provided in the table below were obtained ex-post in accordance with past monitored periods. All biomass residues categories presented in this table as well as the ones that eventually might be incorporated later on will be continuously monitored in the project plant, in accordance with the monitoring plan.
Source of data	On-site measurements.
Value(s) applied	(see tables below)

Biomass residues category n	Biomass residues type	Biomass residues source	Biomass residues fate in the absence of the Project activity	Biomass residues use in project scenario	Biomass residues Quantity (tDS[78]/yr)
1	Black liquor	On-site production	Heat and power generation on-site (B5)	Heat and power generation on-site.	944,727
2	Methanol	On-site production	Heat and power generation on-site (B5)	Heat and power generation on-site.	6,372
3	CNCG	On-site production	Heat and power generation on-site (B5)	Heat and power generation on-site.	3,850

Power boiler
Power boiler:

4	Sludge from industrial operations.	On-site production.	Heat and power generation on-site. (B5)	Biomass attributable to heat generation.	9,027
5	Mix of sawdust and bark from industrial operations.	On-site production.	Heat and power generation on-site. (B5)	Biomass attributable to heat generation.	85,706
6	Mix of sawdust and bark from industrial operations.	On-site production.	Dumped or left to decay under clearly aerobic conditions (B1)	Biomass attributable to heat generation.	6,546
7	Mix of sawdust and bark from industrial operations.	Off-site production	Dumped or left to decay under clearly aerobic conditions (B1),	Biomass attributable to power generation.	38,207

[78] tDS stands for "ton of dry solids" and means 100% dry biomass. Biomass data estimates considering the environmental restriction, which limit the production of the plant to 550,000 ADt/yr.

8	Mix sawdust and bark from forest operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1),	Biomass attributable to power generation.	0

Measurement methods and procedures

Biomass consumed on the recovery boiler:

Biomass residues category n	Biomass residues type.	Biomass residues measurement system description
1	Black liquor	This variable is monitored using four (4) dedicated flow meters for measuring continuously the black liquor flow (l/s) in combination with two (2) refract meters to measure the average concentration (%) solids, and one (1) transmitter to measure the temperature (°C) of the black liquor flow. To determine the dry biomass flow (tDS), the total wet flow is multiplied by the average concentration (%) of solids using the following equation: **Black liquor (tDS) = black liquor flow (l/s) * (%) solids * density of black liquor**. – Black liquor flow: on-site measurement using proper and dedicated flow meters. – (%) solids: on-site measurement using proper and dedicated refract meters. – Density: obtained as a function of (%) solids and the temperature (°C) of the black liquor flow. The measurement is done continuously (each five seconds), online and fully integrated with the Distributed Control System (DCS) of the pulp mill. Data of biomass consumption is aggregated and reported monthly in the emission reduction calculation sheet. The accuracy class of this type of flow meter is +/- 0.25%, the accuracy class of this type of refract meters is +/- 0.1% DS, and the accuracy class of this type of temperature transmitter is +/- 0.15°C.
2	Methanol	This variable will be monitored continuously using a dedicated mass flow meter(s). Measurement is done continuously, online and fully integrated with the DCS of the pulp mill. The accuracy class of this type of flow meter are: Flow: 0.5% O.R., T°: 0.5% O.R. and Pressure: 1% O.R. The meter will receive periodic maintenance according to manufacturer's specifications. In order to determine the quantity of dry biomass, the dry flow will be determined by multiplying the wet flow with the concentration. **Methanol (Kg/s) = [m_{total}, total flow MeOH / H_2O mixture to [kg/s] * (W_{eOH})].** m_{total}: The liquid methanol flow to the recovery boiler is injected into the recovery boiler through the port on a dedicated burner mounted on the wall of the boiler furnace. The flow of methanol/water mixture through the port will be measured by a dedicated mass flow meter.

		W_{eOH}: Liquid Methanol Concentration: This means the fraction of methanol in the liquid methanol/water mixture[79].
3	CNCG	CNCG will be collected from various source vents and drawn through the piping by a single stage steam jet ejector. Upstream of the ejector the CNCG piping and equipment will be under vacuum. The gas flow upstream of the ejector will be measured continuously using a dedicate flow meter that consists of a venture tube type flow element with a differential pressure cell transmitter. Measurement is done continuously, online and fully integrated with the DCS of the pulp mill This measured flow will be indicated in normal cubic meters per hour (volumetric flow at 273.15 °K and 101.3 kPa absolute). The accuracy class of this type of flow meter are: Flow: 2% O.R., T°: 0.5% O.R. and Pressure: 1% O.R. The meter will receive periodic maintenance according to manufacturer's specifications.

<u>Biomass consumed on the power boiler:</u>

Biomass residues category n	Biomass residues type.	Biomass residues measurement system description
4	Sludge from on-site industrial operations.	This variable will be monitored continuously using a dedicated weight meter(s) installed at the conveyor belt. The accuracy class of these type of flow meters are: (+/- 0.6 kg) The weight meter will receive periodic maintenance according to manufacturer's specifications. The sludge measurement is done continuously, online and fully integrated with the Distributed Control System (DCS) of the pulp mill. Data of dry solids of sludge consumption are aggregated and reported monthly in the emission reductions calculation sheet. This parameter will be monitored continuously. At the time of the revalidation process the measurement method proposed to comply with monitoring requirements has not been installed yet. It is foreseen that after techno economic valuation the project participant will take a decision. The Project Participant would like to state that as a conservative approach, no sludge from on-site industrial operations will be claimed as attributable to the project activity until the weight meter is installed and properly measuring. <u>Responsible to undertake the measurement:</u>

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			The pulp mill will be responsible to undertake continuously measurement.
	5	Mix of sawdust and bark from on-site industrial operations.	Mix of sawdust and bark: The mix of sawdust and bark will be determined online by the difference obtained among measurements of the following proper and calibrated meters: weight meter (+/-0.6 kg) and weight bridge system (+/- 30kg) and mass flow meter. Data will be continuously recorded in the DCS system of the plant. Note that perform directly measurements was technically unfeasible by the Project Participant. The Project Participant would like to state that as a conservative approach, no biomass from on-site industrial operations will be claimed as attributable to the project activity until these meters are properly measuring. The amount of biomass residues of category 5 which will be calculated from the heat demanded by the facility processes using equation 14 of the ACM0006 (Version 14.0).
	6	Mix of sawdust and bark from on-site industrial operations.	Mix of sawdust and bark: The mix of sawdust and bark corresponding to categories 6 and 5 are the same type of biomass originated from off-site industrial operations, and due to the same origin, they will be jointly monitored. In the case, process heat demand of the plant is satisfied by category 5, the category 6 should be used for power generation, in accordance with the algorithm of biomass consumption (most/available least/costly)
	7	Mix of sawdust and bark from off-site industrial operations.	Mix of sawdust and bark from off-site industrial operations The flow of the mix of sawdust and bark from off-site industrial sites transported by trucks towards the plant will be measured at the entrance of the plant by the weighbridge system of accuracy +/- 30 kg. This parameter will be monitored continuously. Responsible to undertake the measurement: The Power Boiler Department will be responsible to undertake continuously measurement.
	8	Mix of sawdust and bark from forest operations.	The mix of sawdust and bark from off-site transported by trucks to the plant will be measured at the entrance of the plant by the weighbridge system of accuracy +/- 30 kg. This parameter will be monitored continuously. Responsible to undertake the measurement: The Power Boiler Department will be responsible to undertake continuously measurement.

Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.
QA/QC procedures	Crosscheck the measurements with an energy balance based on purchased quantities and stock changes.
Purpose of data	Baseline and project emissions calculations.
Additional comment	Monitoring quantities of each category of biomass residue will be performed and be updated every year during the crediting period, as per required by the monitoring plan.

Data / Parameter table 21

Data / Parameter:	**For biomass residues categories for which scenarios B1, B2 or B3 is deemed a plausible baseline alternative, project participants shall demonstrate that this is a realistic and credible alternative scenario.**
Unit	Tonnes
Description	– Quantity of available biomass residues type n in the region. Quantity of biomass residues of type n that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region. Availability of a surplus of biomass residues type n (which cannot be sold or utilized) at the ultimate supplier to the project and a representative sample of other suppliers in the defined geographical region.
Source of data	Surveys or statistics. In this case the Project Participant will use statistics.
Value(s) applied	The Project Participant will use the first procedure described in the methodology (Refer to ACM0006 (Version 14.0), to demonstrate the selection of the baseline scenario B1/B3 for the additional biomass residues attributable to the project activity. For results of the biomass balance, refer to section B.6.1 under leakage emissions, of the registered PDD.
Measurement methods and procedures	---
Monitoring frequency	At the validation stage for biomass residues categories identified ex ante, and always that new biomass residues categories are included during the crediting period
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	According to the table informed in section Leakage emissions of this PDD, the supply/demand indexes for each of the biomass types consumed by the project activity are higher than the 1.25 threshold established by the criteria of the ACM0006 (Version 14.0). This clearly indicates that the proposed project activity counts with enough biomass locally, and therefore, is not causing other biomass plants in the area to switch to fossil fuels. A considerable surplus of this type of biomass residues remains unused in the region; the additional biomass consumed by the proposed project activity would most likely be left in piles for natural (aerobic) decomposition (B1) and in some particular cases, the biomass would be burned in the open-air in an uncontrolled manner (B3).

Data / Parameter table 22

Data / Parameter	$BR_{PJ,n,y}$
Unit	Tonnes on dry-basis.
Description	Quantity of biomass residues of category n used in the CDM project activity in year y (tonnes on dry-basis)
Source of data	On-site measurements.
Value(s) applied	Recovery boiler:

Biomass residues category n	Biomass residues type	Biomass residues source	Biomass residues fate in the absence of the Project activity	Biomass residues use in	Biomass residues Quantity (tDS[80]/yr)

[80]tDS stands for “ton of dry solids” and means 100% dry biomass.

				project scenario	
1	Black liquor	On-site production	Heat and power generation on-site (B5)	Heat and power generation on-site.	944,727
2	Methanol	On-site production	Heat and power generation on-site (B5)	Heat and power generation on-site.	6,372
3	CNCG	On-site production	Heat and power generation on-site (B5)	Heat and power generation on-site.	3,850

Power boiler:

4	Sludge from industrial operations.	Off-site production.	Heat and power generation on-site (B5)	Biomass attributable to heat generation.	9,027
5	Mix of sawdust and bark from industrial operations.	On-site production.	Heat and power generation on-site (B5)	Biomass attributable to heat generation.	85,706
6	Mix of sawdust and bark from industrial operations.	On-site production.	Dumped or left to decay under clearly aerobic conditions (B1),	Biomass attributable to power generation.	6,546
7	Mix of sawdust and bark from industrial operations.	Off-site production	Dumped or left to decay under clearly aerobic conditions (B1),	Biomass attributable to power generation.	38,207
8	Mix sawdust and bark from forest operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1),	Biomass attributable to power generation.	0

Measurement methods and procedures	See table describing measurement procedures under variable "Biomass residues categories and quantities used in the Project activity".
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.
QA/QC procedures	Crosscheck the measurements with an energy balance that is based on purchased amounts and stock changes.
Purpose of data	Baseline and project emissions calculations.
Additional comment	---

Data / Parameter table 23

Data / Parameter	$BR_{B1/B3,n,y}$

<table>
<tr><td>Unit</td><td>Tonnes of dry-basis.</td></tr>
<tr><td>Description</td><td>Quantity of biomass residues of category n used in the CDM project activity in year y for which the baseline scenario is B1 or B3 (tonnes on dry-basis)</td></tr>
<tr><td>Source of data</td><td>On-site measurements.</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><td>Biomass residues category n</td><td>Biomass residues type</td><td>Biomass residues source</td><td>Biomass residues fate in the absence of the Project activity.</td><td>Biomass residues use in project scenario</td><td>Biomass residues Quantity (BDt/yr.)</td></tr>
<tr><td>6</td><td>Mix of sawdust and bark from industrial operations.</td><td>On-site production.</td><td>Dumped or left to decay under clearly aerobic conditions (B1).</td><td>Biomass attributable to power generation.</td><td>6,546</td></tr>
<tr><td>7</td><td>Mix of sawdust and bark from industrial operations.</td><td>Off-site production.</td><td>Dumped or left to decay under clearly aerobic conditions (B1).</td><td>Biomass attributable to power generation.</td><td>38,207</td></tr>
<tr><td>8</td><td>Mix of sawdust and bark from forestry operations.</td><td>Off-site production.</td><td>Dumped or left to decay under clearly aerobic conditions (B1),</td><td>Biomass attributable to power generation.</td><td>0.0</td></tr>
</table>
</td></tr>
<tr><td>Measurement methods and procedures</td><td>See table describing measurement procedures under variable “Biomass residues categories and quantities used in the Project activity”.</td></tr>
<tr><td>Monitoring frequency</td><td>Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.</td></tr>
<tr><td>QA/QC procedures</td><td>Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock variations.</td></tr>
<tr><td>Purpose of data</td><td>Baseline and project emissions calculations.</td></tr>
<tr><td>Additional comment</td><td>---</td></tr>
</table>

Data / Parameter table 24

Data / Parameter	$BR_{B4,n,y}$
Unit	Tonnes of dry basis (BDt)
Description	Quantity of biomass residues of category n used in the CDM project activity in year y for which the baseline scenario is B4 (tonnes on dry-basis)
Source of data	On-site measurements.
Value(s) applied	0(tonnes) It is not foreseen that these biomass residues types will be used in the project activity in the future. However, the Project Participant will include this parameter in the monitoring plan, in case the situation changes in the future.
Measurement methods and procedures	

	The Project Participant will use proper weight meters. Measurements obtained will be adjusted for the moisture content in order to determine the quantity of dry biomass.
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.
QA/QC procedures	Crosscheck the measurements with an annual energy balance, based on purchased quantities and stock changes.
Purpose of data	Baseline and project emissions calculations.
Additional comment	---

Data / Parameter table 25

Data / Parameter	$BR_{B5,n,y}$
Data unit	Tonnes on dry-basis.
Description	Quantity of biomass residues of category n used in the CDM project activity in year y for which the baseline scenario is B5 (tonnes on dry-basis)
Source of data	On-site measurements

<table>
<tr><td>Value(s) applied</td><td>
<u>Recovery boiler:</u>
<table>
<tr><th>Biomass residues category n</th><th>Biomass residues type</th><th>Biomass residues source</th><th>Biomass residues fate in the absence of the Project activity</th><th>Biomass residues use in project scenario</th><th>Biomass residues Quantity (tDS/y)</th></tr>
<tr><td>1</td><td>Black liquor</td><td>On-site production</td><td>Heat and power generation on-site (B5)</td><td>Heat and power generation on-site.</td><td>944,727</td></tr>
<tr><td>2</td><td>Methanol</td><td>On-site production</td><td>Heat and power generation on-site (B5)</td><td>Heat and power generation on-site.</td><td>6,372</td></tr>
<tr><td>3</td><td>CNCG</td><td>On-site production</td><td>Heat and power generation on-site (B5)</td><td>Heat and power generation on-site.</td><td>3,850</td></tr>
</table>
<u>Power boiler:</u>
<table>
<tr><th>Biomass residues category n</th><th>Biomass residues type</th><th>Biomass residues source</th><th>Biomass residues fate in the absence of the Project activity</th><th>Biomass residues use in project scenario</th><th>Biomass residues (BDt/y)</th></tr>
<tr><td>4</td><td>Sludge from industrial operations.</td><td>On-site production.</td><td>The biomass residues are used for heat generation at the project site in new and/or existing plants. (B5)</td><td>Biomass attributable to heat generation.</td><td>9,027</td></tr>
<tr><td>5</td><td>Mix of sawdust and bark from industrial operations.</td><td>On-site production.</td><td>The biomass residues are used for heat generation at the project site in new and/or existing plants. (B5)</td><td>Biomass attributable to heat generation.</td><td>85,706</td></tr>
</table>
</td></tr>
<tr><td>Measurement methods and procedures</td><td>See table describing measurement procedures under variable “Biomass residues categories and quantities used in the Project activity”.</td></tr>
<tr><td>Monitoring frequency</td><td>Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.</td></tr>
<tr><td>QA/QC procedures</td><td>Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes.</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions calculations.</td></tr>
<tr><td>Additional comment</td><td>It is described in Step 1.4 of this PDD all biomass residues types and total amount would be consumed exclusively in the recovery boiler.</td></tr>
</table>

Data / Parameter 30

Data / Parameter	**$HC_{BL,y}$**
Unit	GJ
Description	Baseline process heat generation in year y (GJ).
Source of data	On-site measurements.
Value(s) applied	The applied value is 7,791,122(GJ) (See section Additional comment)

Measurement methods and procedures	Measurement of this parameter should be performed in accordance with the procedure established hereby: This parameter will be determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generator. The respective enthalpies will be determined based on the mass (or volume) flows, the temperature and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. For superheat steam, condensates and feed water, the level of accuracy of the pressure is 0.1% O.R., of temperature measurement is 0.25% O.R., and of flow meters measurement is 0.075% O.R.
Monitoring frequency	This parameter will be monitored continuously and aggregated monthly, to calculate the emission reductions.
QA/QC procedures	----
Purpose of data	Baseline and Project emissions calculations.
Additional comment	For the emission reduction calculation the value of 7,721,514 (GJ/yr) is used. This value corresponds to total baseline process heat generation using data obtained from the project case energy and mass balances with the environmental restriction, which limits the plant production to 550,000 ADt/yr. The value 9,107,566 (GJ) corresponds to the total baseline process heat calculated using data from the project case energy and mass balances without environmental restriction, performed under average operational conditions of the pulp mill.

Data / Parameter table 31

Data / Parameter	$EL_{PJ,gross,y}$
Unit	MWh
Description	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y (MWh).
Source of data	On-site measurements.
Value(s) applied	The applied value is 694,485 (MWh) (See section Additional comment)
Measurement methods and procedures	This parameter will be measured using proper and dedicated electric meters. All meters will receive calibration and maintenance according to proper industry standards. The level of accuracy of these meters is +/- 0.5%.
Monitoring frequency	Continuously.
QA/QC procedures:	The consistency of metered electricity generation will be crosschecked with receipts from electricity sales (if available), and the total amount of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years).
Purpose of data	Baseline emission calculations.
Additional comment	For the emission reduction calculation the value of 694,485 (MWh) is used. This value is determined using data obtained from the project case energy and mass balances with the environmental restriction, which limits the plant production to 550,000 ADt/yr. The value 846,253 (MWh) is determined using data from the project case energy and mass balances, performed under average operational conditions of the pulp mill and without the restriction that limit the pup production.

Data / Parameter table 32

Data / Parameter:	$EL_{PJ,imp,y}$
Unit	MWh
Description	Project electricity imports from the grid in year y (MWh)
Source of data	On-site measurements.
Value(s) applied	The applied value is 2,812 (MWh). This value applied is based on plant´s historical range of electricity imports in previous monitoring periods.
Measurement methods and procedures	This parameter will be measured using proper electric meters. All meters will receive calibration and maintenance according to proper industry standards. The level of accuracy of these meters is +/- 0.5%.
Monitoring frequency	Continuously.
QA/QC procedures	The consistency of metered electricity imports will be crosschecked with receipts from electricity purchases.
Purpose of data	Baseline emission calculations.
Additional comment	See Section B.6.1 of this PDD.

Data / Parameter table 33

Data / Parameter	$EL_{PJ,aux,y}$
Unit	MWh
Description	Total auxiliary electricity consumption required for the operation of the power plants at the project site in year y (MWh)
Source of data	On-site measurements.
Value(s) applied	The applied value is 25,403 (MWh) (See section Additional comment).
Measurement methods and procedures	The PP will determine the additional electric power consumption of the project pulp mill as a percentage of the total monitored electric power consumption of the pulp mill with surplus electric power capacity. $EL_{pj,aux,j} = EL_{pulp\ mill} \times 4.71\%$ Where: $EL_{pulp\ mill}$: Directly measured value of the electric power consumption of the pulp mill. Determined using proper and dedicated electric meters. The accuracy level of these metes is +/- 0.5% The factor 4.71%[81]: determined as the additional internal power consumption of the project activity divided by the total internal power consumption of the project activity.
Monitoring frequency	Continuously.
QA/QC procedures	The consistency of metered electricity generation will be crosschecked with receipts from electricity sales (if available), and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years). All meters will receive calibration and maintenance.
Purpose of data	Baseline emission calculations.
Additional comment	The project participant would like to note that total auxiliary electricity consumption includes all electricity required for the operation of all power or heat generating plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.).

[81] Determined as the additional internal power consumption (3.0 MW) divided by the total internal power consumption of the project plant (63.5 MW). Refer to Emission reduction calculation spread sheet, Data sheet!.

Data /parameter table 34

<table>
<tr><td>Data / Parameter:</td><td>$NCV_{BR,n,y}$</td></tr>
<tr><td>Unit</td><td>GJ/tonnes of dry-matter.</td></tr>
<tr><td>Description</td><td>Net calorific value of biomass residues of category n in year y (GJ/tonne of dry-matter).</td></tr>
<tr><td>Source of data</td><td>On-site measurements.</td></tr>
<tr><td>Value(s) applied</td><td>
<u>Recovery boiler:</u>
<table>
<tr><th>Biomass residues category n</th><th>Biomass residues type</th><th>Net calorific value (GJ/tDS)</th></tr>
<tr><td>1</td><td>Black liquor</td><td>[11.37 (pine) /10.49 (euca)][82]</td></tr>
<tr><td>2</td><td>Methanol</td><td>19.37[83]</td></tr>
<tr><td>3</td><td>CNCG</td><td>6.90[84]</td></tr>
</table>
These values, used in the energy/mass balance of the project plant, are estimated ex-ante based on real values used in the pulp industry. Note that major suppliers of evaporation plants and recovery boilers worldwide were requested to comment on the values used in the energy and mass balance at the validation process. As a result, ex-ante estimates above informed resulted in reasonable values when compared with normal values used in the pulp industry.
<u>Biomass power boiler:</u>
<table>
<tr><th>Biomass residues category n</th><th>Biomass residues type</th><th>Net calorific value (GJ/tDS)</th></tr>
<tr><td>4</td><td>Sludge from on-site industrial operations.</td><td>5.150</td></tr>
<tr><td>5</td><td>Mix of sawdust and bark from on-site industrial operations.</td><td>16.93</td></tr>
<tr><td>6</td><td>Mix of sawdust and bark from on-site industrial operations.</td><td>16.93</td></tr>
<tr><td>7</td><td>Mix of sawdust and bark from off-site industrial operations.</td><td>16.93</td></tr>
<tr><td>8</td><td>Mix of sawdust and bark from forest operations.</td><td>16.93</td></tr>
</table>
These values, used in the energy/mass balance of the project plant, are average heating values from the monitored period 2016 of this project activity.
</td></tr>
</table>

[82] The selected net calorific value of [11.37 pine and 10.48 euca (GJ/tDS)] for black liquor was used in the energy/mass balance calculation for the Valdivia project activity. This value is fully consistent with the default net calorific value of 11.8 (GJ/tDS) for Sulphite (black liquor) provided in table 1.2 of Volume 2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Note that it is common practice in the design of pulp mills to consider black liquor amounts without ash recirculation. As it was described before in this PDD the ash recirculation is implemented in order to improve the reutilization of the inorganic chemicals used in the cooking process of the kraft pulping process.

[83] This corresponds to a default value used by the consulting in the energy/mass balances diagrams presented in this PDD. This value result to be as reasonable and conservative value when compared with values used by major suppliers of evaporation plants and recovery boilers worldwide, and AF Celpap, a leading Scandinavian consulting company. As a result, the default value informed above results in a reasonable value when compared with values used by Valmet: (19.9 GJ/tDS), Andritz: (21 GJ/tDS) and AF Celpap consulting (16.9-20.5 GJ/tDS). Note that from literature the NCV of 19.93 (MJ/kg) corresponds to pure methanol. Since MeOH is mixed with sulphur containing compounds the heating values can be lower and higher the heating value from pure MeOH. The amount of sulphur compounds is related to the white liquor sulphidity, temperature in the evaporation plant and other factors.

[84] This corresponds to a default value used by AFCelpap consulting in the energy/mass balance diagrams presented in this PDD. This value results to be as a reasonable and conservative value when compared with values used by major suppliers of evaporation and recovery boilers worldwide and AF Celpap. As a result, default value above informed results in a reasonable value when compared with values used by Valmet: (7.9 GJ/tDS), Andritz: (10 GJ/tDS) and AF Celpap consulting (7.5GJ/tDS). Note that in this case tDS stands for tones of dry gas.

Measurement methods and procedures	Black-liquor: Measurements of this parameter will be performed in accordance with the procedure established hereby: This parameter will be carried out at least every six months, taking at least three samples for each measurement. Measurements of this parameter will be based on dry basis. Net calorific measurements will be carried out by reputed local or foreign laboratories and according to relevant international standards. Methanol (MeOH): To determine the heating value of methanol, the liquid methanol concentration will be determined (W_{MeOH}). This is the mass fraction or concentration of methanol in the liquid methanol/water mixture. This mass fraction will be computed on-line and displayed by the Distributed Control System (DCS) of the pulp mill. Furthermore, the extensive[85] net heating value of methanol will be determined, using the intensive[86] net heating value (NCV) for methanol as energy per mass of fuel reported in the literature as 19.93 (MJ/kg). To determine net calorific value (NCV) of the methanol, the mass flow of pure methanol will be determined on-line and the net calorific values will be registered in the DCS in real time and expressed in units of energy. Data will be aggregated as appropriate, to emission reduction calculations. Concentration of Non Condensable Gas (CNCG): According to the Methodology ACM0006 (Version 14.0) the source of the NCV should be either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice. In the case of this project activity, the Project Participant will use, as a default value at the validation stage, a reliable value when compared with normal values used in the pulp industry provided by major suppliers of evaporation plants and recovery boilers worldwide. Alternatively, the Project Participant will perform on-line monitoring of heating value for biomass fuel stream of CNCG in the recovery boiler. This monitoring will be performed using existing system instrumentation and the appropriate calculations configured in the distributed control system (DCS). The net calorific value (NCV), the gross heating value (HV), the water vapour weight fraction (W_{H2O}), and the gross heating value per kilogram of dry gas will be continuously reported in the DCS.
Monitoring frequency	At least every six months, taking at least three samples for each measurement (for black-liquor only). For methanol and CNCGs the Project Participant will perform on-line monitoring of heating value for these biomass fuel streams and will be registered in the DCS in real time and expressed in units if energy.
QA/QC procedures	Check the consistency of the measurements by comparing the results with the measurements performed in previous monitoring periods, relevant data sources (e.g. values in the literature, values used in the national GHG inventory if available) and default values by the IPCC. Additional measurement will be conducted in case measurement results differ significantly from previous measurement or other relevant data.

[85] The extensive value of NCV as total energy per unit of time is readily computed by multiplying the intensive value by the total mass flow of liquid methanol/water mixture and by the methanol weight fraction.
[86] The intensive value of NCV for methanol as energy per mass of fuel is reported in the literature as 19.93 (MJ/kg).

	NCV measurements will be determined on the basis of dry biomass. Note that sample will be taken only for black-liquor biomass type. For methanol and CNCGs the Project Participant will perform on-line monitoring of heating value for these biomass fuel streams.
Purpose of data	Baseline and Project emission calculations.
Additional comment	---

Data / Parameter 35

Data / Parameter:	$h_{LOW,y}$ $h_{HIGH,y}$
Unit:	(GJ/tonnes)
Description:	$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes). $h_{HIGH,y}$ = Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes).
Source of data	On-site measurements.
Value applied	$h_{LOW,y}$ = 2.7661 (GJ/tonnes) for pine and 2,7754 (GJ/tonnes) for euca. $h_{HIGH,y}$ = 3.3550 (GJ/tonnes) for both cases. This value is estimated ex-ante from the corresponding energy / mass balance of the project plant.
Measurement methods and procedures	The specific enthalpies should be determined based on the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. For superheated steam, condensates and feedwater, the level of accuracy of the temperature measurement is estimated as 0.1 % O.R. (only transmitter), of temperature measurement is estimated as 0.25 % of O.R., and of flow meters measurement is estimated as 0.075% O.R. Calibration frequency of all meters will be in accordance with the manufacturer's specifications and / or the national / local standards of the Pulp and Paper industry. The data will be monitored continuously and aggregated as appropriate, to calculate emission reductions.
Monitoring frequency	--
QA/QC procedures	--
Purpose of data	The process heat demand side refers to where heat is finally used for heating purposes by end-users and the heat generator side refers to where heat is generated.

Data /parameter table 41

Data / Parameter:	LOC_y
Unit:	(Hour)
Description:	LOC_y = Length of the operational campaign in year y (hour).
Source of data	On-site measurements.
Value applied	8,496 (hours). This value is estimated ex-ante from the corresponding energy / mass balance of the project plant.
Measurement methods and procedures	The Technical Superintendence will be in charge of recording and adding the operation hours of the project activity during the year y.
Monitoring frequency	--

QA/QC procedures	--
Purpose of data	--
Additional comment	--

Tool Project and leakage emissions from biomass (Version 04.0)

Data / Parameter	**Moisture content of the biomass residues**
Unit	% Water content in mass basis in wet biomass residues.
Description	Moisture content of each biomass residues type n.
Source of data	On-site measurements.
Value(s) applied	See tables and notes below.

Biomass residues category n	Biomass residues type	Moisture content (% of water in wet biomass residues)
1	Black liquor	26%[87]
2	Methanol	20%[88]
3	CNCG	12.3% (saturated at 60°C)[89]

The Project Participant would like to note the following:

- Moister content informed for black-liquor is based from measurements conducted in previous monitoring periods.
- Moister contents of methanol and CNCGs, used in the energy/mass balance of the project plant, are estimated ex-ante based on normal values used in the pulp industry. In this case, major suppliers of evaporation plants and recovery boilers worldwide have been requested to comment on the values informed and used in the energy and mass balance at the validation process.

  As a result, ex-antes estimate values above presented resulted in reasonable and reliable data when compared with normal values used in the pulp industry, provided by major suppliers of evaporation plants and recovery boilers worldwide.

Biomass residues category n	Biomass residues type	Moisture content (% of water in wet biomass residues)
4	Sludge from on-site industrial operations.	(75-85) %
5	Mix of sawdust and bark from on-site industrial operations.	(42-65)%
6	Mix of sawdust and bark from on-site industrial operations.	(42-65)%
7	Mix of sawdust and bark from off-site industrial operations.	(44-65)%
8	Mix of sawdust and bark from forest operations.	(52-65)%

[87] This corresponds to an estimate based on previous monitoring periods of the first crediting period.

[88] This corresponds to a default value based on normal values used in the industry. The Project Participant validated this value as a reasonable value when compared with values used by major suppliers of evaporation plants and recovery boilers worldwide, and AF Celpap, a leading Scandinavian consulting company. As a result, the default value informed above results in a reasonable value when compared with values used normally by Valmet: (20%), Andritz: (20%) and AF Celpap consulting (< 20%).

[89] This corresponds to a default value based on normal values used in the industry. The Project Participant validated this value as a reasonable value when compared with values used by major suppliers of evaporation plants and recovery boilers worldwide, and AF Celpap, a leading Scandinavian consulting company. As a result, the default value informed above results in a reasonable value when compared with values used normally by Valmet: (13%), Andritz: (12.3%) and AF Celpap consulting (saturated).

Measurement methods and procedures

Recovery boiler:

Biomass residues category n	Biomass residues type	Procedure	Accuracy level of instruments involved
1	Black liquor	Moisture content will be determined through an on-line measurement of the solid content, performed by the refract meters installed in the pipeline that carry out black liquor to the recovery boiler.	+/- 0.1%
2	Methanol	Moisture contents of the MeOH will be determined through an on-line measurement of the density carried out by a dedicated coriolis flow meter installed in the pipeline that will carry out the MeOH to the recovery boiler. Temperature corrections are included in order to determine the weight fraction of methanol in the mixture of methanol/ H_2O. The density of the mixture will be monitored and displayed by the Distributed Control System (DCS) of the pulp mill. Furthermore, the density measurement, combined with established table of concentrations, will let the DCS to compute the concentration of methanol in the mixture on-line, continuously, and aggregated as required in the emission reduction calculations.	+/-0.5%.
3	CNCG	Considering the CNCG are saturated, water content will be determined by measuring the temperature online at this point. This will let the DCS to compute the moisture content, continuously, and aggregated as required in the emission reduction calculations.	+/-0.5%.

Power boiler:

Biomass residues category n	Biomass residues type	Procedure	Accuracy level of instruments involved
4	Sludge from industrial operations.	The sludge will be monitored and registered by taking periodic samples from containers feeding. Moisture content will be calculated by evaporating the water content of the samples and measuring the weight before and after the water content has been evaporated. This process will be carried out by dedicated scales.	Electronic moisture analyser with accuracy class of +/-0.001.
5 y 6	Mix of sawdust and bark from on-site industrial operations.	Moisture content of this biomass type will be monitored and registered periodically, by taking biomass samples from the corresponding sources. Moisture content will be calculated by evaporating 100% of the water of the wet sample and measuring the weight before and after water content has been evaporated. This process will be carried out in dedicated scales.	Electronic moisture analyser with accuracy class of +/-0.001.

	7	Mix of sawdust and bark from off-site industrial operations.	Moisture content of this biomass type will be monitored and registered periodically, by taking biomass samples from the corresponding sources. Moisture content will be calculated by evaporating 100% of the water of the wet sample and measuring the weight before and after water content has been evaporated. This process will be carried out in dedicated scales.	Electronic moisture analyser with accuracy class of +/- 0.001.
	8	Mix of sawdust and bark from forest operations.	Moisture content of this biomass type will be monitored and registered periodically, by taking biomass samples from the corresponding sources. Moisture content will be calculated by evaporating 100% of the water of the wet sample and measuring the weight before and after the water has been evaporated. This process will be carried out in dedicated scales.	Electronic moisture analyser with accuracy class of +/- 0.001.
Monitoring frequency	Monthly			
QA/QC procedures	---			
Purpose of data	Baseline and Project emission calculations.			
Additional comment	---			

<u>Monitored parameters for the tool to calculate "Project or leakage emissions from transportation of freight" (Version 01.1.0)</u>

Data / Parameter	$\mathbf{D_{f,m}}$
Unit	Kilometre.
Description	Return trip road distance between the origin and destination of freight transportation activity *f* in monitoring period m.
Source of data	Records by Project Participants in which are specified the total biomass residues purchased (monthly), from known locations with known distances to the plant.
Value(s) applied	Distances are estimated. See Appendix 5 of this PDD).
Measurement methods and procedures	Distance will be determined once for each freight transportation activity *f* using road map, from each supply centre of biomass to the power plant and will be recorded in the Valdivia Procurement Department IT system. This parameter will be updated whenever the road distance changes.
Monitoring frequency	The Project Participant will update whenever the road distance changes.
QA/QC procedures	**---**
Purpose of data	Project emissions calculations.
Additional comment	Applicable to <u>Option B</u> of the tool "Project and leakage emissions from transportation of freight" to calculate the CO_2 emissions from transportation of biomass to the Power Plant.

Data / Parameter	$\mathbf{FR_{f,m}}$
Unit	Tonnes.
Description	Total mass of freight transported in freight transportation activity *f* in monitoring period m.

Source of data	Records by Project Participant.
Value(s) applied	In the case of this project activity, the applied value is: <table><tr><td>Biomass residues category n</td><td>Biomass residues type</td><td>Biomass residues source</td><td>Biomass residues fate in the absence of the project activity</td><td>Biomass residues use in project scenario</td><td>Biomass residues Quantity (BDt/y)</td></tr><tr><td>7</td><td>Mix of sawdust and bark from industrial operations.</td><td>Off-site production.</td><td>Dumped or left to decay under clearly aerobic conditions (B1).</td><td>Biomass attributable to power generation.</td><td>38,207</td></tr><tr><td>8</td><td>Mix of sawdust and bark from forest operations.</td><td>Off-site production.</td><td>Dumped or left to decay under clearly aerobic conditions (B1).</td><td>Biomass attributable to power generation.</td><td>0</td></tr></table>
Measurement methods and procedures	Mix of sawdust and bark from off-site production sources brought by trucks to the Power Plant will be duly measured (weight) by proper and calibrated weighbridges with accuracy +/-30 kg when they enter the Plant. The (wet) freight, measured by weighbridges, will be adjusted for moisture content and converted into tonnes on dry biomass. Moisture content will be measured on-site using calibrated scales of Raw Material Analyst of the Quality Department. Weighbridges, scales and all the equipment required for determining this parameter will receive periodic maintenance and calibration (if required), according to proper industry standards. This parameter will be monitored continuously.
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.
QA/QC procedures	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data	Project emissions calculations.
Additional comment	– This parameter is applicable to Option B of the “Project and leakage emissions from transportation of freight”. – Only biomass coming from outside the Plant and attributable to the project activity will be considered in this case.

Monitored parameters for the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (Version 03.0)

Data / Parameter	$FC_{i,j,y}$
Unit:	Mass or volume per year (ton/y or m^3/y)
Description	Quantity of fuel type i combusted in process j (recovery and power boiler) during the year y.
Source of data	On-site measurements.
Value(s) applied	In the case of this project activity, the applied values are: A total of 18,329 (ton/yr) of Fuel oil is estimated to be consumed in both boilers. • An estimate of 2,523(ton/yr) of Fuel oil will be burned in PB. • An estimate of 15,806 (ton/yr) of Fuel oil will be burned in RB.

Measurement methods and procedures	Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift). Accessories such as transducers, sonar, and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance. In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions. Measurement of this parameter will be performed in accordance with the procedure established hereby: Fossil fuel consumption in the Recovery Boiler: The measurements of fossil fuels are online and fully integrated with the Distributed Control System (DCS) of the pulp mill. Fossil fuel amount (Fuel Oil): is determined as the sum of the measurement of mass flow meters measuring the fossil fuel entering to the recovery boiler burner ring, minus the sum of the flow meters measuring the fossil fuel returned (not consumed by the recovery boiler) to the pipeline. The accuracy level of the instruments that are used for the measurement of this parameter is +/- 0.5%. Fossil fuel consumption in the Power Boiler: Fossil fuel amount (Fuel Oil): is determined as the sum of the measurement of mass flow meters measuring the fossil fuel entering to the power boiler load and start burners minus the sum of the mass flow meters measuring the fuel returned (not consumed by the power boiler) to the pipeline. The accuracy level of the instruments that are used for the measurement of this parameter is +/- 0.5%. The Project Participant informs that alternatively or additionally to Fuel oil, other fossil fuel types, such as Diesel, liquid petroleum gas may be consumed in the plant. Responsible for monitored data will be the Boiler department.
Monitoring frequency	The total quantity of fossil fuel per type used in the boilers is online and fully integrated with the Distributed Control System (DCS) of the pulp mill. Data will be continuously monitored at the boilers by proper and dedicated instruments and recorded monthly in the emission reduction sheet.
QA/QC procedures	The consistency of fuel consumption measurement should be cross-checked by an annual energy / mass balance based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Project emissions calculations.
Additional comment	---

Data / Parameter	$\mathbf{FC}_{i,j,y}$
Unit:	Mass or volume per year (ton/y or $m^{3/}y$)

Description	Quantity of fuel type i combusted in process j (biomass transportation in the plant) during the year y.
Source of data	On-site measurements.
Value(s) applied	The applied value applied of 88 ton of diesel consumed due to on-site biomass transportation in the plant.
Measurement methods and procedures	Fuel amount calculated considering the total fuel consumed for on-site transportation of biomass. The total fuel amount is reported by the front loader operator (or corresponding subcontractor) to the person in charge of reporting this information for project activity emission reduction calculation.
Monitoring frequency	Continuously.
QA/QC procedures	Consistency checks based on monthly or annual operational indices (e.g. check whether front loader fossil fuel consumption divided by the operation hours results in a reasonable index, comparable to the ones observed in previous years).
Purpose of data	Project emissions calculations.
Additional comment	This variable does not include fossil fuels co-fired in the project plant but any other fuel consumption at the project site that is attributable to the project activity (e.g. for mechanical preparation of the biomass residues).

Data / Parameter	$\rho_{i,y}$
Unit	Mass unit/volume unit
Description	Weighted average of density of fuel type i in year y.
Source of data	(see data source table below) In this case, a) is not available. The selected source is the one provided in <u>Option c)</u> of table above and therefore, the Project Participant will select default values from the reliable and documented National Energy Statistic (National Energy Commission, energy balance 2012) is used to calculate emissions.
Value(s) applied	The values applied are: 0.84(kg/lt) for Diesel. 0.95(kg/lt) for Fuel Oil 550 (kg/m3) for Natural Gas. 0.65(kg/lt) for LPG
Measurement methods and procedures	Any future revision of the National Energy Statistics should be taken into account.
Monitoring frequency	The appropriateness of the data will be reviewed annually.
QA/QC procedures	Not applicable since a default factor will be used in this case.
Purpose of data	Project emissions calculations.
Additional comment	---

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices.	This is the preferred source if the carbon fraction if the fuel is not provided.
b) Measurements by the project participants.	If a) is not available.
c) Regional or national default values.	If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).

Data / Parameter	$NCV_{i,y}$
Unit	GJ per mass or volume unit (e.g. GJ/m^3, GJ/ton)
Description	Weighted average net calorific value of fossil fuel type i in year y.
Source of data	<table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>a) Values provided by the fuel supplier in invoices.</td><td>This is the preferred source if the carbon fraction if the fuel is not provided.</td></tr><tr><td>b) Measurements by the project participants.</td><td>If a) is not available.</td></tr><tr><td>c) Regional or national default values.</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td><td>If a) is not available.</td></tr></table> In this case, a) is not available. The selected source is the one provided in Option d) of table above and therefore, the Project Participant will select default values from the IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, and Table 1.2 at the upper limit of the uncertainty at a 95% confidence interval.
Value(s) applied	The values applied are: 43.3(GJ/ton) for Diesel. 41.7(GJ/ton) for Fuel Oil 50.40 (GJ/ton) for Natural Gas. 52.2(GJ/ton) for LPG
Measurement methods and procedures	Any future revision of the IPCC Guidelines should be taken into account.
Monitoring frequency	The appropriateness of the data will be reviewed annually.
QA/QC procedures	Not applicable since a default factor will be used in this case.
Purpose of data	Project emissions calculations.
Additional comment	The monitoring of this variable applies, since according to the "Tool to calculate projector leakage CO_2 emissions from fossil fuel combustion", this PDD is using Option B ($COEF_{i,y} = NCV_{i,y} * EF_{CO2,i,y}$) to determine the CO_2 emission coefficient of fuel type i.

Data / Parameter	$EF_{CO2,i,y}$
Unit	(tCO_2/GJ)
Description	Weight average CO_2 emission factor of fuel type i in year y.
Source of data	<table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>a) Values provided by the fuel supplier in invoices.</td><td>This is the preferred source.</td></tr><tr><td>b) Measurements by the project participants.</td><td>If a) is not available.</td></tr><tr><td>c) Regional or national default values.</td><td>If a) is not available.</td></tr></table>

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td><td>If a) is not available.</td></tr>
</table>

In this case a) is not available.The Project Participant will use option d) of the table above: The IPCC default value at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.</td></tr>
<tr><td>Value(s) applied</td><td>The applied values are:

0.0748 (tCO_2/GJ) for Diesel.
0.0788 (tCO_2/GJ) for Fuel Oil.
0.06560 (tCO_2/GJ) for LPG</td></tr>
<tr><td>Measurement methods and procedures</td><td>Any future revision of the IPCC guidelines will be taken into account.</td></tr>
<tr><td>Monitoring frequency</td><td>Annually.</td></tr>
<tr><td>QA/QC procedures</td><td>Not applicable since a default factor will be used in this case.</td></tr>
<tr><td>Purpose of data</td><td>Project emission calculations.</td></tr>
<tr><td>Additional comment</td><td>---</td></tr>
</table>

B.7.2. Sampling plan

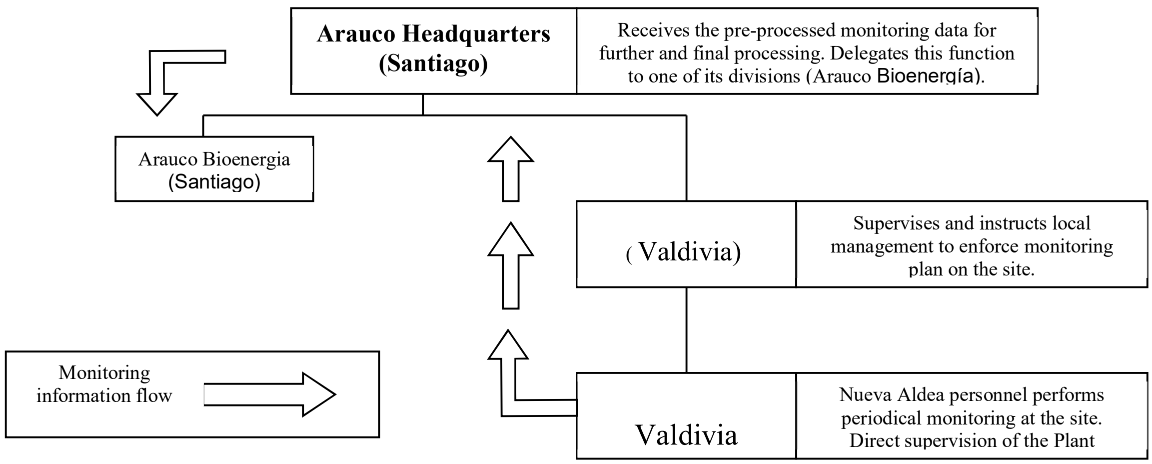
Not applicable in the case of this project activity.

B.7.3. Other elements of monitoring plan

The Project Participant will implement monitoring procedures according to the monitoring methodology chosen for this project activity. This monitoring methodology will account for emission reductions and leakage effects (in case it corresponds) in an accurate and conservative manner. According to the monitoring methodology ACM0006 (Version 14.0) all data collected as part of monitoring will be archived electronically and kept at least for 2 years after the end of the last crediting period.

The monitoring methodology will be supported by a dedicated management information system designed exclusively to guarantee the quality of the information related to the proposed project activity. The system will use the same principles of the ISO 9001 and will be incorporated to the plant's management information system. In order to ensure the quality and integrity of the management system, Arauco Bioenergia S.A. personnel will perform periodic internal audits.

Monitoring information flow of Valdivia biomass power boiler



The Project Participant counts with on-site personnel (at the project activity site), who will be in charge of gathering and registering all the required information described in the monitoring plan. Such duties will be incorporated to the personnel's everyday activities to ensure continuity and high-quality standards. The

information will be partially processed and stored there, and will be sent periodically (monthly) to Arauco Bioenergia S.A. in Santiago for further and final processing (table formats, reports, etc.). With the information at this level, Arauco will be in condition to certify the emission reduction of the Valdivia Phase 1 project activity periodically (i.e. once every year).

Finally, since the pulp mill is a modern facility and counts with very high quality, security and environmental standards, there are plenty of safety measures and security procedures implemented in the facility in case of emergencies or accidental events that might lead to unintended emissions. Particularly, for events related to accidental fires, the pulp mill counts with on-line fire sensors that continuously monitor the entire production cycle and has a fire brigade especially trained to fight any fire contingency in the site.

SECTION C. Start date, crediting period and duration.

C.1. Start date of the project activity

01/02/2002.

This is the date in which the purchase of the recovery boiler (a major equipment of the pulp mill) was formalized.

C.2. Expected operational lifetime of project activity

Minimum of 30 years, considered from 14/05/2004, which is the date in which the project activity started operating.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period.

C.3.2. Start date of crediting period

>>

01/04/2016. This is the start date of the second crediting period.

<u>First crediting period</u>

01/04/2009. This is the start date of the first crediting period.

The starting date of the crediting period is defined as the first day of operation of the Valdivia biomass power plant

The Project Participant would like to note that the original starting date established in the registered PDD was 01/07/2008. However, due to some technical problems during the start-up operation, the Project Participant requested a delay of eight months in the starting date of crediting period resulted to be in April 1st, 2009.

C.3.3. Duration of crediting period

Maximum length of the crediting period: 3 x Seven (7) years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The impacts of the project that were identified in the EIA are the following:

- **<u>Solid and Liquid Wastes:</u>** The operation of the plant will generate sewage water that will be treated in a sewage treatment plant in accordance with the Chilean regulations. The project will consume all the biomass that will be generated by the plant. Very low amounts of residues, like ashes, plastics and other industrial waste will be send to a landfill, also according with the Chilean regulations. Pulp mill effluents will receive tertiary treatment, which is the most advanced and effective technology available in the world today.
  -
- **<u>Atmospheric emissions:</u>** The emissions are related to noise and particulate material. Both of them are treated with state of art technology that put them below the emission limit factor required by the Chilean regulations.

All the impacts addressed above, were mentioned and resolved during the environmental impact assessment procedure.

All these statements were duly reviewed and confirmed by the Designated National Authority (CONAMA) when the proposed project activity went through the Host Country Approval process. In that instance, the DNA reviewed all the different environmental permits related to the project activity and found them to be in accordance with all national environmental regulations.

No transboundary impacts are considered for this project.

D.2. Environmental impact assessment

The project complies with the specific applicable regulations of the host country with regards to Environment Impact Assessment (EIA). The EIA follows the regulations for EIA System set in Chile by the Supreme Decree N 30/97 of the Ministry General Secretariat of the Presidency, Regulation for the Environmental Impact Assessment System and its modifications set in Supreme Decree N 95/2001, and the Act N 19,300 on the Environmental Framework.

The project proponent submitted an Environmental Impact Assessment (EIA) for the pulp mill, in which the project activity is realized, in order to comply with the Chilean regulation. The EIA was approved in October 30, 1998 by Resolution Nº 279/98.

The pulp mill where the proposed CDM project activity is located went through a thorough examination process by the local environmental authorities and received all the relevant authorizations in order to operate in accordance with the outstanding environmental legislation.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation.

In addition to the legal requirements imposed by the Environmental Impact System procedure, such as, publications in local newspapers and community meetings, Arauco invested a significant amount of effort, time and resources to explain to the local authorities and the local community the characteristics and implications of the Valdivia project. This was a long process, in which all the different aspects of the construction of a pulp mill were detailed addressed and dealt with. It began in 1995, year in which the idea of building a pulp mill was presented to the local community and lasted until 2004, the date in which the Valdivia mill was finished and started operating.

In addition to the formal consultation process, Arauco implemented a “free phone line” in order to permanently receive and consider any comment about the operation of the Valdivia mill (and its other industrial facilities as well) from the local community / stakeholders.

The Stakeholders involvement was organized through the following channels:

1. Technical staff of Arauco met with local community and authorities in order to discuss all economic, technical, social and environmental aspects of the Valdivia project. This was done with the commune of San José de la Mariquina and the surrounding communities in the Valdivia province. The conclusions of those meetings were compiled in a document that was distributed to the communities and local authorities.

2. Meetings with the communities of the Valdivia province and the management of the Company: the meetings were announced through leaflets, letters, local press, announcements in local radios, and television. Again the conclusions of those meetings were distributed to all stakeholders.

3. Presentation of the project (the EIA) to different institutions and organizations: Local universities, corporations of different nature and research centers.

4. Visits to the construction site: representatives of different communities and local authorities were invited to visit the construction site.

5. The associated CDM project activity (which is part of the Valdivia project) was also announced in different CDM seminars in Chile.

As stated above, all comments were compiled in documents that were distributed back to all stakeholders. All those comments were taken into account and accommodated in accordance with the characteristics of the project and the local authorities' requests.

E.2. Summary of comments received

The comments related to the project activity were related to the emissions of the project and waste management. For the emissions issue, the company emphasized their commitments to comply with all the requirements imposed by the local authorities.

All other technical and environmental aspects were resolved at the EIA and approved by the environmental authorities.

E.3. Consideration of comments received

All clarifications done by the authorities were clarified and incorporated in due time. This allowed the environmental approval of the project, as stated in Section D and E.

The whole process related to the EIA approval, stakeholders and authorities comments and how they were incorporated in the process of approval of the EIA can be follow at the web through the Environmental Impact Assessment System dedicated link by CONAMA, at: www.e-seia.cl.

SECTION F. Approval and authorization

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The Project Participant indicates that the letters of approval from the Parties for the project activity was available at the time of submitting the PDD to the validating DOE.

Appendix 1. Contact information of project participants.

Organization name	CELULOSA ARAUCO Y CONSTITUCIÓN S.A.
Country	Chile
Address	Santiago, El Golf 150, piso 14 Las Condes.
Telephone	56-2- 462 3888
Fax	56-2-462 7003
E-mail	christian.rodriguez@arauco.com
Website	www.arauco.com
Contact person	Mr. Christian Rodriguez Lewald

Appendix 2. Affirmation regarding public funding

Public Funding:

The financial plans for the Project do not involve public funding.

Appendix 3. Further background information on ex ante calculation of emission reductions

BASELINE INFORMATION

SIC GRID DATA FOR COMBINED MARGIN CALCULATION

BUILD MARGIN CALCULATION, EX - ANTE FOR THE SECOND AND THIRD CREDITING PERIODS

OPERATING MARGIN CALCULATION, EX – ANTE FOR THE SECOND AND THIRD CREDITING PERIODS.

(ACCORDING TO THE "TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM" VERSION 07.0.0)

BUILD MARGIN CALCULATION

BUILD MARGIN CALCULATION, EX - ANTE FOR THE SECOND AND THIRD CREDITING PERIODS

BUILD MARGIN CALCULATION

ACCORDING TO THE ACM0002 (VERSION 2.0.0)

Power plants	POWER OUTPUT (MW)	PLANT TYPE	FUEL TYPE	START OPERATION	CDM PROYECT	NET GEN IN 2017 (GWh)	SIC EMISSION 2017 (tCO_2/GWh)
Dos Valles	0	Run of the river	Hydro	01-10-2017	No	2.64	0
La Bifurcada	0.23	Run of the river	Hydro	01-10-2017	No	0.22	0
La Viña - Alto La Viña	0.55	Run of the river	Hydro	01-10-2017	No	0.52	0
Embalse Ancoa	0	Run of the river	Hydro	01-10-2017	No	21.80	0
El Nogal	3	Diesel engine	Fuel oil 6	01-10-2017	No	0.09	325
Lepanto				01-10-2017	No	0.50	0
Solar Cuz Cuz	3	Solar	Sun	01-10-2017	No	1.85	0
Solar Las Turcas	3	Solar	Sun	01-10-2017	No	2.01	0
Carilafquén	19.8	Run of the river	Hydro	01-10-2017	No	59.72	0
Solar Valle de la Luna II	3	Solar	Sun	01-09-2017	No	2.11	0
Solar San Francisco	3	Solar	Sun	01-09-2017	No	2.33	0
Solar La Quinta	2.9	Solar	Sun	01-09-2017	No	2.27	0
Solar El Pelícano	0	Solar	Sun	01-09-2017	No	86.89	0
Solar Doña Carmen Solar	0	Solar	Sun	01-07-2017	No	11.06	0
Solar Antay	9	Solar	Sun	01-06-2017	No	5.33	0
La Mina	0	Run of the river	Hydro	01-05-2017	No	35.51	0
Solar El Boco	3	Solar	Sun	03-03-2017	No	0.00	0
Río Colorado	2	Run of the river	Hydro	01-03-2017	No	48.30	0
Solar Piloto Solar Cardones	0.44	Solar	Sun	02-02-2017	No	0.34	0
Rihinahue	1	Run of the river	Hydro	01-02-2017	No	6.23	0
Eólica Lebu III	5.25	Wind	Wind	01-01-2017	No	0.00	0
Malalcahuello	9.2	Run of the river	Hydro	01-01-2017	No	21.23	0
Molinera Villarrica	0.6	Run of the river	Hydro	01-01-2016	No	0.00	0
Cumpeo	5.76	Run of the river	Hydro	01-01-2016	No	14.46	0
El Galpón	1.3	Run of the river	Hydro	01-01-2016	No	6.43	0
Río Mulchén	3	Run of the river	Hydro	01-01-2016	No	7.51	0
Chanleufu	8.4	Run of the river	Hydro	01-01-2016	No	0.00	0
El Agrio	2.51	Run of the river	Hydro	01-01-2016	No	9.58	0
Tránquil	0.35	Run of the river	Hydro	01-01-2016	No	8.96	0
El Colorado	2	Run of the river	Hydro	01-01-2016	No	8.17	0
La Montaña 1	3	Run of the river	Hydro	01-01-2016	No	7.66	0
Chufkén (Traiguén)	1.6	Diesel engine	Diesel	01-01-2016	No	0.05	2,133
Andes Generación 1 Diesel	32.5	Diesel engine		01-01-2016	No	4.88	0
Andes Generación 2 Diesel				01-01-2016	No	0.00	0
Andes Generación 3 Diesel				01-01-2016	No	0.00	0
Andes Generación 4 Diesel				01-01-2016	No	0.00	0
Andes Generación 1 FO6				01-01-2016	No	0.00	0
Andes Generación 2 FO6				01-01-2016	No	0.00	0
Andes Generación 3 FO6				01-01-2016	No	0.00	0
Andes Generación 4 FO6				01-01-2016	No	0.00	0
El Molle			Biogas	01-01-2016	No	0.00	0
El Canelo 1	3	Diesel engine	Diesel	01-01-2016	No	0.00	0
Raso Power	2.68	Diesel engine	Diesel	01-01-2016	No	0.00	0
HBS GNL	3.5	Diesel engine		01-01-2016	No	0.00	0
Rey	0.8	Diesel engine		01-01-2016	No	0.00	0
Eólica Cuel	33	Wind	Wind	01-01-2016	No	0.00	0
Eólica La Esperanza	10.5	Wind	Wind	01-01-2016	No	31.76	0
Eólica Los Buenos Aires	24	Wind	Wind	01-01-2016	No	78.03	0
Eólica Renaico	88	Wind	Wind	01-01-2016	No	274.39	0
Eólica San Juan	193.2	Wind	Wind	01-01-2016	No	563.04	0
Eólica San Pedro II	65	Wind	Wind	01-01-2016	No	139.35	0
Eólica Huajache	6	Wind	Wind	01-01-2016	No	0.00	0
Solar La Silla	1.89	Solar	Sun	01-01-2016	No	4.45	0
Solar Las Mollacas	2.78	Solar	Sun	01-01-2016	No	2.55	0
Solar La Chapeana	2.78	Solar	Sun	01-01-2016	No	2.71	0
Solar Quilapilún	103.02	Solar	Sun	01-01-2016	No	189.55	0
Solar Los Loros	45.8	Solar	Sun	01-01-2016	No	26.10	0
Solar Conejo	104	Solar	Sun	01-01-2016	No	238.89	0
Solar Bellavista	3	Solar	Sun	01-01-2016	No	3.49	0
Solar Las Araucarias	0.14	Solar	Sun	01-01-2016	No	0.18	0
Solar Santa Julia	3	Solar	Sun	01-01-2016	No	7.10	0
Solar Til Til	3	Solar	Sun	01-01-2016	No	4.63	0
Solar Chuchiñi	2.88	Solar	Sun	01-01-2016	No	5.59	0
Solar El Divisadero	3	Solar	Sun	01-01-2016	No	0.00	0
Solar Cordillerilla	1.43	Solar	Sun	01-01-2016	No	2.45	0
Solar El Romero	196	Solar	Sun	01-01-2016	No	269.46	0
Solar Alturas de Ovalle	6	Solar	Sun	01-01-2016	No	0.00	0
Solar San Pedro	3	Solar	Sun	01-01-2016	No	0.00	0
Solar Ñilhue	1.1	Solar	Sun	01-01-2016	No	0.00	0
Solar Hormiga Solar	2.54	Solar	Sun	01-01-2015	No	3.95	0
Llauquereo	1.8	Run of the river	Hydro	01-01-2015	No	8.34	0
Puleifu	9	Run of the river	Hydro	01-01-2015	No	62.06	0
El Paso	60.2	Run of the river	Hydro	01-01-2015	No	119.78	0
Trailelfú	2.5	Run of the river	Hydro	01-01-2015	No	9.97	0
Itata	20.4	Run of the river	Hydro	01-01-2015	No	60.50	0
Bureo	2.2	Run of the river	Hydro	01-01-2015	No	9.15	0
El Mirador	3	Run of the river	Hydro	01-01-2015	No	2.30	0
Munilque 1	0.55	Run of the river	Hydro	01-01-2015	No	6.52	0
Munilque 2	0.55	Run of the river	Hydro	01-01-2015	No	0.00	0
El Arrayán	0.15	Run of the river	Hydro	01-01-2015	No	282.71	0
Contra	0.33	Run of the river	Hydro	01-01-2015	No	0.00	0
Los Colonos	0.64	Run of the river	Hydro	01-01-2015	No	0.00	0
Panguipulli	0	Run of the river	Hydro	01-01-2015	No	0.00	0
Dosal	0.27	Run of the river	Hydro	01-01-2015	No	0.00	0
Guacolda 5	131.6	Coal/Steam	Natural Gas	01-01-2015	No	767.65	991
Biocruz	1.8	Diesel engine	Biomass	01-01-2015	No	0.11	504
Los Guindos	139	Diesel engine	Biomass	01-01-2015	No	7.27	771
CMPC Cordillera	24	Biogas engine		01-01-2015	No	164.28	50
CMPC Tissue	5	Biogas engine	LNG	01-01-2015	No	11.64	131
Eólica Talinay Poniente	60.6	Wind	Wind	01-01-2015	No	175.89	0
Eólica Raki	9	Wind	Wind	01-01-2015	No	0.00	0
Solar Lalackama	72	Solar	Sun	01-01-2015	No	125.75	0
Solar Javiera	69	Solar	Sun	01-01-2015	No	128.44	0
Solar Loma Los Colorados	0	Solar	Sun	01-01-2015	No	1.49	0
Solar Luz del Norte	141	Solar	Sun	01-01-2015	No	301.01	0
Solar Luna	2.9	Solar	Sun	01-01-2015	No	5.13	0
Solar Lalackama 2	16.5	Solar	Sun	01-01-2015	No	37.56	0
Solar El Pilar - Los Amarillos	3	Solar	Sun	01-01-2015	No	0.06	0
Solar Sol	3	Solar	Sun	01-01-2015	No	4.97	0
Solar Lagunilla	3	Solar	Sun	01-01-2015	No	0.22	0
Solar Carrera Pinto	22	Solar	Sun	01-01-2015	No	180.30	0
Solar PV Salvador	68	Solar	Sun	01-02-2014	No	156.13	0
Solar Las Terrazas	3	Solar	Sun	31-01-2014	No	2.57	0
Solar PSF Lomas Coloradas	2.4	Solar	Sun	30-01-2014	No	4.31	0
Solar PSF Pama	2.4	Solar	Sun	29-01-2014	No	4.06	0
Solar Diego de Almagro	30	Solar	Sun	28-01-2014	No	58.79	0
Solar Techos de Altamira	0.1	Solar	Sun	27-01-2014	No	0.08	0
Solar San Andrés	48	Solar	Sun	26-01-2014	No	61.60	0
Solar Llano de Llampos	93	Solar	Sun	25-01-2014	No	234.67	0
Eólica Taltal	99	Wind	Wind	24-01-2014	No	293.11	0
Eólica Los Cururos	109.6	Wind	Wind	22-01-2014	No	229.98	0
Eólica Ucuquer 2	10.5	Wind	Wind	19-01-2014	No	0.00	0
CMPC Santa Fe	5	Biogas engine	Biomass	18-01-2014	No	410.91	0
Energía León (Coelemu)	7.5	Biogas engine	Natural Gas	17-01-2014	No	24.64	0
San Lorenzo de D. de Almagro U3	7.7	Diesel engine	Biomass	15-01-2014	No	0.12	389,299
Watts II	1.6	Diesel engine	Diesel	14-01-2014	No	0.00	0
Curileufu	0	Run of the river	Hydro	13-01-2014	No	0.00	0
Boquiamargo	1.1	Run of the river	Hydro	12-01-2014	No	0.41	0
Angostura	330.3	Run of the river	Hydro	11-01-2014	No	1088.30	0
Las Flores	1.6	Run of the river	Hydro	10-01-2014	No	12.11	0
Collil	6	Run of the river	Hydro	09-01-2014	No	28.65	0
María Elena	0.3	Run of the river	Hydro	08-01-2014	No	0.00	0
Pichilonco	1.2	Run of the river	Hydro	07-01-2014	No	5.31	0
Quillaileo	0.8	Run of the river	Hydro	06-01-2014	No	1.55	0
Alto Renaico	6.3	Run of the river	Hydro	05-01-2014	No	8.91	0
Los Padres	2.2	Run of the river	Hydro	04-01-2014	No	8.15	0
Maisan	0.6	Run of the river	Hydro	03-01-2014	No	1.76	0
Auxiliar del Maipo	5.1	Run of the river	Hydro	02-01-2014	No	34.37	0
Solar Pampa Solar Norte	69.3	Solar	Sun	01-01-2014	No	158.89	0
Solar Chañares	36	Solar	Sun	01-01-2013	No	81.83	0
Los Corrales II	1	Run of the river	Hydro	01-01-2013	No	0.30	0
Renaico	6.3	Run of the river	Hydro	01-01-2013	No	44.14	0
Don Walterio	2.9	Run of the river	Hydro	01-01-2013	No	0.01	0
MC1	9	Run of the river	Hydro	01-01-2013	No	45.87	0
MC2	3.2	Run of the river	Hydro	01-01-2013	No	12.45	0
El Llano	1.9	Run of the river	Hydro	01-01-2013	No	5.03	0
Las Vertientes	1.6	Run of the river	Hydro	01-01-2013	No	10.39	0
Campiche	272	Coal/Steam	Biomass	01-01-2013	No	1668.72	1,007
Viñales	22	Biomass/steam	Diesel	01-01-2013	No	221.11	0
Los Álamos	0.8	Diesel engine	LNG	01-01-2013	No	0.00	0
Estancilla	3	Diesel engine	Biomass	01-01-2013	No	0.15	752
Trebal Mapocho	8.2	Biogas engine	Biomass	01-01-2013	No	49.27	0
Laja CMPC	25	Biomass/steam	Biomass	01-01-2013	No	107.56	0
Tamm	0.2	Open Cycle	Biomass	01-01-2013	No	0.00	0
Ancali	1.6	Biogas engine	Biomass	01-01-2013	No	0.00	0
Santa Irene	0.4	Biomass/steam	Biomass	01-01-2013	No	1.77	0
Las Pampas	0.4	Biogas engine	Biomass	01-01-2013	No	1.84	0
CMPC Pacífico	33	Biogas engine	Biomass	01-01-2013	No	176.91	0
Eólica Ucuquer	7.2	Wind	Wind	01-01-2013	No	0.00	0
Solar SDGx01	1.2	Solar	Sun	01-01-2013	No	0.00	0
Solar Esperanza	2.88	Solar	Sun	01-01-2013	No	0.00	0
Santa Marta	13.8	Biomass/steam	Biomass	13-01-2012	No	73.25	0
Sta Fe	67.2	Biogas engine	Biomass	12-01-2012	No	0.00	0
Santa María	370	Coal/Steam	Biomass	11-01-2012	No	2510.55	909
Contulmo	0.8	Diesel engine	Diesel	10-01-2012	No	0.00	0
Bocamina 2	350	Coal/Steam	Natural Gas	09-01-2012	No	1697.47	903
Rucatayo	59.5	Run of the river	Hydro	07-01-2012	No	303.04	0
El Canelo	6	Run of the river	Hydro	04-01-2012	No	17.94	0
Purísima	0.4	Run of the river	Hydro	02-01-2012	No	2.23	0
Solar Santa Cecilia	3	Solar	Sun	01-01-2012	No	5.49	0
JCE	0.8	Diesel engine	Diesel	26-01-2011	No	0.00	0
Danisco	0.8	Diesel engine	Coal	25-01-2011	No	0.00	0
Tirúa	0.8	Diesel engine	Diesel	23-01-2011	No	0.05	840
Lonquimay	1.6	Diesel engine	Biomass	22-01-2011	No	0.39	840
Energía Pacífico	15.6	Biomass/steam	Biomass	21-01-2011	No	108.33	0
Skretting Osorno	3	Diesel engine	Diesel	20-01-2011	No	0.00	0
Tomaval	2.6	Diesel engine	Diesel	19-01-2011	No	0.08	500
HBS	2.2	Biomass/steam	Biomass	18-01-2011	No	0.00	0
Lautaro	0.8	Diesel engine	Diesel	17-01-2011	No	0.00	0
Southern	0.8	Diesel engine	LNG	16-01-2011	No	0.00	0
Calle-Calle	13	Diesel engine	Diesel	15-01-2011	No	0.59	696
Donguil	0.25	Run of the river	Hydro	13-01-2011	No	1.33	0
Reca	1.7	Run of the river	Hydro	12-01-2011	No	8.66	0
Muchi	1	Run of the river	Hydro	10-01-2011	No	3.10	0
Mallarauco	3.4	Run of the river	Hydro	07-01-2011	No	25.99	0
Diuto	3.3	Run of the river	Hydro	06-01-2011	No	15.84	0
Mariposas	6.3	Run of the river	Hydro	05-01-2011	No	26.35	0
Solar Tambo Real	2.9	Solar	Sun	01-01-2011	No	0.00	0
Eólica Punta Colorada	20	Wind	Wind	01-01-2010	No	7.89	0
Juncalito	1.4	Run of the river	Hydro	01-01-2010	No	1.95	0
El Tártaro	0.1	Run of the river	Hydro	01-01-2010	No	0.00	0
Los Corrales	0.8	Run of the river	Hydro	01-01-2010	No	0.03	0
Doña Hilda	0.42	Run of the river	Hydro	01-01-2010	No	0.85	0
El Salvador	23.8	Open Cycle	Diesel	01-01-2010	No	0.28	1,066
Guacolda 4	152	Coal/Steam	LNG	01-01-2010	No	751.39	991
Nueva Ventanas	272	Coal/Steam	Coal	01-01-2010	No	1764.17	981
Yungay 4ca	40	Open Cycle	Diesel	01-01-2010	No	0.54	938

Power plants	POWER OUTPUT (MW)	PLANT TYPE	FUEL TYPE	START OPERATION	CDM PROYECT	NET GEN IN 2017 (GWh)	SIC EMISSION 2017 (tCO_2/GWh)
Loma Los Colorados I	2	Biogas engine	IFO 380	01-01-2010	Yes	0.00	0
Emelda U1	33.3	Open Cycle	Coal	01-01-2010	No	0.52	499
Emelda U2	36	Open Cycle	IFO 380	01-01-2010	No	0.00	0
Colihues IFO	22	Diesel engine	Diesel	01-01-2010	No	0.00	0
Colihues DIE	22	Diesel engine	Biomass	01-01-2010	No	15.18	0
Punta Colorada IFO	17	Diesel engine	Fuel oil 6	01-01-2010	No	0.00	0
Punta Colorada Diesel	17	Diesel engine	Diesel	01-01-2010	No	0.16	278
Cabrero	11	Biomass/steam	Diesel	01-01-2010	No	41.04	0
Cem Bio Bio IFO	13	Diesel engine	Diesel	01-01-2010	No	36.07	157
Cem Bio Bio DIESEL	13.6	Diesel engine	Biomass	01-01-2010	No	8.20	0
Eólica Totoral	46	Wind	Wind	01-01-2010	No	76.42	0
Eólica Monte Redondo	48	Wind	Wind	01-01-2009	Yes	0.00	0
Lircay	19	Run of the river	Hydro	01-01-2009	Yes	0.00	0
Pehui	1.1	Run of the river	Hydro	01-01-2009	No	0.01	0
Truful Truful	0.8	Run of the river	Hydro	01-01-2009	No	4.86	0
Guacolda 3	152	Coal/Steam	Diesel	01-01-2009	No	639.34	986
Los Pinos	104.1	Open Cycle	Diesel	01-01-2009	No	69.29	607
Cenizas	14.5	Diesel engine	Diesel	01-01-2009	No	0.26	757
Santa Lidia	139	Open Cycle	Diesel	01-01-2009	No	0.91	839
Trapén	81	Diesel engine	Diesel	01-01-2009	No	14.74	691
Los Espinos	124	Diesel engine	Diesel	01-01-2009	No	0.73	701
San Gregorio	0.5	Diesel engine	Diesel	01-01-2009	No	0.01	0
Linares Norte	0.4	Diesel engine	Diesel	01-01-2009	No	0.00	0
Biomar	2.4	Diesel engine	Diesel	01-01-2009	No	0.00	0
Eagon	2.4	Diesel engine	LPG	01-01-2009	No	0.00	0
Salmofood I	1.6	Diesel engine	LPG	01-01-2009	No	0.00	0
Teno	58	Diesel engine	Natural Gas	01-01-2009	No	21.14	691
Newen Diesel	15	Open Cycle	LPG	01-01-2009	No	0.65	902
Newen Butano	15	Open Cycle	Diesel	01-01-2009	No	0.00	0
Newen Propano	15	Open Cycle	Diesel	01-01-2009	No	0.00	3,664,004
Newen Gas Natural	15	Open Cycle	Diesel	01-01-2009	No	0.00	0
Newen Mezcla Butano/Propano	15	Open Cycle	Diesel	01-01-2009	No	6.58	13
Watts I	0.8	Diesel engine	Diesel	01-01-2009	No	0.00	0
Multiexport I	0.8	Diesel engine	Diesel	01-01-2009	No	0.00	0
Multiexport II	1.6	Diesel engine	Diesel	01-01-2009	No	0.00	0
Cardones	165	Diesel engine	LNG	01-01-2009	No	5.96	755
Quintero DIESEL A	257	Diesel engine	Diesel	01-01-2009	No	0.00	0
Quintero DIESEL B	257	Diesel engine	Diesel	01-01-2009	No	0.00	0
Quintero GNL A	257	Diesel engine	Diesel	01-01-2009	No	408.03	318
Quintero GNL B	257	Diesel engine	Diesel	01-01-2009	No	0.00	0
Louisiana Pacific	2.9	Diesel engine	Diesel	01-01-2009	No	0.00	0
El Peñón	81	Diesel engine	Natural Gas	01-01-2009	No	10.56	691
San Lorenzo de D. de Almagro U1	28.5	Diesel engine	Diesel	01-01-2009	No	0.39	2,398
San Lorenzo de D. de Almagro U2	26	Diesel engine	Diesel	01-01-2009	No	0.34	87,502
Tapihue	6.4	Diesel engine	IFO 180	01-01-2009	No	0.01	1,615
Termopacífico	101.3	Diesel engine	IFO 180	01-01-2009	No	3.57	711
Curicó	2	Coal/Steam	Diesel	01-01-2009	No	0.00	0
Eólica Canela 2	60	Wind	Wind	01-01-2009	Yes	0.00	0
Eólica Lebu	3.6	Wind	Wind	01-01-2008	Yes	0.00	0
Hornitos	61	Run of the river	Hydro	01-01-2008	Yes	0.00	0
Puclaro	5.6	Run of the river	Hydro	01-01-2008	Yes	0.00	0
Ojos de Agua	9	Run of the river	Hydro	01-01-2008	Yes	0.00	0
Coya	12	Run of the river	Hydro	01-01-2008	No	55.61	0
El Manzano	4.8	Run of the river	Hydro	01-01-2008	Yes	0.00	0
Nueva Aldea 3	37	Biomass/steam	Diesel	01-01-2008	Yes	0.00	0
Yungay G3	60	Open Cycle	Diesel	01-01-2008	No	0.00	0
Yungay Diesel 3	60	Open Cycle	Diesel	01-01-2008	No	0.43	862
Escuadrón (ex FPC)	15.5	Biomass/steam	Diesel	01-01-2008	Yes	0.00	0
Olivos	115.2	Open Cycle	Diesel	01-01-2008	No	0.06	727
Totoral	3	Open Cycle	Diesel	01-01-2008	Yes	0.00	945
Quintay	3	Open Cycle	Diesel	01-01-2008	No	0.01	1,103
Placilla	2.4	Open Cycle	Diesel	01-01-2008	No	0.01	1,868
Chiloé	9	Diesel engine	Diesel	01-01-2008	No	0.00	886
Quellon II	10	Diesel engine	Diesel	01-01-2008	No	0.16	749
Colmito GNL	58	Open Cycle	Diesel	01-01-2008	No	5.98	505
Colmito Diesel	58	Open Cycle	Diesel	01-01-2008	No	6.61	942
Chuyaca	2.5	Diesel engine	Diesel	01-01-2008	No	0.03	698
Skretting	2.7	Diesel engine	Diesel	01-01-2007	No	0.00	0
Eyzaguirre	1.9	Run of the river	Hydro	01-01-2007	No	5.95	0
Quilleco	70.8	Run of the river	Hydro	01-01-2007	Yes	0.00	0
El Rincón	0.2	Run of the river	Hydro	01-01-2007	No	1.96	0
Chiburgo	19.4	Run of the river	Hydro	01-01-2007	No	59.41	0
Palmucho	32	Run of the river	Hydro	01-01-2007	No	218.88	0
Los Vientos TG	132	Open Cycle	Diesel	01-01-2007	No	17.76	844
San Isidro II	399	Combined Cycle	Coal	01-01-2007	No	0.00	0
San Isidro II Diesel	399	Combined Cycle	Biomass	01-01-2007	No	2.70	527
San Isidro II GNL	399	Combined Cycle	Fuel oil 6	01-01-2007	No	2271.74	332
Licantén LN	6	Biomass/steam	Biomass	01-01-2007	No	17.18	0
Curanilahue	2.4	Diesel engine	Natural Gas	01-01-2007	No	0.00	0
Cañete	4	Diesel engine	Diesel	01-01-2007	No	0.09	760
Curacautin	3	Diesel engine	Diesel	01-01-2007	No	0.19	693
Yungay G1	60	Open Cycle	Diesel	01-01-2007	No	0.00	0
Yungay G2	60	Open Cycle	Diesel	01-01-2007	No	0.00	0
Yungay Diesel 1	60	Open Cycle	Diesel	01-01-2007	No	0.35	881
Yungay Diesel 2	60	Open Cycle	Diesel	01-01-2007	No	0.48	793
Casablanca 1	0.6	Diesel engine	Diesel	01-01-2007	No	0.00	1,013
Casablanca 2	0.6	Diesel engine	Diesel	01-01-2007	No	0.00	0
Las Vegas	2	Diesel engine	Diesel	01-01-2007	No	0.00	0
Curauma	2	Diesel engine	Diesel	01-01-2007	No	0.00	0
Concon	2.2	Diesel engine	Diesel	01-01-2007	No	0.00	0
Constitución 1	9	Diesel engine	Diesel	01-01-2007	No	2.69	886
Maule	6	Diesel engine	Diesel	01-01-2007	No	0.39	886
Monte Patria	9	Diesel engine	Diesel	01-01-2007	No	0.00	0
Punitaqui	9	Diesel engine	Diesel	01-01-2007	No	0.00	0
Esperanza 1	1.6	Diesel engine	Diesel	01-01-2007	No	0.38	79
Esperanza 2	1.8	Diesel engine	Diesel	01-01-2007	No	0.00	0
Esperanza TG	18.8	Open Cycle	Diesel	01-01-2007	No	0.42	569
Degan	39.6	Diesel engine	Diesel	01-01-2007	No	2.78	688
Eólica Canela 1	18.2	Wind	Wind	01-01-2007	Yes	0.00	0

TOTAL GEN. PER YEAR	**(GWh / yr)**		**53,382**
20% OF GEN. PER YEAR	**(GWh / yr)**		**10,676.3**
5 MOST RECENT PLANT GEN	**(GWh / yr)**		**25.3**

EMISSION FACTOR 5 PLANTS	**(tCO_2/GWh)**		**1.1**
EMISSION FACTOR 20% GEN	**(tCO_2/GWh)**		**427.81**

BUILD MARGIN	**(tCO_2/GWh)**		**427.81**

OPERATING MARGIN CALCULATION, EX – ANTE FOR THE SECOND CREDITING PERIODS.

OPERATING MARGIN CALCULATION

(ACCORDING TO THE METHODOLOGICAL TOOL (VERSION 0.7.0)

Selected option: Ex-ante option: considers the last 3-year data available.

		2015	2016	2017
Total emissions from non-low cost / must run power plants	(tCO_2/yr)	19,619,686	19,309,716	17,256,288
Total emissions from low-cost / must-run power plants	(tCO_2/yr)	545,449	433,095	379,865
Total net energy generated in the grid (incl. imports)	(GWh/yr)	52,987	52,432	53,382
Total net energy by non-Low cost / must run power plants	(GWh/yr)	23,405	26,146	23,869
Total net energy by low cost / must run power plants (incl. imports	(GWh/yr)	29,582	26,286	29,512
Factor λ	(number)	0.0000	0.0000	0.0000
Operating Margin	**(tCO_2/GWh)**	**838.25**	**738.52**	**722.95**

Generation weighted-average Operating Margin	**(tCO_2/GWh)**	**766.57**

COMBINED MARGIN CALCULATION, EX – ANTE FOR THE SECOND CREDITING PERIODS.

COMBINED MARGIN CALCULATION

ACCORDING TO THE TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM

OM: Calculated ex ante (Option 2, the year in which the emissions occur)
BM: Calculated exante (Option 1, updated annually from the date the first emissions occur)

		2017	
Operating Margin	(tCO_2/GWh)	766.57	note 1
Build Margin	(tCO_2/GWh)	427.80	note 2
Combined Margin other credit period	(tCO_2/GWh)	**512.5**	

note 1:The Project Proponent uses the Ex-ante option to calculate the OM; that is, the OM will be calculated once at the validation stage. A.
as a result, no monitoring and recalculation of the emissions factor during the crediting period is required
note 2:For the second and third crediting period, the Build Margin (BM) emission factor shall be calculated ex ante, as previously described in Option 1.

Appendix 4. Applicability of methodology and standardized baselines.

Not applicable in this case.

Appendix 5. Further background information on monitoring plan

DOCUMENTATION OF FREIGHT TRANSPORTATION ACTIVITIES UNDER THE PROJECT ACTIVITY

(ACCORDING TO THE “TOOL“PROJECT AND LEAKAGE EMISSIONS FROM TRANSPORTATION OF FREGIHT (VERSION 1.1.0)

Activity	Freight type	FR,f,m	Origin	Destination	Trip distance	Vehicle class
1	Biomass residues (mix of sawdust and bark)	1091	Imperial	Valdivia	105	Heavy class
2	Biomass residues (mix of sawdust and bark)	606	Lautaro	Valdivia	205	Heavy class
3	Biomass residues (mix of sawdust and bark)	1159	Loncoche	Valdivia	89	Heavy class
4	Biomass residues (mix of sawdust and bark)	1824	Los Lagos	Valdivia	69	Heavy class
5	Biomass residues (mix of sawdust and bark)	24498	Mariquina	Valdivia	49	Heavy class
6	Biomass residues (mix of sawdust and bark)	547	Osorno	Valdivia	113	Heavy class
7	Biomass residues (mix of sawdust and bark)	2164	Panguipulli	Valdivia	117	Heavy class
8	Biomass residues (mix of sawdust and bark)	23	Temuco	Valdivia	171	Heavy class
9	Biomass residues (mix of sawdust and bark)	2222	Valdivia	Valdivia	57	Heavy class
10	Biomass residues (mix of sawdust and bark)	642	Victoria	Valdivia	234	Heavy class
11	Biomass residues (mix of sawdust and bark)	689	Villarrica	Valdivia	130	Heavy class
12	Biomass residues (mix of sawdust and bark)	180	Freire	Valdivia	142	Heavy class
13	Biomass residues (mix of sawdust and bark)	28885	Paillaco	Valdivia	46	Heavy class
14	Biomass residues (mix of sawdust and bark)	0	La Unión	Valdivia	85	Heavy class
15	Biomass residues (mix of sawdust and bark)	0	Rio Bueno	Valdivia	80	Heavy class
16	Biomass residues (mix of sawdust and bark)	0	Gorbea	Valdivia	124	Heavy class
17	Biomass residues (mix of sawdust and bark)	0	Lanco	Valdivia	70	Heavy class
18	Biomass residues (mix of sawdust and bark)	0	Traiguen	Valdivia	265	Heavy class
Note: The Project Participant documents which freight transportation activities f occurred under the project activity based on previous monitoring period and to the extent of available information at the Validation stage of the first renewal crediting period. Monitoring each freight transportation activity will be performed and be updated every year during the crediting period, as per required by the monitoring plan.						

$PE_{TR,m}$	956	tCO_2	956
$D_{f,m}$		2 x km	114.8
∑Df,m * FR,f,m	7,410,002	t	7,410,002
$EF_{CO2,f}$	0.000129	$gCO_2/t*km$	0.000129

Appendix 6. Summary report of comments received from local stakeholders

Not applicable in this case.

Appendix 7. Summary of post registration changes

Not applicable in this case.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.

Version	*Date*	*Description*
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document