Project design document form for CDM project activities

(Version 05.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Nueva Aldea Biomass Power Plant Phase 1.
Version number of the PDD	04
Completion date of the PDD	24 of December 2014.
Project participant(s)	Celulosa Arauco y Constitución S.A.
Host Party	Chile
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Scope 1, ACM0006 (Version 12.1.1), "Consolidated methodology for electricity and heat generation from biomass".
Estimated amount of annual average GHG emission reductions	206,350 CERs

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The project activity consists in the installation of a new biomass cogeneration power plant in the New Alde Complex site. The new cogeneration plant is equipped with a new 250 ton high-pressure steam per hour on combined steaming capacity with auxiliary fossil fuel fluidized bed biomass power boiler, and a 29.94 MW condensing/extracting turbo generator unit (See section A.3.Technologies and/or measures, Figure 5). The new cogeneration power plant is integrated with the rest of the mills of Phase 1 and designed so that approximately 60% of the power is destined to serve the internal needs of the Nueva Aldea Complex while the remainder 40% of the power is injected to the grid (SIC).

The project is presented by Celulosa Arauco y Constitución S.A. (from now on, Arauco) a leading forest and pulp-producing company in Chile, but the project itself was realized by Paneles Arauco S.A. an MDF/wood panel board producing company in Chile, subsidiary of Arauco.

The project activity is designed to use biomass residues from industrial operations (mix of sawdust and bark, mainly from Sawmills and Panel board mills and sludge resulted from pulp mill operations) and biomass residues (mix of sawdust and bark) from forest operations (from harvesting, thinning and pruning operations) for electric power generation. In the absence of the project activity, such biomass would be left in piles to natural decay (aerobically) and in some specific cases would be burned uncontrollably.

The Nueva Aldea Industrial Complex is built in two phases.

Phase 1, that consists in the construction of:

- A Sawmill.
- A Plywood mill.
- A Log-merchandizer.
- A biomass cogeneration power plant.

Phase 2 that consists in the construction of:

- A new Kraft pulp mill.

Since the common practice in the Sawmill and Plywood industries [1] does not include the cogeneration of electric power, the entire net electric power generation capacity of the new power plant in Phase 1 represents a net increase of clean energy in the SIC, and therefore considered part of the project activity.

Phase 2 of the Nueva Aldea project contemplates the construction of a pulp mill, which will add approximately 37MW to the power surplus of approximately 13 MW generated by the Nueva Aldea biomass power plant. Though modern pulp mills are currently designed to be self-sufficient in terms of steam and electric power generation, the Nueva Aldea pulp mill was deliberately designed to generate a considerable amount of surplus electric power to the grid. In fact, both, the cogeneration power plant in Phase 1 and in Phase 2, were conceived as CDM project activities. In both cases, the facilities were designed to co-generate (additional) electric power in a context in which such power generation did not constitute the conventional practice of the corresponding industries. However, due to differences in the way the baseline methodology is applied to the project activity in the two Phases and for clarity reasons, the Nueva Aldea Biomass Power Plant

[1] The log-merchandizer does not really constitute an industry in Chile; however it is not the common practice in these mills to have a cogeneration unit in-site either. For simplicity, this PDD will only address the common practice in the Sawmill and Plywood mills in Chile.

Phase 2 is presented in a separate PDD. Therefore, this PDD only presents the biomass cogeneration power plant in Phase 1.

Considering that both phases are electrically interconnected, the power surplus of Phase 2 would have been more than enough to provide electric power to the industrial facilities in Phase 1. However, when the Arauco management evaluated the Nueva Aldea Industrial Complex, it considered the abundance of biomass in the area, the CDM potential and decided to build a new on-site biomass cogeneration power plant. This decision involved installing a high-pressure boiler and a steam turbine, which meant going clearly beyond the traditional practice in the Sawmill and Plywood industries. Considering the higher cost of this alternative compared to the conventional solution, the decision of building such Power Plant relied on the possibility of not depending on the SIC 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 project activity assists Chile's sustainable growth by providing power to the Nueva Aldea Industrial Complex and to the SIC through biomass power generation which is a clean and renewable energy source. Without the project activity, not only there would have been no new clean energy injection to the SIC, but the Nueva Aldea Industrial Complex itself would have had to continue sourcing its power requirements from the grid. In addition, this project accomplishes an additional greenhouse (GHG) reduction benefit derived from a reduced disposal or uncontrolled burning of biomass, which results into less methane emissions.

The project participant believes that biomass power generation constitutes a sustainable source of power generation that brings clear advantages to mitigate global warming. Using the available natural resources in a rational way, the Nueva Aldea Phase 1 project activity helps to enhance 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 power generation as a source of revenue not only to the Plywood and Sawmill industries, but to all forest-related industries. Very few wood-panel producing facilities in Chile have on-site electric power generation capacity, making the Nueva Aldea cogeneration power plant Phase 1 quite unique and particular in its type. Although this technological improvement is consistent with Arauco´s internal policy of energy efficiency, this initiative must be recognized as an activity that goes beyond the common practice of the Sawmill and Plywood mill industries in Chile.

The Nueva Aldea Phase 1 project activity (ref.0258) was successfully registered in the CDM in 31-03, 2006. PDD version 2 was developed to apply for the first crediting period renewal of the project activity. The revised PDD (version 4) is developed to correct issues raised during first verification process of the second crediting period.

A.2. Location of project activity

A.2.1. Host Party

Chile, South America.

A.2.2. Region/State/Province etc.

VIII Region of Bío-Bío, Province of Ñuble.

A.2.3. City/Town/Community etc.

Ránquil, Nueva Aldea area.

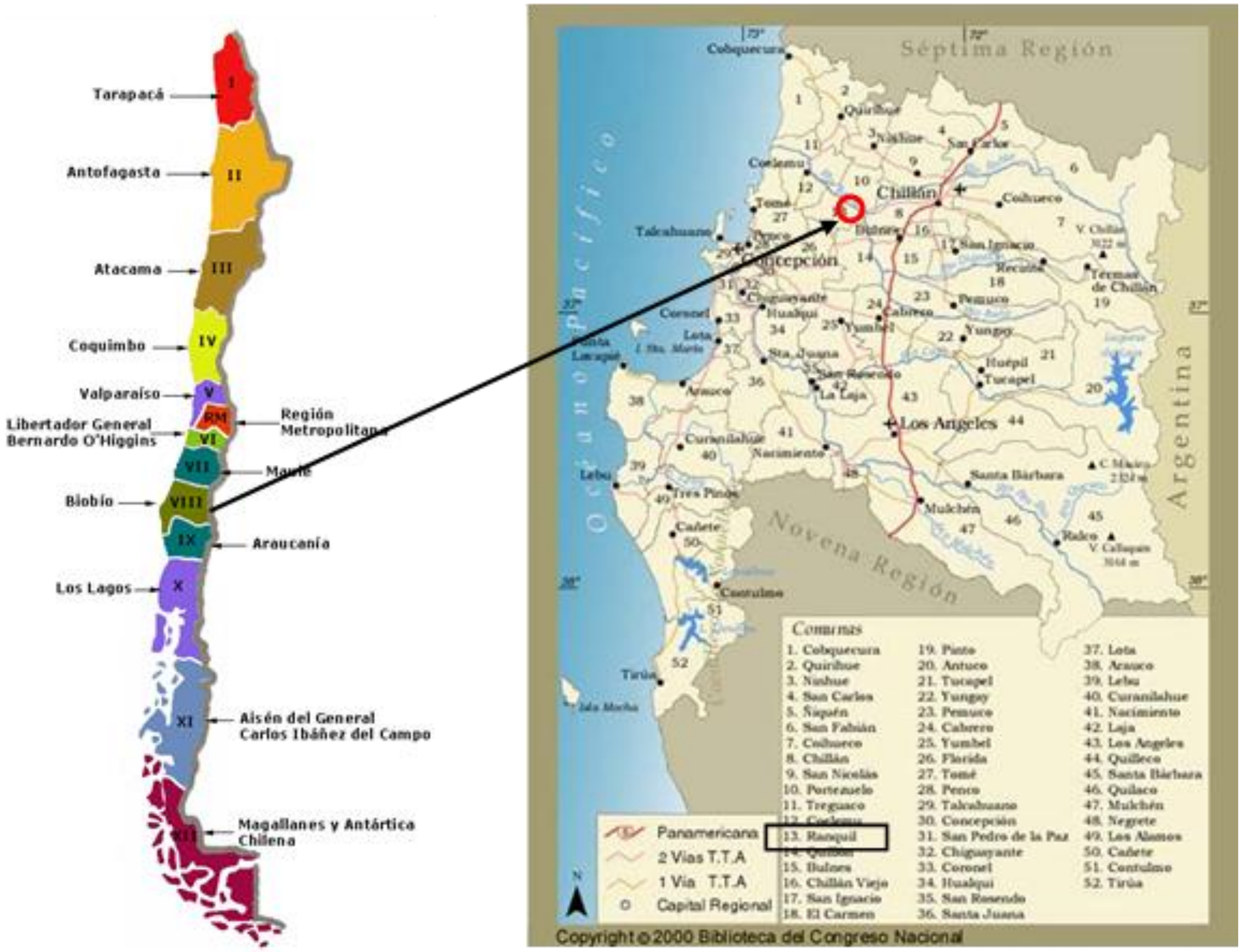
A.2.4. Physical/Geographical location

The project activity is located in the Nueva Aldea Industrial Complex site. The Nueva Aldea Industrial Project is located near the Nueva Aldea community area, Comuna of Ránquil, in the province of Ñuble. It is 30 km. west of the Chillán city and 28 km. south east of the Coelemu city in the VIII Region (Bío-Bío Region). The Bío-Bío Region can be directly accessed from Santiago through the 5 Sur or Panamericana Sur highway.

The Bio-Bio Region holds 12.4% of the total Chilean population of 15 million inhabitants, the second most populated after the Metropolitan Region. Its economy relies basically on exports of steel and pulp, wood, fish meal and frozen products.
The geographical coordinates of the project plant is:

- Longitude: -72.5564
- Latitude: -36.6574

Figure 1: Geographical location of the Nueva Aldea project activity (Comuna Ránquil)



The overview of the Nueva Aldea Industrial Complex, where the project activity is located, is shown as follows:

Figure 2: Nueva Aldea Industrial Complex overview

A.3. Technologies and/or measures

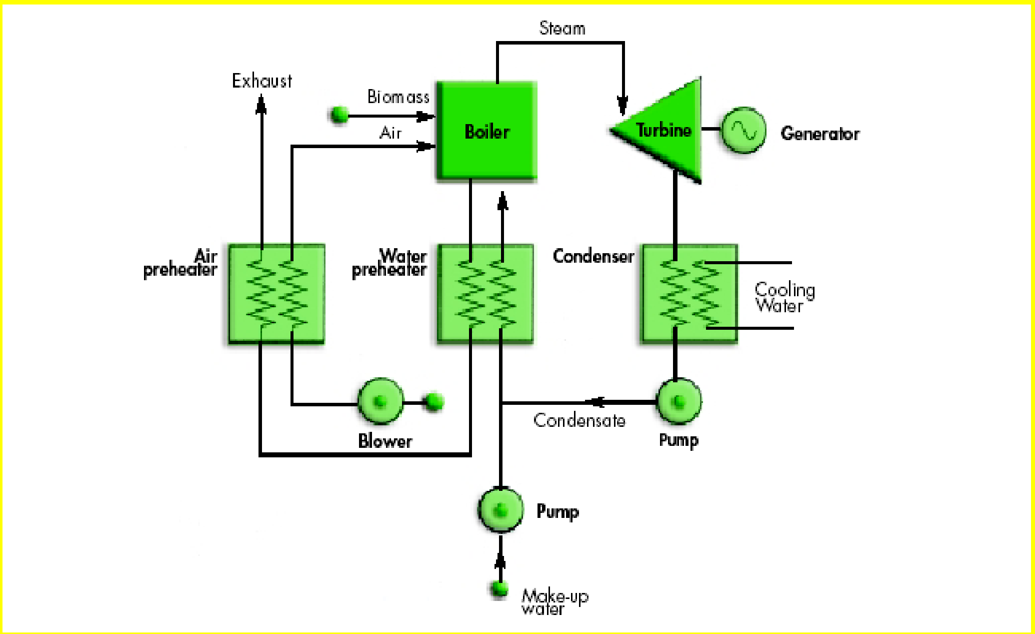
The predominant technology in all parts of the world today for generating megawatt (MW) levels of electricity from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in a boiler to generate steam, which is then expanded through a turbine. The steam-Rankine technology is 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 de-aerator 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 steam, 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 Nueva Aldea Biomass Power Plant Phase 1 was built in conjunction with the Nueva Aldea Industrial Complex Phase 1, the best way to outline and describe the equipment's related to the project activity is to describe how the power plant would have been built if it had maintained the conventional "business as usual" design, without electric power generation capacity. To do so, Arauco requested the same consulting company who designed the real project to design a project alternative which did not include the electric power generation capacity option. The differences between these two project alternatives are presented and described below:

- There would have been no turbo generator in the Power Plant.
- There would have been no or only a very small cooling tower.
- There would have been a smaller boiler installed of 150 t/hr. of nominal capacity on biomass.
- The boiler would have generated saturated or near-saturated steam at 25 / 30 bar and 250ºC.
- There would have been a de-aerator and feed water tank operating at a lower pressure and temperature, about 110 ºC.
- There would have been a more simple boiler feed water treatment plant with no mixed bed units.
- There would have been no process condensate cooling system.
- There would have been no low pressure steam system in the mill.
- There would have been only middle pressure sawmill drying chambers, which are less expensive.
- The power consumption in the boiler house would have been lower.
- The external fuel need (biomass) would have been lower.

It must be noted that the alternative BAU Nueva Aldea Phase 1 Industrial Complex would have had the same output as the real Complex (with CDM project activity) and would have contemplated the installation of a power boiler designed (i.e. dimensioned) to generate the same amount of process-steam the mills in Phase 1 would have required. The BAU Nueva Aldea Phase 1 project would have contemplated the construction of standard modern new mills, and as such; they would have

included the installation of standard equipment used in the corresponding industries. The differences between the two projects alternatives presented above are exclusively derived from the on-site electric power generation capacity of the project alternative with CDM project activity.

The following diagrams below show the energy / mass balances of the conventional BAU power plant and the real power plant. As mentioned above, the energy / mass balances of the two project alternatives show the same steam flow consumptions for the Nueva Aldea Phase 1 mills. The high-pressure steam generation capacity of the CDM project alternative is for on-site electric power generation.

Figure 4: Nueva Aldea Biomass Power Plant Phase 1 lay-out without electric power generation capacity

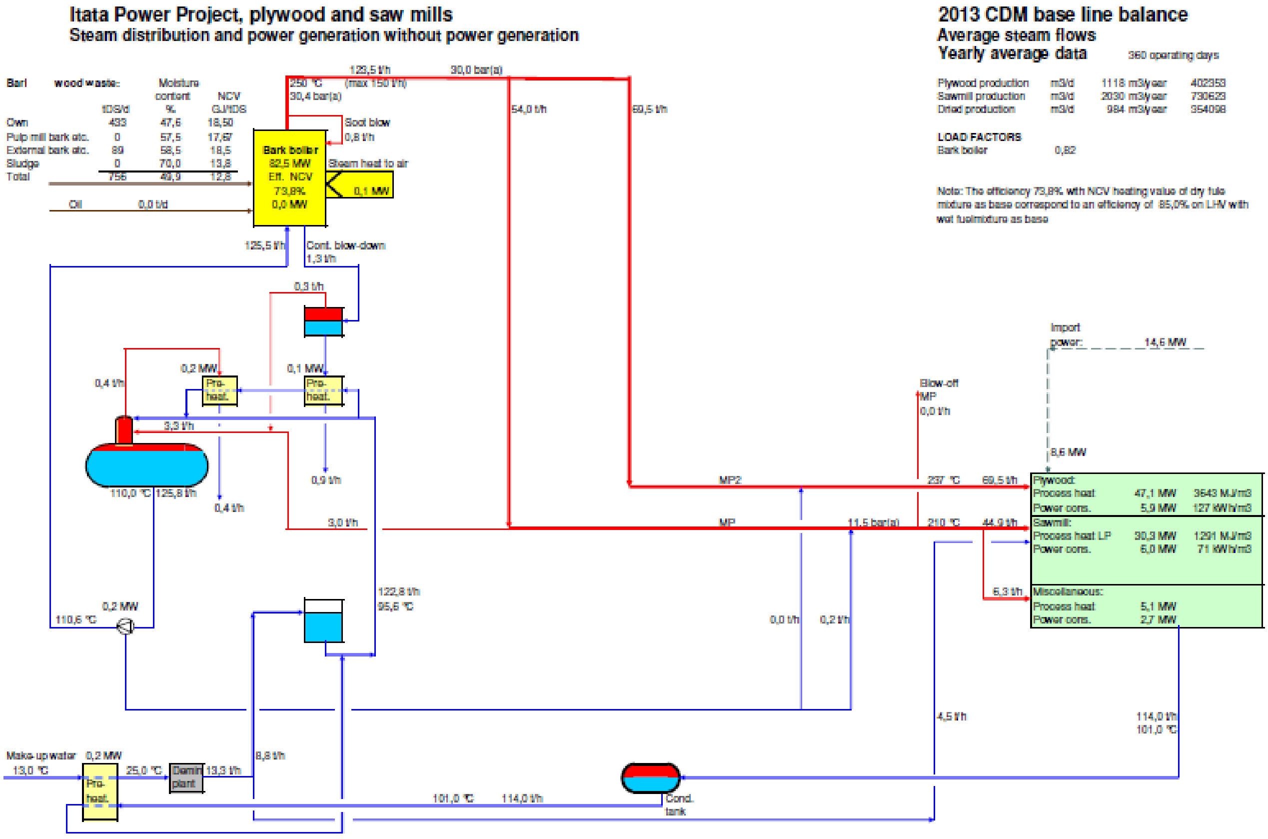
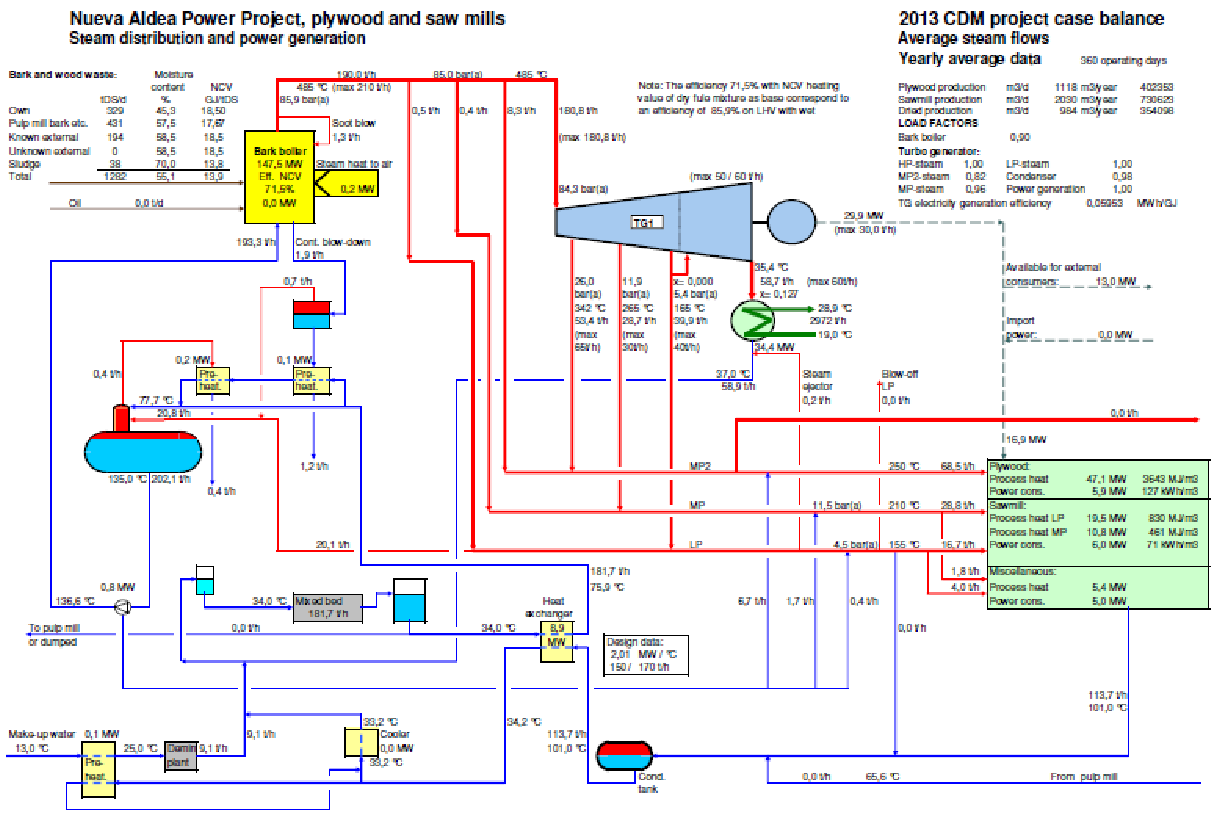


Figure 5: Nueva Aldea Biomass Power Plant Phase 1 lay-out with electric power generation capacity



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. (private entity)	No
United Kingdom of Great Britain and Northern Ireland	Celulosa Arauco y Constitución S.A. (private entity)	No

A.5. Public funding of project activity

The financial plans for the project activity do not involve public funding. The investment made in the Nueva Aldea Biomass Power Plant Phase 1 was financed with Arauco's own resources.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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

ACM0006 (Version 12.1.1), “Consolidated methodology for 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 12.1.1).

- “Tool to calculate the emission factor for an electricity system (Version 03.0.0)”.
- “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 02)”.
- “Tool to determine the baseline efficiency of thermal or electric energy generation systems (Version 01)”.
- “Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01)”.

Since this PDD is designed to revalidate the crediting period of the Nueva Aldea Biomass Power Plant Phase 1 project activity, the document also relies on the last versions of the following procedures/tools:

- “Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period (Version 03.0.1)”.
- “Tool for project and leakage emissions from transportation of freight (Version 01.1.0)”.

B.2. Applicability of methodology and standardized baseline

The Nueva Aldea Biomass Power Plant Phase 1 CDM project activity consists in the construction of a new biomass cogeneration power plant that generates electricity and heat 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 per cent 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 electric power, approach a) seems to be the applicable option in selecting the baseline scenario for the Nueva Aldea Biomass Power Plant Phase 1 project activity.

The project activity consists in the installation of a new biomass residue power plant in a site where no power and heat was generated before. The project activity is a **Greenfield power generation project.**

The project activity fully complies with all the applicability criteria of the ACM0006 (Version 12.1.1):

1) **No other biomass types than biomass residues are used in the project plant.** The project activity uses biomass residues (mix of sawdust and bark, sludge) generated from on-site and off-site industrial operations and from forest operations.

2) **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:** Some fossil fuels may be co-fired due to operational reasons (e.g. start-up operations, shut down operations, etc.) and to a limited extent to enhance the economic performance of the plant.

3) **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 residues generated in the Nueva Aldea Phase 1 is absolutely determined by the input capacity of the Sawmill and Plywood mill, which has already been established and will not change due to the implementation of the project activity. Sawmill and plywood mill productions are determined by the sawn timber and wood panel market conditions, respectively and not by the existence of the cogeneration power plant. In addition, the power unit contemplates the uses of biomass residues (mix of sawdust and bark, sludge) which are already available and mainly generated from on-site production and to a much less extend from third party providers. Therefore, it is not required to increase the local generation of biomass residues to generate power or increase the power generation of the power plant.

4) **The biomass residues used by the project facility are not stored for more than one year:** The biomass residues used in the boiler generated from on-site and off-site industrial operations and from forest operations are stored in a dedicated place near the project activity. The residence time of the stored biomass (total biomass residues stored/biomass residues consumption rate of the power plant) is not meant to surpass one week (40,000 m^3st max.) at most. The biomass stockpile is conveniently managed in order to avoid that part(s) of the pile get stored for too long and suffer the consequent degradation of its calorific value as fuel.

5) **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.** The project activity only contemplates biomass transportation to the power plant, and eventually, some mechanical treatment of the biomass from forest operations. No bio or chemical treatment is involved whatsoever and the project activity involves the use of biomass residues (mix of sawdust and bark, sludge) as fuel for heat generation purpose mainly for wood drying in sawmills and drying and presses in plywood mills).

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

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

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

9) 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.
- For biomass residues use: Scenarios B1 to B8, or any combination of those scenarios.
- For scenarios B5 to B8, leakage emissions should be accounted for as per procedures of the methodology.

As will be shown in subsequent sections of this PDD, the corresponding baseline scenarios for power, heat and biomass use are:

Project type	Baseline scenario		
	Power generation	**Use of biomass**	**Heat generation**
Power greenfield projects	P7	B4 and B1	H5

According to the above, the proposed project activity fully complies with these conditions.

B.3. Project boundary

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 very small [b].
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small [b].
	Off-site transportation of biomass residues	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 very small [b].
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small [b].
	Combustion of biomass residues for electricity and heat generation	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.
	Storage of biomass residues	CO_2	Excluded	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	Excluded	Excluded for simplification. Since biomass residues are stored for not longer than one year, the emission source is assumed to be small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Waste water from treatment of	CO_2	Excluded	It is assumed that CO2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.

	biomass residues	CH_4	Excluded	This emission source shall be included in cases where the waste water is treated (partly) under anaerobic conditions. Since the proposed project activity does not contemplate waste water treatment under anaerobic conditions this emission source is excluded in this case.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small.
	Cultivation of land to produce biomass feedstock.	CO_2	Excluded	Excluded. No dedicated energy biomass plantations are considered part of the project activity.
		CH_4	Excluded	Excluded. No dedicated energy biomass plantations are considered part of the project activity.
		N_2O	Excluded	Excluded. No dedicated energy biomass plantations are considered part of the project activity.

The Project Participant would like to note the following:

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 12.1.1), 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 12.1.1), 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.

In the host country, Chile, the relevant geographical area for the proposed CDM project activity, between V and X region, does count with more than ten projects similar and comparable to the

proposed project activity without considering the implementation of the CDM project activity. These facilities correspond mostly to the Sawmill and Panel board industries.

As will be shown in subsequent sections of this PDD, sawmills and panel board/plywood mills consume local biomass residues in low-pressure boilers to generate heat for their internal processes, while electric power is sourced from the local grid.

As it was indicated above, since heat generation for big-scale Sawmills and Panel board/Plywood mills is part of the business as usual (BAU) practices in the respective industries the emission reductions are not claimed for heat generation in the baseline scenario.

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?

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 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.

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 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.

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.

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.	Yes.
B3:	The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes.	Yes.
B4:	The biomass residues are used for power or heat generation at the project site in new and/or existing plants.	Yes.
B5:	The biomass residues are used for power or heat generation at other sites in new and /or existing plants.	No. Considering the surplus amount of biomass residues available in the region, the additional biomass consumed by the cogeneration power plant compared to the conventional heat generating plant would most likely simply be left to decay or in some cases burned in an uncontrolled manner.
B6:	The biomass residues are used for other energy purposes, such as the generation of biofuels.	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.
B7:	The biomass residues are used for non-energy purposes, e.g. as fertilizer or as feedstock in processes (e.g. in the pulp and paper industry).	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.
B8:	Biomass residues are purchased from a market, or biomass residues retailers, or the primary source of the biomass residues and/or their fate in the absence of the project activity 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.

According to the above, the feasible baseline scenarios would be: B1, B2, B3 and B4.

Given that steam generation for big-scale sawmills and plywood mills is part of the BAU practice in the respective industries, this project activity only claims emission reductions from on-site electric power generation and the use of biomass that would otherwise be left in piles or burned in the open air. As a result, the project options presented below only correspond to alternative scenarios for power generation and biomass usage.

In each option, it is mentioned the feasibility of becoming the baseline scenario for the proposed project activity and also it is addressed what would happen to any difference in power generation

and biomass usage between each alternative and the project plant, in the absence of the proposed project activity.

1. A conventional Sawmill / Plywood mill boiler, without power generation capacity:
This is the standard practice in the Sawmill / Plywood mill / MDF panel wood mill industries in Chile and in the world.
Technical assumptions: Under this scenario, installed capacity, load factor, energy efficiencies, fuel mixes and equipment configuration correspond to the ones considered under baseline scenario. Therefore, the technical specifications will be not presented again in this section. The Project Participant would like to note that technical assumptions can be seen in a detailed energy / mass balance carried out and presented in this PDD.
Power generation: The technology for these plants is proven and fully developed. In fact, Arauco has 14 sawmills and 7 wood processing plants, and only the ones related to the CDM have been deliberately designed with electric power generation in mind; the rest are sourced from the local grid. The applicable baseline scenario for power would be: • The power required would be obtained from the power grid: P7
Biomass residues: Use biomass residues as fuel for heat generation purpose (mainly wood drying in Sawmill and drying and presses in panel board/plywood mills) (B4) while a considerable surplus of biomass remains unused in the region, which is mostly dumped or left to decay (B1). The applicable baseline scenarios for biomass types would be: 1) Sludge from off-site industrial operations: B4 2) Mix of sawdust and bark from on-site industrial operations: B4 3) Mix of sawdust and bark from on-site industrial operations: B1 4) Mix of sawdust and bark from off-site industrial operations: B1 5) Mix of sawdust and bark from off-site forest operations: B1

2. Conventional Sawmill and Panel board/Plywood mill, with a conventional fossil fuel power unit as back-up.
This alternative is similar to the previous one.
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: The Sawmill and Panel board/Plywood mills would consume electric power from the grid on a regular basis, however in this case the consumption is backed with a Natural gas or Diesel or Fuel Oil 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 represents 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 to the system); Third, it can generate surplus power to the grid when the spot price of electricity is sufficiently high. The applicable baseline scenario for power would be: • The power required by conventional sawmill and panel board/plywood mill would be obtained from the power grid: P7

- The surplus of electric power to the grid: P5 and P7 (it is possible that 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).

Biomass residues: Use of biomass residues as fuel for heat generation only (mainly wood drying in sawmill and presses and drying in panel board mill).

The applicable baseline scenarios for biomass types would be:

1) Sludge from off-site industrial operations: B4
2) Mix of sawdust and bark from on-site industrial operations: B4
3) Mix of sawdust and bark from on-site industrial operations: B1
4) Mix of sawdust and bark from off-site industrial operations: B1
5) Mix of sawdust and bark from off-site forest operations: B1

3. Sawmill / Plywood mill with on-site electric power generation at lower efficiency or at a later stage, not undertaken as a CDM project activity

As the project activity, this is also a possible alternative, however from the project participant's point of view; such undertaking would not constitute the usual practice in the relevant industries either. It would face similar barriers as the proposed project and therefore, would most likely not happen without the incentives of the CDM. Additionally, a less efficient biomass power plant would have slightly lower investment cost than the more efficient counterpart and would certainly not be able to generate as much electric power as the more efficient plant. This would make the project less attractive from a financial point of view and therefore less viable. No such project has been implemented in sawmills, plywood mills or MDF board mills in Chile (or very few –if any- in the world) up to date.

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.

Installed capacity:
- Power boiler: heat to steam capacity 107.2MW and max high-pressure steam of 171 (t/h) on wood based fuels.
- Condensing with extraction heat engine: 24.3 MW

Load factor:
- Heat generator (biomass power boiler): 0.80
- Heat engine (Condensing with extraction heat engine): 0.80

Efficiency:
- Heat generator (based on NCV-dry basis): 72.7%. This efficiency corresponds to an efficiency of 86.8% on LHV based on wet fuel mixture.
- Heat engine (Condensing with extraction heat engine): specific power generation of 0.042648 (MWh/GJ).

Note that energy/mass balance contemplated the default value of 95% as mechanical/electrical efficiency according to the methodology.

Fuel mixes:
- Sludge: 13,680 (BDt/yr).
- Biomass residues from own site production: 110,520(BDt/yr).
- Biomass residues from off-site production: 133,200(BDt/yr).

The Project Participant would like to note that figures presented above were taken from a

detailed energy / mass balance carried out specifically for this alternative configuration. Compared to the Project activity this Sawmill / Plywood would generated on-site electricity but there would generate less surplus power to the grid.

Power generation:

The applicable baseline scenario for power would be:

- The power required by the Sawmill/Plywood mill: P5
- The surplus power to the grid: P7 (since the power boiler is less efficient that the one proposed under de project activity part of the surplus electric generated by the project activity would be produced by grid-connected power plants).

Biomass residues: In this case, biomass residues would be used, in the absence of the project activity, for power (heat and electricity) generation in a higher pressure boiler at the project site. The applicable baseline scenarios for biomass types would be:

1) Sludge from off-site industrial operations: B4
2) Mix of sawdust and bark from on-site industrial operations: B4
3) Mix of sawdust and bark from on-site industrial operations: B1
4) Mix of sawdust and bark from off-site industrial operations: B1
5) Mix of sawdust and bark from off-site forest operations: B1

4. Sawmill / plywood mill boiler with additional electric power generation capacity based on fossil fuels:

Fossil fuels are considerably more expensive than biomass residues; however biomass generation capacity including fuel preparation is extremely more expensive than fossil fuel capacity. In the Nueva Aldea Phase 1 project, this alternative could be implemented by installing a power boiler with additional high pressure steam generation capacity based on fossil fuel.

Technical assumptions:

The Sawmill/plywood mill would be equipped by installing a power boiler similar to the one that would be installed in the baseline case but with an additional high pressure steam generation capacity based on fossil fuel.

Additional installed capacity:
- Power boiler: 44.8 MW, max high-pressure steam capacity of 73 (t/h) on fossil fuel.
- Condensing with extraction heat engine: 19.8 MW

Load factor:
- Heat generator (biomass power boiler): 0.71
- Heat engine (Condensing with extraction heat engine): 0.79

Efficiency:
- Heat generator (based on fossil fuel): 90%
- Heat engine (Condensing with extraction heat engine): specific power generation of 0.096821(MWh/GJ),

Note that energy/mass balance contemplated the default value of 95% as mechanical/electrical efficiency according to the methodology.

Fuel mixes consumed for additional high pressure steam generation:
- Fuel Oil: 38,232(ton/yr)
- Diesel: 0 (ton/yr) as an alternative fuel option.

The Project Participant would like to note that figures presented above were taken from a detailed energy / mass balance carried out specifically for this alternative configuration. An

additional high pressure steam generation capacity based on fossil fuel would be installed to generate surplus power to the grid.
Power generation: The applicable baseline scenario for power would be: • The power required by the Sawmill/Plywood mill and a fraction of the surplus power to the grid contemplated under the proposed project activity: P5 • The remaining surplus power to the grid: P7 (part of the surplus of electricity generated by the project activity would be produced by grid-connected power plants)
Biomass residues: The applicable baseline scenarios for biomass types would be: 1) Sludge from off-site industrial operations: B4 2) Mix of sawdust and bark from on-site industrial operations: B4 3) Mix of sawdust and bark from on-site industrial operations: B1 4) Mix of sawdust and bark from off-site industrial operations: B1 5) Mix of sawdust and bark from off-site forest operations: B1

According to page 13 of the ACM0006 (Version 12.1.1), 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.

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.

Sludge from off-site industrial operations: This is a solid waste generated in the pulp production process, which is an industrial activity. In the absence of the proposed 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.

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.

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 off-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.

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.

Sludge from off-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.

B4: The biomass residues are used for power or heat generation at the project site in new and/or existing plants.

Mix of sawdust and bark from on-site and off-site industrial operations: As a common practice in the Sawmills and Panel board industries, this type of biomass residues are used as fuel to generate heat for wood drying in Sawmills and presses, and drying in the Panel board industries. As a result, this baseline scenario is not applicable in this case.

Sludge from off-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. This type of biomass is the least available/most costly to be consumed. As a result, this baseline is not applicable in this case.

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

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 not applicable in this case.

Sludge from off-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 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. 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.

B6: The biomass residues are used for other energy purposes, such as the generation of biofuels.

This option is not available to the proposed project activity. In this case, the technology required to generate 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.

B7: The biomass residues are used for non-energy purposes, e.g. as fertilizer or as feedstock in processes (e.g. in the pulp and paper industry).

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.

B8: Biomass residues are purchased from a market, or biomass residues retailers, or the primary source of the biomass residues and/or their fate in the absence of the project activity 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 the Nueva Aldea Phase 1 CDM project activity.

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

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	Biomass residues quantity (tonnes)
1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for power or heat generation at the project site (B4).	Heat generation.	15,552
2	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 (B4).	Heat generation.	130,405
3	Mix of sawdust and bark from industrial operations.	On-site production.	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.	104,327
4	Mix of sawdust and bark from industrial operations.	Off-site production	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.	126,189
5	Mix of sawdust and bark from forestry operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.	3,803

As can be seen from table above, biomass residues types (sludge, mix of sawdust and bark) would be used for heat generation purpose in the baseline scenario. The rest would be simple dumped or left to decay under aerobic conditions.

For biomass types of categories N°3, N°4 and N°5 for which the corresponding baseline scenario is (B1), the Project Participant should demonstrate that this is a realistic and credible alternative scenario, and may choose one among the procedures presented in the ACM0006 (Version 12.1.1), page 14 to demonstrate this.

According to the analysis presented above, for biomass residues types of categories N°3, N°4 and N°5 for which the corresponding baseline scenario is B1, the following can be concluded:

- It is clear that in this particular case the proposed project activity implies an additional consumption of mix of sawdust and bark from on-site and off-site industrial operations from nearby sawmills and panel board/plywood mills, and to a less extent some mix of sawdust and bark from forest operations (harvesting, pruning and thinning operations) for electricity generation.

- Though part of the mix of sawdust and bark generated in some Sawmills is used as fuel for energy purpose, a significant surplus still remain unused in the region. This surplus has no other use than to be left in piles to natural (aerobic) decomposition and in some cases, burned in the open air, in order to avoid the risk of forest fires.

The same baseline analysis as the one presented above for mix of sawdust and bark from industrial operations is valid for mix of sawdust and bark from forest operations. There is a considerable surplus of this type of biomass that is not used for energy purposes and therefore, simply left in piles for natural decay.

In order to demonstrate that there would be no leakage to be account for biomass types of categories N°3, N°4, and N°5, subsequently the Project Participant will demonstrate that there is an abundant surplus of mix of sawdust and bark from industrial and from forest operations in the region of the project activity which is not utilized. This will be done by demonstrating that the quantity of available biomass residues type of categories N°3, N°4 and N°5 in the region is at least 25% larger than the quantity of biomass residues that are utilized (Refer to section: B.6.3 Leakage emissions).

Consequently and according to page 14 of the ACM0006 (Version 12.1.1), there would be no leakage to be account for biomass types of categories N°3, N°4, N°5 presented in table above.

<u>Project scenarios for biogas use</u>

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

<u>Sub-step 1b</u> 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.

<u>Consistency of project scenarios for power generation</u>

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.

Consistency of project scenarios for heat generation

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.
B2	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.
B4	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 scenarios: B1, B2, B3 and B4 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 Project Participant identified the following set of barriers that prevent the alternative scenarios to occur:

Investment barriers: With the current prevailing conditions in Chile, biomass power generation projects are normally not viable from a financial perspective. This is supported by the low share of this type of technology in the Chilean power matrix. Depending the particular case and context, there are difficulties in accessing credit for this type of projects.

The Nueva Aldea Biomass Power Plant Phase 1 project activity contemplates the construction of a new grid-connected biomass power plant in the Nueva Aldea Complex site. This implies additional risks and/or costs for Arauco. For example, any contingency in the power system (e.g. black-out), normally translates into an economic penalty that is applied to all power producers in the system, regardless of which company was responsible for the contingency[2]. To date, Arauco has paid around US$ 130,000 in fines to the corresponding national authority. The original amount, however, was approximately 7 times higher. In each case, Arauco had to appeal to the corresponding national authority.

Given the limited amount of information related to penalties available from other power companies (this information is not made public) and the high level of uncertainty related to the fines actually paid by the companies (court disputes with the national authority are private), it is not possible to

[2] Historically, penalties have been applied in proportion to the owner's total generation capacity. 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.

reliably translate this risk into an additional cost, in order to incorporate it into the financial evaluation of this type of projects.

Technological barriers: Being biomass power cogeneration a technology not common in the context of the Sawmills and wood Panel board industries in Chile, projects using cogeneration face several technological barriers:

Skilled and/or properly trained labour to operate and maintain grid-connected cogeneration plants is not really available in Chile. This translates into additional risks of underperformance, malfunctioning or accident.

A cogeneration power plant is considerably more sophisticated and complex to operate than a conventional low pressure boiler. According to specialized literature[3], poor operational and maintenance skills generally translate into improper operation, which in the long-run result into early deterioration and failure of the power generation equipment. Skilful and fully involved personnel are crucial to achieve optimal plant operation and a low breakdown rate.

The required skills to operate and maintain this kind of cogeneration plants is not readily available in Chile and particularly in the Panel board industry, since power generation is not part of the common practice in this industry. There are not many big-scale biomass cogeneration facilities operating as power plants in Chile[4] and other than Arauco, there is no other company in Chile that operates a cogeneration facility as a self-power producer[5] in the grid.

Furthermore, according to national statistics[6], people tend not to accept or stay long in job positions that are based in another country region. This restricts the universe of potential candidates and contributes to a high-job rotation, which tends to perpetuate the lack of experience problem for high-level technical positions. As a result, it is usual that the power plant owner ends up hiring people with lower competencies, who are not sufficiently qualified for the job.

Risk of technological failure: The integration of a high-pressure extracting turbine with low-pressure steam equipment such as sawmills and panel board mills present higher operational risks than those observed in conventional facilities. Heat in wood panel mills is used for panel pressing and drying, which is normally done in batches. This translates into high fluctuations in steam demand for heating. These fluctuations have the following adverse effects:

The high steam demand fluctuations make the turbo generator to operate in areas of low efficiencies. In some extreme cases, low stream flows through the turbo generator may cause system trips. This can be clearly seen in the efficiency versus steam load chart of a turbo generator machine[7] (provided by turbo generator vendors).

The fluctuations also compromise the power generation capacity of the cogeneration plant, forcing the power plant to reduce its power generation to the grid. If this situation happens during a peak power demand period, the plant may be penalized on its future power revenues by the Dispatch

[3] For example, refer to chapter 14 of the "Handbook for cogeneration and combined cycle power plants" by Dr. Meherwan P. Boyce, P.E, 2002 or public papers in the field such as "Assessment of Training Needs for Cogeneration Technology in Schuykill County" by Gary D. Geroy and David L. Passmore, 1987.

[4] Please refer to the list of grid-connected biomass power plants in the SIC interconnected system in Chile in Annex 3 of this PDD.

[5] A self-power producer is a modality contemplated in the CDEC-SIC Dispatch Center regulation, under which a company that has surplus power generating capacity is allowed to operate as a grid-connected power plant in the grid, declaring only its surplus power capacity to the system.

[6] Please refer to 1992-2002 migration study by the National Statistics Institute (INE, Spanish abbreviation).

[7] As supporting evidence, please see figure 6 in page 6 of the document "Steam Turbine Thermal Evaluation" by Paul Albert. This is a GE document and is available in the web at: http://site.ge-energy.com/prod_serv/products/tech_docs/en/downloads/ger4190.pdf

Center for non-compliance with the dispatch program. This is not a minor issue, considering that currently approximately 25% of the annual revenue of a power plant of this type corresponds to firm power sales.

It must be noted that since there are very few Panel Board mills in Chile that integrate cogeneration power plants in their operation (see official statistics below), it is not possible to reliably translate these barriers into additional cost. However, the low occurrence of this type of projects in Chile (even in the context of other big forest companies) clearly demonstrates that these barriers are real.

Previous experience of the Project Participant

According to the "Guidelines for objective demonstration and assessment of barriers" (Version 01) approved in the EB 50, it is suggested that the Project Participant should complement the information provided above with information related to the nature of the company, the organization and its ownership, as well as its previous experience with similar projects as this project activity.

Arauco is a leading forest company in Chile and has the following business units:

- Forest division.
- Pulp division.
- Sawmill division.
- Wood panel division.
- Power division: This division was created to provide commercial services to the other divisions for selling the additional power to the grid (e.g. from other power generation CDM projects).

Arauco is fully owned by COPEC, a leading fuel distribution company in Chile. Arauco owns another biomass power generation project in Chile which is similar to this project activity: The Trupan (Ref. 0259), which is also registered in the CDM.

Arauco's past experience with this type of projects does contribute to mitigate some of the technological barriers outlined above. However, some of the barriers still persist, since they are structural to the industry contexts to which these type of projects are related (e.g. Sawmill and Panel board industries) and tend to prevail regardless of the project participant's past experience (e.g. high steam demand fluctuation, turbo generator efficiency range, etc.).

The significance of the technological barriers mentioned above can be substantiated by considering the marginal use of the biomass power cogeneration technologies in the Power and Forest (e.g. Sawmill and Panel board) industries in Chile:

Use of the biomass power generation technology in the Power industry in Chile:

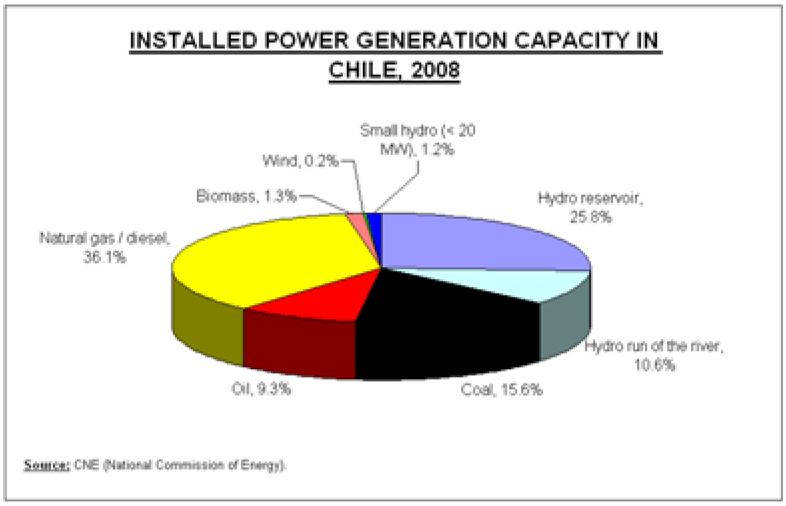
According to the most recent national statistics available, non-conventional renewable power generation capacity accounts for just 3% of the total power generation capacity installed in Chile. Furthermore, biomass power generation (available to the grid) merely represents 1.3% of the total power generation capacity in Chile. This is illustrated in the following table and graph below:

<u>Power generation capacity per technology type in Chile, 2008</u>

		Interconnected transmission systems				
Source		**SIC**	**SING**	**Magallanes**	**Aysén**	**Total**
Hydro (> 20 MW)	(MW)	4,781	0	0	0	4,781
Fossil fuels	(MW)	4,292	3,589	99	28	8,008
Total conventional	**(MW)**	**9,073**	**3,589**	**99**	**28**	**12,789**
Hydro (< 20 MW)	(MW)	129	13	0	21	163
Biomass	(MW)	166	0	0	0	166
Wind	(MW)	18	0	0	2	20
Total non-conventional renewable power	**(MW)**	**313**	**13**	**0**	**23**	**349**
Total natinonal level	**(MW)**	**9,386**	**3,602**	**99**	**51**	**13,138**
Percentage ERNC	(%)	3.3%	0.4%	0.0%	45.1%	2.7%
Percentage Biomass	(%)	1.8%	0.0%	0.0%	0.0%	1.3%

<u>Source:</u> CNE statistics for 2008. Available at: <http://www.cne.cl/cnewww/opencms/06_Estadisticas/energia/ERNC.html>.

<u>Installed power generation capacity in Chile, 2008</u>



Use of the biomass power generation technology in the forest industry in Chile (e.g. Sawmill and Panel board industries):

The significance of the barriers for biomass power cogeneration can also be verified in the Sawmill and Panel board industries:

- According to Infor (National Forestry Institute)[8], in 2007 there were 1,310 sawmills in Chile. Of these, only 2 have implemented power cogeneration at a comparable scale to the one considered by the proposed project activity. These two cogeneration power plants are registered CDM project activities. At a lower scale (not comparable to the proposed project activity), the number of sawmills that count with on-site cogeneration in Chile are no more than 2 or 3. In all, the number of sawmills that count with cogeneration technology do not surpass 0.4% of the total existing sawmills in Chile (including registered CDM projects).

- According to Infor (National Forestry Institute)[9], in 2007 there were 21 panel board mills in Chile. Of these, only 2 have integrated cogeneration technology. In both cases, the cogeneration power plants are registered CDM project activities.

[8] See, statistical bulletin N° 123, "La industria del aserrío 2008", page 10, Table 11.

[9] See, statistical bulletin N° 123, "La industria del aserrío 2008", page 10, Table 11.

Lack of prevailing practice barrier:

As previously mentioned and shown, the utilization of the cogeneration technology in the context of the Sawmill and Panel board industries is marginal (e.g. less than 10% in each case) and clearly departs from the conventional practice in these industries. For that reason, the implementation of this kind of projects face barriers related to the lack of the prevailing practice in these industries (e.g. one of the few of its kind in Chile[10]).

Cultural barriers:

A company's culture in the forestry sector is very much influenced by the commodities: wood-products and pulp, which differs from the culture in the electric power sector. This has the following implications:

- Commercial implications: Unlike forestry products, electric power cannot be stored in order to speculate on price. Power Purchase Agreements require different negotiation skills, which are not part of the competencies of companies that sell commodities such as metals, paper, wood, etc.

In the case of Arauco, this is quite evident, since unlike other power companies in Chile, Arauco only has 30% of its available power capacity engaged in long-term contracts. The usual standard in the Power generation sector in Chile is higher than 60%. This makes Arauco more vulnerable to spot market fluctuations than other power companies.

- Operational implications: As mentioned above, cogeneration power plants are far more sophisticated than conventional low pressure steam boilers and therefore, require trained and experienced personnel to operate them. This is not valid only for the cogeneration plant operators, but also for the operators of the facilities that use the steam for heating purposes such as sawmills and panel board mills. According to Arauco's experience, people-training is possible, however since there are two types of equipment operating at the same site (e.g. two operational standards coexist at the same site) the operational problems tend to prevail in time. This has been confirmed by external consultants hired be Arauco, who have detected these kinds of problems in other facilities (similar projects currently under the CDM) that have been in operation for some years.

- The cultural barriers can be further substantiated by considering that in Chile, there are two big players in the forest industry (e.g. comparable to Arauco) and none of them have developed the biomass power cogeneration technology to the point of becoming a self-power producer in the grid, to date. All the initiatives currently under development by other players in the forest industry (both big and small) consider the use of the CDM. Evidence supporting this argument can be found in the corresponding Annual Reports of these companies and in the Environmental Impact Assessment studies of new cogeneration projects that are publicly available[11.]

Regulatory barriers in the Power industry:

The proposed project activity also faces regulatory barriers in the Power industry; some of which are mentioned and explained below:

[10] The only similar project in Chile is the Trupan Plant. This project (Ref: (0259) is currently registered under the CDM.

[11] Please see < http://www.e-seia.cl/busqueda/buscarProyecto.php>.

Technical barriers faced by self-power producers derived from the Electric law:

- Article 3-8 of the Technical Norm (RM 40, May, 2005) establishes the frequency range in which all grid-connected power plants (including self-power producers) must operate grid-connected. Unfortunately, this range is set too wide and the norm does not allow self-power producers to disconnect their facilities from the grid until the frequency limits have been exceeded. As a result, self-power producers are not capable of re-establishing their internal power supply and go to island operation in case of extreme frequency fluctuations. This situation exposes the self-power producer production processes to instability and power outages, which translate into additional downtime and start-up operations. This problem has been addressed by external consultants the company has hired (see below).

- As a result of the low flexibility allowed in the Technical Norm for self-power producers, the configuration of the protection system is crucial to efficiently deal with the fluctuations observed in the grid system. Since there are no other self-power producers than Arauco in Chile, there are no local companies capable of designing a suitable protection system for self-power producers in the country. Furthermore, the protection equipment that is available in the market is designed to react upon an external system failure and not to give the required time to the power producing facility to stabilize its electric system and go to island operation. In the case of Arauco, the company has to hire specialized consulting companies abroad and redesign the protection system of its power plants every time it modifies or install a new facility that functions as a self-power producer in the grid.

Commercial barrier faced by self-power producers derived from the Electric law:

- Unlike some developed countries in which biomass cogeneration receives favourable treatment and incentives (e.g. 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 Dispatch Center rules, Article 118, page 47.

- Despite the regulatory authorities have recently incorporated some measures[12] 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 producing 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 Nueva Aldea Biomass Power Phase 1, given that this cogeneration facility falls under this power plant category.

Other barriers faced by self-power producers derived from the Electric law:

- The coordination with other generating/distribution/transmission companies also constitutes another barrier for cogeneration power plants such as the Nueva Aldea Biomass Power Phase 1. 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

[12] Short Law I in March 2004 and Short Law II in May 2005.

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 ratifies and complements the 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 becomes 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) start-ups delays[13].

It must be noted that:

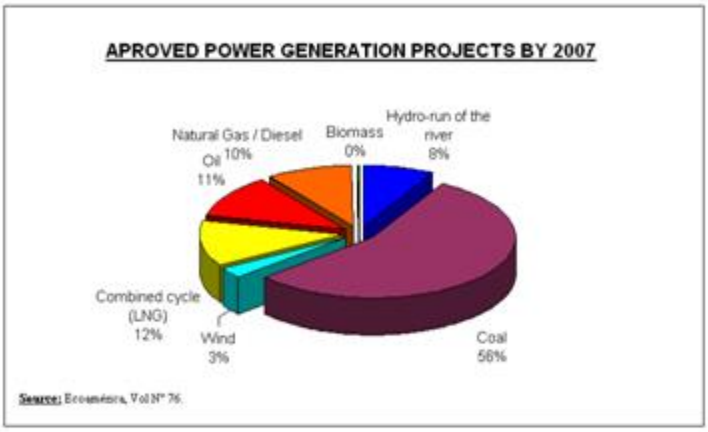
- The regulatory barriers outlined above are structural to the country as they equally apply to all kind of companies, regardless of their size and/or previous experience with this type of projects.
- The regulatory barriers cannot be reliably translated into additional cost due to the limited amount of information available. However, the best way to confirm the existence and significance of these barriers is by noting the low development of the cogeneration technology in the Power industry.

Finally, 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. This can be substantiated by national statistics. The following graph below shows the new power generation projects that have been approved by the corresponding national authority in 2007:

[13] In some cases, these additional costs are hard to anticipate and estimate ex-ante.



As can be seen, the development of future power generation in Chile is primarily aiming at coal technology in the mid to long term.

Node price of electricity still 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 projects do not reflect all the positive externalities related to these technologies.

As a ratification of the above, the Project Participant would like to note that all (or most) of the barriers presented in this analysis have been also addressed by sectoral studies in Chile, carried out by reputed third parties (not the Project Participant) and explicitly mentioned in articles of the specialized press:

1. The study: "Evaluaciones del Desempeño Ambiental Chile" (Environmental Performance Review study for Chile)[14], published by the OECD in 2005, addresses the difficulties faced by renewable power generation projects in Chile. In particular, the study identifies the following barriers:

   a) Current power prices and policies do not reflect the externality costs caused by more polluting power generation technologies (page 19).
   b) There is insufficient promotion of low-contaminating power generation technologies (page 33).
   c) Non-conventional renewable power generation projects must compete in the same terms and conditions as conventional power generation projects (page 63).

2. The study: "Aporte Potencial de Energías Renovables no Convencionales y Eficiencia Energética a la Matriz Eléctrica, 2008 – 2025" (Potential contribution of non-conventional renewable power sources and energy-efficiency to power generation, 2008 – 2025)[15], June 2008, developed by Universidad de Chile and Universidad Técnica Federico Santa María. Chapter 8 of the study addresses the barriers faced by non-conventional renewable power generation technologies in Chile. In particular, the study mentions the following barriers:

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[14] Available at: http://www.bcn.cl/carpeta_temas_profundidad/copy3_of_temas_profundidad.2007-05-02.5434448168/documentos_pdf.2007-06-28.4716180007/archivos_pdf.2007-06-28.5843705619/carpeta_temas_profundidad/temas_profundidad.2007-07-25.4772415999/documentos_pdf.2007-06-28.4716180007/archivos_pdf.2007-06-28.5843705619/archivo1

[15] Available at: <http://www.freewebs.com/infoenergia/Informe%20Ejecutivo%20Consolidado.pdf>.

a) Poor identification/insufficient information about the available energy resources.
b) The geographical situation of Chile (extremely long and narrow country) makes it difficult for mini/micro power plant to interconnect to the SIC (main transmission system).
c) Lack of skilled labor, experience and technological development.
d) Insufficient incentives.
e) Current power prices do not truly reveal the cost of externalities.
f) Lack of negotiating capacity with equipment suppliers and long waiting times.
g) (For biomass power generation only) The dispersed availability of the biomass residues limits the size biomass power plants. This increases the biomass transportation costs (logistics) and compromises the financial viability of the power generation projects (e.g. the interconnection cost becomes more relevant for a smaller plant).

3. The report: "Chile Energy Policy Review 2009"[16], October 2009, developed by the International Energy Agency. Chapter 7 is dedicated to renewable energy sources and in page 165, box 7.1 the study explicitly mentions the barriers faced by non-conventional renewable energy sources:

a) Lack of information on energy sources.
b) Uncertainty in processing permits for new technologies.
c) Regulatory barriers: Regulatory framework under development (first drafts started only in 2004).
d) Technological barriers: Weak infrastructure (especially access to some resources).
e) Investment barriers: Difficulty in accessing credit (capital-intensive with long pay-back periods).
f) Technological barriers: Uncertainty regarding technological options, their costs and performance.
g) Operational barrier: Need to adapt systems (e.g. the grid) to operate with more intermittent (power) sources.

4. The article "Inversiones por US$ 3,000 millones en energías verdes estarían en riesgo por rigidez de la ley" (Investments for US$ 3,000 million would be at risk due to law rigidities), published in November 25th, 2009 in "Electricidad Interamericana", a specialized journal that focus on the Chilean electric power sector. The article describes that investment in future "green" (non-conventional and renewable) power generation projects would be at risk due to rigidities of the Chilean electric law. In particular, the article mentions the following problems/barriers:

a) Restrictions imposed by the current law to non-conventional renewable power generation technologies make them less competitive compared to other conventional power generation technologies.
b) The current law does not provide enough incentives to develop non-conventional renewable power generation technologies in Chile.
c) Current power prices and policies do not reflect the externality costs caused by more polluting power generation technologies.
d) The presence of commercial restrictions for non-conventional renewable power generation technologies.
e) Financing restrictions for non-conventional renewable power generation technologies.

It must be noted that in each of the references presented above, the barriers mentioned are structural and inherently related to the country. The significance of the barriers is not altered or diminished by the type/size of the entity/company behind these kinds of projects. Once again, this can be demonstrated by considering:

[16] This study is publicly available in the IEA web page.

1. The low share (3.86 %) of non-conventional renewable power generation in Chile. In particular, for biomass power generation technology, this share is less than 1.10%.

2. The marginal implementation of the cogeneration technology (clearly less than 10%, including CDM projects) in the Sawmill and Panel board industries in Chile.

3. The fact that other relevant players in the forest industry in Chile (comparable to Arauco) have not developed this technology without the aid of the CDM. All the initiatives currently underway by these companies (and smaller companies as well), consider the CDM to overcome the barriers outlined in this section of the PDD.

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	• Investment barriers. • Technological barriers. • Barriers due to the prevailing practice. • Cultural barriers. • Regulatory barriers. The integration of a cogeneration facility to Sawmill and/or Wood Panel board mills is not common practice in Chile. Therefore, they do not contemplate the generation of power on-site.	No.
P7	This project option would not face barriers and is consistent with the common practice of the sawmill industry in Chile.	Yes.

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 Sawmill and Wood Panel board industries in Chile. Since, the generation of heat in boilers using mix of sawdust and bark from industrial and forest operations is consistent with the common practice of the Sawmill and Panel board/Plywood industries in Chile, as it was stated above, the proposed project activity only claims emission reductions from on-site electric power generation and the use of biomass that would otherwise be left in piles to natural decay.	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 in the Sawmill and/or Wood Panel board industries in Chile.	Yes.
B2	This project option would not face barriers and is consistent with the common practice in the Sawmill and/or Wood Panel board industries in Chile.	Yes.
B3	This project option would not face barriers and is consistent with the common practice in the Sawmill and/or Wood Panel board industries in Chile.	Yes.
B4	This project option would not face barriers and is consistent with the common practice in the Sawmill and/or Wood Panel board industries in Chile.	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
P7	The generation of power in 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	Associated emissions (1=lowest, 3=highest)
(B1) or	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 the fields.	2
(B2) or	The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to landfills which are deeper than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.	3
(B3)	The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes	1

and

(B4)	The biomass residues are used for power or heat generation at the project site in new and/or existing plants.

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 proposed project activity				
P7	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 residues category (k)	Biomass residue type.	Biomass residue source.	Biomass residues fate in the absence of the project activity.	Biomass residues use in project scenario.
1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for heat generation at the project site (B4)	Heat generation.
2	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass residues are used for heat generation at the project site (B4).	Heat generation.
3	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass residues are dumped of left to decay mainly under aerobic conditions (B1).	Power generation.
4	Mix of sawdust and bark from industrial operations.	Off-site production.	The biomass residues are dumped of left to decay mainly under aerobic conditions (B1).	Power generation.
5	Mix of sawdust and bark from forest operations.	Off-site production.	The biomass residues are dumped of left to decay mainly under aerobic conditions (B1).	Power generation.

This baseline scenario would be translated into the alternative (baseline) project Option 1, presented in section B.4 of this PDD, consisting in:

• **A conventional sawmill / plywood mill boiler, without power generation capacity:**
The installation of a new low pressure boiler on biomass fuels for heat generation (no cogeneration) in the Nueva Aldea Complex site. This is the standard practice in the Sawmill / Plywood mill / MDF Panel Wood mill industries in Chile and in the world.

To complement the analysis above, the Project Participant would like to present information that further ratifies and substantiates the selection of the baseline scenario of the proposed project activity. This information is provided in the tables below:

Electric power generation baseline

Industry	Current practice in Chile	Documentation/reference	Description of the technology used in the absence of the proposed project activity
Electric power generation industry	• Electric power generation through conventional technologies. • Biomass co-generated power accounts for merely 1 to 2 % of the total energy generated into the grid for external consumption in the country.	• CDEC SIC and CDEC-SING Dispatch Centers annual generation statistics.	• The additional power generated by the Nueva Aldea Biomass Power Plant Phase would be generated in other conventional power plants connected to the SIC grid. The power generation technologies in the SIC grid include mainly: hydro, combined cycle, open cycle and conventional coal.
Sawmill and Panel board industries	• Sawmills and Panel board mills do not integrate cogeneration power plants to their facilities and therefore do not contemplate the generation of power on-site.	• Baseline solution design for the Nueva Aldea Biomass Power Plant Phase 1 (see section A.4.3 of this PDD). • Other industry players company information in their web pages, Annual Reports and Sustainability Reports.	• Conventional low-pressure boiler for heat generation. This technology used under the chosen baseline scenario is the one normally used in the Sawmill and Panel board mills in Chile. • For more details, please see section A.4.3 of this PDD.
Pulp industry	• Pulp mills in Chile tend to be (not all currently are) self-sufficient in electric power generation. Modern pulp mills achieve this by burning black liquor in their recovery boilers. • It is also part of the business-as-usual practice to have a small boiler for heat generation (e.g. to aid start-up operations). These boilers usually run on biomass fuels (from the debarking section of the mill) or fossil fuels.	• AF-Celpap baseline mill design for several Arauco pulp mill projects. • Pulp industry publications such as ATCP Chile. • DIA and EIA studies of pulp mills in Chile by other industry players. SEIA and CONAMA web pages. • Other industry player's company information in their web pages. Other industry player's Annual Reports and Sustainability Reports. • International documentation on best practices in the pulp industry: Please see table 2.46 of the BREF document (the "European IPPC Bureau. 2001. Integrated Pollution Prevention and Control (IPPC), Reference Document on Best Available Techniques in the Pulp and Paper Industry, p 111."The link: http://eippcb.jrc.es/reference/BREF/ppm_bref_1201.pdf.	• Conventional low-pressure boiler for heat generation running on biomass or fossil fuels. No cogeneration.

Heat generation baseline

In the Sawmill and Panel board industries, heat generation using biomass residues is a common practice. As a result, the proposed project activity does not claim emission reductions due to this source.

Industry	Current practice in Chile	Documentation/reference	Description of the technology used in the absence of the proposed project activity
Sawmill industry	• Use biomass residues as fuel for heat generation (mainly wood drying).	• Company information of other relevant Sawmill players in Chile. • Forest industry publications such as Lignum, Ecoamérica and Infor reports.	• Conventional low pressure boiler on biomass residues for heat generation. No cogeneration.
Panel board industries	• Use biomass residues as fuel for heat generation (presses and drying).	• Company information of other relevant Panel board players in Chile. • Forest industry publications such as Lignum, Ecoamérica and Infor reports.	• Conventional low pressure boiler on biomass residues for heat generation. No cogeneration.
Pulp industry	• Pulp mills in Chile tend to be (not all currently are) self-sufficient in electric power generation. Modern pulp mills achieve this by burning black liquor in their recovery boilers. • It is also part of the business-as-usual practice to have a small boiler for heat generation (e.g. to aid start-up operations). These boilers usually run on biomass fuels (from the debarking section of the mill) or fossil fuels.	• AF-Celpap baseline mill design for several Arauco pulp mill projects. • Pulp industry publications such as ATCP Chile. • DIA and EIA studies of pulp mills in Chile by other industry players. SEIA and CONAMA web pages. • Other industry player's company information in their web pages. Other industry player's Annual Reports and Sustainability Reports. • International documentation on best practices in the pulp industry: Please see table 2.46 of the BREF document (the "European IPPC Bureau. 2001. Integrated Pollution Prevention and Control (IPPC), Reference Document on Best Available Techniques in the Pulp and Paper Industry, p 111." The link: http://eippcb.jrc.es/reference/BREF/ppm_bref_1201.pdf	• Conventional low-pressure boiler for heat generation running on biomass or fossil fuels. No cogeneration.

Unused biomass baseline

The following table establishes the baseline of the additional biomass that will be burned in the Nueva Aldea Biomass Power Plant Phase 1, as a result of implementing the project activity. The baseline is established using a per-industry analysis.

Industry	Current practice in Chile	Documentation/reference	Description of the technology used in the absence of the proposed project activity
Sawmill and Panel board industries	• Use part of the biomass residues generated internally as fuels to generate heat (i.e. for wood drying), sell the remaining residues if possible. Still, a considerable surplus of biomass remains unused in the region, which is dumped or burned in an uncontrolled manner.	• Sawmill and Panel board industries information in Chile. • Forest industry publications such as Lignum, Ecoamérica and Infor reports.	• The additional biomass consumed by the proposed project activity would most likely be left in piles for natural decay. In some particular cases, the biomass would be burned in the open-air in an uncontrolled manner.
Forest industry	• Residues from harvesting, pruning and thinning operations are mostly left in piles to natural decay. In some particular cases the residues are burned in an uncontrolled manner.	• Conventional forest management practices of Arauco and other forest companies of comparable size in Chile. • Forest industry publications such as Lignum, Ecoamérica and Infor reports.	• The additional biomass consumed by the proposed project activity would most likely be left in piles for natural decay. In some particular cases the residues would be burned in an uncontrolled manner.
Pulp industry	• Pulp mills in Chile tend to be (not all currently are) self-sufficient in electric power generation. Modern pulp mills achieve this by burning black liquor in their recovery boilers. • It is also part of the business-as-usual practice to have a small boiler for heat generation (e.g. to aid start-up operations). These boilers usually run on biomass fuels (from the debarking section of the mill) or fossil fuels.	• AF-Celpap baseline mill design for several Arauco pulp mill projects. • Pulp industry publications such as ATCP Chile. • DIA and EIA studies of pulp mills in Chile by other industry players. SEIA and CONAMA web pages. • Other industry player's company information in their web pages. Other industry player's Annual Reports and Sustainability Reports. • International documentation on best practices in the pulp industry: Please see table 2.46 of the BREF document (the "European IPPC Bureau. 2001. Integrated Pollution Prevention and Control (IPPC), Reference Document on Best Available Techniques in the Pulp and Paper Industry, p 111." The link: http://eippcb.jrc.es/reference/BREF/ppm_bref_1201.pdf	• The additional biomass consumed by the proposed project activity would most likely be left in piles for natural decay. In some particular cases the residues would be burned in an uncontrolled manner.

Currently there is some demand for biomass residues (mix of sawdust and bark) from industrial operations i.e. from sawmill operations, which mainly is related to heat generation in big-scale sawmills, and some isolated examples of small-scale electric power generation. However, there is virtually no use for biomass generated from forestry operations (thinning, pruning and harvesting operations), which is mainly left on the ground to natural decay and in some cases, burned in the open-air in order to avoid forest fires. As a result, the baseline for these biomass types is that the

biomass would be dumped in piles to natural decay and in some cases, burned in the open air to avoid the risk of forest fires.

To complement the analysis above, table below shows the expected consumption amount per categories of biomass before and after the implementation of the project activity and the corresponding baselines for each type of biomass used.

(+) Most Available/least Costly (-)

Biomass residues category (k)	Biomass residues type	Biomass residues sources	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario	Consumption before project activity		Biomass consumption in the new power plant	
					BDt	%	BDt	%
1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for power or heat generation at the project site in new and/or existing plants. (B4)	Heat generation.	**15,552**	10.7%	**15,552**	4.09%
2	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 in new and/or existing plants. (B4)	Heat generation.	**130,405**	89.3%	**130,405**	34.29%
3	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation	**0**		**104,327**	27.43%
4	Mix of sawdust and bark mix from industrial operations.	Off-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation	**0**		**126,189**	33.18%
5	Mix of sawdust and bark from forest operations.	Off-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation	**0**		**3,803**	1.0%
Total					**145,957**		**380,276**	

This clearly and unequivocally demonstrates that the baseline scenario chosen for the Nueva Aldea Biomass Power Plant Phase 1 is still valid. Further evidence of this will be shown in the section below, in which the Project Participant applies the last version of the tool used to assess the validity of the chosen baseline scenario.

<u>Revalidation of the baseline for the Nueva Aldea Biomass Power Plant Phase 1 project activity</u>

Considering that this PDD corresponds to the first renewal of the Nueva Aldea Biomass Power Plant Phase 1's crediting period, the Project Participant will follow the "CDM project standard (Version 05.0)".

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:

<u>Step 1: Assess the validity of the current baseline for the next crediting period</u>

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 (P7), heat (H5) and biomass use (B4 and B1) complies with all relevant mandatory national and/or sectorial policies which have come into effect after the submission of the Nueva Aldea Biomass Power Plant Phase 1 for validation. In particular:

<u>Electricity:</u> The sourcing of electric power from the grid (P7). There have been no new regulations or policies that prevent Sawmill and Panel board mills 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.

<u>Heat:</u> The generation of heat inside forest industrial facilities, using biomass residues (H5). As in the previous case, there have been no new regulations or policies that prevent Sawmill and Panel board mills or other forest industrial facilities that prevent them from generating heat using biomass residues, since the date in which the proposed project activity was submitted for validation.

<u>Biomass use:</u> 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 are similar to those that prevailed at the date of sending the proposed project activity to validation. Electric power generation is not mandatory in Sawmills or Panel board mills and recently built facilities do not include on-site electric power generation as a normal practice.

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 (a low pressure biomass power boiler for heat generation only; no power generation) 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

- The proposed project activity uses some IPCC default factors. At the time the project activity was submitted for validation, the IPCC default factors came from the 1996 IPCC Guidelines. For the current version of the PDD, the Project Participant has replaced all the 1996 IPCC default factors for the ones available in the 2006 IPCC Guidelines. These default factors are presented in sections B.6.2. ”Data and parameters that are available at validation” and B.7.1 “Data and parameters monitored” of this PDD.

- The registered PDD for the first crediting period used a CH_4 emission factor for uncontrolled burning of biomass for the baseline emission calculation related to the additional biomass used for power generation. This factor was measured in September of 2006 in the south part of Chile. In order to update this emission factor for subsequent crediting periods, the Project Participant decided to carry out a new measurement at the beginning of 2009. The 2009 measurement was carried out at the end of the dry season (summer), in which the piled biomass residues are drier. This facilitates the combustion of the biomass residues, which leads to a lower methane emission factor than if biomass residues were more humid (as if happened with the 2006 measurement). This new measurement included the determination of the baseline CH_4 emission factor for biomass residues (mix of sawdust and bark) from on-site and off-site from industrial and from forest (harvesting, pruning and thinning operations) operations. These new CH_4 emission factors associated to both biomass types biomass used in this project activity are presented in section B.6.2.”Data and parameters that are available at validation” of this PDD.

  The registered PDD for the first crediting period used the default emission factors for the controlled burning of the biomass residues in the power boiler provided by the ACM0006

(Version 02). In this case, the Project Participant will directly monitor this parameter according to the new monitoring plan of the ACM0006 (Version 12.1.1) described in section B.7.1 Data and parameters monitored of this PDD.

- All other monitored parameters have been updated according to the new monitoring methodology of the ACM0006 (Version 12.1.1).

<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.

Step 2.2: Update the data and parameters

All data and parameters determined at the start of the first crediting period for the Nueva Aldea Biomass Power Plant Phase 1 project have been updated.

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.

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

The CDM brings significant benefits to the Nueva Aldea Phase 1 Complex. However, these benefits do not only circumscribe to the Complex itself, but also to Arauco for overcoming the associated barriers to carry out 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 financial benefit derived from the sale of CERs to Annex I countries is a strong incentive to develop the CDM project activity to Arauco. The additional investment related to a biomass electric power generation capacity is about 2 to 3 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. As previously mentioned, they cannot be easily/reliably quantified ex-ante, but they invariably end up translating into additional costs, deteriorating and compromising the financial performance of this type of projects ex-post.

- The proposed project activity will unquestionably reduce anthropogenic greenhouse emissions by generating electric power via a clean energy source. This is consistent with Arauco's Corporate Policy of Sustainable Development and its current stand of combating Climate Change[17]. The CDM has allowed the company to leverage its energy-efficiency policy, by making the big-scale biomass cogeneration technology feasible. As a result, the company has developed this technology in a way no other company has done it in Chile to date.

- This has positively contributed to position Arauco as an "environmental friendly" company not only in Chile, but also in the international context. This is relevant to Arauco, since approximately 60% of the company's consolidated annual sales come from exports to countries that have a high environmental consciousness and care about the use of sustainable technologies. The registration of the proposed project in the CDM will definitely acknowledge

[17] Arauco's Corporate Policy of Sustainable Development and the role of the CDM in combating Climate Change has been widely described in the Company's annual reports, sustainability reports, internal company bulletins and several presentations and papers prepared for national and international seminars, discussion tables and industrial guild events.

Arauco's effort of using high-end environmental-friendly technology, giving the company a competitive edge in this field.

The prospects of a project that will generate CERs, attract financiers who would normally not finance this kind of projects without CDM. The Project Participant would like to mention the following evidence that supports this argument:

– Every year, the Chilean Economic Development Agency (CORFO) organizes the International Conference on Renewable Energy Investments and CDM. The event provides the opportunity for networking by bringing together private investors, carbon market intermediaries, national project developers, service suppliers, banks, public agents and experts in the renewable energy and CDM sectors. One of the main aims of this event is to provide the possibility of Project Participants of renewable power generation projects to meet potential investors and financiers. The great success and continued growth in importance of this conference over the last years demonstrates that the CDM is in fact a mechanism that attracts potential investors and financiers who would normally not finance this kind of projects without the aid of this mechanism.

– In the case of the proposed project activity, from the moment Arauco started the validation of the proposed project activity, the company received several communications from financial institutions and investors who manifested interest in financing the project.

– Finally, in the last 20 years, Chile has had a sound macroeconomic management and as a result, Chile is regarded today as one of the most attractive countries to do business with in Latin America. With the 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 40% of its GNP). This makes the Chilean economy very sensitive to external shocks and currency fluctuations. The CDM provides a new/additional hard-currency cash flow stream for the proposed project activity that positively contributes to mitigate the effects of inflation and exchange rate fluctuation.

Step 3: Investment analysis

Not chosen.

According to ACM0006 (Version 12.1.1), 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,

According to the ACM0006 (Version 12.1.1) page 20, the previous steps shall be complemented with an analysis of other project activities that are of similar scale, take place in a comparable environment with respect to the regulatory framework and are undertaken in the relevant geographical area, as defined in Sub-step 1a above. Other registered CDM project activities should not be included as part of this analysis.

Arauco is the only company to have developed big-scale biomass cogeneration technology to the point of becoming a net power exporter to the grid in Chile. It is also the only company to have integrated the cogeneration technology to industrial facilities, which normally do not use this technology to generate power.

Other company's initiatives:

A relevant competitor in the pulp industry in Chile installed a biomass (bark) power boiler (150 t/h at 60 bar) inside one of its pulp mills. This initiative was mainly oriented towards the generation of steam for a future wood products mill that will be installed near the pulp mill area. It also provided additional steam to increase the electric power 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.

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.

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

As it was mentioned above, the project activity is probably the only large scale biomass cogeneration initiative integrated to Sawmill and Plywood mill in Chile. The most relevant features that distinguish this biomass cogeneration power plant from other initiatives are:

The type and capacity of the heat generator:

- Power boiler (steam) capacity:

The power boiler has the following maximum continues capacities, without soot blowing in operation:

Max. High-pressure steam on wood based fuels.[(a)]	t/h	210
Max. High-pressure steam combined with auxiliary fossil fuel.[(b)]	t/h	250

The Project Participant would like to note the following:

a) Max. steam rate production based on design solid fuel mixture (sawdust, bark and sludge) without considering auxiliary fossil fuel consumption. Refer to the project case energy/mass balance stated in this PDD.
b) Max. steam rate production based on design solid fuel mixture (sawdust, bark and sludge) (w=56%) with auxiliary Fuel Oil #6 with a design Fuel Oil burning capacity of 120 (t/h).

Design parameters of the Power boiler:

- Steam pressure at main steam stop valve 85 bar(g)
- Steam temperature 485 +/- 10 °C.
- Feed water temperature at economizer inlet 136.6 °C.

The Project Participant would like to note that the design parameters previously presented have been chosen in order to maximize the electric power generation at the facility.

This project activity has been designed to generate surplus (approximately 15 MW) to the local grid. Other biomass cogeneration initiatives have been presented and discussed in the preceding section. From the Project participant'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	2007	2008
Total power generation in Chile	(GWh)	42,636	45,409	48,970	50,937	53,916	56,279	56,679
Total biomass power generation in Chile	(GWh)	374	429	649	516	571	744	884
Biomass power generation / total power generation in Chile	(%)	0.9%	0.9%	1.3%	1.0%	1.1%	1.3%	1.6%
Nº of biomass power plants in the SIC (and in Chile)	(Number)	4	5	7	8	8	10	10
Total Number of power plants in the SIC	(Number)	54	56	60	67	70	90	106

Sources: CNE, <http://www.cne.cl/>, CDEC-SIC.
Note: Biomass power generation includes all types of biomass. 2008 includes 4 Arauco biomass power generation projects registered under the CDM.

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 CDM projects from Arauco. 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 (mostly) Arauco under the CDM.

Wood Panel industry: Plywood mills and other wood panel producing mills are not designed to operate with high pressure steam, so on-site power generation is not considered a normal practice either. Normal practice in these industries contemplates the generation of heat from biomass residues (mix of sawdust and bark) from industrial operations. Heat is basically used for wood panel pressing and drying.

Sawmill industry: As mentioned in the preceding section of this PDD, in 2007 there were 1,310 sawmills in Chile. According to Infor, the typical process flow chart of a well-established sawmill includes an artificial drying stage of the sawn timber. It must be mentioned that in 2007 stage was applied to 54.2% of the total sawn timber produced in Chile. In addition, only the "Very big scale" sawmills are capable of implementing this process and they do it in 64.6% of their total output

Artificial drying is accomplished using two techniques. The first one uses traditional drying chambers in which the wood is dried at approximately 70ºC and ambient pressure. The energy required to heat the chamber is normally generated by a saturated steam boiler fuelled by the

wood residues from the same saw-milling process. The second consists in vacuum drying, in which the wood is dried in a vacuum chamber at ambient temperature. This system is more efficient than the previous one, but implies the consumption of electric power, which is supplied from the grid. On-site electric power cogeneration from biomass sources is not considered (even hardly mentioned) as normal practice in this industry[18].

Pulp industry: Though cogeneration is widely used in the Pulp industry and part of the business as usual (BAU) 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 industrial and/or forest operations), which is part of the Kraft cycle. In some cases, a small (50 to 80 ton/hr) 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 and operates as a power plant in the grid to which it is connected. Even today, there are examples of pulp mills recently built in Chile that are not self-sufficient in electric power generation, and must rely on power from the grid to serve their internal power requirements on a normal basis.

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

- The proposed project activity is one of the few of its kind in Chile.
- Biomass cogeneration projects in the forest industry context (Panel board and Sawmill industries) are not observed as common initiatives.
- Biomass cogeneration projects in the Power industry are equally unique and therefore not observed as common initiatives either.
- The utilization of the biomass cogeneration technology in the Pulp industry context is normally found and justified to the point of making the pulp mill facility self-sufficient in heat and electric power generation; not to generate surplus power to the grid. In addition, there are sufficient differences in scale and context to make this project activity not comparable to power generation initiatives in the Pulp industry.

For these reasons, the proposed project activity is still not part of the common practice in the relevant (and comparable) industries in Chile and therefore, considered additional from a common practice perspective analysis.

B.5. Demonstration of additionality

The project will reduce anthropogenic GHG emissions by:

1. Replacing fossil fuel-based electricity with GHG - free biomass CHP power generation. The project will generate about 1,357,354(tCO_{2e}) for the second crediting period, an average of 193,908(tCO_{2e}).
2. The project will assist Chile with greenhouse gas (GHG) reduction by curbing methane emissions from biomass degradation derived from wood-related industries (Sawmills, Wood Panel/Plywood mills and forest companies).

To do so, the Project Participant built a large scale biomass cogeneration initiative that is integrated to Sawmill and Panel board/Plywood mills and has been designed to generate surplus to the power grid. For reasons presented in previous section, the project activity is still not part of the common practice in the relevant (and comparable) industries in Chile and therefore, considered additional from a common practice perspective.

[18] Refer to "Boletín Estadístico 123", "La Industria del Aserrío, Chile 2008", that provides a description of the Sawmill industry in Chile.

The Project Participant clearly demonstrated the additionality of the proposed project activity in the preceding section by following the stepwise approach of the ACM0006 (Version 12.1.1). For that reason, the Project Participant will not repeat this analysis in this section of the PDD.

Starting date of Nueva Aldea Biomass Power Plant Phase 1

The first contract for the construction of the Power Plant was signed in September 29th, 2003, its construction was carried out during 2003/2004 and started its operation at the beginning of 2005, which is before the date of validation and registration (March 31st, 2006) of the CDM project activity.

Considering the above and according to EB 66 Report, Annex 8, "Guidelines for Completing the Project Design Document" establishes in point B.5 that if the starting date of the project activity is before the date of validation, then evidence must be provided in order to show that the CDM was seriously considered in the decision to proceed with this project activity and therefore to demonstrate its additionality.

Evidence of serious consideration of Climate Change and the CDM in the Nueva Aldea Phase 1 project activity:

c) Arauco first considered the CDM principles in cogeneration initiatives in 1998. A study called "Estudio de Factibilidad de Cogenerar en Chile"[19] carried out by SERCOR S.A., a research company; subsidiary of Arauco explicitly considered the benefits related to power cogeneration: mainly higher efficiency and lower CO_2 emissions. It must be noted that unlike the environmental regulations in other countries, the Chilean and Argentinean environmental regulations do not consider CO_2 a pollutant and therefore, they do not contemplate any emission restriction at all. As a result of this study and other subsequent studies in the coming years, Arauco introduced the sustainability criteria in power generation and made it part of its Environmental Corporate Policy of Sustainable Development. As a highly integrated conglomerate in the forest industry, Arauco consistently and systematically applied this policy throughout all the business areas in which the company participates: forest management, wood processing (sawmills), Hardboard / MDF / Plywood panel manufacturing, pulp producing and power generation. Evidence that explicitly mentions Arauco's Environmental Corporate Policy and its compromise towards sustainable development in all of its business areas and subsidiaries can be found in Arauco's 1997 to 2011 Annual Reports and in the Environmental and Social Responsibility Reports.

- Arauco first considered the incentives of the CDM in 1999. In the study "Proyecto de fijación de carbono en plantaciones de Pinus Radiata en la VI y VII regiones, Chile"[20], carried out by the FIA (Foundation for Agriculture Innovation). This study was a result of a shared initiative of FIA, CONAF (National Forestry Corporation) and Forestal Celco (an Arauco subsidiary related to forest management) and was aimed at developing a participative mechanism that allowed small land owners located in the coastal dry lands of the south of Chile to reforest abandoned and/or eroded lands. The study evaluated the financial feasibility of the reforestation program and explicitly considered the carbon revenues derived from the reforestation program. As a result of this initiative, Forestal Celco and later on, Licancel (an Arauco subsidiary related to pulp production) implemented the reforestation program. Since in those years the CDM was in its early beginnings, Arauco was unable to certify the emission savings from this reforestation project. As a result, the company maintained the reforestation program until 2002, the year in which it was no longer feasible to maintain the program without the economic incentives of the CDM.

[19] "Feasibility Study of Cogeneration in Chile", the English translation.

[20] "Carbon capture project from Radiata Pine plantation in the VI and VIII regions, Chile", the English translation.

- The Nueva Aldea Phase 1 EID (Environmental Impact Declaration) explicitly mentions that one of the objectives of the Nueva Aldea Biomass Power Plant Phase 1 project is to achieve high power generation efficiency and to curb gaseous emissions. The EID is an official and public study that is mandatory by the Chilean Environmental Regulation for all projects of a certain scale in Chile.

- During 2002, SERCOR S.A. developed the study "Bonos de Carbono"[21] about the Kyoto Protocol, the CDM and the Carbon Market possibilities available at that time. This study was presented to members of the Arauco board and contributed to foster the interest in the CDM and the Kyoto Protocol.

- During 2003, considering that still no baseline methodology suitable for Arauco's biomass projects had been developed, Arauco decided to develop its own internal CDM competencies and develop a CDM baseline methodology that suited its biomass cogeneration projects. The first methodology calculations are dated June/July 2003. As a result of these developments, Arauco finally presented the first CDM grid-connected baseline methodology for biomass projects in Chile (the NM0081) in October 28th 2004, and got the approval by the Executive Board by the end of February 2005[22.] The successful development of this methodology clearly proves Arauco's serious commitment with the CDM principles and its intention to continue developing biomass power cogeneration initiatives in the future.

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[21] "Carbon Bonds", the English translation.

[22] Most of the supporting evidence mentioned here has not been included in this PDD, however the evidence will be made fully available at the validation stage of this project activity.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

According to ACM0006 (Version 12.1.1), 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):	<u>The boiler has the following maximum continues capacities, without soot blowing in operation:</u> • 210 ton high-pressure steam per hour (t/h) on wood based fuels. 147.5MW heat to steam capacity. • 250 ton high-pressure steam per hour (t/h) on combined steaming capacity with auxiliary fuel (Fuel Oil #6 or alternatively Diesel).
The type and quantities of fuels used in the heat generator (s):	<u>Power Boiler:</u> • Sludge from off-site production for heat generation: 15,552(BDt[23]/y). • Mix of sawdust and bark from on-site production from industrial operations for heat generation: 130,405(BDt/y) and for electric power generation: 104,327(BDt/y). • Mix of sawdust and bark from off-site production from industrial operations for electric power generation: 126,189(BDt/y). • Mix of sawdust and bark from forest operations for electric power generation**:** 3,803(BDt/y). • Diesel: 1,092(ton/y) equivalent to 1,300,000(l/y) (See note below). • Fuel Oil: 0(ton/y) or alternatively Diesel. • LPG: 0.29(ton/y) equivalent to 520(l/y) <u>The Project Participant would like to note the following:</u> As a reasonable (average) estimate, the Project Participant has contemplated the total fossil fuel consumption of 1,300,000 (l/y), in this case Diesel, based on measurements conducted in previous monitoring periods.
The type and capacity of the heat engines and direct heat extractions:	<u>One condensing with extraction turbine:</u> • Capacity of the heat engine: 29.940(MW) • Design capacity of the inlet flow: 180.8(ton/h). • Design capacity of the heat extraction N°1: 65(ton/h), medium pressure bleeding flow.

[23] BDt stands for “Bone-dry ton” and means 100% dry biomass.

	• Design capacity of the heat extraction N°2: 30(ton/h), medium pressure bleeding flow. • Design capacity of the heat extraction N°3 40(ton/h), low pressure steam. • Design capacity at the tail of the turbine: 60(ton/h) exhaust flow. (Refer to the project case energy/mass balance on this PDD)

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:	• There would have been only one low pressure boiler on biomass fuels for heat generation (no cogeneration) plus back-up fossil fuel consumption (See below). • There would have been no heat engine in the Power Plant: 0 MW
The type and capacity of heat generator (s):	• There would have been a smaller boiler with nominal installed capacity of 150 (t/hr.) on biomass and 190 (t/h) on combined steaming capacity with auxiliary fossil fuel Diesel or alternatively Fuel oil.
The type and capacity of the heat engine (s) and electric power generator (s):	• There would have been no heat engine and electric power generator in the Power Plant.
The types and quantities of fuels which would be used in each heat generator:	Power boiler: • Sludge from off-site production for heat generation: 15,552(BDt/y) • Mix of sawdust and bark from on-site production from industrial operations for heat generation : 130,405(BDt/y) and for electric power generation: 0 (BDt/y) • Mix of sawdust and bark from off-site production from industrial operations for electric power generation: 0(BDt/y). • Mix of sawdust and bark from forest operations for electric power generation: 0(BDt/y). • Diesel:419.13(ton/y) equivalent to 498,965(l/y) (See note below) • Fuel Oil: 0(ton/y), or alternative to Diesel. • LPG:0.11(ton/y) equivalent to 200 (l/y) (See note below) The Project Participant would like to note the following: The fossil fuel amount that would be consumed in the baseline scenario, in this case Diesel, is determined as follows: total fossil fuel consumed in the project multiplied by the ratio (biomass that would be consumed in the baseline / total biomass residues in the project) (Refer to Step 3 of this PDD for additional information).
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: 14.6 (MW). 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 conventional sawmill /plywood mill complex without on-site electric power generation which have had to source its energy requirements from the local grid (i.e. Interconnected Central System. 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 includes the possibility to import electricity from the grid. However, this project activity is designed to generate surplus of electricity to the grid and therefore, only under particular circumstances the project activity might be sourced from the grid such as, start-up operations and maintenance circumstances. As a reasonable (conservative) estimate, the Project Participant has contemplated an import amount of 2,000 (MWh/y) in the emission reduction calculations based on measurements conducted in previous monitoring periods In addition to the above the Project Participant would like to note that events such as internal clients demand for electricity (sawmill and log processing mill) during maintenance periods and operational events, such as trips are not contemplated in this estimation, since these are unpredictable circumstances. 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.

Equations used to calculate emissions reductions

The net emission reductions of the proposed project activity are calculated through equation 1 of the ACM0006 (Version 12.1.1):

$$ER_y = BE_y - PE_y - LE_y$$

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 12.1.1), the Project Participant shall 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 12.1.1):

$$BE_y = EL_{BL,GR,y} * EF_{EG,GR,y} + \sum FF_{BL,GR,y,f} * EF_{FF,y,f} + EL_{BL\frac{FF}{GR},y} * \min(EF_{EG,GR,y} \, . \, EF_{EG,FF,y}) + BE_{BR,y}$$

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 page 23 of the ACM0006 (Version 12.1.1) 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 12.1.1), the amount of process heat refers to the heat utilized to meet process heat demand of industrial mills in the baseline ($HC_{BL,y}$).[24]

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 12.1.1):

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

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

- Preparation, storage and transport of biomass residues:

Item	Description of the auxiliary equipment
Transport of biomass residues to the power boiler.	a) <u>One conveyor belt (from pulp mill to power plant).</u> The auxiliary electricity consumed in a dedicate conveyor belt, used to transport biomass residues from pulp mill to power plant, attributable to the project activity, will be contemplated in the emission reduction calculations. b) <u>Two closed pipelines (from Plywood mill to power plant).</u>

[24] The estimate amount of process heat demanded in the baseline case is the same as the amount contemplated in the project case. The only difference between baseline and project case 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 and mass balance diagrams.).

	The auxiliary electricity consumed in four engines of the two pipelines, used to transport biomass residues from Plywood mill to the power plant, attributable to the project activity, will be contemplated in the emission reduction calculations. In this particular case, since electricity consumed is not possible to measure directly, the Project Participant has proposed an alternative (conservative) approach, which is described as follows: As a reasonable (conservative) estimate, according to manufacture specification, nominal consumptions of these four engines will be contemplated in the emission reduction calculations: Electricity consumption: 6,936(MWh/y) = 1,473(kW) * (360*24) (h) (For additional information refer to Appendix 5: Diagram of auxiliary electricity consumption for biomass transportation in the project activity). c) One conveyor belt (from log-merchandizer to stored field). Auxiliary electricity consumptions of one conveyor belt used to transport biomass residues from the Log-merchandizer to the power plant, are attributable to the project activity, and therefore will be contemplated in the emission reduction calculations. This case is similar to the above description, and therefore the Project Participant has proposed an alternative (conservative) approach described as follows: As a reasonable (conservative) estimate, according to manufacture manual, the nominal electricity consumptions of the conveyor belt engine will be contemplated in the emission reduction calculations: Electricity consumption: 129.6 (MWh/y) = 15(kW) * (360*24)(h) (For additional information refer to Appendix 5: Diagram of auxiliary electricity consumption for biomass transportation in the project activity). As a reasonable estimate five hours per year are contemplated for maintenance.
Preparation and storage of biomass residues.	Not applicable since for preparation and storage of biomass residues only fossil fuel will be consumed instead of electricity.

The Project Participant would like to note the following:

- The total auxiliary electricity consumption of 12,856(MWh/y) corresponds to the sum of values informed in point b) and c) under bullet point Preparation, storage and transport of biomass residues,
- The value informed above will remain fixed for the whole second crediting period for emission reduction calculations, since directly measurements will be not possible. However, in the case the Project Participant finds the way to directly conduct measurements of auxiliary electricity consumptions; this will be the preferred approach.

- Operation of power and/or heat generation plants (located in the project site and included in the project boundary):

Item	Description of the auxiliary equipment.
Power boiler, Turbo generator and ash treatment.	Auxiliary electricity consumed in the power boiler, turbine and ash treatment, attributable to the project activity, will be measured and contemplated in the emission reductions calculation.

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

According to the baseline methodology ACM0006 (Version 12.1.1), the Project Participant should determine the total capacity of electric power generation available in the baseline scenario.

In the baseline scenario, there would be one low pressure boiler on biomass fuels for heat generation purpose, and there would be no cogeneration-type heat engine (i.e. $CAP_{EG,CH,i}$= 0) and no power-only type heat engine on-site. (i.e. $CAP_{EG,CG,j}$= 0)

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

According to the baseline methodology ACM0006 (Version 12.1.1), page 26, 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 ($BR_{B4,ny}$).

– All biomass residues types identified under the baseline scenario would be burned exclusively in a low pressure boiler for heat generation (B4). The other (additional) amount of biomass residues that would be used as fuel in a biomass power boiler under the project activity would be dumped or left to decay under clearly aerobic conditions (B1). These are described in table below:

Category k	Type/source of the biomass residues	Fate of the biomass residues in baseline.	Fate of the biomass residues in the project scenario
$BR_{B4,1,y}$	Sludge from off-site industrial operations.	Biomass residues would be burned in the low pressure power boiler for heat generation B4).	Heat generation.
$BR_{B4,2,y}$	Mix of sawdust and bark from on-site industrial operations.	Biomass residues would be burned in the low pressure power boiler for heat generation (B4).	Heat generation.
$BR_{B1,3,y}$	Mix of sawdust and bark from on-site industrial operations.	Dumped or left to decay under clearly aerobic conditions (B1).	Power generation.

According to the ACM0006 (Version 12.1.1), in the case that one biomass residues type from one particular source has two different fates in the baseline scenario, this biomass residue used under the project shall be allocated to one of the following fates:

- Power or heat generation (B4), or
- Dumping, leaving to decay or burning (B1, B2 and/or B3), or
- Other fates (B5-B8).

– In the case of the baseline scenario, the biomass residues (mix of sawdust and bark) would be obtained from one particular source (on-site production) and would have had two different fates: Part would be used for heat generation (B4) purpose and the rest (additional) would be dumped to natural decay (B1).

– In the case of the project scenario, the biomass residues (mix of sawdust and bark) obtained from one particular source (on-site production): part would be allocated to heat generation and the rest (additional) would be allocated to power generation, as can be seen in table above.

According to the baseline methodology ACM0006 (Version 12.1.1), the Project Participant should specify and justify in a transparent manner how the relevant allocations of biomass residues should be made and should be adhered to the following rules:

– The sum of biomass residues types consumed in the baseline for power or heat generation in all heat generators shall be equal to the total amount of biomass residues consumed under the project activity and for which the baseline scenario is (B4).

  In the case of this project activity, the difference between the baseline and the project scenario configuration (Refer to section A.4.3 of this PDD) would be exclusively derived from the on-site electric power generation capacity attributable to this CDM project activity.

  Considering the above, the higher (additional) consumption of biomass residues types under the project scenario would exclusively due to its electricity generation capacity., and therefore, the biomass residues types and total amount that would be used in the baseline for heat generation (B4) shall be equal to the total amount of biomass residues consumed for the same purpose under the project activity.

– The allocation of biomass residues should be undertaken in a conservative manner which in case of uncertainty an allocation rule should be applied that tends to result in lower emission reductions.

  The Project Participant will follow the conservative approach to prioritize the use of biomass residues over the use of any fossil fuels for heat generation purpose in the baseline scenario. This will tend to result in lower emission reductions.

  The Project Participant will allocate in a clearly and transparently manner the biomass residues according to their types (and the corresponding amounts) and sources by following marginal algorithm described as follows:

  The biomass residues of types (and the corresponding amounts) used in Complex will be ranked from the most available/less costly (on-site production) to the least available/most costly (off-site production) from third parties industrial and forest operations. The biomass residues type ranking is presented as follows:

	Biomass residues category (k)	Biomass residues type	Biomass residues sources	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario
(+) Most Available/least Costly (-)	1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for power or heat generation at the project site in new and/or existing plants. (B4)	Heat generation.
	2	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 in new and/or existing plants. (B4)	Heat generation.
	3	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation
	4	Mix of sawdust and bark mix from industrial operations.	Off-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation
	5	Mix of sawdust and bark from forest operations.	Off-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation

- In the case of biomass residues type from one particular source which part it of has been used prior to the implementation of the project activity partly in heat generators at the project site (B4), and the rest (additional) has been dumped, left to decay or burnt (B1 or B2 or B3), and if this situation would still continue in the baseline scenario, then use, as conservative approach to address the uncertainty associated with such allocation, the maximum value among approaches presented in the methodology for the quantity of biomass residues of category n allocated to scenario (B4).

  This is not applicable as the project activity is a Greenfield power generation project, (i.e. no previous operational history), which consisted in the installation of a new biomass residues fired power plant in a site where no power and heat was generated before.

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 and heat engines:

According to the ACM0006 (Version 12.1.1), page 28, the Project Participant should calculate the efficiencies of heat generators and heat engines 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 01)”.
- 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.

However, in this case a suitable default value is not provided for the technology used in the project activity, as a result, the Project Participant will request for a revision of the corresponding methodological tool to the way the efficiency of the heat generators is determined in the baseline.

Efficiencies and heat-to-power ratio of heat engines:

Not applicable in this case.

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

This assessment is not applicable since there is no fossil fuel based for power generation identified as part of the baseline scenario. Note that in the baseline scenario a low pressure biomass power boiler would be installed for heat generation purpose, 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 (tCO2/MWh)
$EF_{EG,GR,y}$	=	CO_2 emission factor of the fossil fuel type that would b use4d 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 12.1.1) the Project participant will determine the emission factor of the electricity grid as the combined margin (CO_2) emission factor to which the project activity is connected in year y.

This parameter will be calculated following the “Tool to calculate the emission factor for an electricity system” (Version 03.0.0). According to this Tool the following steps shall be followed:

<u>Step 1:</u> 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 Interconectado Central”[25] (SIC). The SIC is composed by the transmission lines and the interconnected power plants that operate from “Rada de Paposo” in the North (II Region), to “Isla Grande de Chiloé” in the South (X Region). The SIC is the largest of the four existing transmission systems in Chile, accounting for about 75% of the power generation capacity of the country and supplying electricity to approximately (93%) of the total population. 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 SIC system. In particular, the Project Participant verified that:

a) Prices in the SIC do not differ more than 5% during 60% or more of the year and
b) There is no transmission line in the SIC that is operated at 90% or more during 90% or more of the year.

The corresponding assessment for the SIC grid was done for the year 2008. The study is provided as supporting evidence during the validation of the project activity.

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.

<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 option b) to calculate the Operating Margin (OM).

[25] The English translation for this would be “ Central Interconnected System”

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 Option A 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:

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

Where:

$EF_{grid,OM-adj,y}$	=	Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh).
λ_y	=	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 λ, are stated in equation N°8 of the "Tool to calculate the emission factor for an electricity system" (Version 03.0.0) 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 Participant will use the *Ex-post option* to calculate the OM; that is, the OM will be calculated the year in which the project activity displaces grid electricity and the emission factor will be updated annually during monitoring period.

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

For the calculation of the Operating Margin (OM), the Project Participant will use:

- Option B to calculate the EF_{grid}, $OM_{-adj,y}$: Use of information is based on the net electricity generation of all power plants serving the system and the fuel types and total consumption of the project electricity system.

- Option A1 for calculating the emission factor of each power unit m ($EF_{EL,m,y}$): Use of information is based on fuel consumption and electricity generation of each power unit m.

$EF_{El,m,y}$, $EF_{EL,k,y}$, $EG_{m,y}$ and $EG_{k,y}$ should be determined using the same procedures as those for the parameters $EF_{EL,m,y}$ and $EG_{m,y}$ in Option A of the simple OM method above.

The CO_2 emission factor of power unit m in year y is obtained following equation 2 of the "Tool to calculate the emission factor for an electricity system" (Version 03.0.0):

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$FC_{i,m.y}$	=	Amount of fossil fuel type i consumed by the power unit m in year y (Mass or volume unit).
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type I in year y (GJ/mass or Volume unit).
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type I in year y (tCO_2/GJ).

This is done in section B.6.3.step 1.7 and further background information on ex ante calculation can be found in Appendix 4 of this PDD.

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.

This is done in section B.6.3.step 1.7 and 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 (second) crediting period.

This is done in section B.6.3.step 1.7 and further background information on ex ante calculation can be found in Appendix 4 of this PDD.

<u>Step 2:</u> Determine the minimum baseline electricity generation in the grid

According to the baseline methodology ACM0006 (Version 12.1.1), page 32, $EL_{BL,GR,y}$ 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 methodology ACM0006 (Version 12.1.1), page 32, the Project Participant will contemplate in the calculation of the baseline the amount of biomass-based heat generation following project-specific conditions:

– The Project Participant will prioritize the use of biomass residues types for which scenario (B4) has been identified as the baseline scenario ($BR_{B4,n,y}$) over the use of any fossil fuels amount, and will monitor the equivalent amount of heat ($HG_{BL,BR,y}$,) that would be generated using these biomass residues types.

- According to the energy and mass balance of the baseline scenario (Refer to section A.3 of this PDD), there would be one low pressure biomass power boiler for heat generation purpose (no cogeneration type heat engine). Additionally, this heat generator would run on the following biomass residues types for which the baseline scenario (B4) has been identified:

  a) Sludge from off-site production.
  b) Mix of sawdust and bark from on-site production.

The Project Participant would like to note that biomass residues types previously presented would be consumed in one heat generator available in the baseline scenario, low pressure biomass power boiler.

According to the ACM0006 (Version 12.1.1), the Project Participant shall identify the fossil fuel types and corresponding amounts required due to technical constraints of the heat generator. These amounts will be added to the parameter FF $_{BL,HG,y,f.}$, and the corresponding heat generated in the monitoring parameter (HG $_{BL,BR,y.}$).

- In the case of the baseline scenario, the heat generator would have included the possibility of co-firing some fossil fuels due to technical constraints. Hence, the Project Participant will define the fossil fuel type (s) and the corresponding amount based on the plant´s historical range of fossil fuel consumed in previous monitoring periods.

  - Fossil fuel type(s): Diesel, LPG and Fuel Oil.
  - As a reasonable estimate the Project Participant contemplates average fossil fuel consumption based on measurements conducted in previous monitoring periods.

The Project Participant informs that the estimate of Diesel and LPG consumed for operational reasons is due to start-ups and for maintaining the heat generator temperature, especially in winter, when the biomass has a higher humidity.

<u>Fossil fuel co-fired per unit of combusted biomass due to technical constraints:</u>

Considering the above, the fossil fuel amount co-fired per unit of biomass residues used in the power boiler is:

- Diesel: average estimate index of Diesel consumption of 3.05 (l/tons on dry basis)

Alternatively to Diesel the project activity might consume Fuel Oil.

<u>Allocation of biomass residues and fossil fuels:</u>

According to the baseline scenario ACM0006 (Version 12.1.1), page 33, the Project Participant should calculate the amount of heat generated with biomass residues, based on the allocation rules established previously, using the equation 14:

$$HG_{BL,BR,y} = \sum_h . \sum_n (BR_{B4,n,h,y} * NCV_{BR,n,y} * \eta_{BL,HG,BR,h})$$

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:

$$\sum_{h}\sum_{n} BR_{B4,n,h,y} = \sum_{n} BR_{B4,n,y}$$

The heat generation in each heat generator should not exceed the total capacity of the heat generator. This is stated in equation 16:

$$\sum_{n} (BR_{B4,n,h,y} * NCV_{BR,n,h,y} * \eta_{BL,HG,BR,h}) \leq LOC_{y} * CAP_{HG,h} * LFC_{HG,h}$$

Where:

$HG_{BL,BR,y}$	=	Baseline biomass heat generation in year y (GJ)
$BR_{B4,n,h,y}$	=	Quantity of biomass residues of category n used in heat generator h in year y with baseline scenario B4 (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.

In the case of this project activity, the baseline scenario would contemplate process heat generated by one conventional low pressure biomass power boiler and there would be no cogeneration of process heat and electricity (no-cogeneration type-engines available in the baseline).

Considering the previously paragraph, this section is not applicable, in this case.

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

According to ACM0006 (Version 12.1.1) 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 12.1.1), 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 12.1.1):

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

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 12.1.1).

Calculate project emissions (PE_y)

Project emissions for this project activity are calculated using equation 37 of the ACM0006 (Version 12.1.1):

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

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).

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

- 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 ($PE_{WW,y} = 0$).

- In this case, the amount of electricity generation on-site in the baseline will 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 the production of biogas as a result, associate project emissions are considered zero ($PE_{BG2} = 0$).

Considering the above simplifications the equation 37 of the ACM0006 Version 12.1.1) 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 12.1.1), 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:

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

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 12.1.1) 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:

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

In the case of this project activity, emissions will corresponds to the possibility of co-firing some fossil fuel under technical constrains circumstances of the power boiler, at the project site, such as start-ups maintenance, and heat generation to maintain the power boiler temperature, especially in winter when biomass is too wet, etc…

– 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 corresponds 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 12.1.1):

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

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 forest 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 $PE_{TR,y..}$, 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 ($FR_{f,m}$).
- The origin and destination of the freight transported and the road distance between the origin and the destination ($D_{f,m}$);
- 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 saw dust 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.

Determination of $PE_{TR,y}$.

$$\sum_f D_{f,m} * FR_{f,m} * EF_{CO2,f} * 10^{-6}$$

Where:

$PE_{TR,y}$	=	Project emissions from transportation of freight monitoring period m (tCO_2).
$D_{f,m}$	=	Return trip road distance between the origin and destination of freight transportation activity f in monitoring period m (km).
$FR_{f,m}$	=	Total mass of freight transported in freight transportation activity f (gCO_2/km).
$EF_{CO2,f}$	=	Default CO_2 emission factor for freight transportation activity *f* (g CO_2/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 12.1.1):

$$PE_{BR,y} = GWP_{CH4} * EF_{CH4,BF} * \sum_{K} BR_{pj,N,Yk,y} * NCV_{BR,n,y}$$

Where:

$PE_{BR,y}$	=	Emissions from the combustion of biomass residues during the year y (tCO_2e).
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period (tCO_2/tCH_4).
$EF_{CH4,BR}$	=	CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ).
$BR_{PJ,n,y}$	=	Quantity of biomass residues of category n used in the project activity in year y (tonnes on dry-basis).
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis).

According to the baseline methodology ACM0006 (Version 12.1.1), page 50, 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 the case of this project activity, the Project Participant decided to measure the methane emission factor due from the Power Boiler flue gas in accordance with the ACM0006 (Version 12.1.1) monitoring methodology. Additionally, the conservativeness factor will be determined from **Table 5** of this methodology.

<u>Leakage emissions</u>

According to the ACM0006 (Version 12.1.1), page 53, where the most likely baseline scenarios for which potential leakage is relevant are B5, B6, B7 and B8: 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 B5, B6, B7 or B8 the Project Participant shall calculate leakage emissions using equation 42 presented as follows:

$$LE_y = EF_{CO2,LE} * \sum_{n} BR_{B5/B6,n,y} * NCV_{BR,n,y}$$

Where:

LE_y	=	Leakage emissions in year y (tCO_2).
EF_{CO2}	=	CO_2 emissions factor of the most carbon intensive fossil fuel used in the

		country (tCO_2/GJ).
$BR_{B5/B8,y}$	=	Quantity of biomass residues of category n used in the project activity in year y, for which the baseline scenario is B5:, B6:, B7:, or B8: (tones on dry-basis).
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry basis).
n	=	Biomass residue category.
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 (B4), 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).

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 12.1.1), 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.

The Project Participant would like to note that only one heat generator would be available in the baseline and no heat engines and 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 to determine the baseline of thermal or electric energy generation system" at the date of revalidation of this project activity.

However, the Project Participant notes that at Table 1 of Option F only fossil fuel boilers are listed, and there is no option that could be chosen in order to represent the technology of this project activity.

As a result, since the default value is not provided for the technology of this project activity, according to the ACM006 (Version 12.1.1) the Project Participant has requested a deviation to the methodological "Tool to determine the baseline efficiency of thermal or electric energy systems" in order to be able to use the proposed efficiency value of 85%.

Default value types	Name	Unit	Value	Justification/comment
Heat efficiency of the power boiler (heat generator)	$\eta_{BL,HG,BR,PB}$	%	85	The value of 85% was not available under option F (use of default values) 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 process. This value is chosen due to the following reasons: The applied value of 85% is more conservative than the default value of 100% available under Option F since lower baseline efficiency leads to higher amount of biomass residue consumption in the (baseline) power boiler. In the case of this project activity, a higher consumption of biomass residues in the baseline scenario will not impact the emissions of this project activity because this activity will not claim emissions due to heat generation, as steam

				generation for big-scale Sawmills and Panel board/Plywood mill is part of the business as usual (BAU) practice in the Sawmills and Panel board industries. Considering the above, this project activity will only claim emission reductions from on-site electricity generation and avoided methane emissions of biomass residues attributable to electricity generation. Additionally, the applied value of 85% was chosen as the lowest value, given that the efficiency values of this type of boilers would be between 85% and 90% and 88%, according to worldwide reputed consultants and equipment suppliers in the energy sector. Consequently, according to equation 14 of the ACM0006 (Version 12.1.1) presented above, the higher the amount of biomass required to meet process heat demand (in the baseline scenario), the lower the additional biomass residues attributable to electricity generation, and therefore the lower avoided methane emissions.

<u>Methane emission factor for uncontrolled burning of biomass:</u>

According to the baseline methodology ACM0006 (Version 12.1.1), page 45, the Project Participant may undertake measurements or use referenced default values to calculate the methane emission factor from uncontrolled burning of biomass residues in the baseline. In this case, in order to accomplish a higher accuracy in the baseline emission calculations, the Project Participant conducted a local measurement of this factor at the start of the project activity instead of using the default factor provided by the methodology. These values are already presented in section B.6.2 “Data and parameters that are available at validation” of this PDD. As a result, values will be not presented again in this section. (Refer to Appendix 5 of this PDD).

B.6.2. Data and parameters fixed ex ante

Data and parameters not monitored for ACM0006 (Version 12.1.1)

Data / Parameter	GWP_{CH4}
Unit	(tCO_2e/tCH_4)
Description	Global Warming Potential for CH_4.
Source of data	IPCC
Value(s) applied	21 for the first commitment period. 25 for the second commitment period. 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 emissions calculations.
Additional comment	---

Data / Parameter:	$CAP_{HG,h}$
Unit	(GJ/h)
Description	**$CAP_{HG,h}$= Baseline capacity of heat generator h (GJ/h)**
Source of data.	Reference plant design parameters.
Value(s) applied	Low pressure power boiler (heat generator): 420.47(GJ/h)
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. It is based on the installed capacity of the heat generator. In the case of this project activity, the applied value is based on plant design data for the baseline scenario: $CAP_{HG,h}$: 420.47 (GJ/h) =150 (t/h) * 2.80317 (GJ/ton) Where: – According to the plant design for the baseline scenario there would be a smaller low pressure power boiler installed with a max high-pressure steam capacity of 150 (t/h) consuming biomass residues. – The applied value for the enthalpy is determined based on thermodynamic conditions of saturated steam generated or near-saturated steam at predefined operational set points: 250 °C, pressure at 25 / 30 bar (a).
Purpose of data	---
Additional comment	– Refer to section A.3. Technology and/or measures under the energy/mass balance of conventional BAU power plant.

Data / Parameter	$LFC_{HG,h}$
Unit	Ratio
Description	**$LFC_{HG,h}$= Baseline load factor of heat generator h (ratio)**
Source of data	Reference plant design parameters.
Value(s) applied	Low pressure power boiler (heat generator): 0.82

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. The load factor is defined as the ratio between the average load and the maximum design capacity for the baseline situation.
Purpose of data	---
Additional comment	The load factor has been chosen to be 0.82. According to reputed consultants 20% is a reasonable margin considering sawmill and panel/plywood mills would not suffer from big variations in steam demand because of summer and winter conditions. This can further be explained as dryers for Sawmills and Panel board/Plywood consume relatively small volume of air and thereby, environmental conditions, such as outside temperature would have relatively low impact internal steam consumption.

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	0.695(tCO_2/MWh) The Build Margin (BM) will remain fixed for the second and third crediting periods.
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 03.0.0)”. All information required for the calculation of this emission factor is provided in Appendix 4 of this PDD.
Purpose of data	For the purpose of ex ante calculation of emission reductions in section B.6.3 of this registered PDD.
Additional comment	---

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 a default methane emission factor provided by the baseline methodology. The result of measurements performed by type of biomass residues is presented as follows:

Biomass residues category k.	Biomass residues type.	Biomass residues source.	CH_4 factor for biomass uncontrolled burning ($KgCH_4/TJ$)	Conservativeness factor (%) (Note)	Adjusted CH_4 default factor

	<table><tr><td>3</td><td>Mix of sawdust and bark from industrial operations.</td><td>On-site production</td><td>930 +/- 167</td><td>0.94</td><td>874.20</td></tr><tr><td>4</td><td>Mix of sawdust and bark from industrial operations.</td><td>Off-site production.</td><td>930 +/- 167</td><td>0.94</td><td>874.20</td></tr><tr><td>5</td><td>Mix of sawdust and bark from forest operations.</td><td>Off-site production.</td><td>114 +/- 114</td><td>0.82</td><td>93.48</td></tr></table> The Project Participant would like to note that the conservativeness factor has been obtained from Table 3, page 46 of the ACM0006 (Version 12.1.1).
Choice of data or Measurement methods and procedures	The Project Participant measured once at the start of the project activity. The CH_4 measurement shall be performed for each type of biomass residues consumed, as a result of the implementation of this project activity.
Purpose of data	For the purpose of ex-ante calculation of emission reductions in section B.6.3
Additional comment	The Project Participant would like to 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 the mix of sawdust and bark from industrial operations, it was densely packed allowing for very little oxygen in the combustion process, which leads to high methane emission factors. In the case of the mix of sawdust and bark from forest operations, since these are mainly branches allow for plenty of oxygen during the combustion, which leads to much lower methane emission factors. (For additional information see Appendix 5 of this PDD)

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

Data / Parameter:	$EF_{CO2,f}$
Unit	g CO_2 / t km
Description	Default CO_2 emission factor for freight transportation activity *f*.
Source of data	<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><tr><td>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</td><td>Heavy vehicles</td></tr></table>

	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.	
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).	

B.6.3. Ex ante calculation of emission reductions

The Project Participant would like to note the following:

1. According to the ACM0006 (Version 12.1.1), the way in which the emission reduction calculation is carried out can present several variations depending on the operational behaviour of the project plant. In this case, the Project Participant will contemplate in the emission reduction calculations of the project activity monitored data from previous monitoring periods.

2. In some cases where it is required, the Project Participant will use design parameters of the baseline and project case in the emission reduction calculations. In other cases, the Project Participant will use data from the energy/mass balance[26] 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 12.1.1) 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.

[26] The energy/mass balances of the baseline and project case were performed using average steam flows based on yearly average data.

Calculation of Baseline Emissions (BE_y)

Emissions due Baseline electricity generation

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

According to the ACM0006 (Version 12.1.1), the 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.

The baseline scenario of this project activity would have had the same output as the real scenario (with the CDM project activity) since the former would have contemplated the installation of a power boiler dimensioned to meet the same process heat demand[27] of the internal clients i.e. Sawmill and Panel/Plywood mills of the real plant.

Considering the above, the estimate amount of process heat generation is determined based on measurements conducted in previous monitoring periods. The Project Participants will use medium and low pressure steam flows (average) measurements and its thermodynamic conditions (i.e. enthalpies, Pressure and Temperature) calculated as a function of temperature and pressure of steam. This will lead to a more accurate and realistic determination of the process heat that would be generated in the baseline scenario than using design values.

Data:

Medium pressure line	
1) Process heat enthalpy (medium pressure line)	1,402,526(GJ/y)
2) Feed and make up-water, boiler blow-down and condensate enthalpy	283,010(GJ/y)
Low pressure line	
3) Process heat enthalpy (low pressure line)	1,292,583(GJ/y)
4) Feed and make up-water, boiler blow-down and condensate enthalpy	262,241(GJ/y)

Calculations:

5) Total baseline process heat generation	**$HC_{BL,y}$**	**[(1) - (2) + (3) - (4)]**	**2,149,857**

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 12.1.1), the baseline electricity generation in the grid can be calculated as follows:

[27] The difference between the energy/mass balance of the baseline scenario and the CDM project case presented in section A.3 of this PDD would be exclusively derived from the high-pressure steam generation capacity of the CDM project case for on-site electric power generation.

Data:

(1) Gross quantity of electricity generated.[a]	$EL_{PJ,gross,y}$	223,822(MWh)
(2) Project electricity imports from the grid.[a]	$EL_{PJ,imp.y}$	2,000(MWh)
(3) Auxiliary electricity consumption required for the operation of the power plants.[a]	$EL_{PJ,aux,y}$	43,900(MWh)
(4) Estimate amount of auxiliary electricity consumption.[b]		12,856(MWh)

Notes:
[(a)] The applied values are based on measurements conducted in previous monitoring periods.
[(b)] (Refer to step 1.2 and Appendix 5 of this PDD for additional information).

Calculations:

(5) Baseline electricity generation capacity in year y	$EL_{BL,y}$	(1) + (2) - [(3) + (4)]	169,066(MWh)

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

According to the baseline plant design, there would be one low pressure boiler i.e. heat generator, no cogeneration type heat engine ($CAP_{EG,CG,I}$ = 0) and no power-only-type heat engine ($CAP_{EG,PO,j}$ = 0) in the baseline scenario.

Baseline electricity generation capacity of heat engine i	$CAP_{EG,total,y}$	**0(MWh)**

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 generation purpose. According to the algorithm of biomass consumption previously described in which types of biomass residues are ranked from the most available/less costly (on-site operations) to the least available/most costly (off-site operations), the expected consumption of biomass residues types that would be available for heat generation in the baseline are the following:

Category k	Biomass residues types		Units	Average Amounts [(c)]
1	Sludge from off-site industrial operations.[(a)]	$BR_{B4,1,y}$	(BDt/y)	15,552(BDt/y)
2	Mix of sawdust and bark from on-site industrial operations.[(b)]	$BR_{B4,2,y}$	(BDt/y)	130,405(BDt/y)

Notes:

[(a)] Sludge is the least costly biomass residues type generated in Nueva Aldea Phase 2 pulp mill operations.
[(b)] Mix of sawdust and bark type is the most available biomass residues originated from on-site industrial operations.
[(c)] Estimate based on measurements conducted in previous monitoring periods.

The Project Participant would like to note the following:

- According to the common practice in the Sawmill and Panel board industries in Chile, there is normally one fate for the biomass residues identified above: Sludge and mix of saw dust and bark from on-site industrial operations are used as fuel for heat generation, mainly for wood and presses drying.

– Since in the baseline scenario, there would be one heat generator i.e. a conventional low pressure boiler, then (all) the biomass residues types identified in table above can be completely allocated to this heat generator.

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 and heat engines in the baseline:

According to Option 1 the use of default values from Option F of the "Tool to determine the baseline of thermal or electric energy generation system", if there are no default efficiency values available for a specific generation technology, the Project Participant may propose a revision of the corresponding tool in order to incorporate new default efficiency values. Alternatively, the Project Participant may propose a deviation to the baseline methodology in order to use a more project-specific efficiency values.

In the particular case of the baseline efficiency of the power boiler, the Project Participant presented a project specific efficiency value to the CDM Executive Board on August 20th, 2012 and obtained the corresponding approval on **October 10th, 2013**. The reasons behind presenting a specific efficiency value to the power boiler instead of a modification to the corresponding tool is that the proposed parameter is suitable (conservative) in the proposed project context, but this might not be the case in other project contexts.

Consequently, for a specific generation technology, the Project Participant will propose the following default efficiency value which is stated below:

Heat generator in the baseline		Value
Low pressure power boiler	$\eta_{BL,HG,BR,low\ pressure\ boiler}$	85%

The Project participant would like to note that in this case there was no cogeneration-type heat engine in the baseline scenario.

Proceed to step 1.6 to determination of 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 12.1.1) the Project Participant will do:

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

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

According to the ACM0006 (Version 12.1.1), 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". The calculation procedure is presented below:

Operating Margin calculation:

According to the explanation given in section B.6.1 in this PDD, the Operating Margin ($EF_{OM,y}$) will be calculated according to Option B ($EF_{grid,OM-adj,y}$) of the alternatives presented in the tool to calculate the emission factor for an electricity system. The Project Participant will also use ex-post data to calculate the Operating Margin; that is, the coefficient will be calculated the year in which the project generation occurs.

For the Operating Margin calculation presented in this PDD, the Project Participant will use information of the year 2010. This was the last information available at the date this PDD was reviewed and finished.

From the data that generates the curve (See Appendix 4 of this PDD), it is possible to determine the fraction of the year in which low-cost/must-run sources are on the margin for the year 2010:

$$\lambda_y = \lambda_{2010} = 0.0065068$$
$$\lambda_{2010} = 0.0065068$$

The rest of the parameters used to calculate the $EF_{grid,OM-adj,y}$ for 2010, were obtained from the CDEC-SIC dispatch centre (official and public information). In some cases the project participant also used information from power company's web pages. The calculation is as follows:

1. CO_2 emissions of non-low cost/must-run power sources for 2010.

$$\sum_m EG_{m,y} \cdot EF_{EL,m,y} = 16{,}083{,}918 (tCO_2 / yr)$$

2. Total power generation in the SIC by non-low-cost/must-run power sources in 2010.

$$\sum_m EG_{m,y} = 19{,}887 (GWh/ yr)$$

3. CO_2 emissions of low-cost/must run power sources in 2010. Since in Chile low-cost/must-run power sources include mostly hydro energy, the total emissions for this part of the equation are low.

$$\sum_k EG_{k,y} \cdot EF_{EL,k,y} = 764{,}752 (tCO_2 / yr)$$

4. Total power generation in the SIC by low-cost/must-run resources for 2010.

$$\sum_k EG_{k,y} = 22{,}381 (GWh/ yr)$$

Replacing the above values in the equation used to calculate the $EF_{grid,OM-adj,y}$ for the year 2010, the operating margin results:

$$EF_{grid,OM-adj,y} = (1-0.0065068)\cdot\frac{16,083,918}{19,887} + 0.0065068\cdot\frac{64,752}{22,381} = 803.52(tCO_2/GWh)$$

$$EF_{grid,OM-adj,y} = 803.52(tCO_2/GWh)$$

Build Margin calculation:

According to 2010 SIC data, the group of plants that accounts for the largest generation in that year are the ones responsible for the 20% of the total generation in 2010. These plants are considered to calculate the Build Margin for 2010:

$$EF_{BM,y} = 695.29(tCO_2/GWh)$$

As in the previous case, the Build Margin calculation also considered official CDEC-SIC data and/or other official data publicly available. For more details about the Build Margin calculation, please see Appendix 4 of this PDD.

Having obtained both $EF_{OM,y}$ and $EF_{BM,y}$, and assuming the default value of (0.25) for the weights W_{OM} and (0.75) for the W_{BM}, it is possible to calculate $EF_{grid\ CM,y}$ for the year 2010:

Data

1) Operating Margin (OM)	$EF_{grid,OM,y}$	0.8035(tCO_2/MWh)
2) Build Margin (BM)	$EF_{grid,BM,y}$	0.6953(tCO_2/MWh)
3) Weighting of Operating Margin	W_{OM}	25%
4) Weighting of Build margin	W_{BM}	75%

Calculations:

5) Combined Margin calculation (CM)	**$EF_{grid,CM,y}$**	**(1)*(3) + (2)*(4)**	**0.722(tCO_2/MWh)**

For more details regarding the calculation of the Operating Margin (OM) and Build Margin (BM) refer to Appendix 4 of this PDD.

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

According to equations 13 of the ACM0006 (Version 12.1.1), baseline minimum electricity generation in the grid can be calculated as follows:

Data:

(1) Baseline electricity generation in year y.	$EL_{BL,GR,y}$	**169,066(MWh)**
(2) Baseline electricity generation capacity in year y.	$CAP_{EG,total,y}$	**0(MWh)**

Calculations:

(3) Minimum baseline electricity generation in the grid in year y.	**$EL,_{BL,GR,y}$**	**Max [0,(1)-(2)]**	**169,066(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 12.1.1):

1. There would be only one heat generator (no cogeneration type heat engine) that would use biomass residues in the baseline scenario.

2. Such heat generator would consumed all the biomass residues for which the baseline scenario $BR_{B4,k,y}$ has been identified.

3. Since, such heat generator would have included the possibility of co-firing some fossil fuels due to operational reasons; the type and quantity required would be identified based on the estimated number of start-ups and for maintaining the heat generator temperature, especially in winter, when the biomass has a higher humidity. Such amounts of fossil fuels are shown below:

Fossil fuel consumption due to technical constraints:	Paramete r	(l/y)	(ton/y)
Diesel consumption: Annual shut down due to maintenance (once a year): Fossil fuel consumed for shut-down and start-up activities. Operational constraints: Fossil fuel required to maintain operational temperature and reduce moisture content.	$FF_{BL,HG,y,i}$	498,965	419.13
LPG consumption : Due to operational constraints.	$FF_{BL,HG,y,i}$	200	0.11

The Project Participant informs that as an alternative fuel to Diesel the project activity might use Fuel Oil for technical requirements.

According to ACM0006 (Version 12.1.1), 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 biomass power boiler, and also considered in the baseline emission calculation of the project.

In this case, the Project Participant will determine, according to equation 14 of the ACM0006 (Version 12.1.1), 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.

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

Determine the total heat generated in the power boiler considering all biomass residues types available in the baseline:

Data:

1) Sludge from off-site industrial operations, heat generation.	$BR_{B4,1,y}$	15,552(BDt/y)
2) Net calorific value of sludge.	$NCV_{B4,1,y}$	10.70(GJ/ton)
3) Mix of sawdust and bark from on-site industrial operation, heat generation.	$BR_{B4,2,y}$	130,405(BDt/y)
4) Net calorific value of mix of sawdust and bark.	$NCV_{B4,2,y}$	17.98(GJ/ton)
5) Baseline biomass-based heat generation efficiency of the power boiler.	$\eta_{BL,HG,BR,power\ boiler}$	85%

Calculations:

6) Baseline biomass-based heat generation of the power boiler in year y (without FF)	$HG_{BL,BR,y}$	**[(1)*(2) + (3)*(4)]*(5)**	**2,134,426(GJ/y)**

Determine the heat contribution due to fossil fuel consumption in the power boiler:

This is accomplished considering the total fossil fuel due to technical constraints for starts-ups and for maintaining the power boiler temperature, especially in winter, when biomass has a higher humidity.

Data:

1) Baseline Diesel consumption due to operational reasons.	$FF_{BL,HG,y,Diesel}$	419(ton/y)
2) Diesel net calorific value.	NCV_{Diesel}	43.30(GJ/ton)
3) Baseline LPG consumption due to operational reasons.	$FF_{BL,HG,y,LPG}$	0.11(ton/y)
4) LPG net calorific value.	NCV_{LPG}	52.20(GJ/ton)
5) Baseline biomass-based heat generation efficiency of the power boiler.	$\eta_{BL,HG,BR,PB}$	85%

Calculations:

6) Fossil fuel heat contribution in year y	$HG_{BL,FF,y}$	**(1)*(2)*(3)**	**15,431(GJ/y)**

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

Data:

1) Diesel heat contribution in year y	$HG_{BL,FF,y}$	15,431(GJ/y)
2) Baseline biomass-based heat generation of the power boiler in year y (without FF)	$HG_{BL,BR,y}$	2,134,426(GJ/y)

Calculations:

3) Baseline biomass-based heat generation of the power boiler in year y.	$\mathbf{HG_{BL,BR,y}}$	**(1) + (2)**	**2,149,857(GJ/y)**

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

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

Data:

1) Length of the operational campaign in year y	LOC_y	8,592(h)
2) Baseline capacity of heat generator h [(a)]	$CAP_{HG,h}$	420.47(GJ/h)
3) Baseline load factor of heat generator h.	$LFC_{HG,h}$	0.82

Calculations:

4) Total capacity of heat generation of the power boiler	**(1) * (2) * (3)**	**2,962,435(GJ/y)**

Considering the above calculations both restriction 15 and 16 are met:

Restriction 15: All biomass residues types available in the baseline would be used in the only heat generator i.e. low pressure 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 only heat generator is less than the total capacity of the boiler.

$\sum BR_{B4,n,h,y} * NCV_{BR,n,y} * h_{BL,HG,BR,Power Boiler} = <LOC_y * CAP_{HG,h} * LFC_{HG,h}$	This restriction is met.

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

This step is not applicable since there would be no heat engines in the baseline, and therefore no co-generation occurred. Consequently the biomass-based heat generated would be extracted from a low pressure boiler and used directly (without reductions) without co-generation of power.to meet process heat demand

Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode

Not applicable since there would be no heat engines in the baseline.

Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation.

Not applicable in this case.

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

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.	$BR_{PJ,3,y}$	104,327(BDt/y)
2) Mix of sawdust and bark from off-site industrial operations, electricity generation.	$BR_{PJ,4,y}$	126,189(BDt/y)
3) Mix of sawdust and bark from forest operations, electricity generation.	$BR_{PJ,5,y}$	3,803(BDt/y)
4) Net calorific value of mix of sawdust and bark from on-site industrial operations.	$NCV_{BR,3,y}$	17.98(GJ/ton)
5) Net calorific value of mix of sawdust and bark from off-site industrial operations.	$NCV_{BR,4,y}$	17.98(GJ/ton)
6) Net calorific value of mix of sawdust and bark from forest operations.	$NCV_{BR,5,y}$	16.76(GJ/ton)
7) Adjusted CH_4 factor for uncontrolled burning of mix of sawdust and bark from on-site and off-site industrial operations.	$EF_{BR,3,y}$ $EF_{BR,4,y}$	874.20(kgCH_4/TJ)
8) Adjusted CH_4 factor for uncontrolled burning of mix of sawdust and bark from forest operations.	$EF_{BR,5,y}$	93.48(kgCH_4/TJ)
9) CH_4 Global Warming Potential (2012)	GWP	21(number)
9.b) CH_4 Global Warming Potencial (2013 and forward)	GWP	25 (number)

Calculations:

10) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,3,y}$)	[(1) * (4) * (7) * (9)]/10^6	34,436(tCO_2/y)
10.b) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,3,y}$)	[(1) * (4) * (7) * (9.b)]/10^6	40,995(tCO_2/y)
11) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,4,y}$)	[(2) * (5) * (7) * (9)]/10^6	41,653(tCO_2/y)
11.b) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,4,y}$)	[(2) * (5) * (7) * (9.b)]/10^6	49,586(tCO_2/y)

12) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,5,y}$)	[(3) * (6) * (8) * (9)]/10^6	125(tCO_2/y)
12.b) Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues ($BR_{B1/B3,5,y}$)	[(3) * (6) * (8) * (9.b)]/10^6	149(tCO_2/y)
13) Emissions (during 2012)		**76,214(tCO_2/y)**
13.b) Emissions (2013 and forward)		**90,731(tCO_2/y)**

Proceed to step6: Calculate baseline emissions

According to equation 2 of the ACM0006 (Version 12.1.1), the emission reductions due to electricity displacement can be calculated as follows:

Data:

1) Baseline minimum electricity generation in the grid in year y.	$EL_{BL,GR,y}$	169,066(MWh)
2) Grid emission factor in year y.	$EF_{EG,GR,y}$	0.722(tCO_2/MWh)
3) Baseline fossil fuel demand for process heat in year y.	$FF_{BL,HG,y,f}$	15,431(GJ/y)
4) CO_2 emission factor for fossil fuel type f in year y.	$EF_{FF,y,f}$	0.0748(tCO_2/GJ)
5) Baseline uncertain electricity generation in the grid or on-site in year y.	$EL_{BL,FF/GR,y}$	0(MWh)
6) CO_2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y.	min($EF_{EG;GR;Y}$, $EF_{EG;FF;Y}$)	0.722(tCO_2/MWh)

Calculations:

7) Baseline emissions due to minimum grid electricity displacement.	(1) * (2)	122,124(tCO_2eq/y)
8) Baseline emissions due to fossil fuel demand for process heat generation in year y.	(3) * (4)	1,518(tCO_2eq/y)
9) Baseline emissions due to uncertain electricity generation in the grid in year y.	(5) * (6)	0(tCO_2eq/y)
10) Baseline emissions.		**123,642(tCO_2eq/y)**

Project emissions

Considering the simplifications of equation 37 of the ACM0006 Version 12.1.1) presented in the preceding section of the PDD, the project emissions are calculated as follows:

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

a)

Determination of $PE_{FF,y}$: Emissions due to fossil fuel consumption at the project site

– Fossil fuel consumption in the power boiler

A larger power boiler with a higher biomass combustion capacity and thereby higher steam generation capacity than baseline power boiler will lead to some additional consumption of fossil fuel required due to operational reasons, such as start-up and shut downs operations, fuel required to increase the combustion efficiency during winter operation, when biomass is extremely wet. As a result, this fossil fuel consumption may present a significant variation from year to year.

As a reasonable (average) estimate, the Project Participant contemplates 1,300,000 (l/y) equivalents to 1,092 tons per year of Diesel consumption based on measurements conducted in previous monitoring periods. Additionally, the Project Participant contemplates 520 (l/y) equivalents to 0.29(ton/y) of LPG consumption based on measurements conducted in previous monitoring period.

The Project Participant would like to inform the following:

- Alternatively to Diesel consumption, the project activity might use Fuel Oil for operational requirements.
- Any other fuel consumed at the project site attributable to the project activity, such as consumption for mechanical treatment of the biomass, conveyor belts, driers, etc… will be not contemplated under this parameter.

The amount generates GHG emissions, which can be estimated as follows:

Data:

(1) Diesel consumption due to operational reasons.	$FC_{Diesel, y}$	1,092(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)
(4) LPG consumption due to operational reasons.	$FC_{LPG, y}$	0.29(ton/y)
(5) LPG net calorific value.	$NCV_{,LPG,y}$	52.20(GJ/ton)
(6) LPG CO_2 emission factor.	$EF_{,LPG,y}$	0.0656(tCO_2/GJ)
(7) Fuel Oil consumption due to operational reasons.	$FC_{FO,y}$	0.0(ton/y)
(8) Fuel Oil net calorific value.	$NCV_{FO,y}$	41.70(GJ/ton)
(9) Fuel Oil CO_2 emission factor.	$EF_{FO,y}$	0.0788(tCO_2/GJ)

According to this, the total GHG emissions from this source are:

Calculations:

(10) Total emissions.	**[(1)*(2)*(3)+(4)*(5)*(6) +(7)*(8)*(9)]**	**3,538(tCO_2/y)**

– 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 residues consumption attributed to the project activity to the power boiler area. The value applied contemplates a total amount of 89,659 (l/y) equivalents to 75.31(ton/y), in this case Diesel, based on measurements performed in previous monitoring periods, thus generating the following emissions:

Data:

(1) Diesel for on-site biomass transportation due to the project act.	$FC_{Diesel,\ y}$	75.31(ton/y)
(2) Diesel net calorific value.	$NCV_{FF,Diesel,y}$	43.30(GJ/ton)
(3) Diesel CO_2 emission factor.	$EF_{FF,y,Diesel}$	0.075(tCO_2/GJ)

According to this, the total GHG emissions from this source are:

Calculations:

(4) Total emissions.	**(1) * (2) * (3)**	**244(tCO_2/y)**

– Fossil fuel consumption for processing biomass residues from forest operations:

It is estimate the project activity will imply a consumption of 3,803(BDt/y) of mix of saw dust and bark from forest operations. The mechanical processing of this biomass residue will contemplate a total of fossil fuel consumption of 30,259 (l/y) equivalents to 25.42 (ton/y), in this case Diesel, thus generating the following emissions:

Data:

(1) Diesel consumption for processing biomass from forest oper.	$FC_{Diesel,y}$	25.42(ton/y)
(2) Diesel net calorific value.	$NCV_{Diesel,y}$	43.30(GJ/ton)
(3) Diesel CO_2 emission factor.	$EF_{Diesel,y}$	0.075(tCO_2/GJ)

According to this, the total GHG emissions from this source are:

Calculations:

(4) Total emissions.	**(1) * (2) * (3)**	**82(tCO_2/y)**

$PE_{FF,y}$: Emissions due to fossil fuel consumption at the project site	
Emissions from fossil fuel consumption in the power boiler.	3,538(tCO_2/y)
Emissions from fossil fuel consumption due to on-site transportation of biomass.	244(tCO_2/y)
Emissions from fossil fuel consumption due to processing forestry biomass.	82(tCO_2/y)
Total emissions $PE_{FF,y}$	**3,864(tCO_2/y)**

The Project Participant would like to note that the latest approval version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" is used in this PDD for emission calculations.

b) Determination of $PE_{GR1,y}$: Emissions due to electricity imports from the grid to the project site.

According to equations 38 of the ACM0006 (Version 12.1.1), the following calculation can be done to calculate project emissions:

Data:

1) Project electricity imports from the grid.	$EL_{PJ,imp,y}$	2,000(MWh)
2) Grid emission factor.	$EF_{EG,GR,y}$	0.722(tCO_2/MWh)

According to this, the total GHG emissions from this source are:

Calculations:

3) Total emissions	**(1) * (2)**	**1,445(tCO_2/y)**

c) Determination of $PE_{GR2,y}$: Emissions due to a reduction in electricity generation at the project site as compared to the baseline scenario.

Not applicable in this case.

d) Determination of $PE_{TR,y}$: Emissions due to transport of the biomass residues to the project plant.

The project activity includes the following categories of biomass residues:

- Category N°4: Mix of sawdust and bark from off-site industrial operations without biomass residues (mainly bark with sawdust) from pulp mill operations as it is transported by a conveyor belt to the power plant; and
- Category N°5: Mix of sawdust and bark from forest operations.

Both biomass residues categories previously described are transported by heavy trucks to the power plant and therefore, 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.	$BR_{PJ,4,y}$	126,189(BDt/y)
2) Mainly bark with sawdust from off-site pulp mill operations, electricity generation. [(a)]		95,767(BDt/y)
3) Mix of sawdust and bark from off-site industrial operations, electricity generation.	[(1) – (2)]	30,422(BDt/y)
4) Biomass residues (mix of sawdust and bark) from forest operations, electricity generation.	$BR_{PJ,5,y}$	3,803(BDt/y)
5) Total mass of freight transported in freight transportation activity f.	$FR_{f,m}$ = [(3) + (4)]	34,225(BDt/y)
6) Return trip road distance between the origin and destination of freight transportation activity f. [(b)]	$D_{f,m}$	84.76(km)x2
7) Weight average calculation. [(c)]	$\sum[D_{f,m} * FR_{f,m}]$	4,955,475
8) Default CO_2 emission factor for freight transportation activity f.	$EF_{CO2,f}$	129(gCO_2/t-km)

The Project Participant would like to note the following:

(a) This biomass residues amount will be transported from the pulp mill using a dedicated conveyor belt to the power plant; therefore, in this case, the project emissions due to freight transportation are contemplated.

(b) 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).

(c) The applied value in project emission calculation was determined using weight average calculation between return distance of freight activity *f* and the corresponding mass weight measurements obtained in previous monitoring period (See Appendix 5 of this PDD).

Calculations:

(14) Total emissions.	**$[(7) * (8)]/10^6$**	**640(tCO_2/y)**

Determination of $PE_{BR,y}$: Emissions from the combustion of biomass residues.

According to equation 40 of the ACM0006 (Version 12.1.1), 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:

Data:

1) Sludge from off-site industrial operations, heat generation.	$BR_{PJ,1,y}$	15,552(BDt/y)
2) Mix of sawdust and bark from on-site industrial operations, heat generation.	$BR_{PJ,2,y}$	130,405(BDt/y)
3) Mix of sawdust and bark from on-site industrial operations, electricity generation.	$BR_{PJ,3,y}$	104,327(BDt/y)
4) Mix of sawdust and bark from off-site industrial operations, electricity generation.	$BR_{PJ,4,y}$	126,189(BDt/y)
5) Mix of sawdust and bark from forest operations, electricity generation.	$BR_{PJ,5,y}$	3,803(BDt/y)
6) Net calorific value of sludge from off-site industrial operations.	$NCV_{BR,1,y}$	10.70(GJ/ton)
7) Net calorific value of mix of sawdust and bark from on-site industrial operations.	$NCV_{BR,2,y}$	17.98(GJ/ton)
8) Net calorific value of mix of sawdust and bark from on-site industrial operations.	$NCV_{BR,3,y}$	17.98(GJ/ton)
9) Net calorific value of mix of sawdust and bark from off-site industrial operations.	$NCV_{BR,4,y}$	17.98(GJ/ton)
10) Net calorific value of mix of sawdust and bark from forest operations.	$NCV_{BR,5,y}$	16.76(GJ/ton)
11) Adjusted CH_4 emission factor for controlled burning, mix of sawdust and bark from forest operations.[(a)]	$EF_{CH4,BR}$	0.00(tCH_4/GJ)
12) Conservativeness factor [(b)]		1.02(number)
13) CH_4 Global Warming Potential.	GWP	21(number)
13.b) CH_4 Global Warming Potential	GWP	25(number)

The Project Participant would like to note the following:

(a) The value applied is zero based on measurements performed in previous monitoring periods instead of using the default methane emission factor provided by the methodology.
(b) Conservativeness factors from Table 5 of the ACM0006 (Version 12.1.1).

Calculations:

(14) Emissions (2012)	**[(1)*(6)+(2)*(7)+(3)*(8)+(4)*(9)+(5)*(10)]*(11)*(12)*(13)**	**0(tCO_2eq/y)**
(14.b) Emissions (2013 and forward).	**[(1)*(6)+(2)*(7)+(3)*(8)+(4)*(9)+(5)*(10)]*(11)*(12)*(13.b)**	**0(tCO_2eq/y)**

e) Determination of $PE_{ww,y}$: Emissions from wastewater generated from the treatment of biomass residues

Not applicable in this case.

f) Determination of $PE_{BG2,y}$: Emissions from the production of biogas

Not applicable in this case.

Total project emissions

Project emission sources		
Emissions due to fossil fuel consumption at the project site.	$PE_{FF,y}$	3,864(tCO_2eq/y)
Emissions due to grid electricity imports to the project site.	$PE_{GR1,y}$	1,445(tCO_2eq/y)
Emissions due to reduction in electricity generation at the project site as compared to the baseline.	$PE_{GR2,y}$	0(tCO_2eq/y)
Emissions due to transport of the biomass residues to the project plant.	$PE_{TR,y}$	640(tCO_2eq/y)
Emissions from the combustion of biomass residues.	$PE_{BR,y}$	0(tCO_2eq/y)
Emissions from wastewater generated from the treatment of biomass residues.	$PE_{ww,y}$	0(tCO_2eq/y)
Emissions from the production of biogas.	PE_{BG2}	0(tCO_2eq/y)
Total emissions.		**5,949(tCO_2eq/y)**

Leakage emissions

As it was previously stated in the PDD, the proposed project activity does not consider biomass residues for which leakage is potential. As a result, and according to equation 42 of the ACM0006 (Version 12.1.1), the leakage emissions are assumed to be zero for the proposed project activity.

$$LE_y = EF_{CO2,LE} * \sum_n BR_{B5/B8,n,y} * NCV_{BR,n,y}$$

Where:

LE_y = Leakage emissions in year y (tCO_2).
$EF_{CO2,LE}$ = CO_2 emission factor of the most carbon intensive fossil fuel in the country (tCO_2/GJ).
$BR_{B5/B8,n,y}$ = Quantity of biomass residues of category n used in the project activity in year

y, for which the baseline scenario is B5:, B6:, B7:, or B8 (tonnes on dry-basis).

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

n = Biomass residue category.

y = Year of the crediting period.

For biomass residues categories for which scenarios B1, B2, or B3 is deemed a plausible baseline scenario, project participant should demonstrate that the quantity of available biomass residues of this type in the region is at least 25% larger than the quantity of biomass residues of this type that are utilized.

The biomass types for the Nueva Aldea Phase 1 project activity are presented below:

1. **Biomass from industrial operations**, consisting in biomass residues (a mix of sawdust and bark) generated mainly in sawmills. Currently, a fraction of this biomass is normally used to generate heat for wood-drying in sawmills. The remaining biomass is sold to other facilities for other industrial uses. However a considerable surplus still remains, which is not used for energy purposes and is left in piles to natural decay.

Biomass from industrial operations

Biomass from forestry operations

It must be mentioned that all the biomass residues considered for the Nueva Aldea Phase 1 project activity consist basically in a mix of sawdust (wood) and bark. The main difference between the biomass types identified for the project activity is related to the place where the residues are generated. Also, since all the biomass residues come from managed forest plantations, all the biomass used as fuel comes from renewable sources.

Uses for biomass residues (sawdust and bark) from industrial operations:

1. Fuel for heat generation at sawmills for drying the sawn timber. Small demand compared to the supply generates a considerable surplus that is available to third parties.

2. Electric power generation in some power plants (few cases and small plants). Most have exclusivity biomass supply contracts with nearby sawmills.

Uses for biomass from forestry operations:

1. Fuel for home warming; however the demand for this biomass is almost negligible compared to the supply.

In both cases above, the supply is higher (and in some cases, considerably higher) than the demand. This generates a surplus of biomass residues that is left on the ground or piled for natural decay.

Leakage due to the proposed project activity might occur in two ways:

1. In sawmills and other biomass producing mills that use the biomass as fuel; if they sell all their biomass to the new biomass power producer and change to fossil fuel instead;

2. In local factories that normally buy and use biomass as fuel and now are forced to switch to fossil fuels given that the new biomass power plant has depleted the biomass resource in the area.

The possibility of leakage in biomass producing facilities that use part of the residues as fuel and sell the surplus to third parties is highly unlikely. Given the nature of the biomass suppliers (mostly small and local sawmills) and the cost of fossil fuels[28], these suppliers will use their biomass to serve their own energy needs in the very first place. Only then, they will sell the surplus biomass to nearby factories and power plants.

[28] By the time this PDD was written, the oil price was around US$ 87 per barrel.

Biomass fuels are much cheaper than any other fossil fuel source available; therefore it is highly unlikely that biomass suppliers would be willing to switch to a much expensive fuel source than biomass. Currently, what happens is that the biomass suppliers generate such an excess amount of biomass, that they do not have another alternative rather than to accumulate it in piles or sell it to a nearby factory or power plant (if there exist).

The possibility of leakage in local power plants and factories may occur in the event there is an insufficient supply of biomass residues (mix of sawdust and bark) from industrial operations. Today this is clearly not the case since all plants that use biomass in the VIII Region operate without restriction. In this case, the project participant has performed a detailed research of the biomass supply/demand situation of the project activity, which is shown in the following table:

SUPPLY/DEMAND SITUATION
(According to the "L2" criteria to establish leakage in the ACM0006 baseline methodology)

NUEVA ALDEA INFLUENCE AREA SUPPLY/DEMAND SITUATION

Biomass supply

		2012
Industrial Operations Biomass residues	(m^3st/yr)	3,074,071
Forestry Operations Biomass residues	(m^3st/yr)	2,471,519

Biomass demand

		2012
Industrial Operations Biomass residues	(m^3st/yr)	2,279,846
Forestry Operations Biomass residues	(m^3st/yr)	84,305

Industrial Biomass residues generated/Industrial Biomass residues consumpt	**(number)**	**1.3484**
Forestry Biomass residues generated/Forestry Biomass residues consumptio	**(number)**	**29.3164**

Source: Index of biomass surplus NAPh1 2012.xls

According to the table above, the supply/demand indexes for each of the biomass types consumed by the project activity are clearly higher than the 1.34 threshold established by the criteria of the ACM0006 (Version 12.1.1). 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.

In addition to the above, it must be noted that Arauco owns a significant portion of the managed forestlands in VII, VIII and IX Regions. This makes Arauco an important supplier of bark and sawdust in the area (i.e. Arauco sawmills) and the main potential supplier of biomass from forest operations for the Nueva Aldea Phase 1 biomass power plant. This certainly contributes to guarantee the biomass availability to the power plant, without compromising the current biomass supply to other consumers in the area.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2012	199,856	5,949	0	193,907
2013	214,373	5,949	0	208,424
2014	214,373	5,949	0	208,424
2015	214,373	5,949	0	208,424
2016	214,373	5,949	0	208,424
2017	214,373	5,949	0	208,424
2018	214,373	5,949	0	208,424
Total	1,486,095	41,640	0	1,444,451
Total number of crediting years	7 years			
Annual average over the crediting period	212,299	5,949	0	206,350

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	**Biomass residues categories and quantities used in the project activity.**
Unit	Type: sludge, mix of sawdust and bark from industrial and forest operations. 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 applied values of biomass residues amounts presented in the table below were obtained from ex-post measurements performed in previous monitored periods. All biomass categories presented in this table as well as new (possible) categories that eventually might be incorporated later on will be continuously monitored in the project plant, according to the monitoring plan.
Source of data	On-site measurements.
Value(s) applied	

Biomass residues category k	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 (BDt[29]/y.)
1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for heat generation at the project site in new and/or existing plants. (B4)	Biomass attributable to heat generation.	15,552
2	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass residues are used for heat generation at the project site in new and/or existing plants. (B4)	Biomass attributable to heat generation.	130,405

[29] BDt stands for "Bone-dry ton" and means 100% dry biomass or tonnes on dry-basis.

3	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.	104,327
4	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.	126,189
5	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.	3,803

Measurement methods and procedures

Biomass residues category k	Biomass residues type.	Biomass residues measurement system description
1	Sludge from off-site industrial operations.	The sludge will be transported from the effluent treatment plant area to the wood-handling area in containers. The amount of (wet) sludge will be measured by weighting all the containers transported to the wood-handling area in the weighbridge system: The accuracy of each weighbridge (from now on the weighbridge system) is +/- 30 kg. The amount of dry sludge will be determined adjusting for the corresponding moisture content which will be determined by measuring the humidity content of a representative number of samples taken from the containers used for transportation of the sludge to the power plant. This parameter will be monitored continuously. Responsible to undertake the measurement: The Power Boiler Department will be responsible to undertake continuously measurement.
2	Mix of sawdust and bark from on-site industrial operations.	The biomass residues amount will be measured using the weighbridge system and proper weight meters. Mix of sawdust and bark from the Sawmill (AASA):
3	Mix of sawdust and bark from on-site industrial operations.	The mix of sawdust and bark corresponding to categories 2 and 3 are the same type of biomass originated from on-site industrial operations, and due to the same origin, they will be jointly monitored. The biomass corresponding to category 3 will be given by the total measurement of biomass residues (category 2 and category 3) minus the amount of biomass residues of category 2 which will be calculated from the heat demanded by the facility processes using equation 14 of the ACM0006 (Version 12.1.1). Responsible to undertake the measurement: The Power Boiler Department will be responsible to undertake continuously measurement.
4	Mix of sawdust and bark from off-site industrial operations.	Biomass residues (mainly bark) from pulp mill operations Mainly bark flow originated from pulp mill operations will be transported using a conveyor belt towards the Power Plant, and will be measured by a proper and calibrated weight meter of accuracy class, according to manufacturing of: The accuracy class, according to manufacturing of 1.5%

		Mix of sawdust and bark from 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.
5	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 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:	**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 12.1.1), page 14, to demonstrate the selection of the baseline scenario B1/B3 for the additional biomass residues attributable to the project activity.
Measurement methods and procedures	---
Monitoring frequency	---
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	$BR_{PJ,n,y}$
Unit	Tonnes on dry-basis.
Description	Quantity of biomass residues of category n used in the project activity in year y (tonnes on dry-basis)
Source of data	On-site measurements.
Value(s) applied	(see table below)

Biomass residues category k	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 (BDt/y)
1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for heat generation at the project site in new and/or existing plants. (B4).	Biomass attributable to heat generation.	15,552
2	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 in new and/or existing plants. (B4)	Biomass attributable to heat generation.	130,405
3	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.	104,327
4	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.	126,189
5	Mix of sawdust and bark from forest operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1).	Biomass attributable to power generation.	3,803

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	– The biomass residues quantities used will be monitored separately for each type and source of production, as it is shown in table above. – Monitoring of this parameter for Project emissions will be required, as in this case methane emissions from biomass combustion in the Power boiler are contemplated in the project boundary.

Data / Parameter	$BR_{B4,n,y}$
Unit	Tonnes on dry-basis.
Description	Quantity of biomass residues of category k used in the 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	(see table below)

Biomass residues category k	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 (BDt/y)
1	Sludge from industrial operations.	Off-site production	The biomass residues are used for heat generation at the project site in new and/or existing plants. (B4)	Biomass attributable to heat generation.	15,552
2	Mix of sawdust and bark from industrial operations.	On-site production	The biomass residues are used for heat generation at the project site in new and/or existing plants. (B4)	Biomass attributable to heat generation.	130,405

Measurement methods and procedures	See table describing measurement procedures under variable **"Biomass residues categories and quantities used in the Project activity"** for further information. Biomass residues type of category 2 will be determined from the heat demanded by the facility processes using equation 14 of the ACM0006.
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.
QA/QC procedures	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data	Baseline emissions calculations.
Additional comment	See procedure described in Step 1.4 of this PDD to determine the baseline availability.

Data / Parameter	$BR_{B1/B3,n,y}$
Unit	Tonnes of dry-basis.
Description	Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B1 or B3 (tonnes on dry-basis).
Source of data	On-site measurements.
Value(s) applied	(see table below)

Biomass residues category k	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 (BDt/yr.)
3	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.	104,327
4	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.	126,189
5	Mix of sawdust and bark from forestry operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1),	Biomass attributable to power generation.	3,803

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	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock variations.
Purpose of data	Baseline and project emissions calculations.
Additional comment	---

Data / Parameter	$BR_{B5/B8,n,y}$
Unit	Tonnes of dry basis.
Description	Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B5:, B6:, B7, or B8 (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 and measurement 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	---

<u>Monitored parameters for the tool to calculate “Project or leakage emissions from road transportation of freight” (Version 01.1.0)</u>

Data / Parameter	$FR_{f,m}$
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 34,225 (BDt/y) based on measurements performed in previous monitoring periods. This values results of the sum between 30,422 (BDt/y) and 3,803 (BDt/y). (Refer to notes below for additional information).

Biomass residues category k	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 (BDt/y)
4	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.	95,767[(a)] 30,422[(b)] 126,189
5	Mix of sawdust and bark from forest operations.	Off-site production.	Dumped or left to decay under clearly aerobic conditions (B1).	Biomass attributable to power generation.	3,803

	The Project participant would like to note the following: Biomass residues of category 4 will be transported to the power plant as follows: a) Biomass amount from pulp mill operations will be transported using a dedicate conveyor belt, hence the PP will not contemplate this amount under the parameter $FR_{f,m}$ b) Biomass amount from off-site will be brought by (heavy) trucks to the plant, hence the PP will contemplate this amount under the parameter $FR_{f,m}$. (See Diagram on Appendix 5 of this revised PDD).
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 when they enter the Plant. – The (wet) freight, measured directly by plant operators, 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.

Data / Parameter	$D_{f,m}$
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 from previous monitoring period. (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 Nueva Aldea Phase 1 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 Option B 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.

Monitored parameters for the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (Version 02)

<table>
<tr><td>Data / Parameter</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Unit</td><td>(tCO_2/GJ)</td></tr>
<tr><td>Description</td><td>Weight average CO_2 emission factor of fuel type i in year y.</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>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.

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>

For this project activity, 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>– In case of measurement: At least every six months, taking at least three samples for each measurement.

– In case of other data sources, such as IPCC the appropriateness of the data will be reviewed annually. This is the option selected by the Project participant.

The measurement of this parameter will be performed using <u>Option B</u> in accordance with the procedure established in the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”:

$EF_{CO2,FF,i}$ (tCO_2/GJ): Carbon content of FF (tC/TJ) * Fraction of carbon oxidized * CO_2/C conversion factor (tCO_2/tC) * (1TJ/1,000GJ)

Where Fossil Fuel (FF) denote for fossil fuels types: Diesel, Fuel oil and LPG.
Any future revision of the IPCC guidelines will be taken into account.</td></tr>
</table>

Monitoring frequency	Annually.
QA/QC procedures	Not applicable since a default factor will be used in this case.
Purpose of data	Project emission calculations.
Additional comment	Note that 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 to determine the CO_2 emission coefficient of fuel type i.

Data / Parameter	**FC** $_{i,\ Project\ Plant,\ y}$
Unit	Mass or volume per year (ton/y or m$^{3/}$y)
Description	Quantity of fuel type i combusted in process j during the year y.
Source of data	On-site measurements.
Value(s) applied	– The applied value of 1,300,000(l/y) equivalents to 1,092(ton/y), in this case Diesel, is based on average consumption in previous monitoring periods. – The applied value of 520(l/y) equivalents to 0.29(ton/y), in the case LPG, based on monitored consumption due to start-up operations.in previous monitoring periods – The applied value of 0 (l/y), in this case FO, as an alternative to Diesel consumption.
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. The Project Participant would like to inform the following: – Annual verification of calibrations will be conducted according to the manufacture recommendations. – The instrument used to measure LPG consumption is property of the supplier and not belong to the Project Participant, calibrations must be done in order to comply with the Chilean law. Measurement of this parameter will be performed in accordance with the procedure established hereby: Fossil fuel consumption in the Power Boiler: Dedicated fuel tank level meter with accuracy of +/- 0.075% will be used to monitor Diesel and Fuel Oil consumption. Since the instrument (s) used to measure the LPG consumption is property of the LPG´s supplier, all information related to the instrument (s) will be managed externally to the plant.
Monitoring frequency	Continuously.

QA/QC procedures	– The consistency of fuel consumption measurement should be cross-checked by an annual energy and 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	Value applied of Diesel contemplates consumption due to technical constraints, start-up operations and general stoppage of the plant based on previous monitored periods. Note that operational events, such as trips of the power boiler and failure of equipment are not contemplated in this range, as these are unpredictable events.

Data / Parameter	$FC_{i, Project Site, y}$
Unit	Mass or volume per year (ton/y or m^3/y)
Description	Quantity of fuel type i combusted in process j during the year y.
Source of data	On-site measurements.
Value(s) applied	The applied value of 89,659 (l/y) equivalent to 75.31 (ton/y), in this case Diesel, is based on consumption due to on-site transportation of biomass residues to the power boiler in previous monitoring periods.
Measurement methods and procedures	– Use either mass or volume meters. – Accessories such as transducers, sonar, and piezo-electronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance. <u>Measurement of this parameter will be performed in accordance with the procedure established hereby</u>: – The Diesel consumption will be determined by monitoring the fuel consumption of trucks, diesel-fuelled bulldozers and/or front loaders that will transport the biomass to the power boiler biomass feeding lines. The Project Participant would like to note that the monitored data of this parameter will be determined from the transportation subcontractors´ information.
Monitoring frequency	Continuously.
QA/QC procedures	– Consistency of measurements should be checked with vehicles specific fuel consumption rates: litres of fuel consumed per hour of operation, litres of fuel consumed per kilometre driven or other as appropriate. – 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. The Project Participant would like to note that the transportation subcontractors will not inform the purchase fuel invoices to the plant, consequently the former of the QA/QC procedures above described will be used to check consistency of measurements obtained.
Purpose of data	Project emissions calculations.
Additional comment	Note that this parameter does not include fossil fuels co-fired in the Project Plant, but any other fossil fuel consumption at the project site attributable to the project activity.

Data / Parameter:	**FC** $_{i, Biomass Processing, y}$
Unit	Mass or volume per year
Description	Quantity of fuel type i combusted in process j during the year y.
Source of data	Fuel consumption records from subcontractors that process the biomass from forest operations.
Value(s) applied	The applied value is 30,259 (l/y) equivalents to 25.42 (ton/y), in this case Diesel.
Measurement methods and procedures	– Use either mass or volume meters. Measurement of this parameter will be performed in accordance with the procedure established hereby: – Fuel consumption records, from subcontractors that process the biomass residues from forest operations consumed in the project activity. The Project Participant would like to note that the monitored fuel consumption will be informed by subcontractors quarterly.
Monitoring frequency	Continuously.
QA/QC procedures	– Consistency of measurements should be checked with vehicles specific fuel consumption rates: litres of fuel consumed per hour of operation, litres of fuel consumed per kilometre driven or other as appropriate. – 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. The Project Participant would like to note that the transportation subcontractors will not inform the purchase fuel invoices to the plant, consequently the former QA/QC procedure above described will be used to cross-check this parameter.
Purpose of data	Project emissions calculations.
Additional comment	

Data / Parameter	**NCV**$_{FF, f, y}$
Unit	GJ per mass or volume unit (e.g. GJ/m^3, GJ/ton)
Description	Weight average net calorific value of fossil fuel type i in year y.
Source of data	(see table below)

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).
d) IPCC default values at the	If a) is not available.

	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.	

	In this case, 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 applied values are: 43.3(GJ/ton) for Diesel. 41.7(GJ/ton) for Fuel Oil 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 uses 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	$\mathbf{EF_{CH4,BR}}$
Unit	tCH_4/GJ
Description	$\mathbf{EF_{CH4,BR}}$ = CH_4 emission factor for the combustion of biomass residues in the Project Plant (tCH_4/GJ).
Source of data	On-site measurements.
Value(s) applied	0.0 (tCH_4/GJ) The Project Participant would like to note that the applied value, based on measurements conducted in previous monitoring periods, is used instead of the default methane emission factor provided by the baseline methodology.
Measurement methods and procedures	The CH_4 emission factor will be determined by taking samples from the power boiler flue gases and performing a gas stack analysis using calibrated analyser in a specialized laboratory.
Monitoring frequency	At least quarterly, taking at least three samples per measurement.
QA/QC procedures	Cross-check measurements performed with measurements obtained in previous monitoring periods, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurements results differ significantly from previous measurements or other relevant data source, additional measurements will be conducted.
Purpose of data	Project emissions calculations.
Additional comment	The monitoring of this parameter for project emissions is required, since

	in the case of this project activity the CH_4 emissions from biomass combustion are contemplated in the project boundary. Note that a conservative factor will be applied, as specified in the baseline methodology.

Data / Parameter	**$EF_{CO2,LE}$**
Unit	tCO_2/GJ
Description	CO_2 emission factor of the most carbon intensive fuel used in the country. (tCO_2/GJ)
Source of data	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication/GHG inventory. If available, use national default values for the CO_2 emission factor. Otherwise, IPCC default values may be used.
Value(s) applied	Not used, since leakage is assumed to be 0.
Measurement methods and procedures	---
Monitoring frequency	The appropriateness of the data will be reviewed annually.
QA/QC procedures	---
Purpose of data	Leakage emissions calculations.
Additional comment	Note that this parameter will be required for a period in which leakage for a biomass type i, could not be ruled out, otherwise, this will be not used.

Data / Parameter	**$HC_{BL,y}$**
Unit	GJ
Description	**$HC_{BL,y}$** =Baseline process heat generation in year y (GJ).
Source of data	On-site measurements.
Value(s) applied	2,149,857(GJ) The applied value is based on measurements in previous monitoring periods.
Measurement methods and procedures	Measurement of this parameter will 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 +/- 0.075%, of calibrated span; of temperature measurement is +/- 0.10 °C of calibrated span, and of flow meters measurement is +/- 0.025% and 0.075% depending on flow meter type.
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	---

Data / Parameter	**$EL_{PJ,gross,y}$**
Unit	MWh
Description	$EL_{PJ,gross,y}$ = 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).
Source of data	On-site measurements.
Value(s) applied	223,822(MWh) The applied value is based on measurements conducted in previous monitoring periods.
Measurement methods and procedures	This parameter will be measured using proper and dedicated electric meters. All meters will receive calibration and maintenance according to manufacture specifications and proper industry standards. The Project Participant compromise an accuracy level of +/-0.3%. Nevertheless, this accuracy might change until +/- 0.5%. In case that the accuracy level of the installed equipment result less than the committed in this PDD, the Project Participant must correct the measurement according Appendix 1, item 4 of the Project Standard Version 07.
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	---

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 2,000 (MWh), based on monitored consumption 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 manufacture specification and proper industry standards. The Project Participant compromise an accuracy level of +/-0.3%. Nevertheless, this accuracy might change until +/- 0.5%. In case that the accuracy level of the installed equipment result less than the committed in this PDD, the Project Participant must correct the measurement according Appendix 1, item 4 of the Project Standard Version 07.
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	---

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 56,756(MWh). The Project Participant would like to note that the applied value is composed by the monitored and an estimate electricity consumption. This is explain as follows: – The value of 43,900 (MWh) is determined based on monitored plant´s auxiliary electricity consumption conducted in previous periods. – The estimate of 12,856 (MWh) is based on manufacture specification of electricity consumption of on-site biomass residues transportation systems. (Refer to step 1.2 and to Appendix 5 of this PDD for additional information).
Measurement methods and procedures	This parameter will be measured using proper electric meters. All meters will receive calibration and maintenance according to manufacture specification and proper industry standards. The Project Participant compromise an accuracy level of +/-0.3%. Nevertheless, this accuracy might change until +/- 0.5%. In case that the accuracy level of the installed equipment result less than the committed in this PDD, the Project Participant must correct the measurement according Appendix 1, item 4 of the Project Standard Version 07.
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	Total auxiliary electricity consumption includes all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and 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.).

Data / Parameter	$NCV_{BR,n,y}$
Unit	GJ/tonnes of dry-basis
Description	Net calorific value of biomass residues of category n in year y (GJ/tonne of dry-basis).
Source of data	On-site measurements.
Value(s) applied	The applied values based on measurements performed in previous monitoring periods are presented below:

	<table><tr><td>Biomass residues category k</td><td>Biomass residues type</td><td>Net calorific value (GJ/tonne of dry matter)</td></tr><tr><td>1</td><td>Sludge from industrial operations.</td><td>10.70</td></tr><tr><td>2</td><td>Mix of sawdust and bark from industrial operations.</td><td>17.98</td></tr><tr><td>3</td><td>Mix of sawdust and bark from industrial operations.</td><td>17.98</td></tr><tr><td>4</td><td>Mix of sawdust and bark from industrial operations.</td><td>17.98</td></tr><tr><td>5</td><td>Mix of sawdust and bark from forest operations.</td><td>16.76</td></tr></table> <u>The Project Participant would like to note the following:</u> The applied values presented above are based on average measurements conducted in previous monitoring periods.
Measurement methods and procedures	Measurement of this parameter will be conducted 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 laboratories and according to relevant international standards.
Monitoring frequency	At least every six months, taking at least three samples for each measurement.
QA/QC procedures	Check consistency of measurements by comparing the measurement results with measurements from previous years, 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. NCV measurements will be determined on the basis of dry biomass.
Purpose of data	Baseline and Project emission calculations
Additional comment	---

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 k.
Source of data	On-site measurements.
Value(s) applied	<table><tr><td>Biomass residues category k</td><td>Biomass residues type</td><td>Moisture content (% of water in wet biomass residues)</td></tr><tr><td>1</td><td>Sludge from on-site industrial operations.</td><td>(60-85) %</td></tr><tr><td>2</td><td>Mix of sawdust and bark from on-site industrial operations.</td><td>(42-65)%</td></tr><tr><td>3</td><td>Mix of sawdust and bark from on-site industrial operations.</td><td>(42-65)%</td></tr><tr><td>4</td><td>Mix of sawdust and bark from off-site industrial operations.</td><td>(44-65)%</td></tr><tr><td>5</td><td>Mix of sawdust and bark from forest operations.</td><td>(52-65)%</td></tr></table> <u>The Project Participant would like to note the following:</u> The ranges above presented are based on measurements conducted in previous monitoring periods.

Measurement methods and procedures	<table><tr><th>Biomass residues category k</th><th>Biomass residues type</th><th>Procedure</th><th>Accuracy level of instruments involved</th></tr><tr><td>1</td><td>Sludge from industrial operations.</td><td>The sludge will be monitored and registered by taking periodic samples from the 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.</td><td>Electronic moisture analyser with accuracy class of 0.001.</td></tr><tr><td>2</td><td>Mix of sawdust and bark from industrial operations.</td><td>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.</td><td>Electronic moisture analyser with accuracy class of +/-0.001.</td></tr><tr><td>3</td><td>Mix of sawdust and bark from industrial operations.</td><td>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.</td><td>Electronic moisture analyser with accuracy class of +/- 0.001.</td></tr><tr><td>4</td><td>Mix of sawdust and bark from industrial operations.</td><td>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.</td><td>Electronic moisture analyser with accuracy class of +/-0.001.</td></tr><tr><td>5</td><td>Mix of sawdust and bark from forest operations.</td><td>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.</td><td>Electronic moisture analyser with accuracy class of +/- 0.001.</td></tr></table> <u>The Project Participant informs the following:</u> – The moisture content will be monitored for each batch of biomass residues category. – The weight average will be calculated for each monitoring period and used in the emission reduction calculations.
Monitoring frequency	This parameter will be monitored for each batch of biomass residues category and aggregated data monthly.
QA/QC procedures	---
Purpose of data	Baseline and Project emission calculations.
Additional comment	---

Monitored parameters from the "Tool to calculate the emission factor for an electricity system (Version 03.0.0)"

Data / Parameter	$EF_{grid,CM,y}$
Unit	(tCO_2/MWh)
Description	CO_2 emission factor for grid electricity during year y.
Source of data	– CDEC-SIC Dispatch Centre reports. – Ministry of Energy reports. – IPCC lower values.
Value(s) applied	The value applied is 0.722(tCO_2/MWh). The grid emission factor is calculated for 2010 and used to estimate the future emission reductions of the project activity. Although, it is likely that this value will suffer changes in the subsequent years, the Build margin (BM) value of 0.695(tCO_2/MWh) will remain fixed for the second and third crediting periods.
Measurement methods and procedures	Arauco Bioenergía 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 03.0.0)". (See Appendix 4 of this PDD).
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	CO_2 Operating margin emission factor of the grid.
Source of data	– CDEC-SIC Dispatch Centre reports. – Ministry of Energy reports. – IPCC lower values.
Value(s) applied	0.803(tCO_2/MWh). (See Appendix 4 of this PDD)
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 03.0.0)".
Monitoring frequency	Annually.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	All data parameters used to determine the grid emission factor, as required by the Tool are included in the monitoring plan.

Data / Parameter	$FC_{i,m,y}$, $FC_{i,k,y}$
Unit	(Mass or volume unit)
Description	Amount of fossil fuel type i consumed by power plant/unit m and k in year y. In this case, "m" denotes all grid power units serving the grid in year y

	except low-cost/must-run power units and "k" denotes all low-cost/must run grid power units serving the grid in year y.
Source of data	Utility or government records or official publications. In this case, the Project Participant will use official publications.
Value(s) applied	(See Appendix 4 of this PDD).
Measurement methods and procedures	---
Monitoring frequency	– Monitoring frequency, Simple adjusted OM: Annually during the crediting period for the relevant year. – Monitoring frequency, BM: For the first crediting period, annually ex-post. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	**$NCV_{i,y}$**
Unit	(GJ / mass or volume unit)
Description	Net calorific value (energy content) of fossil fuel type i in year y.
Source of data	The following data sources may be used in the relevant conditions apply: <table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>Values provided by the fuel supplier of the power plants invoices.</td><td>If data is collected from power plant operators (e.g. utilities).</td></tr><tr><td>Regional or national average default values.</td><td>If values are reliable and documented in regional or national energy statistics / energy balances.</td></tr><tr><td>IPCC default values at the lower 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>--</td></tr></table> In this case, there exist reliable and documented national energy statistics therefore; the source used for the emission reduction calculation is the Energy Balance for 2010 provided by the CNE (National Energy Commission).
Value(s) applied	Diesel: 45.6 (GJ/ton) IFO 180: 44.0 (GJ/ton) Natural Gas: 39.1 (GJ/ton) Coal: 29.3 (GJ/ton) Petcoke: 29.3 (GJ/ton) Butane: 39.1 (GJ/ton) Propane: 39.1 (GJ/ton)
Measurement methods and procedures	---

Monitoring frequency	– Monitoring frequency simple adjusted OM: Annually during the crediting period for the relevant year. – Monitoring frequency BM: For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures	---
Purpose of data	Baseline emission calculations
Additional comment	The gross calorific value (GCV) of the fuel can be used, if gross calorific values are provided by the data sources used. In such cases, also a gross calorific value basis will be used for CO_2 emission factor.

Data / Parameter	$EF_{CO2,i,y}$, $EF_{CO2,m,i,y}$
Unit	(tCO_2/GJ)
Description	CO_2 emission factor of fossil fuel type i used in power unit m in year y.
Source of data	The following data sources may be used in the relevant conditions apply: **Data source** / **Conditions for using the data source**: - Values provided by the fuel supplier of the power plants invoices. — If data is collected from power plant operators (e.g. utilities). - Regional or national average default values. — If values are reliable and documented in regional or national energy statistics / energy balances. - IPCC default values at the lower 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. — --- In this case, the Project Participant will use the IPCC default factors for emission reduction calculations.
Value(s) applied	Diesel: 0.0726(tCO_2/GJ) IFO 180: 0.0722(tCO_2/GJ) Natural Gas: 0.0543(tCO_2/GJ) Coal: 0.0895(tCO_2/GJ) Petcoke: 0.0829(tCO_2/GJ) Butane: 0.0616(tCO_2/GJ) Propane: 0.0616(tCO_2/GJ) For subsequent emission reduction calculations, an alternative source in accordance with the monitoring methodology may be used instead.
Measurement methods and procedures	---
Monitoring frequency	– Monitoring frequency simple adjusted OM: Annually during the crediting period for the relevant year. – Monitoring frequency BM: For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	---

Data source	Conditions for using the data source
Values provided by the fuel supplier of the power plants invoices.	If data is collected from power plant operators (e.g. utilities).
Regional or national average default values.	If values are reliable and documented in regional or national energy statistics / energy balances.
IPCC default values at the lower 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.	---

Data / Parameter	$EG_{m,y}$, $EG_{k,y}$
Unit	MWh
Description	Net electricity generated by power plant/ unit m and k in year y.
Source of data	Utility or government records or official publications.
Value(s) applied	(See Appendix 4 of this PDD).
Measurement methods and procedures	---
Monitoring frequency	– Monitoring frequency simple adjusted OM: Annually during the crediting period for the relevant year.

	– Monitoring frequency BM: For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	---

B.7.2. Sampling plan

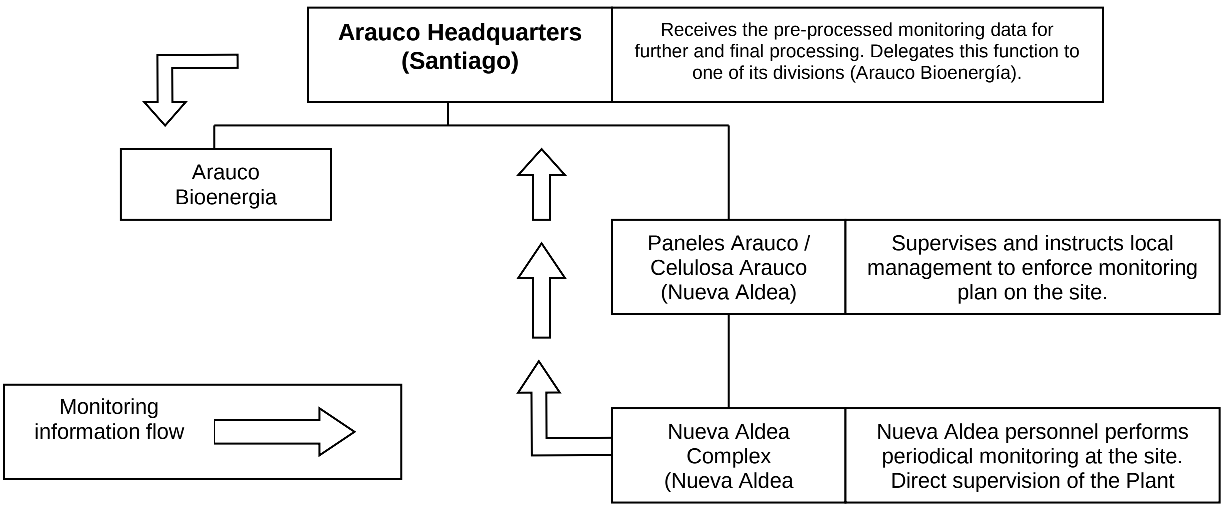
Not applicable in the case of this project activity.

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 12.1.1) 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 version 2000 standard 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 Nueva Aldea Biomass Power Plant Phase 1 project activity



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 Nueva Aldea Phase 1 project activity periodically (i.e. once every year).

Finally, since the Nueva Aldea Industrial Complex 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 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.

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

Methodology/Tool	Date date of completion of study on application of the selected methodology(ies)	Entity(ies) responsible for the application of the selected methodology(ies)
ACM0006 Ver12.1.1 Consolidated methodology for electricity and heat generation from biomass	13/09/2012	Celulosa Arauco y Constitución S.A.
Tool to calculate the emission factor for an electricity system (Version 03.0.0)	23/11/2012	Celulosa Arauco y Constitución S.A.
Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 02)	02/08/2008	Celulosa Arauco y Constitución S.A.
Tool to determine the baseline efficiency of thermal or electric energy generation systems (Version 01)	17/07/2009	Celulosa Arauco y Constitución S.A.
Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01)	16/05/2008	Celulosa Arauco y Constitución S.A.
Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period (Version 03.0.1)	02/03/2012	Celulosa Arauco y Constitución S.A.
Tool for project and leakage emissions from transportation of freight (Version 01.1.0)	23/11/2012	Celulosa Arauco y Constitución S.A.

Contact information	Mr. Christian Patrickson
Title	Development Manager of Arauco Bioenergia S.A.
Mobile	56-9158 3483
Direct tel.	56-2-2462 3795
Personal e-mail	cpatrickson@arauco.cl

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

29/09/2003.

C.1.2. Expected operational lifetime of project activity

Minimum 25 years, considered from the date the project started operating.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Renewable crediting period.

C.2.2. Start date of crediting period

01/01/2012. This is the start date of the second crediting period.

The starting date of the crediting period is defined as the first day of operation of the Nueva Aldea Biomass Power Plant Phase 1.

C.2.3. Length 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 EIS are the following:

- **Solid and Liquid Wastes:** The operation of the Plant (i.e. sawmill, plywood mill) 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.
- **Atmospheric emissions:** 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 those impacts were mentioned and resolved during the environmental impact assessment procedure.

In fact, the Project will not only managed its own biomass by using it as fuel, but it will also collect third parties biomass for its boilers, which will prevent the open-air burning or the decomposition of the biomass.

All these statements are confirmed by the endorsement of the project given by the Designated National Authority (CONAMA), in its Host country approval process. In that instance the DNA reviewed all the different environmental permits related to the project 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 in regard 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 19300 on the Environmental Framework.

The Plant in which the project is located submitted and Environmental Impact Study (EIS) in order to comply with the Chilean regulation.

The EIS was presented originally in March 17, 1999 and approved in January 26, 2001 by Resolution N° 9/2001. Due to some changes in the Project concept, the Plant submitted a new EIA in August 30, 2004 which was approved in March 10, 2005 by Resolution N° 76/2005.

As stated previously, the Plant were the CDM Project activity is located went through the Environmental Impact Assessment procedure successfully receiving all the corresponding authorizations in order to operate in accordance with the environmental legislation.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

Apart from the legal requirements imposed by the Environmental Impact System procedure, such as, publications in local newspapers and community meetings, the company decided to invest a lot of effort, money and hours in order to explain to the local authorities and to the local community the characteristics of the Project.

The Stakeholders involvement was organized through the following channels:

1. Technical staff of the Company met with local community and authorities in order to discuss all the technical aspects of the Project: this was done with the community of Coelemu and Ranquil. 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 Ranquil, Coelemu, Trehuaco and Quillón and the management of the Company were announced through leaflets send to each house and announcements in local radios. Again the conclusions of those meetings were distributed to all stakeholders.

3. Visits to the Construction site: representatives of the different communities and local authorities were invited to visit the construction site.

4. The 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.

With respect to the waste issue, the concern about how the project would manage the biomass was solved by explaining that the project activity would use all the biomass generated internally and even buy biomass from third parties.

All other technical and environmental aspects were resolved at the EIS and approved by the environmental authorities.

E.3. Report on consideration of comments received

All clarifications done by the authorities were clarified and incorporated in due time.

SECTION F. Approval and authorization

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.

The letters of approval and authorization are available at the following link:
http://cdm.unfccc.int/Projects/DB/DNV-CUK1138279173.34/view

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	CELULOSA ARAUCO Y CONSTITUCIÓN S.A.
Street/P.O. Box	El Golf 150
Building	---
City	Santiago
State/Region	Region Metropolitana
Postcode	---
Country	Chile
Telephone	56-2- 462 7000
Fax	56-2-462 7003
E-mail	cpatrickson@arauco.cl
Website	www.arauco.cl
Contact person	Arauco Bioenergía S.A.
Title	Development manager
Salutation	Mr.
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Appendix 2. Affirmation regarding public funding

<u>Public Funding:</u>
The financial plans for the Project do not involve public funding.

Appendix 3. Applicability of methodology and standardized baseline

Not applicable in this case.

Appendix 4. 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

(ACCORDING TO THE "TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM" VERSION 03.0.0)

BUILD MARGIN CALCULATION, EX - ANTE FOR THE SECOND AND THIRD CREDITING PERIODS

Power plants	POWER OUTPUT (MW)	PLANT TYPE	FUEL TYPE	START OPERATION	CDM PROYECT	TOTAL NET GEN IN 2010 (GWh)	SIC EMISSION 2010 (tCO_2/GWh)
Confluencia	155	Run of the river	Hydro	Dic-10	No	3.9	0.0
Mariposas	6	Run of the river	Hydro	Dic-10	No	0.0	0.0
Cem Bio Bio	13.6	Diesel engine	IFO 180	Dic-10	No	4.1	726.9
Cabrero	11	Biomass/steam	Biomass	Nov-10	No	1.3	0.0
Los Corrales	0.8	Run of the river	Hydro	Sep-10	No	0.2	0.0
La Higuera	154.7	Run of the river	Hydro	Sep-10	Yes	0.0	0.0
Juncalito	1.5	Run of the river	Hydro	Sep-10	No	1.3	0.0
El Tártaro	0	Run of the river	Hydro	Sep-10	No	0.1	0.0
Guayacán	12	Run of the river	Hydro	Sep-10	No	20.5	0.0
Carbomet	0	Run of the river	Hydro	Ago-10	No	20.7	0.0
El Salvador	23.8	Open Cycle	Diesel	Ago-10	No	0.3	1,114.8
San Clemente	5.5	Run of the river	Hydro	Jul-10	No	5.9	0.0
Curicó	0	0	0	Jul-10	No	0.4	0.0
Punta Colorada	16.3	Diesel engine	Diesel	Jul-10	No	7.8	624.3
Trueno	5.6	Run of the river	Hydro	Jun-10	No	19.6	0.0
Emelda	72	Open Cycle	IFO 180	Jun-10	No	1.2	966.2
Colihues IFO	22	Diesel engine	IFO 180	Jun-10	No	21.2	684.0
Colihues DIE	22	Diesel engine	Diesel	Jun-10	No	0.1	701.1
La Paloma	5.4	Run of the river	Hydro	May-10	No	3.8	0.0
Loma Los Colorados	14	Biomass/engine	Biomass	Abr-10	No	7.4	0.0
Quidico	0	Diesel engine	Diesel	Mar-10	No	0.0	0.0
Guacolda 4	152	Coal/Steam	Coal	Ene-10	No	948.5	855.2
Totoral (eólica)	46	Aeolics	Wind	Ene-10	No	84.7	0.0
Monte Redondo	48	Aeolics	Wind	Ene-10	No	82.8	0.0
Quintero GNL	240	Open Cyle	LNG	Nov-09	No	244.1	814.5
Canela 2	60	Aeolics	Wind	Nov-09	Yes	0.0	0.0
Tapihue	6.4	Diesel engine	Diesel	Oct-09	No	1.0	803.0
Termopacífico	96	Diesel engine	Diesel	Oct-09	No	19.7	741.2
Truful Truful	0.5	Run of the river	Hydro	Oct-09	No	0.0	0.0
Nueva Ventanas	272	Coal/Steam	Coal	Oct-09	No	1,829.1	1,013.5
San Lorenzo de D. De Almag	60	Diesel engine	Diesel	Sep-09	No	0.3	1,927.5
Louisiana Pacific	2.9	Diesel engine	Diesel	Jul-09	No	0.0	732.4
El Peñón	80	Diesel engine	Diesel	Jul-09	No	57.6	702.5
Pehui	1.1	Run of the river	Hydro	Jun-09	No	7.1	0.0
Biomar	2.4	Diesel engine	Diesel	Jun-09	No	0.0	734.7
Eagon	2.4	Diesel engine	Diesel	Jun-09	No	0.0	732.7
Salmofood I	1.6	Diesel engine	Diesel	Jun-09	No	0.0	0.0
Salmofood II	1.6	Diesel engine	Diesel	Jun-09	No	0.1	728.4
Teno	50	Diesel engine	Diesel	Jun-09	No	57.9	709.1
Newen	15	Diesel engine	Diesel	Jun-09	No	38.8	125.5
Watts	2.64	Diesel engine	Diesel	Jun-09	Yes	0.0	0.0
Multiexport I	1.6	Diesel engine	Diesel	Jun-09	No	0.0	0.0
Multiexport II	1.6	Diesel engine	Diesel	Jun-09	No	0.0	0.0
Tierra Amarilla	142	Diesel engine	Diesel	Jun-09	No	2.2	1,123.6
Quintero	240	Open Cycle	Diesel	Jun-09	No	16.6	800.2
Lebu (Cristoro)	3.6	Aeolics	Wind	Jun-09	No	6.7	0.0
Guacolda 3	152	Coal/Steam	Coal	Abr-09	No	1,081.6	992.0
San Gregorio	0.5	Diesel engine	Diesel	Mar-09	No	0.3	750.7
Linares Norte	0.5	Diesel engine	Diesel	Mar-09	No	0.1	698.1
Chuyaca 1 y 2	20	Diesel engine	Diesel	Feb-09	No	5.5	842.2
Trapén	90	Diesel engine	Diesel	Feb-09	No	42.6	691.8
Los Espinos	122	Diesel engine	Diesel	Feb-09	No	14.1	706.4
Lircay	19	Run of the river	Hydro	Ene-09	No	121.5	0.0
Santa Lidia	136	Open Cycle	Diesel	Dic-08	No	49.0	859.9
El Manzano	4.85	Run of the river	Hydro	Dic-08	No	27.5	0.0
Skretting	2.7	Diesel engine	Diesel	Oct-08	No	0.1	728.4
Cenizas	16.5	Diesel engine	Diesel	Oct-08	No	25.8	120.8
Los Pinos	92.1	Open Cycle	Diesel	Sep-08	No	172.0	698.6
Colmito	55	Open Cycle	Diesel	Ago-08	No	1.1	981.7
Chiloé	9	Diesel engine	Diesel	Jul-08	No	0.0	910.9
Coya	10.8	Run of the river	Hydro	Jul-08	No	83.1	0.0
Ojos de Agua	9	Run of the river	Hydro	Jun-08	Yes	0.0	0.0
Puclaro	6	Run of the river	Hydro	May-08	Yes	0.0	0.0
Totoral	3	Open Cycle	Diesel	Abr-08	No	0.4	694.6
Quintay	3	Open Cycle	Diesel	Abr-08	No	0.9	743.5
Placilla	3	Open Cycle	Diesel	Abr-08	No	1.1	679.5
Olivos	96	Open Cycle	Diesel	Feb-08	No	4.0	749.7
Campanario Diesel	220	Open Cycle	Diesel	Ene-08	No	25.8	825.9
Quellon II	10	Diesel engine	Diesel	Ene-08	No	14.4	742.9
Nueva Aldea 3	37	Biomass/steam	Biomass	Ene-08	Yes	0.0	0.0
Canela 1	18.2	Aeolics	Wind	Sep-07	Yes	0.0	0.0
Hornitos	55	Run of the river	Hydro	Sep-07	Yes	0.0	0.0
Palmucho	32	Run of the river	Hydro	Sep-07	No	232.0	0.0
Constitución 1	9	Diesel engine	Diesel	Jul-07	No	1.9	754.5
Maule	6	Diesel engine	Diesel	Jul-07	No	0.6	614.4
Monte Patria	9	Diesel engine	Diesel	Jul-07	No	0.2	768.2
Punitaqui	9	Diesel engine	Diesel	Jul-07	No	0.3	1,052.6
Chiburgo	19.4	Run of the river	Hydro	Jul-07	No	74.9	0.0
Curanilahue	2.1	Diesel engine	Diesel	Jul-07	No	0.1	0.0
Degan	39.6	Diesel engine	Diesel	Jul-07	No	41.1	704.9
Escuadrón (ex FPC)	14.2	Biomass/steam	Biomass	Jun-07	No	79.4	0.0
Esperanza	22.2	Diesel engine	Diesel	Jun-07	No	1.8	774.5
San Isidro II	353	Combined Cycle	Natural Gas	Abr-07	No	16.8	389.4
San Isidro II Diesel	353	Combined Cycle	Diesel	Abr-07	No	86.7	563.4
San Isidro II GNL	353	Combined Cycle	LNG	Abr-07	No	2,829.3	541.6
Quilleco	70.8	Run of the river	Hydro	Abr-07	Yes	0.0	0.0
El Rincón	0.28	Run of the river	Hydro	Abr-07	No	2.4	0.0
Casablanca	1.2	Diesel engine	Diesel	Abr-07	No	0.2	747.7
Las Vegas	2	Diesel engine	Diesel	Abr-07	No	0.7	688.4
Curauma	2	Diesel engine	Diesel	Abr-07	No	0.5	1,103.6
Concon	2.2	Diesel engine	Diesel	Abr-07	No	0.4	1,466.3
Eyzaguirre	2.1	Run of the river	Hydro	Mar-07	No	6.6	0.0
Campanario Gas	180	Open Cycle	Natural Gas	Mar-07	No	0.1	0.0
Los Vientos TG	132	Open Cycle	Diesel	Ene-07	No	48.9	943.2
Cañete	3	Diesel engine	Diesel	Ene-07	No	0.7	861.4
Los Sauces	3	Diesel engine	Diesel	Ene-07	No	1.1	718.0
Traiguen	3	Diesel engine	Diesel	Ene-07	No	1.1	689.0
Curacautin	3	Diesel engine	Diesel	Ene-07	No	1.5	771.4
Collipulli	3	Diesel engine	Diesel	Ene-07	No	0.6	721.1
Nueva Aldea 2	10	Open Cycle	Diesel	2006	No	0.0	0.0
Ancud	3.3	Diesel engine	Diesel	2006	No	0.8	29,367.3
Quellon	4.99	Diesel engine	Diesel	2006	No	0.8	3.1
Antilhue TG	101.3	Open Cycle	Diesel	2005	No	70.9	855.2
TG_Coronel	46.7	Open Cycle	Natural Gas	2005	No	28.8	234.5
TG_Coronel Diesel	46.7	Open Cycle	Diesel	2005	No	62.8	869.1
Nueva Aldea	14	Biomass/steam	Biomass	2005	Yes	0.0	0.0
Candelaria	253.9	Open Cycle	Natural Gas	2005	No	76.0	804.7
Candelaria Diesel	253.9	Open Cycle	Diesel	2005	No	94.7	933.1
Candelaria GNL	253.9	Open Cycle	LNG	2005	No	11.3	922.1
L.Verde TG	18.8	Open Cycle	Diesel	2004	No	4.2	809.9
Licantén	4	Biomass/steam	Biomass	2004	No	21.5	0.0
Valdivia	61	Biomass/steam	Biomass	2004	Yes	0.0	0.0
Horcones TG	24.3	Open Cycle	Natural Gas	2004	No	0.3	814.2
Horcones Diesel	24.3	Open Cycle	Diesel	2004	No	6.3	1,729.4
Ralco	690	Reservoirs	Hydro	2004	No	2,217.3	0.0
Nehuenco II	398.3	Combined Cycle	Natural Gas	2003	No	209.0	1,390.1
Nehuenco II Diesel	398.3	Combined Cycle	Diesel	2003	No	1,516.7	541.1
Nehuenco II GNL	398.3	Combined Cycle	LNG	2003	No	750.6	523.5
Cholguán	13	Biomass/steam	Biomass	2003	Yes	0.0	0.0
Chacabuquito	25.5	Run of the river	Hydro	2002	Yes	0.0	0.0
Nehuenco TG 9B	108	Open Cycle	Natural Gas	2002	No	2.9	1,146.0
Nehuenco TG 9B Diesel	108	Open Cycle	Diesel	2002	No	0.6	1,027.5
Nehuenco TG 9B GNL	108	Open Cycle	LNG	2002	No	3.6	915.0
San Fco. Mostazal	24	Open Cycle	Diesel	2002	No	0.6	1,495.8
Peuchén	80	Run of the river	Hydro	2000	No	166.2	0.0
Mampil	49	Run of the river	Hydro	2000	No	106.4	0.0
Taltal 2 GNL	122.45	Open Cycle	LNG	2000	No	0.0	756.8
Taltal 1 GNL	122.45	Open Cycle	LNG	2000	No	1.7	888.5
Taltal 2	122.45	Open Cycle	Natural Gas	2000	No	36.4	642.5
Taltal 1	122.45	Open Cycle	Natural Gas	2000	No	19.2	642.4
Taltal	244.9	Open Cycle	Diesel	2000	No	90.4	840.8

TOTAL NET GEN. PER YEAR	**(GWh / yr)**		**42,267.9**
20% OF GEN. PER YEAR	**(GWh / yr)**		**8,453.6**
5 MOST RECENT PLANT GEN	**(GWh / yr)**		**9.6**

EMISSION FACTOR 5 PLANTS	**(tCO_2/GWh)**		**311.61**
EMISSION FACTOR 20% GEN	**(tCO_2/GWh)**		**695.29**

BUILD MARGIN	**(tCO_2/GWh)**		**695.29**

OPERATING MARGIN CALCULATION

(ACCORDING TO THE "TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM" VERSION 03.0.0)

Each year in which the project generation occurs.

		2010
Total emissions from non-low cost / must run power plants	(tCO_2/yr)	16,083,918
Total emissions from low-cost / must-run power plants	(tCO_2/yr)	64,752
Total energy generated in the SIC	(GWh/yr)	42,268
Total energy by non-Low cost / must run power plants	(GWh/yr)	19,887
Total energy by low cost / must run power plants	(GWh/yr)	22,381
Factor l	(number)	0.0065068493
Operating Margin	**(tCO_2/GWh)**	**803.52**

Notes:
- Low cost / must run units present very low GHG emissions, since they are basically hydro plants and very few biomass plants.

COMBINED MARGIN CALCULATION

(ACCORDING TO THE "TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM" VERSION 03.0.0)

OM: Calculated ex post (Option 2, the year in which the emissions occur)
BM: Calculated ex-post (Option 2, updated annually from the date the first emissions occur)

		2010
Operating Margin	(tCO_2/GWh)	803.52
Build Margin	(tCO_2/GWh)	695.29
Combined Margin 2nd/3rd credit period Nueva Aldea	**(tCO_2/GWh)**	**722.35**

Appendix 5. Further background information on monitoring plan

METHANE EMISSION FACTOR OF UNCONTROLLED BURNING OF BIOMASS RESIDUES FROM FOREST OPERATIONS.

1. Introduction

The objective of this project is to quantify the emission factors (EF) of methane (CH_4) from burning forest residues in the open air, natural, uncontrolled conditions in the south central part of Chile. Two fuel types were burned:

a) A mixture of sawdust and bark, which are residues from industrial operations (mainly sawmill industry) and are used at Arauco biomass power plants.
b) A pile of different sizes of branches, which are residues from forestry operations (mainly harvesting, pruning, and thinning).

The mixture of sawdust and bark, collected by third parties, is planned to be used by the Celulosa Arauco y Constitución S.A. (as Arauco) at two new biomass power plants: one in the Horcones Complex, close to Concepcion in the VIII Region. The same biomass residues are being used by Arauco as fuels at the Nueva Aldea, Trupan, Valdivia, and other biomass power plants. Different sizes of branches (2.5–30 cm in diameter), collected from forestry operations, may also be used as supplemental fuel for the new plants.

We conducted field experiments in south central Chile on March 18–26, 2009, a transition period from late summer to early autumn, to quantify methane and other trace gas emissions from burning the two fuel types mentioned above. We will report the weather conditions, the fuel moisture and carbon content, and the average emission factor of methane (EF CH_4) with an associated standard deviation for each fuel type burned under natural conditions. We will also discuss the application of the methane emission factors derived from the experiments to calculate the annual amount of methane emissions from burning these fuels in open air.

Our team has a 20-year experience in studying emissions of trace gases from biomass fires in various ecosystems in the United States, Canada, Mexico, the Amazon in Brazil, Chile, Zambia, South Africa, and central Siberia in Russia. Dr. Hao was the co-author of one of the Intergovernmental Panel on Climate Change (IPCC) reports in 2001 [Hao, 2001]. He was recognized by the IPCC for the contribution to the 2007 Nobel Peace Prize to IPCC.

2. Field Site and Fuel Type

The experimental site (37°18’54.22”S, 71°59’39.50”W, elevation 310 m) was located at a gravel pit near Canteras in south central Chile. The choice of locating at a gravel pit was to prevent fires spreading to adjacent forests. Eight piles of biomass fuels used at the Arauco’s power generating plants were arranged in two rows with four piles on each row and approximately 10 m apart between the piles. Each pile was about 2 m high and had a volume of about 30 m^3. The fuel types include a mixture of sawdust and bark and branches in different sizes. The description of each pile is summarized in Table 1.

Table 1. Fuel Types of the Experiments

Fuel Type	Identification	Piles
Mixture of sawdust and bark	MX4, MX11, MX5, X12	4, 5, 11, 12
j) Branches in different diameters	BR6, BR13, BR7, BR14	6, 7, 13, 14

3. Meteorological Conditions

These experiments were carried out during the transition period from late summer to early autumn. The daily weather conditions at the field site on March 18–26, 2009 are summarized in Table 2. We measured wind speed, temperature, and relative humidity. The weather conditions during the nine days were fairly constant: sunny, windy, warm, and low humidity almost every day.

Table 2. Weather Conditions during the Experiments

Day	March	Condition	Wind Speed (km/hr)	Mean Temperature (°C)	Mean Relative Humidity (%)
1	18	sunny	7 (2–15)	33	24
2	19	sunny	13 (6–23)	24	35
3	20	sunny	7 (3–22)	22	45
4	21	sunny	8 (5–12)	23	31
5	22	sunny			
6	23	sunny	6 (2–12)	23	36
7	24	sunny	7 (3–20)	23	34
8	25	sunny	8 (4–15)	23	42
9	26	sunny	5 (3–8)	21	47

4. Experimental Method

4.1 Combustion Processes

For uncontrolled, open air burning of piled forest residues, a propane torch was used to ignite the piles. The use of fossil fuels, such as diesel or kerosene, for ignition was avoided to prevent contamination of smoke samples. Small tunnels were dug to facilitate air flow in some of the piles. The piles of the sawdust and bark mixture burned for several hours until the combustion process was stabilized and the sampling was initiated. The duration of each pile burned varied considerably. It took several days to burn the piles of mixed sawdust and bark. Windy conditions increased the rate of fuel consumption. Combustion of a pile of sawdust and bark mixture, dominated by prolonged smoldering combustion, is shown in Figure 1. The piles of branches were completely burned within a few hours with predominantly flaming combustion. Combustion of a branch pile is shown in Figure 2.

Figure 1: Burning sawdust and bark mixture shortly after ignition, March 19, 2009

Figure 2: Burning branch pile shortly after ignition on March 20, 2009

4.2 Sampling System

Smoke samples were collected every 2–3 hours during daytime. A background sample of clean air was collected at the start of each day, about 100 m upwind from the burning piles. The sampling system was a portable unit mounted on a metal frame that can be carried as a backpack to collect a sample. The inlet of the sampling system was connected to a sample probe (3 m long, 6 mm O.D.) with a flexible 3/8" (O.D.) stainless steel tube. Smoke samples were collected by inserting the sample probe into the smoke about one meter from the pile.

The sampling system consists of a Rasmussen KNF canister pump with 6 mm (O.D.) stainless steel tubing connected through a T-fitting to a pressure relief valve and a pressure gauge, respectively. The pressure relief valve was used to regulate the pressure of the system and set the final pressure in the canisters. The pressure gauge allowed the operator to monitor the pressure change in the canisters while filling the samples and to check that each canister was evacuated prior to sampling. The sampling system was initially purged with smoke, and then the samples were drawn into the canisters by pressuring the canisters to 25 psia. The flow rate into the canisters was 2 liters/minute and it took approximately 30 seconds to fill each canister. The canisters were 500 ml steel bottles with Nupro model SS-00121 stainless steel ball valves. At the

end of each sampling, a purge valve opened to flush out the residual sample in the sampling line. The sampling pump was powered by a 12 volt gel cell rechargeable battery.

Based on our previous laboratory tests, the storage time for the low molecular weight trace gases in canisters is longer than six months. Thus, within the time frame of 4–6 weeks between sample collection and analysis, it is reasonable to assume that the concentrations of carbon dioxide (CO_2), carbon monoxide (CO), CH_4, and non-methane hydrocarbons (NMHC) in the canisters were stable and did not change during this period.

4.3 Fuel Analysis

Samples of about 250 g for each pile were collected prior to ignition for analysis of fuel moisture content. Samples were immediately weighed in the field with a portable balance. After the samples were transported back to the Fire Sciences Laboratory, they were dried for 48 hours at a 100°C oven and weighed [Allen, 1989]. After fuel moisture analysis, a portion of each sample was milled (40 mesh) and sent to the University of Idaho Analytical Services Laboratory for analysis of the carbon content of the biomass by a CHN (carbon-hydrogen-nitrogen) analyzer.

4.4 Trace Gas Analysis

Trace gas concentrations in canisters were analyzed at the Fire Sciences Laboratory, using the methodology developed by Hao et al. [1996]. The samples were analyzed for CO_2, CO, CH_4, and C_2, C_3, and C_4 alkanes and alkenes with a Hewlett Packard model 5890 Series II gas chromatograph equipped with dual flame ionization detectors (FIDs). The CO_2 and CO analysis utilized a 1 ml sample loop to inject the sample onto a 3.2 mm I.D. x 2 m long Carbosphere (Alltech) column, with a helium carrier gas (flow rate - 16 ml/minute). After separation of CO_2 and CO in the column, the compounds were passed through a methanizer (375°C) that converted CO_2 and CO to methane, enabling detection by the FID at 350°C. The oven temperature program for this analysis was 40°C for five minutes, an increase to 140°C at 20°C/minute, and 4 minutes at 140°C. The CH_4 and C_2–C_4 analyses were performed using a 0.25 ml sample loop, a 0.53 mm x 50 m HP-AL/S column (J&W Scientific), with helium carrier gas at a flow rate of 6 ml/min, and FID at 300°C, with a makeup helium gas flow of 14 ml/min. The oven temperature program for hydrocarbon analysis was the same as the program for CO_2 and CO analysis, as both analyses were performed simultaneously.

Chromatogram data was processed and archived by Hewlett Packard ChemStation II software. A set of CO_2, CO, CH_4, and C_2 and C_3 calibration standards at concentrations close to the samples were analyzed each day to construct a standard curve for each compound. Based on the integrated peak areas, the sample concentrations were calculated from the standard curves and written into an Excel spreadsheet. Duplicate samples were analyzed for every sixth analysis. The National Institute of Science and Technology (NIST) primary CO_2 and CO standards were analyzed periodically to verify the response of the detectors. Both the accuracy and precision are 1% for CO_2, CO, and CH_4 analyses.

The emission factor of a compound is defined as the amount (g) of the compound emitted per kg of biomass burned. The emission factor was calculated by the carbon mass balance method [Ward and Radke, 1993]. The computation was based on the emitted, above-ambient background concentrations of carbon-containing compounds and the carbon content of the biomass. In these experiments, the carbon-containing compounds of CO_2, CO, CH_4, and C_2, C_3, and C_4 gases were analysed in the sample, and C_2-C_4 gases were summed as the non-methane hydrocarbons. High molecular weight hydrocarbons were found in trace concentrations in smoke as compared to the major light carbon compounds (e.g., CO_2, CO, CH_4), and accounted for less than 0.01% of the total emitted carbon. Therefore, the omission of measuring the concentrations of high molecular weight hydrocarbons is insignificant in calculating emission factors of methane.

5. Results and Discussion

The piles were burned under weather conditions during the transition period from late summer to the beginning of autumn. We collected 51 smoke samples from burning four piles of mixed sawdust and bark, 44 smoke samples from burning four piles of branches in different sizes, and nine clean air samples during the nine-day period. The average moisture content of the mixed fuel of sawdust and bark was 45.5% with a standard deviation of 8.2% (n=4). The average moisture content of branches was extremely low (7.3%) with a standard deviation of 3.2% (n=4). The average carbon content of the mixed fuel and branches was 51.3% ± 0.5% (n=4) and 52.0±1.2% (n=4), respectively. These values are very similar to the default value of wood carbon content of 50%.

Clean air concentrations of 376–422 ppm for CO_2, 0.1–0.6 ppm for CO, and 1.6–1.8 ppm for CH_4 were comparable to the clean air concentrations measured in other parts of the world. The background concentrations were subtracted from the pile emission concentrations to obtain net emission concentrations.

The emission factor of methane of each sample from burning mixed fuel or branches is shown in Figure 3. The sample number is the order of the samples taken during the nine-day period. It is apparent that the EF CH_4 of mixed fuel (11.6–24.9 g/kg) were much higher than the EF CH_4 of

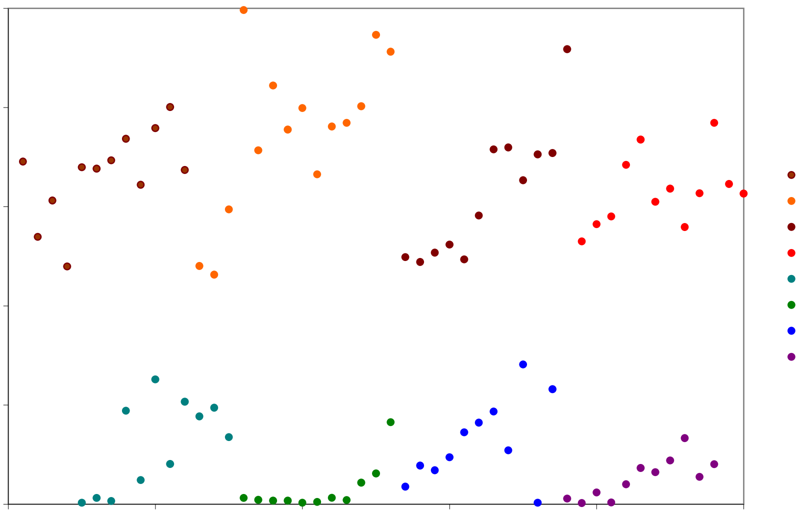

Figure 3. Emission Factor of Methane for Each Sample

branches (0.1–7.0 g/kg). The EF CH_4 in the first week were slightly higher than the ones in the second week.

The average methane emission factor for each fuel type is summarized in Table 3. The average emission factor of methane from burning mixed sawdust and bark (17.2 g/kg or 930 kg/TJ) is consistent with that for the same type of fuels burned in previous experiments in Chile. The standard deviation (±3.1 g/kg or 168 kg/TJ, n=51) is also similar with that of previous measurements carried out in Chile.

The average emission factor of methane for burning branches (2.1 g/kg or 114 kg/TJ) is about eight times lower than the EF CH_4 for burning the mixture of sawdust and bark, because burning branches were dominated by high-temperature flaming combustion (Figure 2)

Table 3. Experimental Results

Fuel Type	EF CH_4 (g/kg)	Standard Deviation (g/kg)	Number of Samples (n)
Mixed sawdust and bark	17.2	3.1	51
Branches	2.1	2.1	44

The EF CH_4 are equivalent to 930 ± 168 kg CH_4 /TJ for mixed sawdust and bark, and 114 ± 114 kg CH_4/TJ for branches, based on the net heat content of fuel to be 18.5 MJ/kg measured and provided by Arauco.

The values of the average methane emission factors of burning a mixture of sawdust and bark or branches in different sizes derived from these measurements are very conservative estimates, if the EF CH_4 are used to determine the amount of methane emitted annually from burning these fuels in the open field. These experiments were carried out in warm, dry, windy conditions near the end of the dry season. The moisture content of the biomass is extremely low because of the weather conditions. The weather conditions favour flaming combustion, which result in low methane emissions. When the fuels are burned
in the rainy season, the conditions favour smouldering combustion and higher methane emission factors than the values in this report.

6. Conclusion

The average emission factor of methane was 17.2 g/kg (or 930 kg CH_4/TJ), with a standard deviation of 3.1 g/kg (or 167 kg/TJ), from open, uncontrolled burning of four sawdust/bark piles in central Chile in March 2009. This value was calculated by averaging the measurements of 51 samples collected in nine days. The piles were large enough to represent the combustion process of large piles. The proposition is based on visual observation of the piles burned and the narrow range of the CH_4 emission factors of the experiments. The average methane emission factor was 2.1 g/kg (or 114 kg CH_4/TJ), with a standard deviation of ±2.1 g/kg (or 114 kg/TJ), for burning four piles of branches in different sizes.

The average methane emission factors derived from these experiments are very conservative values if they are used to calculate the annual methane emissions from burning these fuels in open air. The experiments were conducted in warm, windy, and low humidity weather conditions in nine days. The emissions of methane are expected to be lower under these conditions than the methane emissions in cool, rainy, and high humidity conditions. In addition, digging tunnels, not a common practice, to speed up the experiments also tend to favour flaming combustion and low methane emissions.

The standard deviations of the reported emission factors of methane characterize the natural variability and changes of the combustion process during the duration of the experiments. The standard deviations do NOT represent the variation of the highly reproducible sampling and analytical methods used in this project.

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SUSTAINABLE ORIGIN OF BIOMASS RESIDUES FROM FOREST OPERATIONS USED IN NUEVA ALDEA BIOMASS POWER PLANT PHASE 1

Implications of the DNA approval of this CDM project activity

According to the Chilean DNA, the letter of approval is granted to a CDM project activity if such project fully complies with all the current and pertinent environmental Chilean regulation and positively contributes to the sustainable development of the country. As will be shown below, according to the Chilean law, the harvesting of forests (both native and exotic) that do not count with an authorized management plan is illegal and penalized by criminal and civil law. Furthermore, the purchase of illegal products is also illegal.

Therefore, in case the proposed project activity would have consumed or favored the consumption of illegal forest by-products (i.e. from forests not managed in a sustainable way), the Chilean DNA would have not granted the Letter of National Approval to the project.

On the same lines, the Nueva Aldea biomass power plant Phase 1 was approved by the Chilean Environmental Authority, CONAMA (which also happens to be the DNA for CDM projects in Chile). Such approval would have not been granted if the project did not comply with the outstanding Chilean regulations and in particular with the Chilean Forestry Law.

According to the two arguments above, by complying with the Chilean Law, the Nueva Aldea biomass power plant Phase 1 administration makes sure that all the forest products and by-products used in the plant come from legal and therefore sustainable sources.

Implications of the Chilean Forestry Law:

The Decree Nº 701 of 1974, in its Articles Nº 21 and 22 clearly and explicitly mandates forest and landowners to manage their forest plantations in a sustainable way. This implies to have a pre-approved management plan by CONAF,[30] which requires replanting the forest once it has been harvested. According to this, all forest plantations must be managed in a sustainable way according to the Chilean law.

The law is very stringent for those who do not follow it, specifying hefty fines for the non-compliant companies (Articles 17, 21 and 22 of the Decree Nº701). The fines can go from one to three times the value of the products generated from illegal forest cuts, plus the confiscation of the products. In some cases, forest owners and end buyers of illegally procured wood by-products may face criminal charges. The supervising body in Chile is CONAF, who does so via implementing sea, road and air control mechanisms programs throughout the entire national territory[31].

CONAF is the governmental body that authorizes the cut of artificial forest (i.e. exotic plantations serving productive purposes) and native forests. In both cases, there must be a management plan approved by CONAF, however in the second case, CONAF must issue a special authorization or dispatch bill (a “free transit dispatch document”), which must be kept by the owner to transport each and every product that results from the forest cut. This certificate is passed on to the end buyer of the products and kept for future internal controls and audits by the environmental authorities.

The Nueva Aldea Phase 1 management is aware of the law and the strict control and penalties there are for companies who do not observe the regulation regarding forest management and the consequences that might carry the possibility to purchase biomass fuels from doubtful or

[30] CONAF stands for National Corporation of Forestry, and is a governmental body in charge of administrating the national forestry policy and promoting the development of the forestry sector in Chile. Its main objective is to guarantee the sustainable management of forest ecosystems and of the natural endowment of the country.

[31] See CONAF web page, www.confaf.cl, Legislation, Control of forest legislation.

questionable origin. For that reason, the Nueva Aldea Phase 1 management has the following controls in place:

1. The Nueva Aldea biomass power plant Phase 1 Procurement Department makes all its biomass fuel suppliers (and other suppliers as well) sign a supply contract agreement in which the sellers (for example the sawmills, in this case) declare to know and comply with the pertinent Chilean legislation, that the products they sell count with all permits and authorizations required by law, in particular those related to the origin of the wood that generated the biomass fuels, which are now sold and delivered to the Plant.

2. All biomass fuels used in the Nueva Aldea biomass power plant come from plantations of exotic species, mainly Radiata pine. No biomass fuels from native forests are or have been ever used in the power plant. This can be easily confirmed, since there are no special dispatch bills authorized by CONAF in the Nueva Aldea Phase 1 Procurement Department's archives.

Since the Chilean law penalizes the purchase of illegal products, it is in the Nueva Aldea Phase 1 management's best interest to observe the forest regulation. In order to show the effectiveness of how the Chilean law is actually observed not only by Arauco but by other forest companies as well, the project proponent would like to present some evidence about the forest management situation in Chile.

The Nueva Aldea biomass power plant Phase 1 is located in the VIII Region and exclusively consumes biomass fuels from exotic species. These include mainly Radiata pine and a small fraction of other exotic tree species. The following tables show the situation of the exotic plantations and the way they are used by the different industries of the forest sector in Chile:

EVOLUTION OF THE ANNUAL LAND PLANTED IN CHILE, MAIN SPECIES

(Hectares)

Year	Radiata Pine		Eucalyptus		Other species	
	Forestation	Reforestation	Forestation	Reforestation	Forestation	Reforestation
1994	39,424	23,638	31,591	6,200	6,487	2,546
1995	30,594	32,130	24,126	5,428	5,546	2,034
1996	26,565	26,880	12,033	6,105	3,863	3,148
1997	28,376	27,493	11,444	5,598	4,516	2,057
1998	18,147	40,605	14,044	8,754	3,409	1,621
1999	22,606	47,320	13,243	20,306	3,759	1,037
2000	16,453	42,958	23,173	13,607	4,708	1,451
2001	14,884	33,548	22,739	15,806	6,553	1,325
2002	15,183	23,890	19,689	16,785	11,348	1,194
2003	17,137	41,077	31,029	18,623	8,578	3,053
2004	18,724	42,837	32,657	19,374	16,856	193

Sources: INFOR (National Forestry Institute, www.infor.cl), CONAF, Companies.

Forestation: Plantation of new forests.
Reforestation: Plantation of forests that have been harvested.

ESTIMATION OF THE FUTURE WOOD AVAILABILITY IN CHILE, MAIN SPECIES

(Thousands of cubic meters per year)

Period	Radiata Pine
2003 - 2005	24,288
2006 - 2008	29,223
2009 - 2011	31,425
2012 - 2014	31,453
2015 - 2017	31,453
2018 - 2020	31,453
2021 - 2023	31,453
2024 - 2026	33,538
2027 - 2029	38,191
2030 - 2032	38,705

Period	Eucalyptus
2005 - 2006	4,763
2007 - 2008	6,791
2009 - 2010	7,343
2011 - 2012	10,930
2013 - 2014	13,978
2015 - 2016	14,077
2017 - 2018	14,099

Note: Results obtained according a mathematical programing model that maximizes the physical availability of wood, satisfying restrictions of age at the moment of harvesting and management schemes in order to guarantee the sustainability of wood over time.
Source: INFOR, "2004 Forestry Statistics of the VIII Region", Statistics Bulletin Nº102, Tables 2.15 and 2.16, page 41.

Main conclusion:
All forest plantations, including exotic species, are managed in a sustainable way in Chile.

WOOD CONSUMPTION IN THE NATIONAL FOREST INDUSTRY
(Year 2004, in cubic meters)

Industry	Radiata pine	Eucalyptus	Native	Other exotic	Total
Pulp	8,564,565	2,647,072			**11,211,637**
Sawn timber	14,910,943	11,318	418,528	168,983	**15,509,772**
Wood boards and laminates	1,584,692	6,884	197,016	24,900	**1,813,492**
Export sawn timber	68,025	26	7,019	11	**75,081**
Export pulp timber	116,946	81,290		184	**198,420**
Wood chips	108,166	2,589,997			**2,698,163**
Wood boxes	186,164		1,158	35,678	**223,000**
Wood posts	262,063	4,618		1,718	**268,399**
Total	**25,801,564**	**5,341,205**	**623,721**	**231,474**	**31,997,964**

Source: INFOR

According to the information in the table above, it is possible to estimate the sources of biomass fuels (sawdust and bark) generated by species at a national level:

	(%) per species	Accumulated (%)
Radiata pine	80.6%	80.6%
Eucalyptus	16.7%	97.3%
Other exotic	0.7%	**98.1%**
Native	1.9%	100.0%
Total	**100%**	

Main conclusions:
1. At a national level, the vast majority of the biomass residues (i.e. biomass fuels) come from exotic forests, mainly Radiata pine and Eucalyptus.
2. At a national level, the biomass residues (i.e biomass fuels) that come from native forests are very, very small (less than 2%).

WOOD CONSUMPTION FOR THE PRODUCTION OF SAWN TIMBER IN THE IX AND X REGION
(Year 2005, in cubic meters)

Species	Total IX and X Regions	(%)	Accumulated (%)
Radiata pine	2,458,985	86.0%	86.0%
Other exotic	152,521	5.3%	**91.4%**
Native	246,460	8.6%	100.0%
Annual consumption	**2,857,966**	**100.00%**	

Source: INFOR, "Sawn timber industry", Statistics Bulletin Nº112, Table 15, page 37.

Main conclusions:
1. More than 90% of the wood consumption in the IX and X Region used to generate sawn timber comes from plantations of exotic species (mainly Radiata pine).
2. More than 90% of the biomass residues (sawdust and bark) generated in sawmills of the IX and X Region, come from exotic species (mainly Radiata Pine).

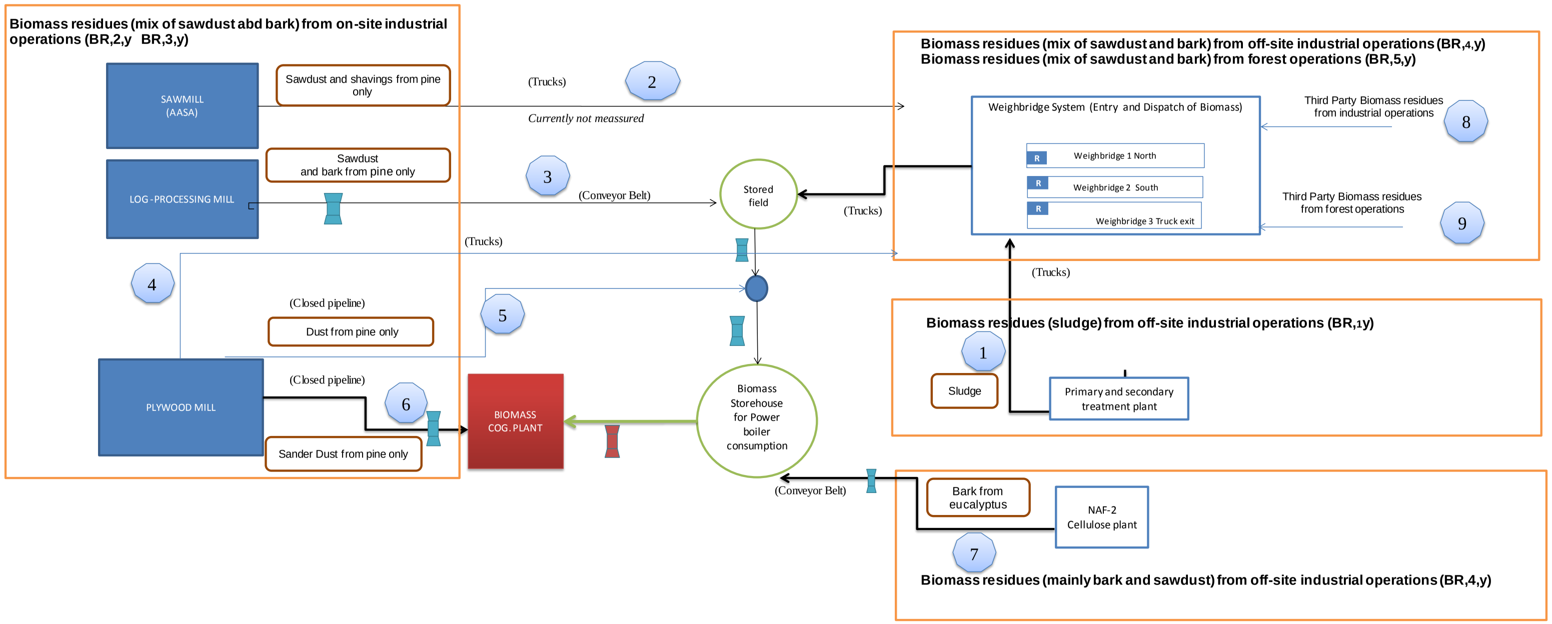
According to the conclusions drawn from the tables above, it is easy to see that all forests and particularly the exotic forest plantations are managed in a sustainable way in Chile. It is possible – then- to conclude that the biomass residues generated by harvesting these forests come from renewable sources. This shows that the Forestry Law (Decree Nº 701) is actually observed and enforced in Chile. The reason behind this is explained by the supervisory role of CONAF and due to the economic incentives provided by the Chilean Government to land and forest owners. These benefits can only be perceived if the forests are managed as prescribed by the Chilean law, which necessarily means that are supervised by CONAF[32].

In summary, by observing the Chilean Forestry Law, Arauco ensures that all the biomass used as fuel in the power boiler comes from sustainable sources. The reliability of this conclusion is based on the high level of compliance of this law in the country, which is confirmed by official information at a national and at a regional level.

[32]CONAF has a dedicated department for controlling the compliance of the Decree Nº 701.

DIAGRAM OF BIOMASS RESIDUES CATEGORIES CONSUMED IN THE PROJECT ACTIVITY AND AUXILIARY ELECTRICITY CONSUMPTION FOR BIOMASS TRANSPORTATION

(ACCORDING TO THE METHODOLOGY ACM0006 (VERSION 12.1.1), "CONSOLIDATED METHODOLOGY FOR ELECTRICITY AND HEAT GENERATION FROM BIOMASS")



Category		Biomass flows
Biomass residues (sludge) from off-site industrial operations	BR 1,y	1
Biomass residues (mix of sawdust and bark) from on-site industrial operations.	BR 2,y + BR3,y	2, 3, 4, 5, 6
Biomass residues (mix of sawdust and bark) from off-site industrial operations.	BR 4,y	7, 8
Biomass residues (mix of sawdust and bark) from off-site forest operations	BR 5,y	9

Biomass transport system	Auxiliary consumption
3	15 kW
4	210 kW
5	773 kW
6	490 kW

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)

DOCUMENTATION OF FREIGHT TRANSPORTATION ACTIVITIES UNDER THE PROJECT ACTIVITY.						
Activity	**Freight type**	**$FR_{,f,m}$**	**Origin**	**Destination**	**$D_{f,m}$**	**Vehicle class**
1	Mix of sawdust and bark	725	ARAUCO	Nueva Aldea phase 1	130	Heavy class
2	Mix of sawdust and bark	1,422	CABRERO	Nueva Aldea phase 1	66	Heavy class
3	Mix of sawdust and bark	2,753	CAUQUENES	Nueva Aldea phase 1	142	Heavy class
4	Mix of sawdust and bark	2,521	CHANCO	Nueva Aldea phase 1	179	Heavy class
5	Mix of sawdust and bark	2,706	CHILLAN	Nueva Aldea phase 1	30	Heavy class
6	Mix of sawdust and bark	12,830	COELEMU	Nueva Aldea phase 1	50	Heavy class
7	Mix of sawdust and bark	582	CONCEPCION	Nueva Aldea phase 1	59	Heavy class
8	Mix of sawdust and bark	1,469	TOMÉ	Nueva Aldea phase 1	70	Heavy class
9	Mix of sawdust and bark	838	FLORIDA	Nueva Aldea phase 1	30	Heavy class
10	Mix of sawdust and bark	13	MAULE	Nueva Aldea phase 1	160	Heavy class
11	Mix of sawdust and bark	841	QUILLON	Nueva Aldea phase 1	8	Heavy class
12	Mix of sawdust and bark	1,053	QUIRIHUE	Nueva Aldea phase 1	123	Heavy class
13	Mix of sawdust and bark	2,599	RANQUIL	Nueva Aldea phase 1	12	Heavy class
14	Mix of sawdust and bark	321	SAN JAVIER	Nueva Aldea phase 1	165	Heavy class
15	Mix of sawdust and bark	227	SAN NICOLAS	Nueva Aldea phase 1	53	Heavy class
16	Mix of sawdust and bark	71	TALCAHUANO	Nueva Aldea phase 1	64	Heavy class
17	Mix of sawdust and bark	3,252	CORONEL	Nueva Aldea phase 1	100	Heavy class

Note: The Project Participant has documented each freight transportation activity f occurred under the project activity based on monitored data from previous monitoring period available at the Validation stage of the first renewal crediting period. The Project Participant will monitor each freight transportation activity (type, origin,etc) every year of the crediting period and used for project emission calculations as per required in the monitoring plan.

Total Project emissions from freight transportation.	$PE_{TR,m}$	tCO_2	640	
Weight average calculation.	$\sum D_{f,m} * FR_{,f,m}$	t	4,959,475	calculation.
Return trip road distance between the origin and destination of freight transportation activity f.	$D_{f,m}$	km	84.76	(See table above).
Total mass of freight transported in freight transportation activity f.	$FR_{f,m}$	(BDt/y)	34,225	(See table above).
Default CO2 emission factor for freight transportation activity f.	$EF_{CO2,f}$	gCO2/t*km	0.000129	Default value.

Appendix 6. Summary of post registration changes

DEVIATION REQUEST FOR APPROVAL FROM METHODOLOGY ACM0006 (VERSION 12.1.1) ENTITLED: "DEVIATION FOR DETERMINING THE BASELINE EFFICIENCY OF THE HEAT GENERATOR".

The following document presents a brief description of the deviation request for ACM0006 (Version 12.1.1) for determining the baseline efficiency of the heat generator.

Deviation request date:	September 20th, 2012
Deviation request approval date	October 10th, 2013
Deviation request register N°:	M-DEV-0478

Brief description of the proposed project activity

Nueva Aldea is a Greenfield power generation project. In the baseline scenario heat would be generated by a biomass boiler and power would be purchased from the grid. For the baseline determination, the efficiency of the biomass power boiler should be determined and the deviation request is related to the way in which the efficiency of the heat generator is determined in the baseline scenario.

The project uses several types of biomass residues which are classified into five biomass categories, according to the methodology ACM0006 (Version 12.1.1), and following the economical algorithm of biomass consumption driven by availability and cost of biomass residues. Each category of biomass transported to and consumed in the Complex is ranked from most available and less costly to least available and most costly biomass. The result of this categorization is presented as follows:

	Biomass residues category (k)	Biomass residues type	Biomass residues sources	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario
(+) Most Available/least Costly (-)	1	Sludge from industrial operations.	Off-site production.	The biomass residues are used for power or heat generation at the project site in new and/or existing plants. (B4)	Heat generation.
	2	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 in new and/or existing plants. (B4)	Heat generation.
	3	Mix of sawdust and bark from industrial operations.	On-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation
	4	Mix of sawdust and bark mix from industrial operations.	Off-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation
	5	Mix of sawdust and bark from forest operations.	Off-site production.	The biomass are dumped or left to decay mainly under anaerobic conditions. This applies for example, to dumping and decay of biomass residues on fields. (B1)	Power generation

Categories 1 and 2 are used for heat generation in the project scenario and would be consumed in the baseline to meet process heat demand of internal clients of the complex.

The Project Participant would like to note that despite the fact that all (five) biomass categories are listed separately, not all of them can be monitored separately. This is the case with categories 2 and 3 which are both mix of sawdust and bark from on-site production with the same origin, but with a different fate under the project scenario (heat or power generation).

Considering the above, categories 2 and 3 are monitored together and variations in these amounts are closely related. As a consequence of this measurement condition the power boiler efficiency in the baseline must be determined in an alternative way to ensure conservativeness.

Baseline efficiency of the Power Boiler

By choosing the lowest reasonable efficiency value of the baseline power boiler is more conservative than the default value of 100% available under Option F since a higher amount of biomass residues would be required to meet process heat demand of internal clients of the complex, and therefore, less consumption of biomass residues would be contemplated, in the project activity case, for avoided methane emissions reduction.

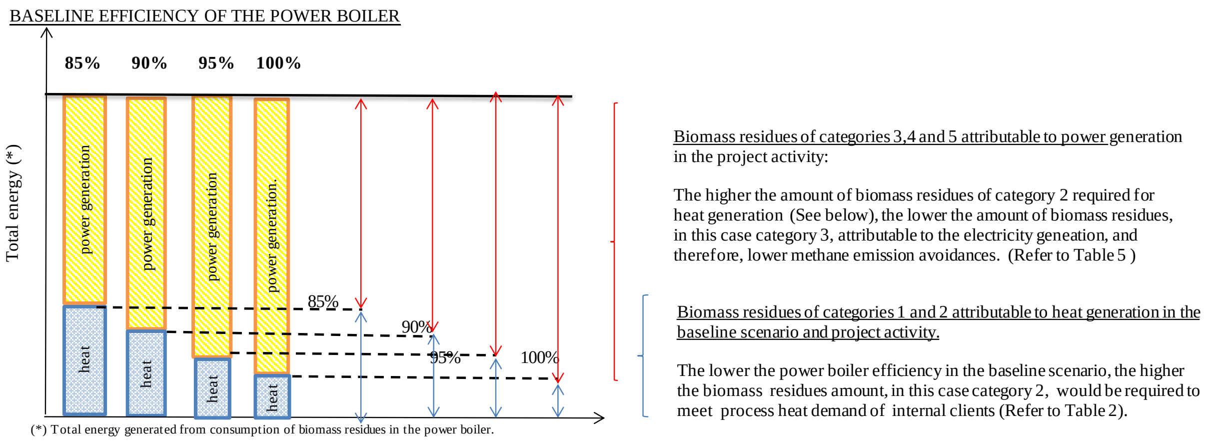
The Project Participant would like to note the following:

- This project activity will only claim emission reductions from on-site electricity generation and avoided methane emissions of biomass residues attributable to electricity generation.
- The Project activity will not claim emissions due to heat generation as steam generation for big-scale sawmills and panel board/plywood mills is a business as usual (BAU) practice in the Sawmills and Panel board/Plywood mill industries. Note that a higher consumption of biomass residues for heat generation in the baseline will not have an impact on emissions reductions of this project activity as it is explained in more detail below.

In the case of the baseline scenario, the value of 85% was chosen as the lowest value given that the efficiency values of this type of boilers would be between 85% and 90%, and 88%, according to globally reputed consultants and equipment suppliers in the energy sector.

Considering variations in the baseline heat generator´s efficiency of 85% to 100% four scenarios are presented below:

Figure 1:



As mentioned previously, biomass residues corresponding to categories 2 and 3 are jointly monitored and therefore, the latter category shall be determined by deducting the consumption of category 2 from the total consumption resulted from the sum of category 2 and category 3. Consequently, the greater the amount of biomass of category 2 determined for heat generation purpose the lower the amount of biomass residues of category 3 consumed in the heat generator

of the project activity. This will ensure a conservative determination of emission reductions of methane avoidance that are directly related to the consumption of biomass residues of category 3.

The deviation of this parameter is further substantiated below:

According to step 1.5 of the methodology (Version 12.1.1) only *Option 1: "Default values should be chosen"* is applicable to the proposed project activity. This option automatically refers to Option F: "Use a default value" of the "Tool to determine the baseline of thermal or electric energy generation system" (Version 1).

However, the efficiency value was not available under Option F (use default values) of the tool at the revalidation stage of this project activity. In cases where no option is applicable the value of 100% should be used as a simple and conservative approach.

However, as previously described in section "Baseline efficiency of the Power Boiler" if the efficiency value of 100% is used for this project activity this would not result in the most conservative scenario for the emission reduction calculation.

Determine the baseline biomass-based heat generation

As previously described the biomass of categories 1 and 2 would be used in the baseline scenario to meet process heat demand of the internal clients of the Complex. Note that the availability of these biomass residues types would be sufficient to generate all the annual process heat demand.

The biomass residues amount of categories 1 and 2 is determined from the process heat demand---$HG_{BL,BR}$ ---using equation 14 of the ACM0006 (Version 12.1.1) presented as follows:

$$HG_{BL,BR} = \sum h \sum n \left(BR_{B4,n,h,y} * NCV_{BR,n,y} * \eta_{BL,HG,BR,h} \right)$$

Where:

$HG_{BL,BR}$	=	Heat demand by the internal clients of the Complex equal to 2,149,857(GJ/y) is estimated based on measurements performed in previous monitoring periods.
$BR_{B4,n,h,y}$	=	amount of biomass residues from categories 1 and 2 to be calculated.
$NCV_{BR,n,y}$	=	Net calorific value per type of biomass based on measurements performed in previous monitoring periods.
$\eta_{BL,BR,n,y}$	=	heat generator efficiency to be determined in this document.

According to equation 14 four scenarios were presented in which the baseline heat generator´s efficiency varied from 85% to 100%. As previously described the value of 85% applied to the baseline heat generator would be between 85% and 90% and 88% according to globally reputed consultants and equipment suppliers in the energy sector. Four scenarios are presented below considering variations in the baseline heat generator´s efficiency of 85% to 100%:

Table 2: Baseline heat generator efficiency

	Units	**85%**	**90%**	**95%**	**100%**
Baseline biomass-based heat generation (See note below)	GJ/y	2,149,857	2,149,857	2,149,857	2,149,857
Biomass category 1	tons/y	15,552	15,552	15,552	15,552
Biomass category 2	tons/y	130,405	122,644	115,700	109,450

<u>The Project Participant would like to note the following:</u>

- The baseline biomass-based heat demand driven by internal clients of the complex will remain constant based on monitored data in previous monitoring periods.
- Biomass residues of category 1 remain fixed as the sludge availability is fixed at 15,552 tons per year and it is the first to be consumed according to the biomass consumption algorithm explained earlier.
- The consumption of biomass residues of category 2 is then inversely proportional to the baseline efficiency of the power boiler when the total heat demand is given.

As mentioned previously biomass residues of category 1 and 2 do not impact the baseline emissions since the project activity only claims emissions from on-site electricity generation, and the use of biomass that would otherwise be left to decay in aerobic conditions in the absence of the project activity.

Considering the above biomass residues of categories 3, 4 and 5 that would be left to decay in the absence of the project activity are evaluated in order to analyse the conservativeness of the project activity in terms of emission reductions versus the baseline efficiency of the heat generator.

The Project Participant would like to note that the biomass residues types of categories 4 and 5 are not impacted by the four scenarios presented in Table 2 above. This can be explained because the project activity will consume first biomass residues more available and less costly from category 3 before start consuming biomass residues from categories 4 and 5 which is less available and more costly.

The total amount of biomass residues of categories 4 and 5 equal to 126,189 (tons/yr) and 3,803 (tons/y), respectively are estimated based on measurements conducted in previous monitoring periods.

Emission reduction calculation

According to equation 14 of ACM0006 (Version 12.1.1) presented above, the higher the amount of biomass required to meet process heat demand (in baseline scenario), the lower the additional biomass residues attributable to electricity generation, and therefore the lower the avoided methane emissions.

For the proposed efficiency value of 85% higher amounts of category 2 would be consumed in the baseline to meet process heat demand which remain constant. Consequently less amount of category 3 would be consumed in the project activity, since category 3 is the result of the total measurement of biomass residues (categories 2 +3)[33] minus the amount of biomass residues of category 2.

Table 3: Power boiler efficiency

Power boiler efficiency.	Units	85%	90%	95%	100%
Biomass category 3.	tons/y	104,327	112,088	119,032	125,282
Biomass category 4.	tons/y	126,189	126,189	126,189	126,189
Biomass category 5.	tons/y	3,803	3,803	3,803	3,803

Using 85% efficiency instead of using the default value of 100% for the baseline biomass power boiler, the emission reductions would decrease by 6,917 tCO_2 due to uncontrolled burning of biomass residues type 3, as can be seen from Table 4 below:

Table 4: Baseline methane emissions avoidance

Baseline methane emissions avoidance.	tCO_2/y	76,214	78,776	81,068	83,131
Biomass category 3.	tCO_2/y	34,436	36,998	39,290	41,353
Biomass category 4.	tCO_2/y	41,653	41,653	41,653	41,653
Biomass category 5.	tCO_2/y	125	125	125	125

Table 5: Total Baseline emissions

Total Baseline emissions.	tCO_2/y	199,856	202,422	202,718	206,785
Grid emission savings.	tCO_2/y	122,124	122,124	122,124	122,124
Fossil fuel emissions savings due to demand for process heat.	tCO_2/y	1,518	1,522	1,526	1,530
Fossil fuel emission savings due uncertain electricity generation.	tCO_2/y	0	0	0	0
Baseline methane emissions avoidance.	tCO_2/y	76,214	78,776	81,068	83,131

[33] As previously described biomass residues of category 3 cannot be monitored directly and need to be determined by deducting biomass residues consumption of category 2 from the total consumption (biomass residues of categories 2 and 3)

Project emissions calculation

The total project emissions associated with the project activity obtained as a result of efficiency variations in the baseline power boiler are presented next:

Table 6: Total Project emissions

Project emissions	**tCO_2/y**	5,949	5,949	5,949	5,949
Emissions from fossil fuel consumption at the project site.	tCO_2/y	3,864	3,864	3,864	3,864
Emissions from electricity generated on-site.	tCO_2/y	1,445	1,445	1,445	1,445
Emissions from biomass transportation to the Power Plant (See note below).	tCO_2/y	640	640	640	640

The Project Participant would like to note the following:

The project emissions originated from biomass transportation to the power plant will remain the same as per efficiency variations of the baseline power boiler. The aforementioned is explained as follows:

- The consumption of residual biomass of categories 4 and 5 was not affected by variations in the efficiency of the power boiler, following the aforementioned residual biomass cost/availability algorithm.
- According to the results presented in table 2 and 3 of this section, varying the power boiler efficiency has resulted in a redistribution of biomass types 2 and 3 destined to generate heat and electricity respectively.

Net emissions savings

Table 7: Net emissions

Net emissions Savings	**tCO_2/y**	**193,908**	**196,473**	**198,769**	**200,836**
Total baseline emissions	tCO_2/y	199,856	202,422	204,718	206,785
Total project emissions	tCO_2/y	5,949	5,949	5,949	5,949

The Project Participant would like to note that differences in baseline and project emission calculations included in tables above 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 for conservative reasons.

Fourth version of the PDD contains the following corrections applied to second:

1. - Name of the methodology ACM0006 Ver 12.1.1, from "Consolidated methodology for electricity and heat generation from biomass residues" to "Consolidated methodology for electricity and heat generation from biomass".
2. - Inclusion of a new host party: United Kingdom of Great Britain and Northern Ireland.
3. - Inclusion of the new value of GWP_{CH4} for the second commitment period and calculation of the ex ante estimates of emission reductions using this new value from 2013 and forward.
4. - Specification to the accuracy level of the electric meters installed in the project.
5. - Section B.7.4 is included to comply with PDD last template (version 05).
6. - Appendix 1, only one table with contact information of the Project Participant is conserved in the current version, to comply with form version 05 of the project design document.

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Document information

Version	*Date*	*Description*
05.0	25 June 2014	Revisions 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;* • Editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b
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