Project design document form for CDM project activities

(Version 05.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Valdivia biomass power plant.
Version number of the PDD	Version 10
Completion date of the PDD	October 08th , 2015
Project participant(s)	CELULOSA ARAUCO Y CONSTITUCION S.A.
Host Party	CHILE
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Scope 1 ACM0006 (Version 5), “Consolidated methodology for generation from biomass residues”. ACM0002 (Version 6), “Consolidated methodology for grid-connected electricity generation from renewable sources.
Estimated amount of annual average GHG emission reductions	126,860

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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

- The installation of a high capacity biomass power boiler, designed for electric power generation.

- The construction of a more efficient pulp mill, capable of generating surplus electric power to the grid.

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

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

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

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[1] The pulp mill has an environmental permit to operate below the cap of 550,000 (ADt/y). It must be noticed that this cap has nothing to do with the design production capacity of the plant.In this regard, according to the energy/mass balances informed in the registered PDD, the pulp mill was designed for a pulp production capacity of 728,640 (Adt/y) defined for the reference and project case plant. The design production capacity is determined as follows: [2,200(ADt/y)*35%+ 2,000(ADt/y)*65%]*352days, where the 2,200(ADt/y) and 2,000(ADt/y) corresponds to euca and pine pulp production, respectively obtained from the energy/mass balances informed originally informed in the PDD. From 352 days of normal operation 65% of the time the plant would operate under pine and 35% of the time under euca campaign.

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

[3] Black liquor is an organic by-product of the pulp production Kraft cycle and falls under the category of *biomass residue*, according to the "Clarifications of definitions of biomass and consideration of changes in carbon pools due to a CDM project activity", Annex 8, of 20th Executive Board meeting report and the "Biomass residue" definition provided in page Nº2 of the ACM0006 (Version 05) baseline methodology used for this project activity.

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

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

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

A.2. Location of project activity

A.2.1. Host Party(ies)

Chile.

A.2.2. Region/State/Province etc.

X Region of Los Lagos, province of Valdivia and commune of San José de la Mariquina.

A.2.3. City/Town/Community etc.

San José de la Mariquina.

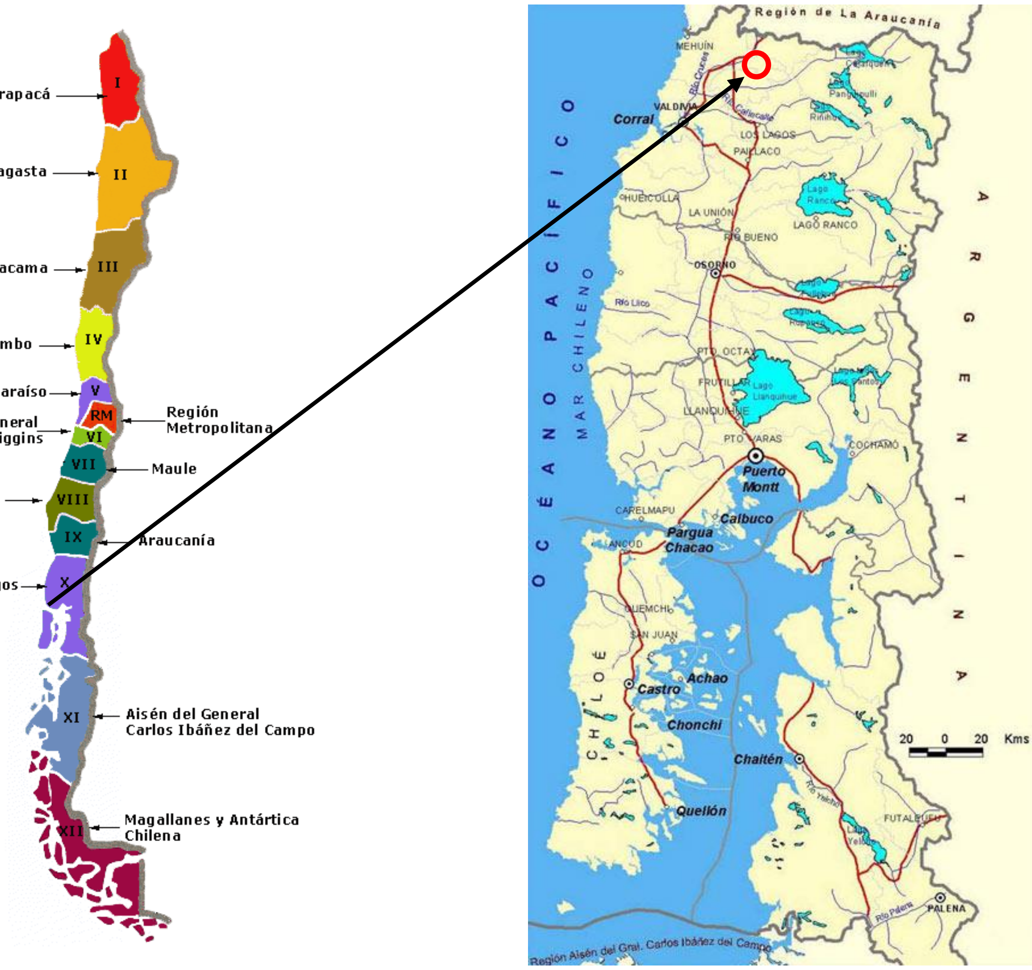
A.2.4. Physical/Geographical location

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

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

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

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



The overview of the Valdivia biomass power plant is shown in Figure 2.

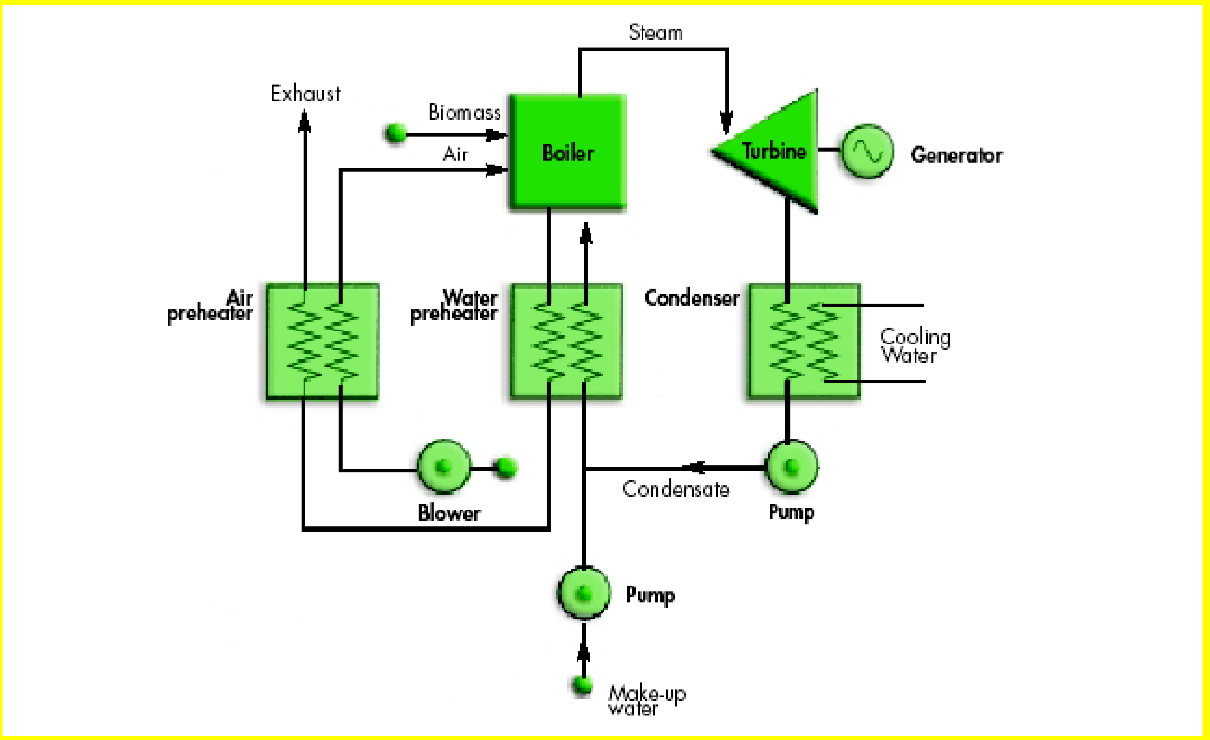
Figure 2: Valdivia biomass power plant overview

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 deaerator must be used to remove dissolved oxygen from water before it enters the boiler.

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



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

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

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

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

Department	Changes
Recovery Boiler	• The recovery boiler would have been designed for the same amount of black liquor to be burned, however the liquor concentration would have been chosen lower, at 72% instead of 74%. • The high-pressure steam data would have been lower, 61 bar(a) 450ºC instead of 85 bar(a) 485ºC. Higher steam data results in a higher investment cost and higher maintenance costs. Lower steam pressure also means less power consumption for the feed water pumps. • The feed water temperature would have been reduced from 135ºC to 125ºC. This would give a smaller and cheaper boiler economizer. The only reason to have a high feed water temperature is to be able to generate more power.
Bark Boiler	• The bark boiler would have generated saturated steam instead of high data steam. • The maximum capacity of the bark boiler would have been similar, however the biomass capacity would have been lower. Boiler biomass capacity inclusive fuel preparation is extremely more expensive than oil capacity.
Boiler water systems	• The feed water tank would have had the same size, but would have been designed for a lower pressure. • The large heat exchanger to cool the process condensate could be reduced in size, the capacity could be reduced from 8 MW/ºC temperature difference to about 6 MW/ºC.
Drier	• Drier input capacity 65,00 t/h., output capacity 46,00 t/h. and water evaporation 19,00 t/h. • Drier surface of 382 m^2 (active drying zone with hot air flowing through) • Total connected electrical load 675,00 kW. Average electrical consumption is approx. 70% of the connected electrical load.
Steam Distribution	• The steam is primarily consumed in two pressures, medium pressure (MP) and low pressure (LP). The middle pressure level should be the same also in the baseline case, but the lower pressure level would have been selected somewhat higher, 5.0 bar (a) instead of 4.5 bar (a). This would have resulted in less expensive equipment by the consumers, especially the evaporation plant and the drying machine would have needed less heat transfer surface. • The low-pressure steam distribution pipes would have been somewhat smaller in size (i.e. less steam carries the same energy).
Turbogenerators	• The real mill is equipped with two 70 MW turbogenerators, one backpressure machine and one condensing machine. Both have extractions to the middle and low-pressure systems. In the alternative pulp mill, there would have been no condensing turbine, but two backpressure units. • The size of the turbogenerators would have been smaller, about 2 x 45 MW.

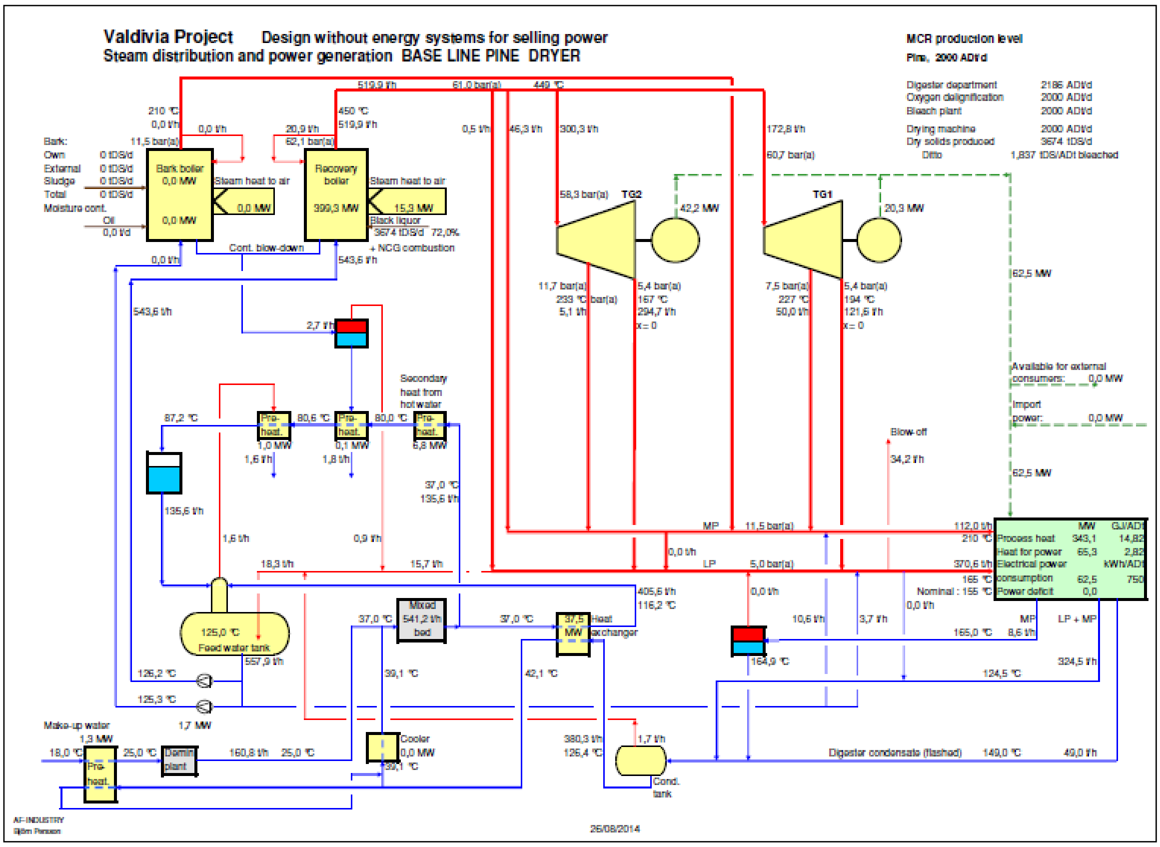
	• In the baseline pulp mill alternative, as there would have not been a condensing machine, there would not have been any condenser cooling water system. The size of the cooling tower would have also been considerably reduced. Possible excess of steam would have been blown off as low-pressure steam and not condensed.
Evaporator Plant	• The number of effects would have been reduced from 6 to 5. This would have reduced the investment cost. • The outlet concentration would have been reduced from 74% to 72%. This would have resulted in a cheaper plant. • The warm water temperature of 50ºC from the surface condenser would have been reduced to 45ºC to reduce the condenser surface.
Drying Machines	• The drying machines of the real pulp mill are equipped with an expensive shoe press. One main reason for the shoe press is the reduced steam consumption in the dryer, to give more excess steam for condensing power generation. If the electrical power generation had been reduced, the shoe press would have not been economically justified and would have not been installed. A system without a shoe press would demand a somewhat larger dryer, but the higher low-pressure steam would have resulted in a small dryer.
Fibre Line	• The hot water temperature would have been reduced from 90ºC to 85ºC, which would reduce the costs for the heat recovery surface somewhat.
Electrical Systems	• As a result of the lower generation capacity of the baseline pulp mill alternative, it would have been chosen a lower distribution voltage: 13.2KV instead of 15KV. • The total capacity of the electrical system would have been reduced in the alternative case. The capacity of the transformer against the external grid would have been reduced, though still allowing the mill to run without the turbogenerators. • The number of variable speed drives would have been reduced.

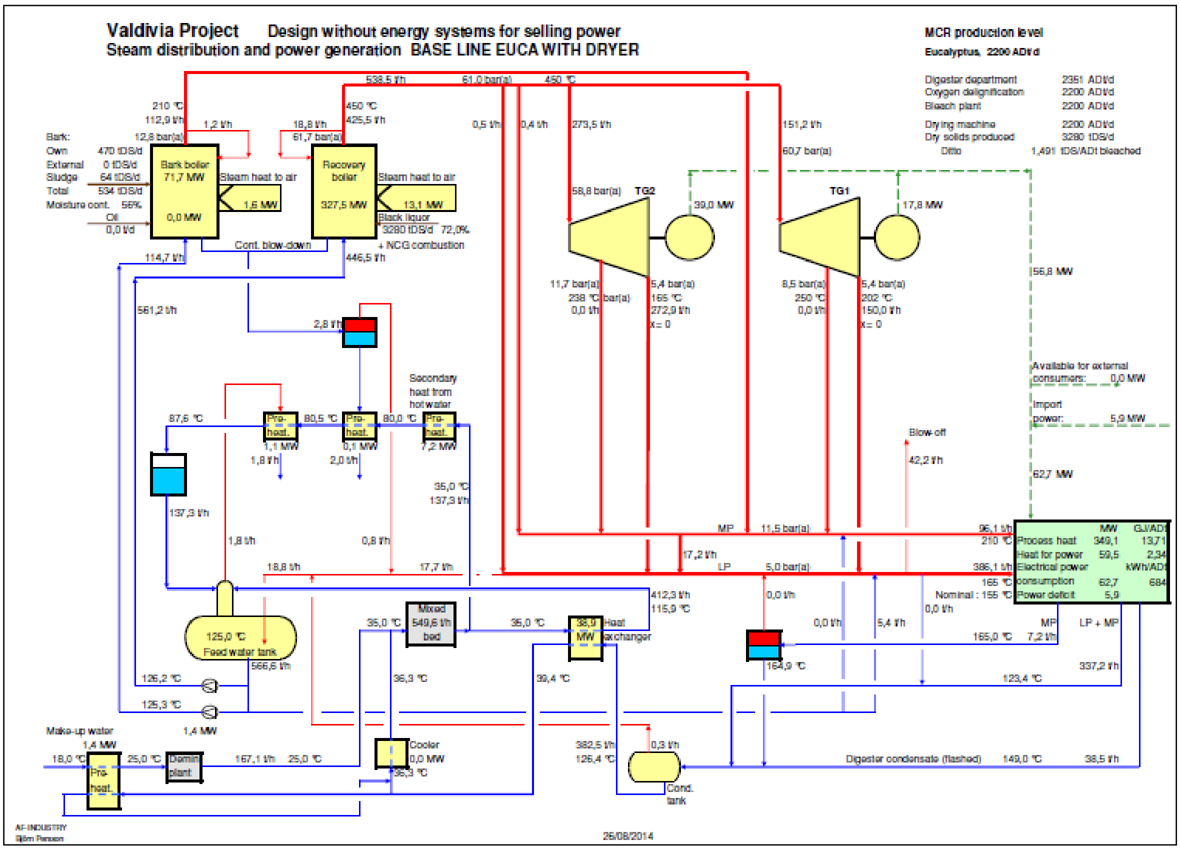
It must be noted that the alternative business-as-usual (BAU) pulp mill (or reference mill) would have had the same capacity as the real mill (with the implementation of the CDM project activity) and would have contemplated the installation of a power and recovery boilers dimensioned to generate the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

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

[6] See explanation below the baseline energy / mass balances.

Valdivia pulp mill configuration without electric power generation capacity

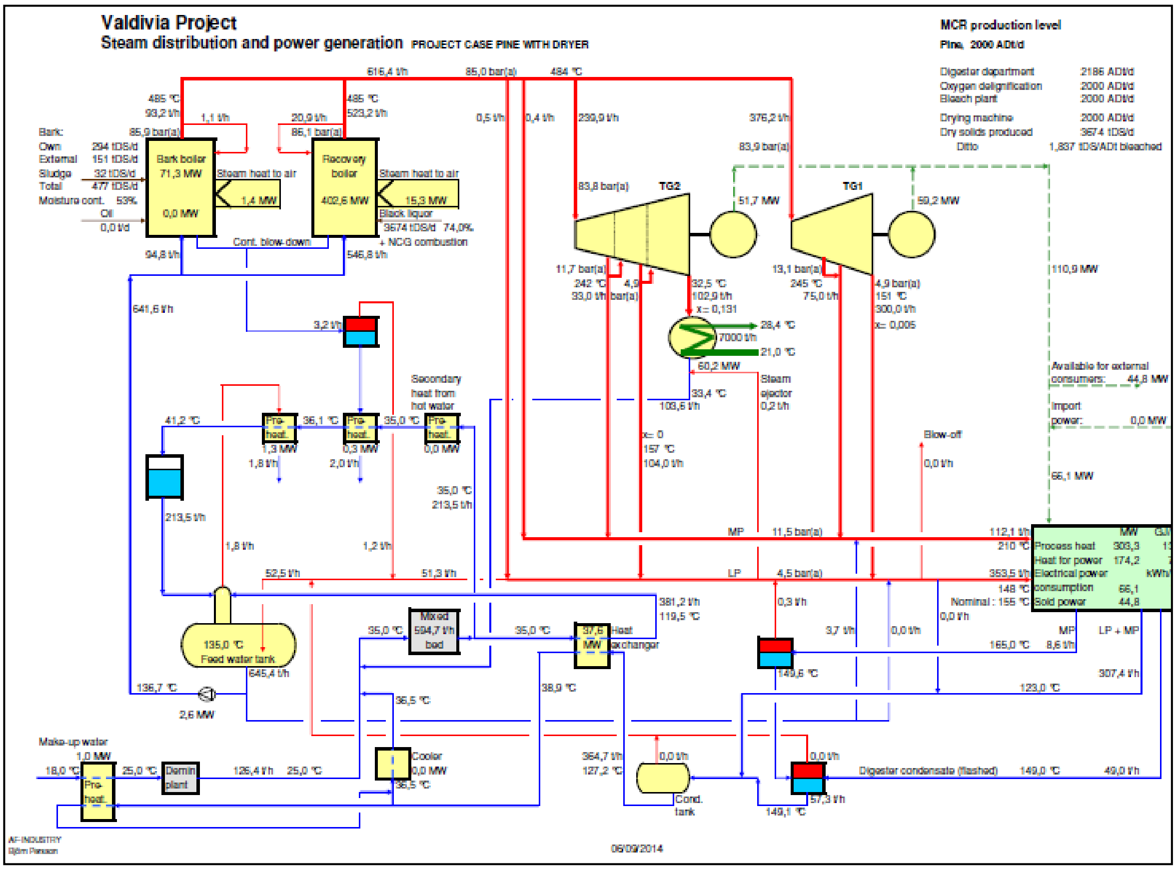


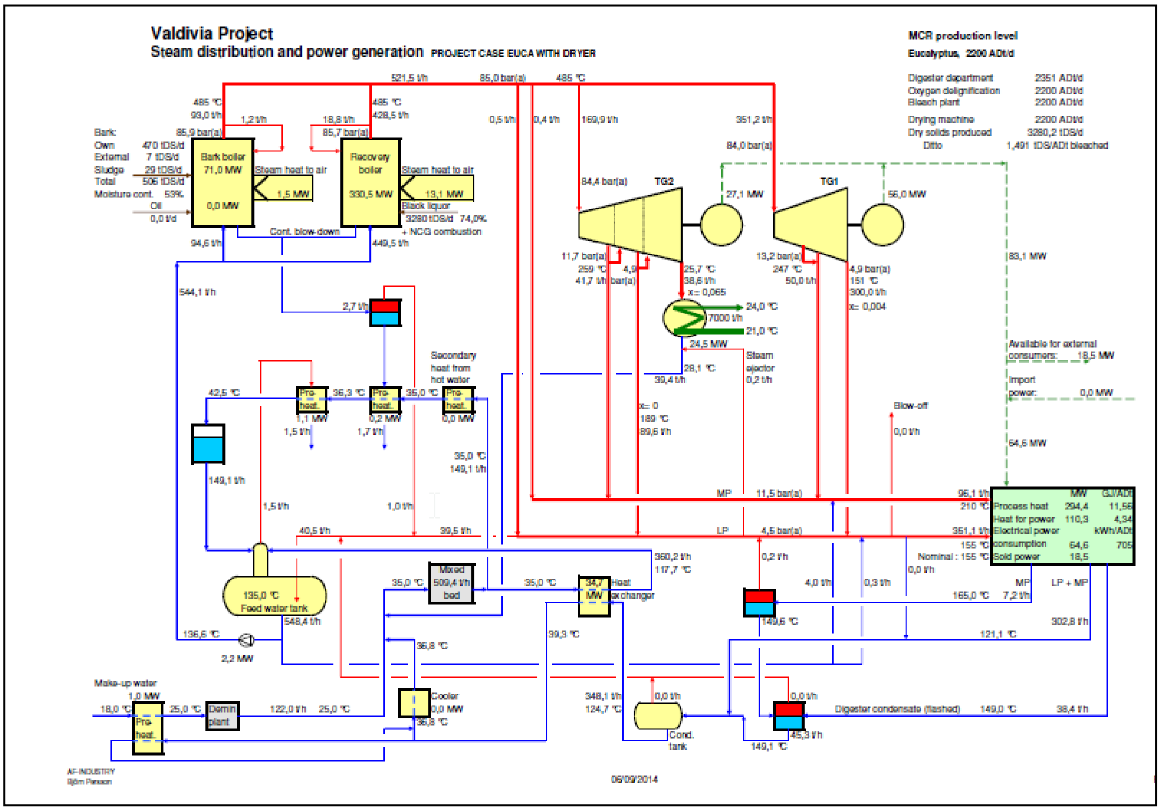


As can be seen above, the Valdivia pulp mill is designed to produce two types of pulp alternatively, from Pine (long fiber pulp) or from Eucalyptus (short fiber pulp). In the first case, the mill is capable of producing all the electric power for internal consumption, however in the second case, the mill is not able to do so and must marginally rely on the grid for power purposes. This happens because under a conventional pulp mill design, the Kraft cycle for Eucalyptus does not produce enough black liquor to generate all the electric power required by the mill. This shortcoming is a characteristic of a conventional pulp mill design, since other modern pulp mills recently built in Chile also present a small power deficit when they produce pulp from Eucalyptus. It is foreseen, however, that the Valdivia pulp mill will only produce pulp from Eucalyptus 35% of the time, leaving the remaining 65% of the time devoted exclusively to Pine pulp production, so the baseline design would still be almost self-sufficient in electric power generation during the year.

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

Valdivia pulp mill configuration with electric power generation capacity





A.4. Parties and project participants

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

A.5. Public funding of project activity

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

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 05),
“Consolidated methodology for generation from biomass residues”.

The project activity also relies on the following methodologies and tools:

ACM0002 (Version 06),
“Consolidated methodology for grid-connected electricity generation from renewable sources”.

“Combined tool to identify the baseline scenario and demonstrate additionality”.

“Tool for the demonstration and assessment of additionality” (Version 04).

B.2. Applicability of methodology and standardized baseline

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

Paragraph 48 of the Marrakesh Accords stipulates that:

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

a) Existing actual or historical emissions, as applicable; or,
b) Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

c) The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 percent of their category.

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

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

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

Further requirements are also fulfilled by the proposed project activity:

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

- **The implementation of the project shall not increase the biomass production in the facility:** The biomass generated in the Valdivia pulp mill is absolutely determined by the processing capacity of the pulp mill. This capacity has already been established and it is 550,000 (ADt/yr). This corresponds to an environmental permits to operate under 550,000 (ADt/y) and do not corresponds to the design capacity of the plant informed as 728,640[7] (ADt/y) in the original energy and mass balances of this PDD. This capacity will not change due to the implementation of the project activity.

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

- **No significant energy quantities, except from transportation or mechanical treatment of the biomass residues are required to prepare the biomass residues for fuel combustion.** The Valdivia biomass project activity only contemplates biomass transportation to the power plant and, although energy for mechanical treatment of biomass may be used in the future (it will be included in the monitoring plan), it is something that does not take place in the Valdivia power plant at present.

[7] The design production capacity is determined as follows: [2,200(ADt/y)*35% + 2,000(ADt/y)*65%]*352days, where the 2,200(ADt/y) and 2,000(ADt/y) correspond to the euca and pine pulp production, respectively obtained from the energy/mass balances informed originally informed in the PDD From 352 days of normal operation 65% of the time the plant would operate under pine and 35% of the time under euca campaign.

B.3. Project boundary

	Source	GHGs	Included?	Justification/Explanation
Baseline scenario	Grid electricity generation	CO2	Included	Main emission source.
		CH4	Excluded	Excluded for simplification. This is conservative.
		N2O	Excluded	Excluded for simplification. This is conservative.
	Uncontrolled burning of surplus biomass residues (only sawdust and bark)	CO2	Excluded	All biomass used in the project activity come from renewable sources. It is assumed that CO2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH4	Included	Surplus biomass (sawdust and bark) if not used for power generation is normally left in piles for uncontrolled burning or natural decay.
		N2O	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 and electricity consumption due to the project activity (stationary or mobile)	CO2	Included	May be an important emission source.
		CH4	Excluded	Excluded for simplification. This emission source is assumed to be very small.[b]
		N2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.[b]
	Off-site transportation of biomass residues	CO2	Included	Maybe an important emission source.
		CH4	Excluded	Excluded for simplification. This emission source is assumed to be very small.[b]
		N2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.[b]
	Combustion of surplus biomass residues (only sawdust and bark) for electricity generation	CO2	Excluded	It is assumed that CO2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector.
		CH4	Included	This emission source must be included, since CH4 emission from uncontrolled burning or decay of biomass residues in the baseline scenario are included.
		N2O	Excluded	Excluded for simplification. This emission source is assumed to be small.
	Storage of biomass residues	CO2	Excluded	It is assumed that CO2 emissions from surplus biomass residues do net lead to changes of carbon pools in the LULUCF sector.
		CH4	Excluded	Excluded for simplification. Since biomass residues are stored for not longer than one year, the emission source is assumed to be small.
		N2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.

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 05), project participants shall identify the most plausible baseline scenario and demonstrate additionality using the latest approved version of the "Combined tool to identify the baseline scenario and demonstrate additionality".

However, Version 02.1 of the aforementioned tool establishes in footnote Nº2 (on the first page) that for project activities in which one or more alternatives are not available options to project participants (such as grid-connected power projects), a different procedure to demonstrate additionality and identify the baseline scenario must be followed. For example, methodologies that involve alternatives that are not under the control of project participants can continue to use, if desired, the additionality tool (provides benchmark and other tools), and provide their own methods to develop and/or assess baseline scenario.

According to the above and considering that the ACM0006 (Version 05) in this case applies to a project activity in which not all the alternatives are available options to the project participants, this PDD will use the last version of the additionality tool to demonstrate additionality and will use the following steps and criteria to determine the baseline scenario:

1. Define plausible, realistic project options consistent with the country laws and regulations.
2. Discard the project options that face financial and / or other barriers that make the scenarios identified in 1 not feasible and or less likely.
3. Discard project options that do not correspond to the business as usual practice.
4. Select the most conservative project alternative from the still standing project alternatives.

This analysis is carried out in the following paragraphs below, in which each project alternative is analyzed considering the steps above.

<u>Definition of the baseline or reference project</u>

Given that the proposed project activity implies the construction of a new pulp mill, the tables below present different project alternatives that can be considered plausible baseline scenarios for the proposed project plant. It is discussed the feasibility and likelihood of each case of becoming the baseline scenario for the proposed project activity. In addition, for each project alternative it is described the situation of power and heat generation, biomass consumption and how this situation compares to the one observed in the project plant. Finally, it is addressed what would happen to any differences in power and heat generation and biomass consumption between each alternative and the project plant, in the absence of the proposed project activity.

1.1 Conventional self-sufficient pulp mill, without surplus power generation capacity.
This is the standard practice in the pulp industry in Chile and in the world. The technology for these pulp mills is proven and fully developed. Under this alternative, the pulp mill would be self-sufficient in heat and electric power generation and would have to rely on the external grid for start-ups and other contingencies.
<u>Power generation:</u> Power would be generated in the cogeneration plant inside the pulp mill, but only to the extent of supplying the pulp mill's internal power requirements. Since no surplus power would be generated, in the absence of the proposed project activity, the surplus would have to be generated by power plants in the grid.
<u>Heat generation:</u> All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.

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

1.2 Conventional self-sufficient pulp mill, with a conventional fossil fuel power unit as a back-up.
This alternative is similar to the previous one, in that the pulp mill would generate its own power internally, but would back its power requirements with a dedicated gas / diesel power unit. This alternative has three advantages over the previous one: first, it provides electric power back-up, which can be used under contingencies (i.e. plant stops and maintenances); second, it is a good business, since the low price of a used / new fossil fuel power back-up units can be rapidly repaid solely on the basis of the firm power revenues (i.e. the unit does not have to operate to repay the investment, just be available for dispatch in the grid); third, it can generate surplus power to the grid when the spot price of electricity is sufficiently high. Arauco has actually implemented this solution in its Arauco mill, where it installed a 25 MW, dual fuel Frame 5 (Horcones power plant) nearby the industrial facility.
Power generation: Power would be generated in the cogeneration plant inside the pulp mill, but only to the extent of supplying the pulp mill's internal power requirements. Additional power could be occasionally generated with the fossil fuel unit, particularly during pulp-mill maintenance and start-up operations or when the price of electricity is high. As a result, in the absence of the proposed project activity, a significant fraction of the surplus power generated by the project plant would still have to be generated by power plants in the grid.
Heat generation: All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.
Biomass residues: The same amount of black liquor and a lower amount of biomass from forest operations (sawdust and bark) would be used as fuel in this case, compared to the amounts used in the project plant, respectively. In the absence of the proposed project activity, the unused biomass residues from forest operations would be burned in the open-air or left in piles to natural decay.

1.3 Pulp mill designed to generate additional electric power at a lower efficiency or at a later stage, not undertaken as a CDM project activity.
As the proposed project activity, this is also a possible alternative, however from the project proponent's point of view, such undertaking would not constitute the usual practice in the relevant industry either. It would face similar barriers as the proposed project activity (i.e. become a visible player in the power industry) and therefore, would most likely not happen without the incentives of the CDM. In addition, since the more sophisticated pulp mill would generate additional power mainly based on black liquor, transforming a conventional pulp mill into a net power exporter (on black liquor) at a later stage would be prohibitively expensive[8]. Similarly, a less efficient power producing pulp mill would have slightly lower investment cost than the more efficient counterpart, and would certainly not be able to generate as much surplus electric power as the more efficient mill. This would make the project less attractive from a financial point of view and therefore less viable and likely to happen.
Power generation: Power would be generated in the cogeneration plant inside the pulp mill. This power capacity would be enough to serve the pulp mill's internal power requirements and would allow for some

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

electricity exports to the grid. Since the surplus power capacity of the pulp mill in this case would be lower than the surplus power capacity of the project mill, in the absence of the proposed project activity the difference would have to be generated in power plants in the grid.
Heat generation: All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.
Biomass residues: The same amount of black liquor and a lower amount of biomass from forest operations (sawdust and bark) would be used as fuel in this case, compared to the amounts used in the project plant, respectively. In the absence of the proposed project activity, the unused biomass residues from forest operations would be burned in the open-air or left in piles to natural decay.

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

1.5 Conventional pulp mill, but with a deficit in electric power generation.
This is also part of the BAU practice in the pulp mill industry in Chile. In fact, currently there are old and new pulp mills that are not self-sufficient in electric power generation. However, given that modern pulp mills tend to be self-sufficient in electric power generation, this alternative does not seem to be a proper (i.e. conservative) baseline scenario for the proposed project activity.
Power generation: Part of the power required by the pulp mill would be generated in the cogeneration plant inside the pulp mill and the rest would be sourced from the grid. Since no surplus power would be generated in this case, it would have to be generated by power plants in the grid.
Heat generation: All the process heat required by the pulp mill would be generated in the cogeneration plant inside the pulp mill, using the same type of biomass residues as the ones used in the project plant.

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

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

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

The baseline mill would have been self-sufficient in electric and thermal power generation, it would have also complied with all outstanding legal and environmental regulations in Chile, as the alternative more sophisticated pulp mill currently does. A description as well as the corresponding energy / mass balances of the alternative pulp mill have already been presented in section A.4.3 of this PDD.

It must be noted that though the baseline pulp mill design presented in section A.4.3 of this PDD present a small power deficit when the mill is producing pulp from Eucalyptus, the project proponent will consider the baseline electric efficiency considering that the mill is 100% self-sufficient in electric power generation (generation of power equals consumption of power in the mill). In this way the project proponent ensures that the baseline is realistic and conservative for the proposed project activity and that is consistent with the baseline defined for other similar CDM project activities by Arauco in Chile.

The baseline scenario for each emission source in which the proposed project activity accomplishes a reduction is then chosen according to the most common practice of the relevant industry (ies) in the country and to the particular situation the project. This analysis is shown 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	• Electric power production 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 Dispatch Center annual generation, CDEC SING Dispatch Center information and CNE future expansion plan.	• The surplus power generated by the Valdivia biomass power plant to the grid would be generated in other conventional power plants connected to the SIC grid. The power generation technology include mainly: hydro, combined cycle, open cycle and conventional coal.

Pulp industry	• Pulp mills in Chile tend to be (not all currently are) self-sufficient in electric power generation.	• AF-Celpap baseline mill design for the Valdivia mill (see section A.4.3 of this PDD). • DIA and EIA studies of pulp mills in Chile by other industry players. SEIA and CONAMA web pages. • Other industry players company information in their web pages. Other industry players Annual Reports and Sustainability Reports.	• Conventional self-sufficient pulp mill with no additional electric power capacity to the grid. • The technology used in the reference mill would be similar to the one used in the mill with the energy capacity additions / improvements. • Table 1 in section A.4.3 of this PDD describes with detail the characteristics the baseline pulp mill would have had if the proposed project activity had not been implemented.

According to ACM0006 (Version 05) and considering that the generation capacity of the proposed project activity is more than 15 MW, the baseline coefficient for the electricity displaced from the grid must be calculated as a Combined Margin (CM). This coefficient clearly and transparently indicates what would have happened if the project activity had not taken place and the additional carbon neutral energy had not been injected to the grid.

<u>Unused biomass baseline</u>

Industry	**Current practice in Chile**	**Documentation / reference**	**Description of the technology used in the absence of the proposed project activity**
Pulp industry	• Some pulp mills have a saturated steam bark boiler for process steam generation and start-up operations. • Some pulp mills have fossil fuel boilers or use fossil fuels in their boilers for process steam generation and/or start up operations.	• DIA and EIA studies of pulp mills in Chile by other industry players. SEIA and CONAMA web pages. • Other industry players company information in their web pages. Other industry players Annual Reports and Sustainability Reports. • Consultant opinions in the pulp / energy industries.	• Conventional saturated steam bark boiler.
Sawmill industry	• Part of the biomass (sawdust and bark) that is generated in the sawmill industry is used for its own energy needs or sold to other facilities for other industrial uses. However a considerable surplus still remains.	• Arauco sawmill plants. • DIA and/or EIA studies of other sawmill plants by other industry players. SEIA and CONAMA web pages. • Official statistics from Infor, such as "Industria del Aserrío en Chile". • Forest industry and Environmental publications such as Lignum and Ecoamérica.	• The additional biomass consumed by the proposed project activity (sawdust and bark) would most likely be left in piles for natural decay. In some particular cases, the biomass is burned in an uncontrolled manner.
Forestry industry	• Residues from harvesting, pruning and thinning operations are mostly left in piles to natural decay. In some particular cases the	• Conventional forest management practices of Arauco and similar sized players in the forest industry in Chile. • Forest industry and	• The additional biomass consumed by the proposed project activity (sawdust and bark) would most likely be left in piles for natural decay. In some particular cases the residues would be burned in an uncontrolled manner in

	residues are burned in an uncontrolled manner.	Environmental publications such as Lignum and Ecoamérica.	order to avoid the risk of forest fires in new or existing plantations.

Chile has a relevant forestry and wood industry that generates significant amounts of biomass residues each year. A small portion of that biomass is used as fuel to source thermal power requirement for small sawmills and other forest-related industries in the south part of the country. However, a significant portion of it is currently is left in piles to natural decay.

According to a very conservative estimation by Arauco[9], the total biomass generated from managed forestlands in Chile during 2006 is presented in the following table:

Biomass sources		2006 figures in (m^3st/yr)
Biomass from industrial operations (sawdust and bark)	(1)	19,663,000
Biomass from thinning, pruning and harvesting ops.	8,908,000	
Total biomass available	**(2)**	**28,571,000**

Source: Arauco.

Currently there is some demand for biomass from industrial operations (mainly 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. As there are no circumstances to suggest that this situation might change in the future, the project proponent deems the baseline of the additional biomass (sawdust and bark) used in the proposed project activity to be that the biomass residues are dumped or left to natural decay.

Since page 41/63 of the ACM0006 (Version 05) considers that under this baseline scenario the corresponding baseline emissions must be those generated as if the biomass were burned in an uncontrolled manner, the calculated baseline emissions are much lower than those that actually take place due to biomass dumping. This happens because when biomass is dumped and left to decay, it releases more of the carbon it contains as methane than when it is burned in the open air. This results in a significantly greater baseline emission, considering the GWP of methane as GHG. This consideration results in a very conservative baseline for the use of the biomass residues.

Heat generation baseline

In the pulp industry, heat generation using the same type of biomass residues as those used in the project plant is a common practice. As a result, the proposed project activity does not imply any displacement of heat and therefore, 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
Pulp industry	• Tend to be 100% self-sufficient in heat generation, predominantly using biomass residues from the pulping process	• Annual reports from Arauco and other relevant competitors in the industry in Chile. • ATCP pulp and paper	• Heat is generated in cogeneration plants using the same type of biomass residues as the ones used by the proposed project activity.

[9] Some experts in the forest industry talk about 30 to 35 million of cubic meters of biomass from managed forestlands for 2006 / 2007.

	(black liquor). In some cases, biomass from forest operations (sawdust and bark) is also used, but to a much lower extent compared to black liquor. Fossil fuels can occasionally be used, but it is not the predominant way of heat generation in this industry.	magazine. • New pulp mill EIA studies from other competitors in the pulp industry in Chile.	

According to the analysis above, the baseline for the proposed project activity would correspond to baseline scenarios Nº3 and Nº4 of the ACM0006 (Version 05). The first scenario applies to additional use of biomass from forest operations (sawdust and bark) for additional electric power generation inside the Valdivia pulp mill. This is accomplished through the installation of a new high capacity, high-pressure steam power boiler in the Valdivia pulp mill. The second scenario applies to the design and construction of a pulp mill with higher electric power efficiency. Both initiatives are intended to increase the power generation in the pulp mill and maximize the surplus power available to the grid. Further details on how the chosen baseline scenarios of the ACM0006 (Version 05) and the corresponding equations apply to the proposed project activity are provided in section B.5 and in Appendix 3 of this PDD.

B.5. Demonstration of additionality

To test whether the project is additional or not, the chosen baseline methodology suggests the "Tool for the demonstration and assessment of additionality (Version 04)" developed by the Meth Panel. The proposed additionality test consists in a number of requirements the project must fulfill, in order to be considered additional and therefore, not part of the baseline scenario.

As will be shown in the following paragraphs, it is clear that without the incentives derived from the CDM, the benefits generated by the project itself are not enough to overcome the technical and institutional barriers biomass cogeneration projects such as the Valdivia biomass power plant face in Chile. Further changes and incentives are still needed in all these areas to unlock the considerable potential that biomass cogeneration has in Chile.

Preliminary screening based on the starting date of the project activity

Though the proposed project activity does not wish to have the crediting period starting before the date registration date of the project, the last version of the PDD Guidelines for Completing the Project Design Document, point B.5 establishes 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 the project activity and therefore demonstrate additionality of the project. Since the Valdivia power plant was built during 2002 / 2003 and started its operation at the beginning of 2004, the following evidence is provided to demonstrate that the incentive of the CDM was seriously considered in the decision to proceed with the project activity:

- Arauco first considered the CDM principles in cogeneration initiatives in 1998. A study called "Estudio de Factibilidad de Cogenerar en Chile"[10] 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

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

environmental regulation in other countries, the Chilean regulation does not consider CO_2 a pollutant and therefore, does not contemplate any emission restriction at all. As a result of this 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 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 its business areas can be found in Arauco's 1997 to 2006 Annual Reports and the Environmental and Social Responsibility Reports.

- Consistent with the above, Arauco's annual report of 2001 (page 28) and 2002 (page 35), explicitly mentions the company's permanent commitment towards realizing new investments related to environmental mitigation projects in sensitive areas such as energy consumption and emission control among others.

- 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"[11], Forestal Celco, a subsidiary of Arauco, evaluated and actually implemented a reforestation program in the coastal dry lands in the south part of the country. Given that the CDM was in its early beginnings, Arauco was unable to certify the emission savings from this reforestation project, therefore, maintained the reforestation program until 2002, until it was not feasible to maintain it without the economic incentives of the CDM.

- Arauco began the construction of its first CDM biomass cogeneration project in April 2001, the "Trupan Biomass Power Plant in Chile" (Ref. Nº 0259). The plant became operational in 2003 and the associated CDM project activity was successfully registered in June 06, 2006.

- Consistent with its policy of sustainable development and considering the potential of the CDM, Arauco implemented similar cogeneration initiatives to the one implemented in the Trupan project in subsequent industrial projects. The "Nueva Aldea Biomass Power Plant Phase I" (Ref. Nº0258) which was started in September 2003 and the "Nueva Aldea Biomass Power Plant Phase II" (Ref. Nº 0346), started in July 2004, both were successfully registered as CDM project activities during 2006.

- The Valdivia EIA (Environmental Impact Assessment) explicitly establishes in page 1, that the Valdivia pulp mill project was conceived along the lines of sustainability development principles.

- During 2002, SERCOR S.A. developed the study "Bonos de Carbono"[12] 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

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

end of February 2005[13]. 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.

To complement the information presented above and according to EB 41, Annex 46, paragraph 5 (b) guidelines, the project proponent would like to present a detailed timeline that shows that real and continuous actions were taken in order to secure the CDM registration of the Valdivia project activity. This timeline also shows the reasons for which the Valdivia project activity could not reach the registration stage earlier.

Date	**Evidence / Event**
February 1st, 2002	Arauco started the construction of the Valdivia pulp mill and the associated CDM project activity.
December 16th, 2002	Arauco contacted and appointed a strategic CDM consultant (Urquidi, Riesco & Cía.) in order to assist the company in the presentation of the Valdivia project to the CDM.
December 30th, 2002	SERCOR S.A. (a subsidiary of Arauco) developed the study "Bonos de Carbono"[14]. This study described Global Warming, the Kyoto Protocol, the CDM and the Carbon Market structure, among others. This study was presented to Arauco board members and helped to promote the knowledge of the carbon market at a corporate level.
May 9th, 2003	Arauco coordinated with the strategic CDM consultant (Urquidi, Riesco & Cía.) in order to start working in the presentation of the Valdivia project activity to the CDM.
May 29th, 2003	Arauco started working with the strategic consultant (Urquidi, Riesco & Cía.) in the presentation of the Valdivia project to the CDM. The scope of the work included: • Defining the baseline scenario for the Valdivia project, • Defining a draft baseline methodology and performing a preliminary calculation of the emission reductions generated by the Valdivia project, • Contacting DOEs to get a quotation for validation services, • Contacting and meeting with brokers for selling the credits generated by the Valdivia project, • Assessing the carbon market, • Contacting and meeting with potential buyers for the credits of the Valdivia project, • Contacting the Chilean DNA for obtaining the LOA for the Valdivia project. Among others (see below).
June 18th, 2003	Arauco had its first meeting with Cantor CO2e.com (a broker) to explore the possibilities of selling the CERs from Arauco's Valdivia CDM project activity.
July 22nd, 2003	Arauco contacted SGS (Mr. Marriott) for a quotation on validation services for the Valdivia CDM project activity.
July 22nd, 2003	Arauco contacted Mr. Rathje, the CDM quality manager of TÜV Anlagentechnik GmbH (member of the TÜV Rheinland Berlin Brandenburg GroupTUV) via email to request information about validation and verification services for the Valdivia CDM project activity.
July 23rd, 2003	Arauco contacted Ms. Svetlana Morozova from Ecosecurities (in the US) to request information about CDM services (PDD writing) for the Valdivia CDM project activity.
July 22nd, 2003	Arauco contacted via phone and mail Mr. Douglas Milne from DNV requesting

[13] 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.
[14] "Carbon Bonds", the English translation.

	information for validation and certification services for the Valdivia CDM project activity. Further contact with DNV was channeled through Mr. Einar Telnes and Mr. Michael Lehmann, both from DNV.
July 30th, 2003	Arauco contacted via mail Ms. Monique Voogt from Ecofys to request information for validation and certification services for the Valdivia CDM project activity.
July 30th, 2003	Arauco received the first proposal for PDD development and CER sales from Ecosecurities for the Valdivia project activity. The mail was send by Ms. Paula Aczel. Subsequent contract versions were sent by Ecosecurities later on.
July 31st, 2003	Arauco received DNV's validation proposal for the Valdivia CDM project activity. The email was send by Michael Lehmann.
August 7th, 2003	Arauco received Ecofys's CDM service proposal for the presentation of the Valdivia project to the CDM. The email was sent by Ms. Diane Phylipsen. There were subsequent emails with new versions of this proposal. There were also visits to Arauco's headquarters.
August 8th, 2003	Arauco received a bundled proposal for developing the Valdivia CDM project activity. The proposal covered the following areas: • Strategic guidance in the CDM process. Urquidi, Riesco & Cía.(Chile). • Technical development of CDM studies. Fundación Chile (Chile). • Sale of credits (CERs): CO2e.com (International broker). At a later stage, this proposal was de-bundled, since each company / consultant decided to offer the services to Arauco separately.
During August 2003	Arauco sent information about the Valdivia CDM project activity to potential buyers through CO2.com. As a result of this information, Arauco started negotiating a Term sheet for the sale of CERs from the Valdivia project activity with Tepco and Mitsui (end of August, 2003).
October 9th, 2003	Urquidi, Riesco & Cía. sent the draft contract.
October 10th, 2003	Fundación Chile sent a proposal to Arauco for developing the technical studies required to present the Valdivia project activity to the CDM.
November 10th, 2003	Poch Ambiental (a technical CDM consultant) sent a proposal to Arauco for developing the technical studies required to present the Valdivia project to the CDM.
December 5th, 2003	Arauco signed the contract with Urquidi, Riesco & Cía. aimed at assisting the presentation process of the Valdivia project activity to the CDM. In this case, the contract was just a formalization of the work that had already been done between Arauco and the strategic consultant (see above).
December 5th, 2003	Arauco signed a contract with Poch Ambiental aimed at developing the CDM documentation of the Valdivia CDM project activity. This contract was unilaterally terminated by Arauco during the second half of 2004, since the company decided to develop the Valdivia CDM documentation by itself.
December 19th, 2003	TEPCO and Mitsui visited the Valdivia CDM project activity site.
December 20th, 2003	TEPCO and Mitsui had a meeting with Arauco's CEO to discuss about the possibilities of signing an ERPA involving the Valdivia CDM project activity.
February 2004	Arauco started preparing the information required to obtain the LOA for the Valdivia CDM project activity.
May, 25th, 2004	Arauco formally presented the Valdivia project to the Chilean DNA for national approval.
September 22nd, 2004	Arauco received the LOA for the Valdivia project activity.
October 28th, 2004	Arauco presented the NM0081, the first consolidated methodology for grid-connected biomass projects, to the CDM.
February, 2005	The EB approved the NM0081 baseline methodology. The methodology was not published though, since the EB decided to consolidate this methodology further.

September 30th, 2005	The EB published the first version of the ACM0006. This version was not applicable to the Valdivia project activity situation, since according to footnote N°6 of the ACM0006, the methodology was not applicable to project activities that used cogeneration technology in the baseline scenarios that could potentially be applicable to the Valdivia project situation.
December 16th, 2005	Arauco sent a request for revision of the ACM0006 (Version 01) through DNV asking the EB to please eliminate footnote Nº6.
March, 2006	The EB published the ACM0006 (Version 02), which eliminated footnote Nº6. The methodology, though, was still not applicable to the Valdivia project situation since it did not have a baseline scenario that exactly suited the Valdivia CDM project situation.
February 2007	Arauco sent a clarification request to the EB asking if it was feasible to simultaneously apply two compatible baseline scenarios of the ACM0006 (N°3 and N°4) to a single project activity. The idea was to apply these baseline scenarios to the Valdivia project situation.
March 30th, 2007	The Meth Panel said that it was not possible to apply two baseline scenarios of the ACM0006 to a single project activity. However, considering the proposed project situation, it recommended Arauco to submit a request for deviation of the ACM0006.
July 12th, 2007	Following the recommendation of the Meth Panel, Arauco finished the Valdivia PDD, prepared the corresponding request for deviation and sent this documentation to DNV. In this date, the validation of the Valdivia CDM project activity formally began.
August 30th, 2007	DNV sent the request for deviation of the ACM0006 to the Secretariat.
December 13th, 2007	The EB sent the corresponding approval to the request for deviation of the ACM0006.
April 9th, 2008	Arauco sent the Valdivia CDM project activity for registration to the Secretariat.
August 13th, 2008	The Secretariat published the Valdivia project activity as a project requesting registration in the UNFCCC web page.

As can be seen, the presentation of the Valdivia project activity to the CDM was clearly in the agenda of Arauco from the beginning, however, the strategy followed by Arauco and the circumstances presented above, (which are all dated and fully documented) explain why the Valdivia project reached the registration stage in 2008 and not earlier.

The following paragraphs below address the additionality of the proposed project, according to the "Tool for the demonstration and assessment of additionality (Version 04)":

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

According to the consolidated baseline methodology for grid-connected biomass projects chosen for the proposed project activity, realistic and credible alternatives must be separately determined regarding:

- How electric power would be generated in the absence of the CDM project activity.
- For cogeneration projects: how the heat would be generated in the absence of the project activity.
- What would happen to the biomass in the absence of the project activity.

Given that steam and electric power generation for internal consumption is part of the BAU practice in the pulp industry, the proposed project activity only claims emission reductions from on-site surplus power generation that is injected to the grid and the additional biomass consumption (sawdust and bark) derived from additional electric power generation capacity of the plant.

The plausible project scenarios for the Valdivia biomass power plant were already presented and analyzed in section B.4 of this PDD. From this analysis, it is clear that the Valdivia biomass power plant is not the only viable project alternative that is available, since there are others that are not only viable and realistic, but actually widely implemented in Chile, even by the same project proponent of the project activity presented in this PDD.

Step 2: Investment analysis

Not chosen.

Step 3: Barrier analysis

The Valdivia biomass power plant project activity faces barriers that:

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

These barriers will be presented and analyzed below.

3.1. Barriers that would prevent the implementation of the proposed project activity:

Investment barriers: The higher investment risk results from the added operational complexity of operating a pulp mill as a power plant connected to the grid. Being part of the grid and the corresponding dispatch center (CDEC-SIC) implies additional risks. For example, any power contingency (i.e. black out) in the system may translate into an economic penalty to the owner of the cogeneration power plant, even if the problem was not related to the operation of the power plant itself[15]. To date, Arauco has paid around US$ 130,000 in fines to the authority. It must be noted however, that the original amounts were -on average- 7 times higher. In each case, Arauco has had to appeal to the corresponding national authority.

Technological barriers: Though Arauco is a relevant player in the pulp industry in Chile, the Valdivia pulp mill does present some particular features that make the plant special and different from the BAU pulp mill. This is due to the fact that the Valdivia pulp mill was specially designed to generate additional electric power, which implies some modifications and technology improvements over the conventional mill that are not standard in the pulp mill industry in Chile[16]. A pulp mill with surplus electric power generation capacity must deal with the following technical issues:

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

- The more energy-efficient pulp mill requires skilled and trained labor in order to operate the mill in a way that both the pulp production and power generation are optimized. It requires qualified personal

[15] Normally, the penalty is proportional to the owner's total generation capacity in the system. Some penalizations that have been applied to Arauco can be found in RE 1433, pages 13-14, RE 809, page 16 and RE 1114 pages 13-14.
[16] "Not standard" is used here to indicate that the pulp mill has additional electric power generation capacity to the grid. For more details about how exactly the project mill departs from the standard pulp mill design, please revisit section A.4.3, Table 1 of this PDD.

that know how to coordinate the pulp production program and at the same time comply with the dispatch program of the CDEC-SIC. These types of skills are not readily available in the host country, since no other company but Arauco has pulp mills that behave as grid-connected power units[17]. This results in a "trial-and-error" learning process, which is costly (i.e. the Dispatch Center severely penalizes power companies with lower power revenues if they fail to deliver full power when instructed to do so) and lengthy.

- From a design point of view, a pulp mill with surplus electric power capacity to the grid tends to work with higher steam data (i.e. 85 bar and 480ªC). To generate this type of steam, the recovery boiler must be equipped with a super heater that works with a higher temperature (650ºC) compared to the one in a mill with no additional power generation capacity. As a result of the higher temperature, the sulfur and potassium present in the flue gases, melt and adhere to the exterior of the boiler tubes, causing corrosion and fouling problems. This increases the maintenance costs and downtime of the mill during the year. Supporting evidence that confirms the above can be found in publicly available studies[18] of the pulp industry.

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

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

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

By the time the Valdivia project was built there was no other player in the pulp industry in Chile that had a pulp mill like the Valdivia pulp mill. No other pulp mill in Chile operated with such a high-pressure steam data (85 bar, 480°C) and was able to generate such a considerable amount of surplus power to the grid (61 MW). Still today, there is no other pulp mill in Chile (including registered CDM project activities) capable of generating such a surplus of electric power to the grid. This statement can be easily checked looking at the type of power plants that are grid-connected to the SIC system.

Cultural barriers: Arauco's culture in the forestry-related industries is very much influenced by the commodities: wood-products and pulp markets, which differ from the culture in the electric power sector. Unlike forestry products, electric power cannot be stored in order to speculate on price. The Power Purchase Agreements require different negotiation skills, which are not the core competences of Arauco

[17] This can be easily verified, looking at the list of power plants connected to the SIC I Appendix 4 of this PDD.

[18] Please see: Fredrik Bruno. 2001. Thermochemical aspect on chloride corrosion in Kraft recovery boilers. Corrosion 2001. Paper N° 04126. Available at: http://www.nace.org/nacestore/assets/ConferencePapers/2001/01426.pdf.

management. For instance, when signing a long-term electricity contract, the PPA, the seller must be confident enough that it will be able to supply the contracted power at a reasonable cost.

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

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

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

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

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

An argument that reinforces and complements the barrier mentioned above, refers to the fact that in the SIC system, the non-conventional renewable energy technologies represent less than 5% of the total energy generated in the system. In addition, the electric power industry is highly concentrated, with mainly four power companies concentrating over 60% of the total energy generated in the SIC grid. The low share of non-conventional renewable energy technologies, the high leverage of conventional power generators and the insufficient incentives for renewable sources in the electric law make these barriers structural and relatively permanent for prospective non-conventional energy producers and current players such as Arauco.

The coordination with sub-distribution, distribution and transmission companies also become more complicated when an industrial facility not only consumes power from the grid but also injects power to the grid. Sometimes the system to which the cogeneration plant must connect is not capable of handling the additional power injected by the power plant. This implies additional investments (reinforcement of

sub-transmission lines and new protection systems), which in some occasions can translate into additional (and costly) startups delays[19].

Despite the regulatory authorities have recently incorporated[20] some measures to promote the use of non-conventional renewable energy sources, the RM17 of 2004 introduced a new algorithm for the firm power calculation for self-power generating companies. This new algorithm introduced a new penalization factor that lowered the firm power for these power producers, which is not present in the calculation of the firm power of conventional power producers. This measure negatively affects biomass cogeneration facilities such as the Valdivia biomass power plant, given that the cogeneration facility falls under this power plant category.

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

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

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

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

   To further illustrate how prohibitive these barriers are, the Project Proponent would like to present an example. During September, 2004 the main competitor of Arauco in Chile built a new pulp mill line in the VIII Region of the country. This new pulp mill line had a similar capacity to the Valdivia's pulp mill capacity and incorporated the latest technology available in the pulp industry (it was built according to the BAT, Best Available Technology in the pulp industry). Nevertheless, the new pulp mill used a lower steam data boiler and was not capable of even

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

generating all the power required by the new pulp mill line itself. The new pulp mill line had to rely on the grid to source all its power requirements. Other pulp mills in Chile also share the same situation and are not capable of generating all the power they require, making them dependent on the grid. This case, however, is a good example since it is a more recent pulp mill than the Valdivia pulp mill.

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

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

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

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

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

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

- The CDM is a new mechanism that has the potential to promote in an economically efficient way the usage of clean technology. However, given that the system is still at its beginnings, the transaction costs for developing new project activities are still very high. This makes it very

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

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

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

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

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

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

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

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

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

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

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

It must be noted that most of the barriers and low incentives for renewable energy sources presented in this section have been addressed and ratified by the OECD Environmental Performance Review study for Chile, published early in 2005[21].

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

Step 4: Common practice analysis,

4.1 Other activities similar to the proposed project activity in Chile

4.1.1 Arauco initiatives:

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

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

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

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

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

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

4.1.2 Other company's initiatives:

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

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

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

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

4.2. Analysis of similar options observed in Chile

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

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

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

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

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

Pulp industry: Though cogeneration is widely used in the pulp industry, and therefore part of the business as usual practice, only modern pulp mills tend to be self-sufficient in thermal and electric power generation. In these mills, all internal thermal and electric power requirements are served by burning black liquor in the recovery boiler (not biomass from forestry operations), which is part of the Kraft process. In some cases, a biomass (bark) power boiler to supplement internal thermal and electric power generation is also considered a normal practice. However, it is not the common practice in Chile (or in the world) that a pulp mill becomes a net electric power exporter to the grid to which it is connected. Even today there are examples of new pulp mills in Chile that are not self-sufficient in electric power generation, and must import electric power from the grid on a normal basis.

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

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

- The Valdivia biomass power plant project is the first of its type in Chile. Comparable initiatives are not observed in other pulp mill facilities in Chile[22].

- Similar biomass cogeneration projects in related industries (i.e. Sawmills, plywood mills and MDF wood panel mills) are equally unique, and therefore, not observed as conventional initiatives either.

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

B.6. Emission reductions

B.6.1. Explanation of methodological choices

Baseline case scenarios

The proposed project activity consists in the construction of a new grid-connected biomass power plant (a Greenfield project), which is a result of the implementation of two CDM project initiatives in a new

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

pulp mill facility. Both CDM project initiatives are aimed at making the new pulp mill a net power exporter to the grid. The two project initiatives are described below:

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

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

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

As a result of these two initiatives, the project proponent has chosen two (compatible) baseline scenarios in Table 2 of the baseline methodology, that clearly reflect the circumstances under which these two project initiatives were implemented. These scenarios are shown in the table below:

<u>Combination of baseline scenarios chosen for the Valdivia biomass power plant project activity</u>

Scenario	Project type	Baseline scenario		
		Power generation	Use of biomass	Heat generation
3	Power greenfield projects	P4	B1	H4
4	Power greenfield projects	P4	B4	H2

Baseline scenario Nº3 is applicable to the CDM project initiative Nº1, while baseline scenario Nº4 is applicable to the CDM project initiative Nº2. Heat generation is really not relevant in this case, since the proposed project activity will not claim credits on heat generation.

The main reason for using baseline scenarios Nº3 and Nº4 in the proposed project activity instead of using each scenario in the corresponding CDM project initiative is because of the possibility to monitor the total net additional electric power generated by the two CDM project initiatives simultaneously in the new power plant. Doing so for each CDM project initiative would imply a far more complex and sophisticated monitoring methodology than the one currently proposed by the baseline methodology ACM0006 (Version 05), since it would require to determine and monitor the exact amount of additional electric power attributable to each individual CDM project initiative in the power plant (i.e. generated in the same turbogenerators). Since at the end, it is only the total additional net amount of electric power generation what is relevant, there is really no gain in monitoring separate additional electric power generations in the same power plant, therefore the convenience of applying the two chosen baseline scenarios simultaneously. It must be noted however, that both scenarios Nº3 and Nº4 are perfectly compatible in this case, and allow monitoring all the variables and parameters identified by each scenario separately and without conflict.

Since the ACM0006 (Version 05) does not allow the use of more than one baseline scenario, the project proponent presented a request for deviation of the baseline methodology during the validation stage, so

that two compatible baseline scenarios (Nº3 and Nº4) could be simultaneously applied to the proposed project activity. The Executive Board accepted this request for deviation in its 36th meeting. The corresponding document submitted for the request for deviation is included in Appendix 3 of this PDD.

Equations used to calculate emission reductions

The net emission reductions from the project are calculated through the following equation:

$$ER_y = ER_{electricity,y} + BE_{biomass,y} – PE_y - L_y$$

Where:

ER_y = Emission reductions of the project activity during the year y (tCO_2/yr).
$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year y (tCO_2/yr).
$BE_{biomass,y}$ = Baseline emissions due to anthropogenic sources of biomass residues during year y (tCO_2e/yr).
PE_y = Project emissions during the year y (tCO_2/yr).
L_y = Leakage emissions during the year y (tCO_2/yr).

Project emissions

Project emissions are calculated through the following equation:

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} * PE_{Biomass,CH4,y}$$

Where:

PET_y = CO_2 emissions during the year y due to transport of the biomass residues to the project plant (tCO_2/yr).
$PEFF_y$ = CO_2 emissions during the year y due to fossil fuels co-fired by the generation facility or other fossil fuel consumption at the project site that is attributable to the project activity (tCO_2/yr).
$PE_{EC,y}$ = CO_2 emissions during the year y due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr).
GWP_{CH4} = Global Warming Potential for methane valid for the relevant commitment period.
$PE_{Biomass,CH4,y}$ = CH_4 emissions from the combustion of biomass residues during the year y (tCH_4/yr).

a) Carbon dioxide emissions from combustion of fossil fuels for transportation of biomass residues to the project plant (PETy)

The proposed project activity contemplates the use of two types of biomass fuel residues: a mix of sawdust and bark (from forest / industrial operations) and black liquor from the pulping process. Since the proposed project activity contemplates an additional consumption of the first type of biomass residues, the transportation of the additional residues to the plant will be accounted for by using the following equation:

$$PET_y = N_y * AVD_y * EF_{km,CO2,y}$$

or

$$PET_y = \frac{\sum_k BF_{T,k,y}}{TL_y} * AVD_y * EF_{km,CO2,y}$$

Where:

PET_y =	CO_2 emissions during year y due to transport of the biomass residues to the project plant (tCO_2/yr).
Ny =	Number of truck trips during the year y.
AVD_y =	Average round trip distance (from and to) between the biomass residue fuel supply sites and the site of the project plant during year y (km).
$EF_{km,CO2,y}$ =	Average CO_2 emission factor for the trucks measured during the year y (tCO_2/km).
$BF_{T,k,y}$ =	Quantity of biomass residue type k attributable to the project activity and transported in trucks from outside of the plant and combusted in the project plant during the year y (tons of dry matter or liter).
TL_y =	Truck average biomass transportation capacity (ton).

It must be noted that project emissions related to this source will only be accounted for the additional consumption of biomass from forest / industrial operations due to the implementation of project initiative Nº1. The calculation of the additional biomass is accomplished by using equation (30) in page 39 of the ACM0006 (Version 05):

$$BF_{PJ,k,y} = BF_{k,y} - \frac{Q_{projectplant,y}}{\varepsilon_{boiler} * NCV_k}$$

Where:

$BF_{PJ,k,y}$ =	Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (tons of dry matter or liter).
$BF_{k,y}$ =	Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or liter).
$Q_{project\ plant,y}$ =	Quantity of heat generated in the cogeneration project plant from firing biomass residues during year y (GJ).
ε_{boiler} =	Energy efficiency of the boiler that would be used in the absence of the project activity.

In this case, the same conditions and requirements stated in the baseline scenario Nº3, which are applicable to the biomass type and associated variables related to this scenario would be applied in this case as well (i.e. leakage monitoring for this biomass type).

b) Carbon dioxide emissions from on-site consumption of fossil fuels ($PEFF_y$)

CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFF_y = \sum (FF_{project\ plant,\ i,y} + FF_{project\ site,\ i,y}) * NCV_i * COEF_i$$

Where:

$FF_{project\ plant,i,y}$ =	Quantity of fossil fuel type i combusted in the biomass residue fired power plant during the year y (mass or volume unit per year).
$FF_{project\ site,\ i,y}$ =	Quantity of fossil fuel type i combusted at the project site for other purposes that are attributable to the project activity during the year y (mass or volume unit per year).
NCV_i =	Net calorific value of fossil fuel type i (GJ / mass or volume unit).
$COEF_i$ =	CO_2 emission factor for fossil fuel type i (tCO_2/GJ).

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

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

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

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

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

To account for the first project emission source, the project proponent will use a specific consumption factor that considers historic fossil fuel consumption per unit of biomass consumed in the Valdivia power boiler under normal operation conditions (i.e. start-up operations, when the biomass is too wet, etc.).

To account for the second project emission source, the project proponent will monitor all the additional fossil fuel consumption used to generate additional electric power to the grid. It must be noted that as in

the previous case, fossil fuel consumption will only be considered as a project emission source when the pulp mill is generating surplus power to the grid. Under that condition, the project will consider all the fossil fuel used to increase the electric power output of the plant as a project emission source.

c) Carbon dioxide emissions from electricity consumption ($PE_{EC,y}$)

This project emission source is considered, but not by directly applying equation (7) of the baseline methodology. Given that the proposed project activity will only claim credits on the net (surplus) electric power generation of the pulp mill, all the electric power consumed internally at the plant (including the one related to the project activity) will be deducted from the gross power generation of the plant[23]. Anyway, if in the future there were any additional electric power consumption attributable to the project activity that were not accounted for in the net surplus electric power calculation, it will be accounted for through equation (7) of the ACM0006 (Version 05).

d) Methane emissions from combustion of biomass residues ($PE_{Biomass,CH4,y}$)

Since this source is included in the project boundary, emissions are calculated using the following equation:

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} * \sum BF_{PJ,k,y} * NCV_k$$

Where:

$BF_{PJ,k,y}$ = Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (tons of dry matter or liter).
NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter).
$EF_{CH4,BF}$ = CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ).

The methodology provides in Tables 4 and 5 default values for the methane emission factor. The selection and justification of the methane emission factor used is explained in the following subsection of this PDD.

Baseline emissions

a) Emission reductions due to displacement of electricity

Emissions are calculated using the following equation:

$$ER_{electricity,y} = EG_y * EF_{electricity,y}$$

Where:

[23] This is equivalent as to use equation (7) of the ACM0006 (Version 05).

$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year y (tCO_2/yr).
EG_y = Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y (MWh).
$EF_{electricity,y}$ = CO_2 emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh).

Determination of $EF_{electricity,y}$

Since the power generation capacity of the project plant is higher than 15 MW, $EF_{grid,y}$ is calculated as a combined margin (CM), following the guidance in the section "Baselines" in the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002). Further explanations about how the OM and BM coefficients are calculated, are presented below.

Operating Margin emission factor calculation ($EF_{OM,y}$)

The ACM0002 (Version 06) offers four methods to calculate the Operating Margin emission factor:

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

The methodology above suggests that option (c) should be the first choice, however, this PDD will select option (b) for determining the Operating Margin. The reasons for choosing option (b) instead of any other option presented in the ACM0002 (Version 06) are outlined below:

Reasons for not choosing option (a), the Simple OM:

According to the ACM0002 (Version 06), the Simple OM method can only be used where low-cost / must run resources constitute less than 50% of the total grid.

Since the average low-cost / must run power generation for the last five most recent years (2002 to 2006, inclusive), represent 68.0%, this option is not available for the project proponent.

Reasons for not choosing option (c) the Dispatch Data Analysis OM:

- The Dispatch data analysis method requires to monitor the top 10% dispatched plants every hour. Despite the fact that the CDEC-SIC makes a lot of information public, hourly dispatched data is not available to third parties. Besides, the information is dispersed, requires considerable processing and has a delay of at least 1 week.

- The dispatch policy of the CDEC-SIC is so dynamic (the top 10% plants changes several times within an hour) that to be accurate enough in the calculation, it would be necessary to monitor the top 10% of dispatched plants in real time instead of in an hourly basis. This introduces uncertainty and complexity to the monitoring procedures and compromises transparency in the OM calculation process.

In order to have a more accurate and informed opinion about the findings above, the project proponent hired a consultant of the electric industry in Chile to perform a study aimed at assessing the feasibility of

implementing the Dispatch Data Analysis method to calculate the OM[24] in the SIC grid. The main conclusions of the study confirmed the original findings of the project proponent and are summarized below:

1. Relevant information that is required to determine the grid system dispatch order of operation for each power plant in each hour h is not publicly available. This lack of information can have a significant impact in the final results of the OM emission factor calculation.

2. The dispatch policy of the CDEC-SIC is so dynamic that the set of plants n changes significantly within an hour. With the current information publicly available, it is not possible to accurately determine the total energy generated by the set of marginal plants n during each hour h.

3. Even in a scenario in which all the information addressed above were publicly available, the correct and accurate application of the Dispatch Data Analysis method would still require specialized know-how about the grid topology, power plants, reservoirs capacities and hydro power plant series that compose the SIC and a unified criteria in the OM calculation process (from the CDEC-SIC Dispatch Center), in order to correctly understand, interpret and process the considerable amount of data required to calculate the OM emission factor. Since this information is not available at this time, the Dispatch Data Analysis method cannot be accurately and transparently used to calculate the OM emission factor for the SIC grid.

Reasons for not choosing option (d), the Average OM:

According to the ACM0002 (Version 06), the Average OM method can only be used if the low cost / must run resources constitute more than 50% of total grid generation and there is not enough data publicly available to use option (b) or (c). As previously indicated, there is not enough data to use option (c), however, there is enough data to use option (b), so option (d) must be discarded.

The Simple Adjusted OM method requires to identify low cost must run resources (*k*) from other power sources (*j*):

$$EF_{OM,simpleadjusted,y} = (1-\lambda_y)\cdot\frac{\sum_{i,j} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y\cdot\frac{\sum_{i,k} F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$

Where:

$EF_{OM,simpleadjusted,y}$ = The Operating Margin of the grid, calculated according to the simple-adjusted method established in the ACM0002 (tCO_2/MWh).

λ = Fraction of time in a year in which non-low-cost / must-run power plants are on the margin. (Number).

$F_{i,j,y}$ = Amount of fuel i consumed by non low-cost / must-run power sources j in year(s) y. (Mass or volume).

$COEF_{i,,j,y}$ = CO_2 emission coefficient of fuel i, taking into account the carbon content of the fuels used by non low-cost / must-run power sources j and the percent oxidation of the fuel in year(s) y. (tCO_2/mass or volume unit of the fuel).

$GEN_{j,y}$ = Electricity delivered to the grid by non low-cost / must-run power sources j. (MWh).

[24] The study was performed by Electronet Consultores Ltda., a highly reputed consulting company in the electric industry in Chile. The study itself was carried out by a consultant who was a former Director of Operations of the CDEC-SIC from 1999 to 2005. This study will be made available to the DOE at the Validation stage of this project.

$F_{i,k,y}$ = Amount of fuel i consumed by low-cost / must-run power sources k in year(s) y. (Mass or volume).

$COEF_{i,k,y}$ = CO_2 emission coefficient of fuel i, taking into account the carbon content of the fuels used by low-cost / must-run power sources k and the percent oxidation of the fuel in year(s) y. (tCO_2/mass or volume unit of the fuel).

$GEN_{k,y}$ = Electricity delivered to the grid by low-cost / must-run power sources k. (MWh).

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

- A 3-year average, based on the most recent statistics available at the time of PDD submission, or
- The year in which project generation occurs, if $EF_{OM,y}$ is updated based on ex-post monitoring.

The project proponent will use the second option to calculate the OM; that is, the OM will be calculated the year in which the project generation occurs.

Build Margin emission factor calculation ($EF_{BM,y}$)

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the Simple Adjusted OM method above for the plants m.

According to the ACM0002 (Version 06), the project proponent will use Option 2 for the first crediting period, which means that the $EF_{BM,y}$ is calculated ex-post for the year in which actual project generation and associated emission reductions occur. For subsequent crediting periods, $EF_{BM,y}$ will be calculated ex-ante, according to Option 1.

Weights w_{OM} and w_{BM} for the combined margin calculation

According to the document "Guidance on selecting alternative weights", ACM0002 (Version 06), there are no reasons to depart from the default weight selection of 0.5 for both the w_{OM} and w_{BM}, since none of the reasons outlined in the document for modifying these values apply in this case (i.e. timing of project output, predictability of project output and demand situation do not provide any reason to change the default values of 0.5 each).

Determination of $EG_{,y}$

In this case, the additional net electric power generation of the CDM project initiatives under scenarios Nº3 and Nº4, would be determined by following the indications of scenario Nº4, using equation (14), which is explained below in the context of the proposed project activity:

$$EG_y = EG_{project\ plant} - \varepsilon_{el,\ other\ plant(s)} * (1/3.6) * \sum (BF_{k,y} * NCV_k)$$

Where:

EG_y = Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during year y (MWh). In this case, the calculation would include the net quantity of increased electricity generation derived from implementing CDM project initiatives Nº1 and Nº2, simultaneously.

$EG_{project\ plant}$ = Net quantity of electricity generated in the project plant during year y (MWh). In this case, the project plant would incorporate the net quantity of increased electric generation capacity derived from implementing CDM project initiatives Nº1 and Nº2.

$\varepsilon_{el,\ other\ plant(s)}$ = Average net energy efficiency of electricity generation in (the) other power plant(s) that would use the biomass residues fired in the project plant in the absence of the project activity ($MWh_{el}/MWh_{biomass}$). In this case, the baseline power plant electric efficiency calculation considers a business-as-usual pulp mill (reference plant), in which project initiatives Nº1 and Nº2 are not implemented. For more details please see pages 10 and 11 of the PDD.

$BF_{k,y}$ = Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or litter). In this case, the project plant would combust a higher amount of biomass from forest operations (CDM project initiative Nº1) but the same amount of black liquor (CDM project initiative Nº2) than the baseline plant (reference plant). This variable includes both types of biomass fired in the project plant.

NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter of GJ/liter). In this case, the NCV for each type of biomass would be monitored and considered in the calculation: the NCV of biomass from forest operations (CDM project initiative Nº1) and the NCV of black liquor (CDM project initiative Nº2).

As in the previous case, the same conditions and requirements stated in scenario Nº4, which are applicable to the biomass type and associated variables related to this scenario would be applied in this case as well.

b) Emission reductions due to uncontrolled burning of anthropogenic sources of biomass residues

Since this project activity requires two project scenarios, Nº3 and Nº4, only the additional biomass under scenario Nº3 can be credited with emission reductions. The additional biomass under this scenario is determined using equation (30) in page 39 of the ACM0006 (Version 05). The emission reductions associated to this source are then calculated using equation (34) of the ACM0006 (Version 05):

$$BE_{Biomass,y} = GWP_{CH4} * \sum BF_{PJ,k,y} * NCV_k * EF_{burning,CH4,k,y}$$

Where,

$BE_{biomass,y}$ = Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year y (tCO_2e/yr).

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4).

$BF_{PJ,k,y}$ = Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (tons of dry matter or liter).

NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter)
$EF_{burning,CH4,k,y}$ = CH_4 emission factor for uncontrolled burning of the biomass residue type k during the year y (tCH_4/GJ).

To determine the CH_4 emission factor for uncontrolled burning of biomass, the project proponent conducted a local measurement. This is shown and explained below.

Leakage emissions

According to the ACM0006 (Version 05), leakage emissions must be monitored for biomass used under scenario Nº3 (mix of bark and sawdust). To do so, the project proponent will use option L2, which requires to establish that the quantity of available biomass residue of type k in the region is at least 25% larger than the quantity of biomass residues of type k that are utilized.

Though the possibility of leakage in the proposed project activity is very low, in case it occurs, leakage emissions will be calculated according to equation (35) in page 44 of the ACM0006 (Version 05).

$$L_y = EF_{CO2,LE} * \sum BF_{PJ,k,y} * NCV_k$$

Where,

L_y = Leakage emissions during the year y (tCO_2/yr).
$EF_{CO2,LE}$ = CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/GJ).
$BF_{PJ,k,y}$ = Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (ton of fry matter or litter).
k = Types of biomass residues for which leakage effects could not be ruled out with one of the approaches L_1, L_2 or L_3 above.
NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter).

Default values

a) Methane emission factor for uncontrolled burning of biomass

In this case, the project proponent will use the default methane emission factor (0.0027 tCH_4/t biomass) provided in page 42/63 of the ACM0006 (Version 05). The project proponent will also use the most conservative conservativeness factor (0.73) provided in the methodology, to adjust the emission factor for uncertainty.

The above choice is by far extremely conservative, considering that the biomass that is not used for power generation in the project plant is mostly left in densely packed piles to natural decay and / or burned in the open air. If the biomass is left to natural decay, the CH_4 emissions far exceed those that occur when the biomass is burned in the open air. Still in this case, when the biomass is burned in the open air, the combustion takes place under very low air (oxygen) presence, which results in high CH_4 emissions.

Unfortunately, by the time the Valdivia project activity was implemented, there were no representative local measurements of this emission factor available in the country, therefore the project proponent had to use the default factor provided in the ACM0006 (Version 05). Nevertheless, the project proponent will

conduct local measurements of this emission factor, and hopes it can use the measured value instead of the default value in the future. This will be consulted with the CDM Executive Board in due time.

b) Methane emission factor for controlled burning of biomass

According to the baseline methodology ACM0006 (Version 05), page 25, the project proponent may conduct measurements at the plant site or use IPCC default values. For the sake of simplicity in the monitoring procedures, in this case the project proponent will simply use the default factor provided by the IPCC.

In September 2006, Arauco hired the U.S. Forest Service of Missoula, Montana, USA to conduct measurements of this factor in two similar power boilers (fluidized bed boiler) to the one used in the Valdivia power plant. The results showed that combustion process of the biomass in a modern fluidized bed boiler was so efficient that the methane concentration in the flue gases was actually lower than the concentration found in the clean air. In other words, the biomass combustion in this type of boilers was actually reducing the methane concentration of the clean air. Taking this into consideration, the project proponent decided to choose the least conservative emission factor of 30.6 Kg CH_4/TJ available from tables Nº4 and Nº5 of the ACM0006 (Version 05) (30 Kg CH_4/TJ with an associated conservative factor of 1.02), to account for this emission source. Considering the measurement results, this factor is still extremely conservative.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	GWP_{CH4}
Unit	(tCO2e/tCH4)
Description	Global Warming Potential for CH4.
Source of data	IPCC
Value(s) applied	Applied value of 21 for the first commitment period from 2009 to 2012. From 2013 to 2016 the applied value was 25 Shall be updated according to any future COP/MOP decisions.
Choice of data or Measurement methods and procedures	Until the next COP/MOP decision, it is the accepted value for emission reduction calculations in CDM project activities.
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	$\varepsilon_{el,reference\ plant}$
Unit	(%)
Description	Average net energy efficiency of power in the reference power cogeneration plant that would use the biomass residues fired in the project plant in the absence of the project activity.
Source of data	The electric efficiency of the Valdivia baseline mill was calculated from the AF Celpap energy / mass balances (Please see section A.4.3 of this PDD). The calculation itself can be found in Appendix 4 of this PDD.
Value(s) applied	12.127[25]% %
Choice of data or Measurement methods and procedures	AF Celpap is a world-class consulting company of the pulp, wood-panel and energy industries, located in Sweden. The electric efficiency calculated for the Valdivia baseline mill design is similar to the electric efficiency calculated in other baseline pulp mill studies of Arauco. It is also higher than the electric efficiency estimated for other comparable pulp mill projects in Chile (Please see Appendix 4 of this PDD). This ensures the conservativeness of the baseline for the proposed project activity.
Purpose of data	Baseline emission calculations.
Additional comment	In this case, since baseline scenarios Nº3 and Nº4 apply to the proposed project activity situation, the total amount of biomass that would be burned to generate power differs with and without the implementation of the project activity. The amount of black liquor would be the same (baseline scenario Nº4), but the amount of biomass from forest operations would be lower in the baseline case situation (baseline scenario Nº3). To correctly reflect the electric efficiency of the baseline / reference plant, the efficiency for the baseline situation was calculated considering the total amount of biomass (black liquor and biomass from forest operations) that would be consumed in the baseline plant and the total electric power generation of the baseline (or reference) plant. This way of calculating the electric efficiency is consistent with the baseline scenario chosen for the Valdivia project activity (self-sufficiency in electric power generation) and with equation (14), which accounts for all the biomass consumed in the project mill.

[25] The net electric efficiency of the reference pulp mill would be 12.127%, which results to be slightly higher, and thereby more conservative from the emission reduction calculation, than using the original value of 12.09% used for the reference pulp mill. The new value of the reference plant was calculated using ex-ante data (not monitored data). This is in accordance with the ACM0006 (ver05) which state that this is a fixed ex-ante (not monitored) parameter. The reason that explain the increase in the value of the electric efficiency is due to biomass drier power consumption. See Appendix 4 of the updated PDD for detailed explanation.

Data / Parameter	Additional electric power consumption of the project mill
Unit	(GWh/time unit)
Description	This is the additional electric power consumption of the project pulp mill with surplus power capacity generation to the grid with respect to a baseline pulp mill, which does not have surplus electric power capacity to the grid. This marginal higher power consumption is derived from the installation of the equipment that enables the project pulp mill to generate additional power (for example: the installation of a higher biomass capacity power boiler in the project mill, compared to the one that would have been installed in a baseline pulp mill).
Source of data	Energy / mass balances of AF Celpap study for the Valdivia mill.
Value(s) applied	Constant 4.59[26]% of the total energy consumed by the pulp mill in the project scenario.
Choice of data or Measurement methods and procedures	The value was obtained from the energy / mass balances of the project mill. Since the energy / mass balances of the project mill are a good representation of the behaviour of the real mill, the calculation was deemed appropriate and realistic (i.e. the higher the electric power consumption of the pulp mill, the higher the additional electric power consumption of the associated power plant).
Purpose of data	Baseline emission calculations.
Additional comment	The direct monitoring of this parameter is not possible, since it would require simulating the power consumption of a mill without surplus power generation capacity to the grid, given the production level of the project mill.

Data / Parameter	Fuel oil consumption per unit of combusted biomass in the Valdivia mill power boiler
Unit	(Kg of fuel oil / m3st)
Description	This parameter refers to the amount of fuel oil that is normally co-fired in a fluidized bed biomass boiler. It considers normal operational reasons such as start-up operations and the wet condition of biomass in winter.
Source of data	Historic fossil fuel and biomass consumption data from the Valdivia biomass power plant.
Value(s) applied	3.43 (kg of fuel oil/m3st)
Choice of data or Measurement methods and procedures	To calculate this parameter, the project proponent used historic fossil fuel consumption of the Valdivia power boiler. This calculation did not consider the situation when the boiler burns fossil fuels to increase high-pressure steam output for additional power generation to the grid, so it can be used to calculate the normal fossil fuel consumption in the baseline scenario.
Purpose of data	Project emission calculations.
Additional comment	---

[26] Determine as the additional internal power consumption (3.0MW) divided by the total internal power consumption of the project plant (65.6MW).

Data / Parameter	Carbon content of Diesel
Unit	(tC/TJ)
Description	Carbon content of fuel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	20.2 (tC/TJ)
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations..
Additional comment	---

Data / Parameter	Carbon content of Fuel Oil
Unit	(tC/TJ)
Description	Carbon content of fuel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	21.1 (tC/TJ)
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Carbon content of Natural Gas
Unit	(tC/TJ)
Description	Carbon content of fuel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	15.3 (tC/TJ)
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Carbon content of Coal
Unit	(tC/TJ)
Description	Carbon content of fuel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	25.8 (tC/TJ)
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Carbon content of Pet-Coke
Unit	(tC/TJ)
Description	Carbon content of fuel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	26.6 (tC/TJ)
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Carbon content of IFO 180 (Residual Oil)
Unit	(tC/TJ)
Description	Carbon content of fuel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	21.1 (tC/TJ)
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fraction of carbon oxidized for Diesel
Unit	(%)
Description	Fraction of carbon that is oxidized in a combustion process.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	100%
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fraction of carbon oxidized for Fuel Oil
Unit	(%)
Description	Fraction of carbon that is oxidized in a combustion process.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	100%
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fraction of carbon oxidized for Natural Gas
Unit	(%)
Description	Fraction of carbon that is oxidized in a combustion process.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	100%
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fraction of carbon oxidized for Coal
Unit	(%)
Description	Fraction of carbon that is oxidized in a combustion process.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	100%
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fraction of carbon oxidized for Pet-coke
Unit	(%)
Description	Fraction of carbon that is oxidized in a combustion process.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	100%
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fraction of carbon oxidized for IFO 180 (Residual Oil)
Unit	(%)
Description	Fraction of carbon that is oxidized in a combustion process.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1.4.
Value(s) applied	100%
Choice of data or Measurement methods and procedures	The direct measurement of this parameter is not easily available in Chile, and the IPCC is a reliable and accurate source to obtain this type of information.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fuel density of Diesel
Unit	(Kg/lt)
Description	Mass per unit of volume.
Source of data	Local fuel providers / suppliers.
Value(s) applied	0.84 (Kg/lt)
Choice of data or Measurement methods and procedures	These parameters are available from local fuel providers / suppliers and are reliable.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fuel density of Fuel Oil
Unit	(Kg/lt)
Description	Mass per unit of volume.
Source of data	Local fuel providers / suppliers.
Value(s) applied	0.95 (Kg/lt)
Choice of data or Measurement methods and procedures	These parameters are available from local fuel providers / suppliers and are reliable.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Fuel density of Natural Gas
Unit	(Kg/m3)
Description	Mass per unit of volume.
Source of data	Local fuel providers / suppliers.
Value(s) applied	0.650 (Kg/m3) (gaseous phase)
Choice of data or Measurement methods and procedures	These parameters are available from local fuel providers / suppliers and are reliable.
Purpose of data	Project emission calculations.
Additional comment	---

B.6.3. Ex ante calculation of emission reductions

Notes:

1. The emission reduction calculations below correspond to a typical year of operation of the project plant.
2. Baseline and project emissions calculations below may present some minor imprecision due to some decimal rounding.

Project emissions

According to the ACM0006 (Version 05), project emissions for the proposed project activity can be calculated using equation (2):

$$(3) \qquad PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} * PE_{Biomass,CH4,y}$$

Where:

PET_y = CO_2 emissions during the year y due to transport of the biomass residues to the project plant (tCO_2/yr).

$PEFF_y$ = CO_2 emissions during the year y due to fossil fuels co-fired by the generation facility of other fossil fuel consumption at the project site that is attributable to the project activity (tCO_2/yr).

$PE_{EC,y}$ = CO_2 emissions during the year y due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr).

GWP_{CH4} = Global Warming Potential for methane valid for the relevant commitment period.

$PE_{Biomass,CH4,y}$ = CH_4 emissions from the combustion of biomass residues during the year y (tCH_4/yr).

1. Carbon dioxide emissions from biomass residues transportation to the power plant

The project activity considers two types of biomass: black liquor from the pulping process and forest residues (sawdust and bark) from forest industry operations in the nearby area. Since the black liquor is generated in the plant and no transportation is involved, the only emissions related to biomass residue transportation are derived from the transportation of the additional biomass consumption from forestry operations that must be purchased from third parties outside the power plant facility.

Under normal conditions, the plant would require to purchase 69,434 BDt of additional biomass per year. According to Option 1, equation (4) of the ACM0006 (Version 05) and using some data estimates from the Valdivia Plant, the emissions related to this source can be calculated as follows:

2009	2010	2011	2012	2013	2014	2015	2016

(1)Biomass supply from 3rd parties (dry)	(BDt/yr)	69,434	69,434	69,434	69,434	69,434	69,434	69,434	69,434
(2)Average moisture content of biomass	(% wet basis)	50%	50%	50%	50%	50%	50%	50%	50%
(3)Average load for one trip	(tons/truck)	25	25	25	25	25	25	25	25
(4)Avg. distance between supplying mills and Power Plant	(km)	100	100	100	100	100	100	100	100
(5)Emission factor for heavy truck transportation (*)	$kgCO_2/km$	1,338	1,334	1,330	1,322	1,337	1,337	1,337	1,337

(*) This parameter was calculated using the Diesel CO_2 emission factor and the performance index of the trucks (2.0 Km/lt), provided by the truck subcontractors of Arauco. For detailed calculation refer to the ex-ante emission reduction spread sheet.

Calculations:

		2009	2010	2011	2012	2013	2014	2015	2016
(6)Biomass transported (wet).	(ton/y)	138,868	138,868	138,868	138,868	138,868	138,868	138,868	138,868
(7)Number of trips needed for the plant per year	(trips/y)	5,555	5,555	5,555	5,555	5,555	5,555	5,555	5,555
(8)Total distance traveled, considering round trip (See note below)	($kmx10^3$)	1,110	1,110	1,110	1,110	1,110	1,110	1,110	1,110
Total emissions.	$[(5)*(8)/10^6]$	1,487	1,482	1,478	1,469	1,486	1,486	1,486	1,486

Note: Estimate distance of 1,110,944 km.

2. Carbon dioxide emissions from on-site consumption of fossil fuels

The proposed project activity implies additional fossil fuel consumption due to:

Fossil fuel consumption in the recovery boiler: The project proponent estimates an additional consumption of 1,453 tons of bunker per year used to increase the electric power output of the power plant. It must be noted that this figure is just an estimate and might suffer variations, depending on the operational situation of the pulp mill and the energy price condition in the grid system (i.e. fluctuation in the pulp production level and energy prices in the SIC). However, under no circumstances the amount of fossil fuel used in the recovery boiler can possibly become the predominant fuel, since the recovery boiler is not designed to operate with fossil fuels on a normal basis.

Project emissions from this source can be calculated as follows:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Fuel Oil consumption related to the project activity.	(ton/yr)	1,453	1,453	1,453	1,453	1,453	1,453	1,453	1,453
(2)Net calorific value.(See note)	(TJ / 000 ton)	40.94	40.67	40.58	40.27	40.67	40.19	40.19	40.19
(3)Carbon content.	(tC / TJ)	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
(4)Fraction of carbon oxidized.	(%)	100%	100%	100%	100%	100%	100%	100%	100%
(5)CO2 / C conversion factor.	(tCO_2 / tC)	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67

Note: Informed values from 2009 to 2013 were monitored net calorific values of Fuel Oil consumed by the project activity. From 2014 to 2016 is used the estimate NCV informed in the original PDD.

Calculations:

(6) CO_2 Conversion factor	(2)*(3)*(4)*(5) (tCO_2/ 000 ton)	3,167	3,147	3,140	3,115	3,146	3,185	3,185	3,185

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

		2009	2010	2011	2012	2013	2014	2015	2016
Total emissions.	(1)*(6) / (1000 ton CO_2)	4,603	4,573	4,563	4,527	4,572	4,572	4,572	4,572

Fossil fuel consumption in the power boiler: The project proponent estimates an additional average annual consumption of 1,752 (ton/yr) of Fuel Oil in the power boiler of the Valdivia mill, due to additional biomass consumption to generate power to the grid. It also estimates 320 (ton/yr) of Fuel Oil to generate additional power to the grid. As in the previous case, this figure is just an estimate and might suffer variations, depending mainly on the operational situation of the pulp mill and the energy price condition in the grid system.

The average total estimated additional fossil fuel consumption at the Valdivia power boiler due to the implementation of the project activity is 2,072 (ton/yr.).

According to the above estimates, project emissions can be calculated as follows:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Additional Fuel Oil consumption related to the project activity. (See note below).	(ton/y)	2,023	2,058	2,066	2,106	2,070	2,085	2,085	2,085
(2)Net calorific value	(TJ / 000 ton)	40.94	40.67	40.58	40.27	40.67	40.19	40.19	40.19
(3)Carbon content	(tC / TJ)	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
(4)Fraction of carbon oxidized	(%)	100	100	100	100	100	100	100	100
(5)CO2 / C conversion factor	(tCO_2 / tC)	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67

Note: Additional fuel oil related to project activity was determined as the total Fuel Oil consumed in the project minus the Fuel oil amount consumed in the baseline scenario. Fuel oil that would be consumed in the baseline was determined as biomass residues consumed in the baseline times the default factor 3.43 kgFO/m^3st defined in this PDD. Baseline biomass residues that would be required to meet process heat demand was determined, according to equation 30 of the ACM0006 (version 5) using [$Q_{projectplant}$ /ε_{boiler} *NCV] where monitored values of NCVs were used.

Calculations:

(6) CO_2 Conversion factor	(2)*(3)*(4)*(5) (tCO_2/ 000 ton)	3,167	3,147	3,140	3,115	3,146	3,109	3,109	3,109

Note: Informed values from 2009 to 2013 were monitored net calorific values of Fuel Oil consumed by the project activity. From 2014 to 2016 were estimate NCVs used in the original PDD.

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

		2009	2010	2011	2012	2013	2014	2015	2016
Total emissions.	[(1)* (6)] (tCO_2/yr)	6,407	6,474	6,485	6,560	6,511	6,482	6,482	6,482

Fossil fuel consumption due to on-site biomass residues from forest operations transportation: This emission source is generated by the front loaders and / or bulldozers used to transport the biomass from forest operations attributed to the project activity to the power boiler area. To calculate this fossil fuel amount, the project proponent will calculate the ratio of the biomass attributable to the project activity to the total biomass combusted in the power boiler, and will multiply this ratio by the total fossil fuel consumption related to on-site biomass from forest operations transportation.

The project proponent estimates a total of 952,456 (m^3st/yr) of biomass from forest operations in the power boiler, of which an average amount of 511,361 (m^3st/yr) are attributable to the project activity[27]. This indicates a fraction of 54% of biomass attributable to the project activity. The project proponent also estimates a consumption of 84 tons of diesel consumed by the front loaders or bulldozers in a year. According to this, the average fossil fuel amount in the period (2009-2016) used for on-site biomass transportation due to the implementation of the project activity is 45.1 (ton/yr).

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Current biomass consumption	(m^3 est/yr)	952,456	952,456	952,456	952,456	952,456	952,456	952,456	952,456
(2)Current Diesel consumption	(ton/yr)	84	84	84	84	84	84	84	84
(3)Baseline biomass consumption	(m^3 est/yr)	455,362	445,317	442,937	431,172	441,769	437,400	437,400	437,400
(4)Baseline Diesel consumption	(ton/yr)	40.2	39.3	39.1	38.0	39.0	38.6	38.6	38.6
(5)Biomass consumption attributable to Project activity.	(m3est/yr)	497,094	507,139	509,519	521,283	510,687	515,055	515,055	515,055

Note: The annual amount of biomass attributable to the project activity was determined as (1) minus (3) from above table. The average value informed of 511,361 (m^3st/yr.) corresponds to the annual estimate amount of biomass attributable to the project activity.

According to the above estimates, project emissions can be calculated as follows:

Data/estimates:

[27] This calculation is shown below, under the baseline emission calculation section.

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Diesel consumption related to the project activity (a)	(ton/yr)	43.8	44.7	44.9	46.0	45.0	45.4	45.4	45.4
(2)Net calorific value (b)	(TJ / 000 ton)	43.03	42.91	42.78	42.52	43.01	43.01	43.01	43.01
(3)Carbon content	(tC / TJ)	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
(4)Fraction of carbon oxidized	(%)	100%	100%	100%	100%	100%	100%	100%	100%
(5)CO_2 / C conversion factor	(tCO_2 / tC)	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67

Notes:
(a)This annual amount was determined as current diesel consumption (2) minus baseline diesel consumption (4) from above table.
(b)Informed values from 2009 to 2013 were monitored net calorific values of Diesel consumed by the project activity. From 2014 to 2016 were estimate NCVs.

Calculations:

(6)CO_2 Conversion factor.	(tCO_2/ 000 ton)	3,187	3,178	3,168	3,149	3,185	3,185	3,185	3,185

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

		2009	2010	2011	2012	2013	2014	2015	2016
Total emissions.	(tCO_2/yr)	140	142	142	145	143	145	145	145

Fossil fuel consumption due to on-site biomass residues from forest operations preparation: Though currently there is no preparation of biomass of any type in the mill since all biomass from forest operations is ready to use, this emission source will be monitored and accounted for whenever the plant establishes a biomass preparation stage. As in the previous cases, only the fossil fuel related to the biomass attributable to the project activity will be accounted as a project emission.

According to the calculations above, the carbon dioxide emissions from on-site consumption of fossil fuels attributable to the implementation of the project activity can be summarized in the table below:

Carbon dioxide emissions from on-site consumption of fossil fuels.		2009	2010	2011	2012	2013	2014	2015	2016
Emissions from fossil fuel consumption in the recovery boiler	(tCO_2/yr)	4,603	4,573	4,563	4,527	4,572	4,572	4,572	4,572
Emissions from fossil fuel consumption in the power boiler	(tCO_2/yr)	6,407	6,474	6,485	6,560	6,511	6,482	6,482	6,482
Emissions from biomass transportation on-site	(tCO_2/yr)	140	142	142	145	143	145	145	145
Emission from fossil fuel consumption due to on-site biomass from forest operations preparation,	(tCO_2/yr)	0	0	0	0	0	0	0	0
Total emissions		**11,150**	**11,189**	**11,190**	**11,233**	**11,227**	**11,145**	**11,145**	**11,145**

3. Carbon dioxide emissions from electricity consumption

The proposed project activity does not imply any additional on-site electricity consumption. This variable, however, will be part of the monitoring plan and will be considered in the future if the current situation changes.

4. Methane emissions from combustion of biomass residues

Since the proposed project activity only implies additional biomass from forest operations consumption in the power boiler, the only source of methane emissions attributed to the project activity is the one related to this additional consumption under controlled burning conditions.

The project proponent estimates an average amount of 511,361 (m^3st/yr) of biomass from forest operations attributable to the project activity[28]. According to this estimate, the project emissions related to this source can be calculated as follows:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Biomass related to the project activity burned in PB	(m3st/yr)	497,094	507,139	509,519	521,283	510,687	515,055	515,055	515,055
(2)Biomass conversion factor.	(BDt/m3 est)	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
(3)Net calorific value (note).	(TJ / 000 ton)	17.29	17.68	17.78	18.26	17.82	18.0	18.0	18.0
(4)CH4 emission factor.	(Kg/TJ)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
(5)Conservativeness factor.	(number)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
(6)CH4 Global Warming Potential.	(number)	21	21	21	21	25	25	25	25

Calculations:

		2009	2010	2011	2012	2013	2014	2015	2016
Total emissions	(1)*(2)*(1ton/1,000kg)*(3)*(1ton/1,000kg)*(4)*(5)*(6)) (tCO2eq/y)	994	1,037	1,048	1,101	1,253	1,277	1,277	1,277

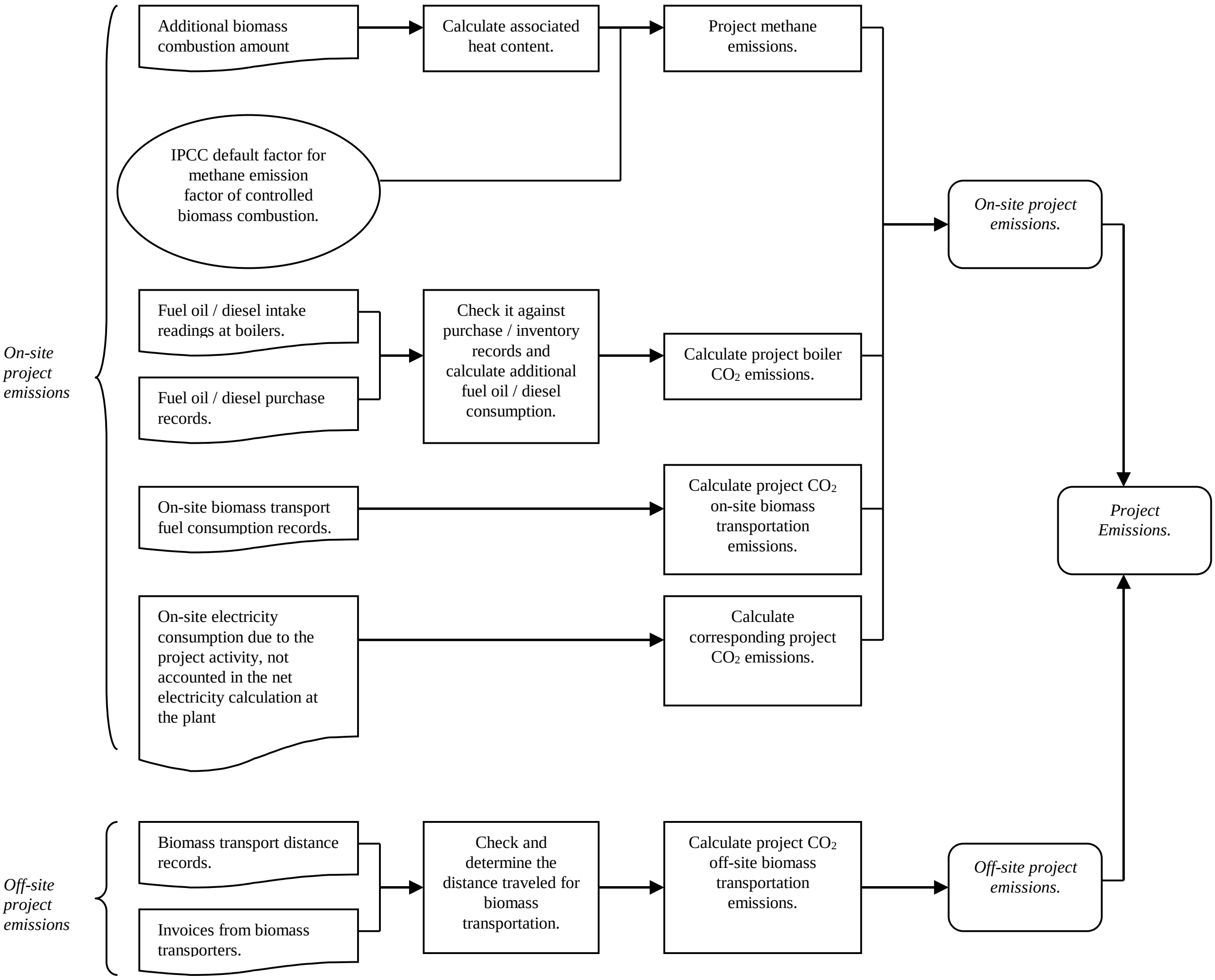
Note: NCVs used from 2009 to 2013 are monitored values from the project activity. NCVs used from 2014 to 2016 are estimated values informed in the original PDD.

Total project emissions

Emission sources		2009	2010	2011	2012	2013	2014	2015	2016
Emissions from biomass transportation to the power plant	(tCO_2/yr)	1,487	1,482	1,478	1,469	1,486	1,486	1,486	1,486
Carbon dioxide emissions from on-site consumption of fossil fuels	(tCO_2/yr)	11,150	11,189	11,190	11,233	11,227	11,145	11,145	11,145
Emissions from additional electric power consumption	(tCO_2/yr)	0	0	0	0	0	0	0	0
Emissions from biomass burning in the power boiler	(tCO_2/yr)	994	1,037	1,048	1,101	1,253	1,277	1,277	1,277
TOTAL PROJECT EMISSIONS	(tCO2eq/yr)	13,630	13,709	13,716	13,803	13,966	13,908	13,908	13,908

[28] This amount results from the average amount of biomass data used in the period (2009 to 2016). Note that calculation is shown below, in the baseline emission calculation section.

Summary of the power plant project emissions:



Baseline emissions

According to the ACM0006 (Version 05), baseline emissions for the proposed project activity can be calculated using the following equation:

$$BL_y = ER_{electricity,y} + BE_{biomass,y}$$

Where:

BL_y = Baseline emissions of the proposed project activity. (tCO_2eq/yr).
$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year y. (tCO_2/yr).
$BE_{biomass,y}$ = Emission reductions due to burning of anthropogenic sources of biomass residues during the year y. (tCO_2eq/yr).

1. Baseline emissions due to electricity displacement

Emission reductions due to the displacement of electricity can be calculated using equation (9) of the ACM0006 (Version 05):

$$ER_{electricity,y} = EG_y * EF_{electricity,y}$$

Where:

$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year y. (tCO_2/yr).
EG_y = Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the tear y (MWh).
$EF_{electricity,y}$ = CO_2 emission factor for the electricity displaced due to the project activity during the year y. (tCO_2/MWh).

According to the ACM0006 (Version 05), since the power capacity of the new power plant exceeds 15 MW, $EF_{electricity,y}$ will be calculated as a combined margin (CM), following the guidance in the section "Baselines" in the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources (ACM0002).

CO_2 emission factor ($EF_{electricity,y}$) calculation for the electricity displaced by the project activity

As previously indicated in section B.6.1 of this PDD, the $EF_{grid,y}$ is calculated as a combined margin (CM). This requires to calculate the Operating Margin ($EF_{OM,y}$) and the Build Margin ($EF_{BM,y}$) of the grid.

Electricity system

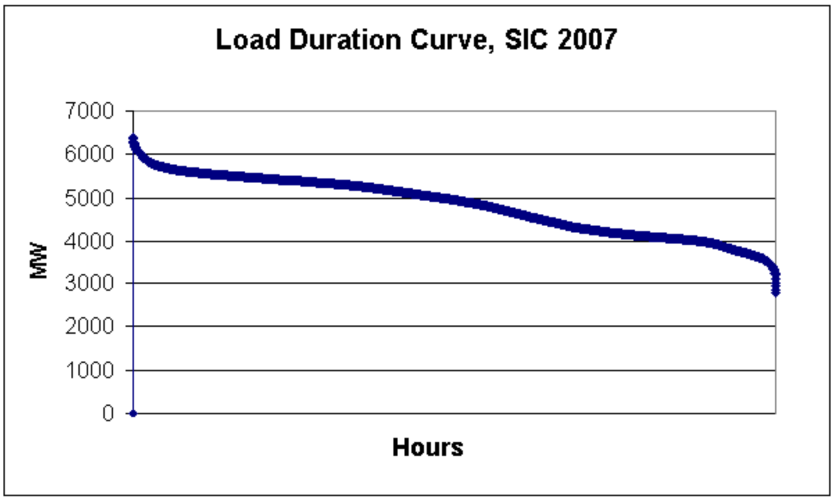
The Central Interconnected System of the Republic of Chile (SIC) is comprised by the transmission systems and the generating Power Plants that operate interconnected from Rada de Paposo in the north (II Region), to Isla Grande de Chiloé in the south (X Region). This system is the largest of the four electric systems that supply energy to the Chilean territory, accounting for about 75% of the power generation capacity in Chile and supplying to approximately 93% of the Chilean population. Despite its long extension[29], the SIC does not present important transmission limitations. This is further reassured by the "Short Law", which requires transmission companies to make all necessary investments in transmission every 4 years to ensure and maintain the quality and safety of the transmission service within the system.

Operating Margin ($EF_{OM,y}$) 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) ($EF_{OM,simpleadjusted,y}$) of the alternatives presented in the ACM0002 (Version 06). The project proponent 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 in this PDD, the project proponent will use some estimates for the year 2007, available at the beginning of 2007. This is justified, since this PDD was written during the first half of 2007 and there was not enough information available to calculate the coefficients for 2007.

[29] The system is basically a long 220KV double / simple circuit transmission line with some higher capacity and alternative circuits in some segments.



Note: The load duration curve for 2007 was estimated from the real 2006 load duration curve.

From the data that generates the curve above, it is possible to determine the fraction of the year in which low-cost / must-run sources are on the margin for the year 2007:

$$\lambda_y = \lambda_{2007} = 0.0086$$

$$\lambda_{2007} = 0.0086$$

The rest of the parameters to calculate the $EF_{OM,simpleadjusted,y}$ for the year 2007, were calculated as follows:

$$\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j} = 10{,}816{,}791 (tCO_2 / yr)$$

- The Plant emission factors for the operating units in the SIC were calculated using information obtained directly from the CDEC-SIC (official and public information) and the power plants themselves (the power plant owner's web page). In the few cases the information was not available, the calculation used the default IPCC values from the IPCC 2006 Revised Guidelines and the IPCC Good Practice Guidance.

- The calculation corresponds to the emissions of power sources (not including low-cost / must-run resources) estimated for year 2007.

$$\sum_{j} GEN_{j,y} = 15{,}243 (GWh / yr)$$

- The information was obtained directly from the CDEC-SIC (official and public information).

- The calculation corresponds to the total energy generated in the SIC grid minus low-cost / must-run resources estimated for the year 2007.

$$\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k} = 515{,}824(tCO_2 / yr)$$

- Since in Chile low operating cost and must-run resources include mostly hydraulic energy, the total emissions for this part of the equation are low.

$$\sum_{k} GEN_{k,y} = 27{,}234(GWh/ yr)$$

- The information was obtained directly from the CDEC-SIC (official and public information).

- The calculation corresponds to the energy generated in the SIC grid of low-cost / must-run resources estimated for the year 2007.

Replacing the above values in the equation used to calculate the $EF_{OM,simpleadjusted,y}$ for the year 2007, the operating margin results:

$$EF_{OM,y} = EF_{OM,simpleadjusted,y} = (1-0.0086) \cdot \frac{10{,}816{,}791}{15{,}243} + 0.0086 \cdot \frac{515{,}824}{27{,}234} = 703.67(tCO_2 / GWh)$$

$$EF_{OM,y} = EF_{OM,simpleadjusted,y} = 703.67(tCO_2 / GWh)$$

Build Margin ($EF_{BM,y}$) calculation

According to 2007 projections for the SIC grid, the most likely group of plants that will account for the largest generation in 2007 will be the last ones built and responsible for the 20% of the (projected) total generation in 2007. These plants will then be considered to calculate (estimate) the Build Margin for 2007:

$$EF_{BM,y} = 239.5(tCO_2 / GWh)$$

As in the previous case, the Build Margin calculation also considered official CDEC-SIC data and / or other official data publicly available. In cases where the data was not available, IPCC default factors were used. For more details about the Build Margin calculation, please see Appendix 4.

Having obtained both $EF_{OM,y}$ and $EF_{BM,y}$, and assuming the default values (0.5) for the weights w_{OM} and w_{BM}, it is possible to calculate $EF_{electricity,y}$ for the year 2007:

$$EF_{electricity,y} = 0.5*703.67 + 0.5*239.5 = 471.60\ (tCO_2/GWh)$$

1. Net quantity of increased electricity (EG_y) calculation

According to equation (14) of the ACM0006 (Version 05), the net quantity of increased electricity can be calculated as follows:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Net energy generation at the project plant	(GWh/yr)	686.5	684.1	684.1	683.3	684.6	684.8	684.8	684.8
(2)Electric efficiency of the baseline mill	(%)	12.127	12.127	12.127	12.127	12.127	12.127	12.127	12.127
(3)Black liquor consumption	(tDS/yr)	944,394	944,394	944,394	944,394	944,394	944,394	944,394	944,394
(4)Biomass from forest operations consumption	(BDt/yr)	81,965	80,157	79,729	77,611	79,518	78,732	78,732	78,732
(5)Black liquor net calorific value (dry substance).	(TJ / 000 tDS)	10.51	12.12	12.10	12.66	11.80	11.66	11.66	11.66
(6) Biomass from forest net calorific value.	(TJ / 000 ton)	17.29	17.68	17.78	18.26	17.82	18.0	18.0	18.0

Notes:

Calculated grid emission factors were used from 2009 to 2013. From 2014 to 20016 values used are the ones informed in the original PDD.

For the period (2009-2013) NCVs from black-liquor and biomass from forest operations are monitored values from the project activity. For the period (2014-2016) values used are the estimated values informed in the original PDD.

Calculations:

		2009	2010	2011	2012	2013	2014	2015	2016
(7)Baseline electric power generation.	(2)*[(3)*(5)+(4)*(6)] GWh/yr	382.1	433.2	432.7	450.3	423.1	418.7	418.7	418.7
(8)Net quantity of energy displaced from the grid.	[(1)-(5)]GWh/yr	252.22	196.59	196.54	175.28	206.25	209.88	209.88	209.88

Considering that the starting date of the crediting period for this project activity resulted to be April 1st, 2009 , the Project Participant used the calculated the annual grid emission factors calculated for the period (2009-2013) and for the period (2014 to 2016) used estimate values informed in the original PDD. The above grid emission factor calculated for 2007 was used in the original PDD for the emission reduction calculations.

For the electricity baseline emission factor annual values were calculated for the period (2009-2013) and estimate values for the period (2014-2016). These values, presented in table below, together with the expected electric energy to be produced by the project activity, are used to determine the total grid emission reductions as follows:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Combined Margin for the CDM activity.	(tCO2/GWh)	647,80	718,68	695,79	694,16	765,88	700,00	500,00	450,00
(2)Net quantity of energy displaced from grid.	(GWh/yr)	252,22	196,59	196,54	175,28	206,25	209,88	209,88	209,88

Note: Combined margin values informed above for the period (2009-2013) were determined according to the last version of the ACM0002. Official and publicly available information was used for that purpose. For the period (2014-2016) are used estimated values informed in the original PDD. .

Calculations:

(3) Total grid emission savings	**(1)*(2)**	**100,356 (tCO_2/yr)**

		2009	2010	2011	2012	2013	2014	2015	2016
Total emissions	[(1) * (2)](tCO2/y)	163,386	141,288	136,752	121,670	157,966	146,919	104,942	94,448

2. Baseline emissions due to burning of anthropogenic sources of biomass residues

To calculate this emission source, it is necessary first to calculate the quantity of biomass residues used as a result of the project activity. As mentioned before, the proposed project activity only involves additional use of biomass from forest operations in the power boiler.

Since in the project mill, the power boiler and the recovery boiler generate high-pressure steam at equal thermodynamic conditions, the best way to determine the process steam that would have been generated in boilers is to determine the fraction of high-pressure steam that is generated by the power boiler with respect to the total high-pressure steam generated at the mill, and multiply this fraction by the total process steam (not for power generation) used in the pulp mill.

From the energy / mass balance of the project mill, it is possible to establish that the fraction of high-pressure steam generated by the power boiler with respect to the total high-pressure steam generated at the mill is 15.5%. The total steam to process is 9,127,331 (GJ/yr). These numbers indicate that a total of 1,417,177 (GJ/yr) of steam that would have been generated by a biomass boiler in a baseline case scenario.

With the above estimates, the additional biomass related to the implementation of the project activity can be calculates as follows:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Biomass from forest operations	(BDt/yr)	171,442	171,442	171,442	171,442	171,442	171,442	171,442	171,442
(2)Net calorific value	(TJ / 000 ton)	17.29	17.68	17.78	18.26	17.82	18.0	18.0	18.0
(3)Process heat attributable to the power boiler (*)	(GJ/yr)* 10^3	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417

(4)Energy efficiency of the power boiler under the baseline case(**)	(%)	100%	100%	100%	100%	100%	100%	100%	100%

Notes:
(*)This value corresponds to 1,417,177 (GJ/yr)
(**) For monitoring simplicity, the 100% efficiency default value proposed by the ACM0006 (Version 05) was used here.

Calculations:

		2009	2010	2011	2012	2013	2014	2015	2016
(5)Biomass combusted in baseline power boiler	(3)/[(4)*(2)] (BDt/yr)	81,965	80,157	79,729	77,611	79,518	78,732	78,732	78,732
(6)Biomass attributable to the project activity	[(1) - (5)] (BDt/yr)	89,477	91,285	91,713	93,831	91,924	92,710	92,710	92,710

With the above estimates, it is possible to calculate the baseline emissions due to uncontrolled burning of anthropogenic sources of biomass residues:

Data/estimates:

		2009	2010	2011	2012	2013	2014	2015	2016
(1)Biomass attributable to the project activity	(BDt/yr)	89,477	91,285	91,713	93,831	91,924	92,710	92,710	92,710
(2)CH_4 factor for biomass uncontrolled burning (3)	(Kg/BDt)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
(3)Conservativeness factor	(number)	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
(4)CH_4 Global Warming Potential	(number)	21	21	21	21	25	25	25	25

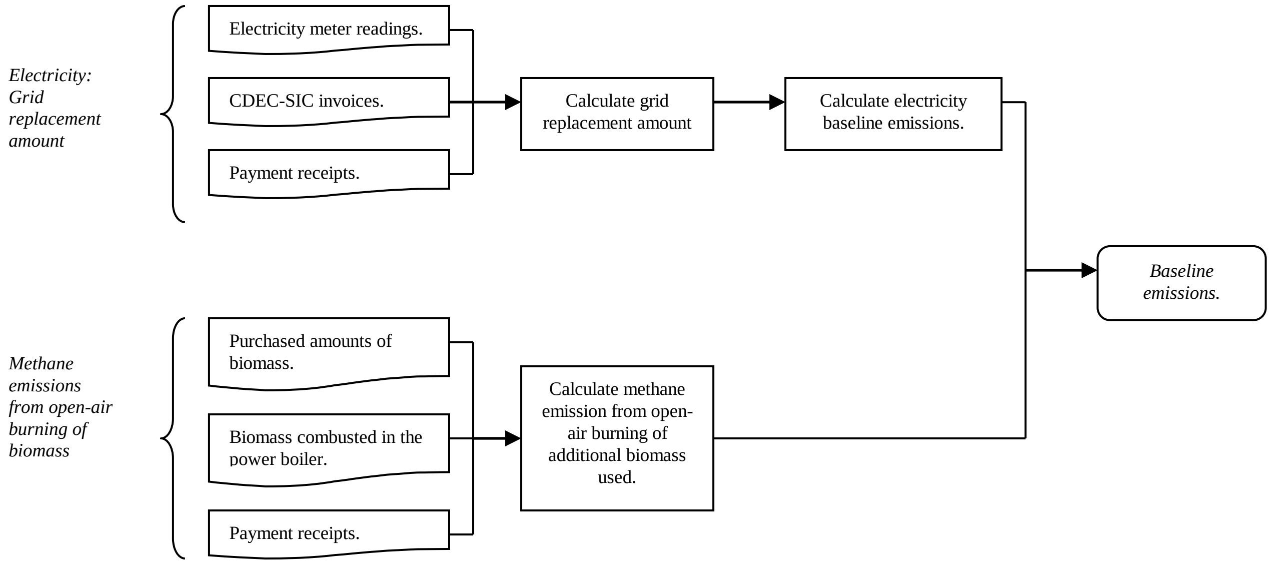
Calculations:

		2009	2010	2011	2012	2013	2014	2015	2016
Total emissions	(1) * (2) (ton/1000kg)* (3)*(4) (tCO_{2eq}/yr)	3,704	3,778	3,796	3,884	4,530	4,568	4,568	4,568

Total baseline emissions

		2009	2010	2011	2012	2013	2014	2015	2016
Total baseline emissions	(tCO_2eq/yr)	167,089	145,066	140,548	125,554	162,495	151,487	109,510	99,016
Total project emissions	(tCO_2eq/yr)	13,630	13,709	13,716	13,803	13,966	13,908	13,908	13,908
NET EMISSION SAVINGS	(tCO_2eq/yr)	153,459	131,358	126,832	111,751	148,529	137,580	95,603	85,108

Summary of the power plant baseline emissions:



3. Leakage emissions

Since the proposed project activity contemplates the utilization of additional biomass from forest operations (sawdust and bark), it is necessary to establish if the project displaces current use of biomass as a fuel. If this occurs and drives current users of biomass to resort to more carbon-intensive fuels, the amount of such fuel switch must be deducted from the project's emission reduction benefits. This is contemplated in the ACM0006 (Version 05), for the baseline scenario Nº3, which is the one that applies to this part of the project activity.

Currently there are two sources of biomass in the south part of Chile (from VI to X Regions) that can that provide biomass from forest operations to a biomass power plant such as the Valdivia power plant:

1. Biomass from industrial operations, consisting basically in biomass generated by local sawmills. Currently, part of this biomass is normally used by the same sawmills for heat generation purposes. Another fraction is sold to other industrial facilities for other uses. However a considerable surplus still remains, which is normally left in piles to natural decay.

Figure 5: Biomass from industrial operations

2. Biomass from forestry operations, consisting basically in operations of harvesting, pruning and thinning in managed forestlands. Currently this biomass has very little (if any) use in the local industry. A very small fraction is used as fuel for local homes warming, while the majority is left on the ground to natural decay. In some cases, these biomass residues are burned in order to prevent fires in new or existing forest plantations.

Figure 6: Biomass from forestry operations

It must be mentioned that all the biomass from forest operations (either from industrial operations and from forestry operations) comes from renewable sources. Further details can be found in Appendix 5 of this PDD.

Uses for biomass 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. Raw material at panelboard mills. Small demand and some generate their own biomass.
3. Electric power generation at some power plants (few cases and small plants). Most have exclusivity biomass supply contracts with some nearby sawmills.

Uses for biomass from forestry operations

1. Fuel for home warming; however the demand for this biomass is very small 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 the mills that currently produce biomass, that use part of it as fuel and sell the surplus to third parties (i.e. biomass power plant) is highly unlikely. Given the nature of the biomass suppliers (mostly small and local sawmills) and the cost of fossil fuels[30], 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. 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 from industrial operations. Today this is clearly not the case since all plants that use biomass in the IX and X Region operate without restriction. Despite the fact there is no official data available, the project proponent has performed a detailed research of the biomass supply / demand situation in the Valdivia influence area, which is shown in the following table:

[30] By the time this PDD was written, the oil price was around US$ 70 per barrel.

Supply / Demand situation in the Valdivia power plant influence area
(Estimation for year 2007)

Biomass residues supply

Biomass from industrial operations	(m^3st/yr)	2,563,560
Biomass from forestry operations	(m^3st/yr)	1,658,696
Total supply	**(m^3st/yr)**	**4,222,256**

Biomass residues demand

Total demand	**(m^3st/yr)**	**1,930,674**

Sources: Infor official bulletins and studies.

Valdivia power plant surplus index
(Estimation for year 2007)

This index was calculated using criteria "L2" of the ACM0006 (Version 05).

Biomass from industrial operations / Total biomass demand	(number)	1.3278
Biomass from forestry operations / Total biomass demand	(number)	0.8591
Total supply / Total demand	**(number)**	**2.1869**

Note: The influence area is outlined in Annex N°4 of this PDD.

According to the information above (approach L2, leakage section of the Baseline methodology), the Valdivia biomass power plant counts with sufficient biomass locally and has not caused other biomass plants in the area to switch from biomass to fossil fuels so far.

In addition to the above, it must be noted that Arauco owns a significant portion of the managed forestlands in the X Region. 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 Valdivia 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.

According to the information presented above, no leakage is anticipated for the Valdivia project activity, therefore leakage emissions are assumed to be zero for the proposed project activity.

$$L_y = 0$$

The supply / demand status within the Valdivia power plant influence area will be periodically monitored as indicated in pages 42 to 44 of the ACM0006 (Version 05).

Net emission savings of the project activity:

		2009	2010	2011	2012	2013	2014	2015	2016
Total baseline emissions	(tCO_2eq/yr)	167,089	145,066	140,548	125,554	162,495	151,487	109,510	99,016
Total project emissions	(tCO_2eq/yr)	13,630	13,709	13,716	13,803	13,966	13,908	13,908	13,908
NET EMISSION SAVINGS	(tCO_2eq/yr)	153,459	131,358	126,832	111,751	148,529	137,580	95,603	85,108

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)
2009	125,317	10,223	0	115,094
2010	145,066	13,709	0	131,358
2011	140,548	13,716	0	126,832
2012	125,554	13,803	0	111,751
2013	162,495	13,966	0	148,529
2014	151,487	13,908	0	137,580
2015	109,510	13,908	0	95,603
2016	24,754	3,477	0	21,277
Total	**984,732**	**96,709**	**0**	**888,023**
Total number of crediting years	**7**			
Annual average over the crediting period	**140,676**	**13,816**		**126,860**

Notes:

(1) The Project Participant informs the starting date of the first crediting periods in April 1st, 2009. This implies: The estimate of baseline emissions were adjusted considering the starting date in April 1st 2009: 125,317 tCO_2 = 167,089 tCO_2 * (9/12)

(2) The annual estimate emission reductions were adjusted considering the March 31st 2016 as the end date of the 1st crediting period: 24,754 tCO_2 =99,016 tCO_2*(3/12).

(3) The project emission were adjusted considering April 1st of 2009 the start date of the 1st Crediting period: 10,223(tCO_2) = 13,630(tCO_2) * (9/12).

(4) The project emission were adjusted considering March 31st of 2016 as the end date of the 1st Crediting period: 3,477(tCO_2) = 13,908(tCO_2) * (3/12).

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$BF_{k,y}$ (and $BF_{T,k,y,}$ see comment below)
Unit	Tons of dry mater or liter.
Description	Quantity of biomass residue type k combusted in the project plant during the year y.
Source of data	On-site measurements.
Value(s) applied	Value applied of 944,394 (tDS/yr) of biomass from the pulping process (black liquor, dry basis) from 2009 to 2016. Value applied of 171,442 (BDt/yr) of biomass from forest operations (sawdust and bark, dry basis) from 2009 to 2016.
Measurement methods and procedures	Black liquor flows to the recovery boiler is measured with flow meters, which transmit on-line data to the DCS of the mill. This information is stored in the mill's databases. The Operation Manager collects, checks and informs the monitored integrated flow values to the person in charge of calculating the emission reductions of the project activity in Arauco Generación S.A. The biomass from forest operations is directly monitored via an on-line weight meter located at the end of the biomass conveyor belt of the power boiler, just before entering to the power boiler. This instrument transmits the monitored data to the pulp mill DCS. As in the previous case, the registered values are integrated collected and informed by the Operation Manager to the person in charge of calculating the emission reductions of the project activity in Arauco Generación S.A.. All instruments (flow meters, sensors, weight meters, etc.) will receive calibration according to proper industry standards. The instruments will also form part of the checking list of equipment that must receive maintenance, be checked or calibrated according to the mill's annual maintenance schedule.
Monitoring frequency	This variable will be monitored continuously.
QA/QC procedures	Crosscheck black liquor consumption with total pulp production and / or energy and balances in the recovery boiler. Crosscheck biomass from forest operations consumption through stock variations (i.e. topographic variations), purchases and internal biomass generation sources.
Purpose of data	Baseline and project emission calculations.
Additional comment	The proposed project activity deals with two types of biomass residues: black liquor from the pulping process and biomass from forest operations (sawdust and bark). Note that $BF_{T,k,y}$ used in equation Nº4 of the ACM0006 (Version 05) corresponds to the fraction of $BF_{k,y}$ attributable to the project activity that must be brought in trucks from outside of the plant. This variable is also monitored.

Data / Parameter	Moisture content of the biomass residues
Unit	(%) of water content (humid basis).
Description	Moisture content of each biomass residue type k.
Source of data	On-site measurements.
Value(s) applied	Black liquor is normally measured in dry/solid terms. Value applied of 50% for biomass from forest operations from 2009 to 2016. This is just an average value, used solely for the purpose of calculating expected emission reductions. Fluctuations might occur, during the monitoring of these variables.
Measurement methods and procedures	There are two ways of determining the humidity of the black liquor (or equivalently, the solid content). The first one consists in the on-line measurement of the solid content carried out by the refractometers installed in the pipes that carry the black liquor to the recovery boiler. The second (which is done in parallel to the first one) consists in taking black liquor samples every two hours and determining the solid content in a laboratory, at the pulp mill site. The Superintendence of Electro Control is responsible for the maintenance and operation of the refractometers. The Superintendence of Liquor is responsible of the black liquor sampling, while the Technical Superintendence is responsible for the execution of the solid-content analysis. The biomass from forest operations moisture will be monitored and registered by taking daily biomass samples from the feed flow of biomass entering to the power boiler. Humidity content will be calculated by evaporating the water of the samples and measuring the weight before and after the water has been evaporated. This process will be carried out in dedicated scales. The Superintendence of Liquor will be in charge of taking the biomass samples, while the Technical Superintendence will be responsible for carrying out the humidity content analysis in a lab inside the pulp mill facility.
Monitoring frequency	This variable will be monitored continuously.
QA/QC procedures	Proper calibration of the instruments, according to industry standards, will be carried out regularly. In case of black liquor, additional analysis might be conducted to ensure the accuracy and quality of the measurements.
Purpose of data	Baseline and project emissions.
Additional comment	---

Data / Parameter	$EF_{CH4,BF}$
Unit	(tCH_4/GJ)
Description	CH_4 emission factor for the combustion of biomass residues in the project plant.
Source of data	On-site measurements or default values, as provided in Table 4 and 5 of the ACM0006 (Version 05).
Value(s) applied	30.0 (Kg CH4/TJ) or 0.00003 (tCH4/GJ) for biomass from forest operations, with an associated conservative factor of 1.02. This implies an adjusted default factor of 30.6 (Kg CH4/TJ) or 0.0000306 (tCH4/GJ). The reasons for which this adjusted factor is chosen can be found in section B.6 of this PDD.
Measurement methods and procedures	Not applicable, since default values will be used in this case.
Monitoring frequency	Not applicable.
QA/QC procedures	Not applicable, since default values will be used in this case.
Purpose of data	Project emission calculations.
Additional comment	It must be noted that on-site CH_4 emissions will only be accounted for biomass controlled burning in the power boiler (Baseline scenario Nº3) and not in the recovery boiler (Baseline scenario Nº4). In the first case, additional quantities of biomass are burned to generate power due to the project activity, while in the second, it is the same amount of biomass (black liquor) that is burned more efficiently to generate power, so no incremental CH_4 emissions are generated due to the implementation of the project activity.

Data / Parameter	AVDy
Unit	(Km)
Description	Average round trip distance (from and to) between biomass fuel supply sites and the project site.
Source of data	Calculations based on records by the biomass Procurement Division.
Value(s) applied	Annual value applied of 200 km on average (round trip) from 2009 to 2016.
Measurement methods and procedures	The Superintendence of Fiber will determine the distance from biomass supply centers to the pulp mill by using a road map. The average distance in a period of time (i.e. month) will be determined by calculating a weighted average distance considering the amount of biomass and the distance from which each supply center provides biomass to the mill.
Monitoring frequency	Continuously.
QA/QC procedures	Check consistency of distance records provided by the truckers by comparing recorded distances with information from other sources.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	Ny
Unit	Nº of trips per month.
Description	Number of truck trips for the transportation of biomass.
Source of data	Calculations based on records by the biomass Procurement Division.
Value(s) applied	Annual average value applied of 5,555 round trips per year from 2006 to 2016. This is an estimated average that is subject to fluctuations due to the biomass consumption rate of the power boiler and the on-site generation of biomass of this type in the pulp mill.
Measurement methods and procedures	The Superintendence of Fiber will monitor and record each raw material dispatched to the mill. This information will be stored in the mill's information system, so the person in charge of reporting this information will extract the number of trucks that arrived to the mill with biomass fuels (biomass from forest operations) and report this information to the person in charge of calculating the emissions reductions of the project activity in Arauco Generación S.A. This variable will be monitored continuously.
Monitoring frequency	Continuously.
QA/QC procedures	Check consistency of the number of truck trips with the quantity of biomass combusted, e.g. by the relation with previous years.
Purpose of data	Project emission calculations.
Additional comment	Monitoring of this variable is applicable, since the project proponent will use option 1 to estimate CO_2 emissions from transportation of biomass to the mill. Alternatively, the project proponent might also monitor the average truckload, TL_y.

Data / Parameter	TLy
Unit	Tons or liter.
Description	Average truckload of the trucks used for the transportation of biomass from forest operations to the pulp mill.
Source of data	On-site measurements.
Value(s) applied	Value applied of 25 (ton/truck) on average from 2009 to 2016.
Measurement methods and procedures	The Superintendence of Fiber will monitor this variable by measuring the truckloads at the project mill's weighbridges. The value will be determined by calculating a weighted average value of the truckloads in tons for the trucks that deliver biomass from forest operations to the pulp mill. This variable will be monitored continuously, aggregated monthly or annually.
Monitoring frequency	Continuously.
QA/QC procedures	The pulp mills' weighbridges will receive proper calibration and maintenance, to ensure high quality of measurements. It must be noted that for an industrial facility like the Valdivia mill, weighbridges must receive periodic maintenance, calibration and sometimes certification by the national authorities to operate.
Purpose of data	Project emission calculations.
Additional comment	Monitoring of this variable is applicable, since the project proponent will use option 1 to estimate CO_2 emissions from transportation of biomass to the mill. Alternatively, the project proponent might also monitor the number of round trips per period of time.

Data / Parameter	$EF_{km,CO2,y}$
Unit	(tCO_2/km)
Description	Average CO_2 emission factor for the trucks during year y.
Source of data	Transportation subcontractors, detailed invoices from trucking companies (to determine fuel consumption of the trucks) and local truck providers.
Value(s) applied	Annual values applied from 2009 to 2016: $EF_{km,CO2,y}$ (tCO_2/km): 1.338(2009); 1.334(2010); 1.330(2011); 1.322(2012); 1.337(2013); 1.337(2014); 1.337(2015) 1.337(2016). Values informed from 2009 to 2013 were obtained from monitored data. Informed values from 2014 to 2016 were estimated values informed in the original PDD.
Measurement methods and procedures	The project proponent will determine the fuel type and the fuel truck performance (km/lts) from the transportation companies. Then, the project proponent will calculate CO_2 emissions from fuel consumption by multiplying with appropriate net calorific values and CO_2 emission factors. For net calorific values and CO_2 emission factors, the project proponent will use reliable national default values or, if not available, (country-specific, if available) IPCC default values. Alternatively, the project proponent might use emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range).
Monitoring frequency	This variable will be monitored at least annually.
QA/QC procedures	Check fuel truck performance with data from fuel invoices from trucking companies if available and possible, or with data from local truck suppliers. Alternatively, cross-check results with emission factors referred to in the literature. Monitoring of this variable is applicable, since the project proponent will use option 1 to estimate CO_2 emissions from transportation of biomass to the mill.
Purpose of data	Project emission calculations.
Additional comment	Monitoring of this variable is applicable, since the project proponent will use option 1 to estimate CO_2 emissions from transportation of biomass to the mill.

Data / Parameter	$EF_{CO2,FF,i}$
Unit	(tCO_2/GJ)
Description	CO2 emission factor for fossil fuel type i.
Source of data	This emission factor will be calculated using IPCC default factors for carbon content of the fuel and % of carbon oxidized in the combustion process. Local fuel CO2 emission factor measurements are not common / easy to obtain in the country.
Value(s) applied	Annual values applied from 2009 to 2016: 0.07407 (tCO_2/GJ) for Diesel. 0.07737 (tCO_2/GJ) for Fuel Oil.
Measurement methods and procedures	No direct measurements will be carried out for this factor.
Monitoring frequency	Annually.
QA/QC procedures	No direct measurements will be carried out for this factor. The project proponent will use IPCC default values to calculate the fossil fuel coefficients.
Purpose of data	Project emission calculations.
Additional comment	The proposed factors were consistent with the IPCC default factors for the corresponding fuels: 0.0741 (tCO_2/GJ) for Diesel. 0.0774 (tCO_2/GJ) for Fuel Oil. These factors were obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 2.2.

Data / Parameter	$FF_{project\ plant,i,y}$
Unit	Mass or volume unit per year.
Description	Quantity of fossil fuel type i combusted in the biomass residue fired power plant during the year y.
Source of data	On-site measurements.
Value(s) applied	Annual values applied during the period 2009-2016: Fuel Oil will be burned in the power boiler: (ton/y). 2,085 (ton/y) for period (2009-2016). Fuel oil estimate to be burned in the recovery boiler would be 1,453 (ton/y) from 2009 to 2016. The total amount of Fuel Oil consumption related to the project activity (ton/y): 3,538 for the period (2009-2016). It must be noted that these fuel amounts are related to the implementation of the project activity. These fuel amounts are estimates subject to fluctuations.
Measurement methods and procedures	Fossil fuel consumption for the power boiler and / or the recovery boiler will be measured using on-line coriolis mass flow meters and / or tank level indicators. In the case of flow meters, the information is registered on-line by the pulp mill's DCS and recorded in databases. The pulp mill operator keeps constant track of the reasons for burning fossil fuels, particularly in the recovery boiler For a detailed explanation on how the fossil fuel amounts related to the implementation of the project activity will be calculated from the total fossil fuel consumption in the power plant, please see section B.6.1, Project emissions, b). The Superintendence of Liquor is responsible for collecting this information and for sending it periodically to the person in charge of calculating the emissions reductions of the project activity in Arauco Generación S.A.
Monitoring frequency	This variable will be monitored continuously.
QA/QC procedures	Consistency checks through fossil fuel consumption calculation (purchases plus stock differences) and / or energy balance calculations.
Purpose of data	Project emission calculations.
Additional comment	This variable includes fossil fuels that are co-fired in the project plant but not any other fuel consumption at the project site that is attributable to the project activity (e.g. for mechanical preparation of the biomass residues).

Data / Parameter	$FF_{project\ site,i,y}$
Unit	Mass or volume per year.
Description	Quantity of fossil fuel type i combusted at the project site for other purposes that are attributable to the project activity during the year y.
Source of data	On-site measurements and recordings from front loaders operators or the corresponding subcontractors.
Value(s) applied	Applied values of Diesel consumed for on-site biomass from forest operation transportation during the period 2009-2016: 43.8(2009); 44.7(2010); 44.9(2011); 46.0(2012); 45.5(2013) 45.5(2014); 45.5(2015); 45.5(2016) Informed values from 2009 to 2013 were obtained from monitored data. Informed values from 2014 to 2016 were estimated.
Measurement methods and procedures	This fuel amount is calculated considering the total fuel consumed for on-site transportation of biomass. The total fuel amount is reported by the front loader operator (or the corresponding subcontractor) to the person in charge of reporting this information for the calculation of the project activity emission reductions. This variable will be monitored continuously.
Monitoring frequency	This variable will be monitored continuously.
QA/QC procedures	Consistency checks based on monthly or annual operational indices (e.g. check whether front loader fossil fuel consumption divided by the operation hours results in a reasonable index, comparable to the ones observed in previous years).
Purpose of data	Project emission calculations.
Additional comment	This variable does not include fossil fuels co-fired in the project plant but any other fuel consumption at the project site that is attributable to the project activity (e.g. for mechanical preparation of the biomass residues).

Data / Parameter	$EG_{project\ plant,y}$
Unit	(MWh/yr)
Description	Net quantity of electricity generated in the project plant during the year y.
Source of data	Project plant measurements and calculations.
Value(s) applied	Values applied (MWh/yr): 684,778 for the period (2009-2016)
Measurement methods and procedures	Electric meters that constantly measure voltage and current will continuously monitor total electric power generation at the mill. This information will be stored in the DCS databases of the pulp mill. The Superintendence of Liquor will be responsible to process (i.e. integrate) this information and to send it periodically to the person in charge of calculating the emission reductions of the project activity in Arauco Generación S.A.
Monitoring frequency	This variable will be monitored continuously.
QA/QC procedures	The consistency of metered net electricity generation will be crosschecked with receipts from electricity sales (if available) and operational indices of the mill (e.g. check whether the electricity generation divided by the amount of steam passing through the turbines results in reasonable efficiencies, comparable to the ones observed in previous years).
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	$Q_{project\ plant,y}$
Unit	(GJ)
Description	Net quantity of heat generated from firing biomass in the project mill.
Source of data	On-site measurements.
Value(s) applied	Annual value applied from 2009 to 2016:1,417,177 (GJ/yr).
Measurement methods and procedures	Total high-pressure steam generated at the project plant will be monitored as well as the total heat to process from the turbogenerator extractions. The process heat that would have been generated by the power boiler in the baseline case scenario will be calculated multiplying the fraction of total high-pressure steam (% of tons) generated by the power boiler in the project plant by the total process heat (GJ) obtained from the turbo generator extractions. All the parameters required to perform this calculation are monitored on-line by the Valdivia DCS. A mill operator will aggregate this information and send it to the person in charge of calculating the project activity emissions. The Superintendence of Liquor will be in charge of monitoring this variable.
Monitoring frequency	This variable will be monitored continuously, aggregated monthly.
QA/QC procedures	The consistency of metered heat flows will be compared with general ad-hoc energy / mass balances and / or operational indices of the mill (e.g. for each of the boilers (recovery boiler and power boiler) check whether the amount of steam produced divided by the amount of fuel fired results in reasonable values compared to the ones observed in previous years).
Purpose of data	Baseline and project emission calculations.
Additional comment	---

Data / Parameter	NCVi
Unit	(GJ / mass or volume unit)
Description	Net calorific value of the fossil fuel type i.
Source of data	Whenever possible, measurements will be carried out. If not feasible, fuel supplier data or country-specific IPCC default values will be used instead.
Value(s) applied	The NCvs (GJ/ton) were directly monitored from the project plant from 2009 to 2013 and values informed from 2014 to 2016 were estimated from the original PDD. Diesel: NCVs (GJ/ton): 43,03(2009); 42,91(2010); 42,78(2011);42,52(2012); 43,01(2013); 43,01(2014); 43,01(2015); 43,01(2016). Fuel Oil (Bunker): NCVs (GJ/ton): 40,94(2009); 40,67(2010); 40,58(2011); 40,27(2012); 40,67(2013); 40,67(2014); 40,67(2015); 40,67(2016). Note: Values informed above results from the average values taken every six months, taking at least three samples for each measurement. Informed values from 2009 to 2013 were obtained from monitored data. Informed values from 2014 to 2016 were estimated.
Measurement methods and procedures	The Technical Superintendence will request reputed local laboratories to determine the net calorific values of the fossil fuels used in the plant. Alternatively, the Superintendence will evaluate the possibility of carrying out these measurements on site, in the pulp mill laboratory. These measurements will be carried out according to relevant international standards. In case the above is not feasible, fuel supplier's information will be used instead, since they normally carry out net calorific measurements of all the fuels they sell. This parameter is part of the specifications of the fuel that is sold to the mill.
Monitoring frequency	Every six months, taking at least three samples for each measurement. In case of other data sources: Review the appropriateness of the data annually.
QA/QC procedures	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Purpose of data	Project emission calculations.
Additional comment	---

Data / Parameter	NCV_k
Unit	(GJ / ton of dry matter) or (GJ / liter).
Description	Net calorific value of biomass residue type k.
Source of data	Local measurements.
Value(s) applied	Black liquor: For period (2009 to 2013) monitored NCV of black liquor were used: NCV (GJ/tDS): 10.51(2009); 12.12(2010); 12.10(2011); 12.66(2012); 11.80(2013); For period (2014 to 2016) The Black-liquor NCV of 11.66 (GJ/tDS) is used and corresponds to the estimate value informed in the original PDD. Biomass from forest operations: For period (2009 to 2013) monitored NCVs (GJ/BDt) were used: NCV (GJ/tDs):17.29(2009); 17.68(2010); 17.78(2011); 18.26(2012); 17.82(2013); For period (2014 to 2016) the NCV of 18.0 (GJ/tDS) is used and corresponds to the estimate value informed in the original PDD. Note that both values are referred to a dry mass basis (i.e. dry ton). Note that values used from 2014 to 2016 are the estimated values informed in the original PDD.
Measurement methods and procedures	The Technical Superintendence will carry out measurements at reputed local laboratories and according to relevant international standards. Alternatively, the Superintendence will evaluate the possibility of carrying out these measurements on site, in the pulp mill laboratory. Measurement of NCV will be based on dry biomass.
Monitoring frequency	This variable will be monitored 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. If measurements results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that NCV is determined on the basis of dry biomass.
Purpose of data	Baseline and project emission calculations.
Additional comment	---

Data / Parameter	$EF_{burning,CH4,k,y}$
Unit	(tCH_4/GJ)
Description	CH4 emission factor for uncontrolled burning of the biomass residue type k during year y.
Source of data	Default value provided in page 42/63 of the ACM0006 (Version 05). Please see comment below.
Value(s) applied	0.0027 (tCH4/BDt) with a conservative factor of 0.73. This results in an adjusted methane emission factor of 0.001971 (tCH4/BDt). Considering a NCV of 18.0 (GJ/BDt) of the biomass used in the project activity, the corresponding methane emission factor is 0.0001095 (tCH4/GJ).
Measurement methods and procedures	Not applicable, since a default value will be used in this case. Please see comment below.
Monitoring frequency	Not applicable.
QA/QC procedures	Not applicable, since a default value will be used in this case. Please see comment below.
Purpose of data	Baseline emissions calculations.
Additional comment	As mentioned in section B.6.2 of the PDD, the project proponent will perform a local measurement of this emission factor in the future in order to use the measured value instead of the default value provided by the ACM0006 (Version 05). The project proponent will make a formal request of this change to the CDM Executive Board in due time.

Data / Parameter	ε_{boiler}
Unit	(% or number)
Description	Average net energy efficiency of heat generation in the boiler that would generate heat in the absence of the project activity.
Source of data	Either use the higher value among (a) the measured efficiency and (b) manufacturer’s information on the efficiency OR assume an efficiency of 100% as a conservative default value.
Value(s) applied	The 100% default value will be used in this case.
Measurement methods and procedures	Direct measurements are not possible for the proposed project activity.
Monitoring frequency	Once at the beginning of the project activity.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	-
Unit	Mass or volume units (tons/yr or m3st/yr).
Description	Quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region.
Source of data	Surveys or statistics, preferable from official sources: INFOR, CORMA, CONAF. Publications: Lignum, Ecoamérica, among others.
Value(s) applied	--
Measurement methods and procedures	Arauco Generación S.A. will be responsible for carrying out the necessary research and studies. .
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	Monitoring of this parameter is applicable since approach L2 will be used to rule out leakage.

Data / Parameter	-
Unit	Mass or volume units (tons/yr or m3st/yr).
Description	Quantity of available biomass residues of type k in the region.
Source of data	Surveys or statistics, preferable from official sources: INFOR, CORMA, CONAF. Publications: Lignum, Ecoamérica, among others.
Value(s) applied	--
Measurement methods and procedures	Arauco Generación S.A. will be responsible for carrying out the necessary research and studies. .
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	---
Purpose of data	Baseline emission calculations.
Additional comment	Monitoring of this parameter is applicable since approach L2 will be used to rule out leakage.

Data / Parameter	**$EC_{PJ,y}$**
Unit	(MWh)
Description	On-site electricity consumption attributable to the project activity during the year y.
Source of data	On-site measurements.
Value(s) applied	0 (MWh/yr).
Measurement methods and procedures	Electric meters. The electricity quantity will be crosschecked with electricity purchase receipts whenever possible. The Superintendence of Liquor will be responsible for monitoring this variable.
Monitoring frequency	This variable will be monitored continuously, aggregated at least annually
QA/QC procedures	Crosscheck measurement results with invoices for purchased electricity if available.
Purpose of data	Baseline emission calculations.
Additional comment	The proposed project activity is not expected to generate any additional on-site electric power consumption other than the one derived from building a pulp mill with additional power generation capacity (i.e. a larger power boiler marginally consumes more power, etc.).

Data / Parameter	$EF_{grid,y}$
Unit	(tCO_2/MWh)
Description	CO_2 emission factor for grid electricity during the year y.
Source of data	The project proponent will use the latest version of the ACM0002 to calculate the grid emission factor.
Value(s) applied	Values applied for this parameter were: For period (2009 to 2013) calculated values were used based on official data of the grid electricity power. 2009: 0.6478 (tCO_2/MWh). 2010: 0.7186 (tCO_2/MWh). 2011: 0.6957(tCO_2/MWh). 2012: 0.6941(tCO_2/MWh). 2013: 0.7658 (tCO_2/MWh). 2014: 0.700 (tCO_2/MWh). (estimate value used in the original PDD) 2015: 0.500 (tCO_2/MWh). (estimate value used in the original PDD) 2016: 0.450 (tCO_2/MWh). (estimate value used in the original PDD)
Measurement methods and procedures	Arauco Generación S.A. will be responsible for performing the calculations to determine the grid emission factor according to the last version of the ACM0002. Official and publicly available information will be used for that purpose.
Monitoring frequency	This variable will be monitored and updated annually, according to the guidance of the ACM0002.
QA/QC procedures	Apply procedures in ACM0002.
Purpose of data	Baseline emission calculations.
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by ACM0002, will be included in the monitoring plan. See the corresponding variables below.

Data / Parameter	**$EF_{OM,y}$**
Unit	(tCO2/MWh)
Description	CO2 Operating Margin emission factor of the grid.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	Values applied: For period (2009 to 2013) calculated values were used based on official data of the grid electricity power. 2009:0.8651(tCO_2/MWh) 2010:0.7261 (tCO_2/MWh) 2011: 0.6428 (tCO_2/MWh) 2012: 0.7091 (tCO_2/MWh) 2013: 0.7310 (tCO_2/MWh) 2014: (Not available) 2015: (Not available) 2016: (Not available)
Measurement methods and procedures	This variable will be calculated as indicated in the relevant OM baseline method of the ACM0002.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	$EF_{BM,y}$
Unit	(tCO2/MWh)
Description	CO2 Build Margin emission factor of the grid.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	Values applied: For period (2009 to 2013) calculated values were used based on official data of the grid electricity power. 2009: 0.4304(tCO_2/MWh) 2010: 0.7111(tCO_2/MWh) 2011: 0.7454(tCO_2/MWh) 2012: 0.6824(tCO_2/MWh) 2013: 0.8010(tCO_2/MWh) 2014: Not available. 2015: Not available. 2016: Not available.
Measurement methods and procedures	This variable will be calculated as [∑iFi,y * COEFi] / [∑mGENm,y] over recently built power plants defined in the BM baseline method of the ACM0002.
Monitoring frequency	This variable will be monitored annually..
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	$F_{i,y}$
Unit	(Mass or volume)
Description	Amount of each fossil fuel consumed by each power source / plant.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	The values used were calculated using annual data from 2009 to 2013 obtained from official sources. From 2014 to 2016 data was not available at the moment this PDD was updated.
Measurement methods and procedures	Not applicable. This information will not be directly measured.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	COEFi
Unit	(tCO_2/mass)
Description	Emission factor coefficient of each fossil fuel type consumed by each power plant / source in the relevant grid.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	The data is used to calculate these coefficients are provided in section B.6.2 of the PDD. The values used were estimated for the year 2007 and might suffer changes in the 2007 and subsequent years.
Measurement methods and procedures	Not applicable. This information will not be directly measured.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	Plant or country-specific values to calculate COEF are preferred to IPCC default values.

Data / Parameter	GENj/k/n,y
Unit	(MWh)
Description	Electricity generation of each power source / plant j, k or n.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	The values used were calculated using annual data from 2009 to 2013 obtained from official sources. From 2014 to 2016 data was not available at the moment this PDD was updated..
Measurement methods and procedures	Not applicable. This information will not be directly measured.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	Plant or country-specific values to calculate COEF are preferred to IPCC default values.

Data / Parameter	--
Unit	(Text)
Description	Identification of power source / plant for the OM.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	The values used were calculated using annual data from 2009 to 2013 obtained from official sources. From 2014 to 2016 data was not available at the moment this PDD was updated
Measurement methods and procedures	Not applicable. This information will not be directly measured.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	Plant or country-specific values to calculate COEF are preferred to IPCC default values.

Data / Parameter	λ_y
Unit	(Number)
Description	Fraction of time during which low-cost / must-run sources are on the margin.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	Values for this parameter were calculated using annual data from 2009 to 2013 obtained from official sources. From 2014 to 2016 data was not available at the moment this PDD was updated.
Measurement methods and procedures	Not applicable. This information will not be directly measured. .
Monitoring frequency	This variable will be calculated annually, following the indications of the ACM0002.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	---

Data / Parameter	**$GEN_{j/k/ll,y\ IMPORTS}$**
Unit	(KWh)
Description	Electricity imports to the project electricity system.
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	0 (KWh). See comment below.
Measurement methods and procedures	Not applicable. This variable will be monitored annually.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	At present, the project system (the SIC) is not interconnected with any other system, however this variable will be monitored in case this situation changes in the future.

Data / Parameter	**$COEF_{j/k/ll,y\ IMPORTS}$**
Unit	(tCO2/mass or volume unit)
Description	CO2 emission coefficient of fuels used in connected electricity systems (if imports occur).
Source of data	CDEC-SIC Dispatch Center, CNE (National Energy Commission) periodic reports, web sites of power generating companies in the grid, local fuel providers, IPCC Guidelines and other official data sources.
Value(s) applied	Currently not used in the emission reduction calculation. See comment below.
Measurement methods and procedures	Not applicable.
Monitoring frequency	This variable will be monitored annually.
QA/QC procedures	Default data (for emission factors) and IEA statistics (for energy data) will be used to check the local data.
Purpose of data	Baseline emission calculations.
Additional comment	At present, the project system (the SIC) is not interconnected with any other system, however this variable will be monitored in case this situation changes in the future.

Data / Parameter	$EF_{CO2,LE}$
Unit	(tCO2/GJ)
Description	CO2 emission factor of the most carbon intensive fuel used in the country.
Source of data	The most carbon intensive fuel type can be obtained from official national communication sources (e.g. CNE, CDEC-SIC). In case such information is not available, IPCC default values will be used instead.
Value(s) applied	This parameter was not considered in the emission reduction estimation of the proposed project activity. See comment below. In case it is necessary to use this parameter in the future, Arauco Generación will be responsible for determining it.
Measurement methods and procedures	Not applicable
Monitoring frequency	In case of leakage, this variable will be monitored annually.
QA/QC procedures	---
Purpose of data	Leakage emission calculations.
Additional comment	Since the project proponent does not consider the proposed project activity will generate leakage, this parameter was not considered in the calculation of the future emission reductions. However, if the situation changes in the future, the project proponent will calculate the corresponding leakage emissions accordingly, using equation (35) of the ACM0006 (Version 05).

B.7.2. Sampling plan

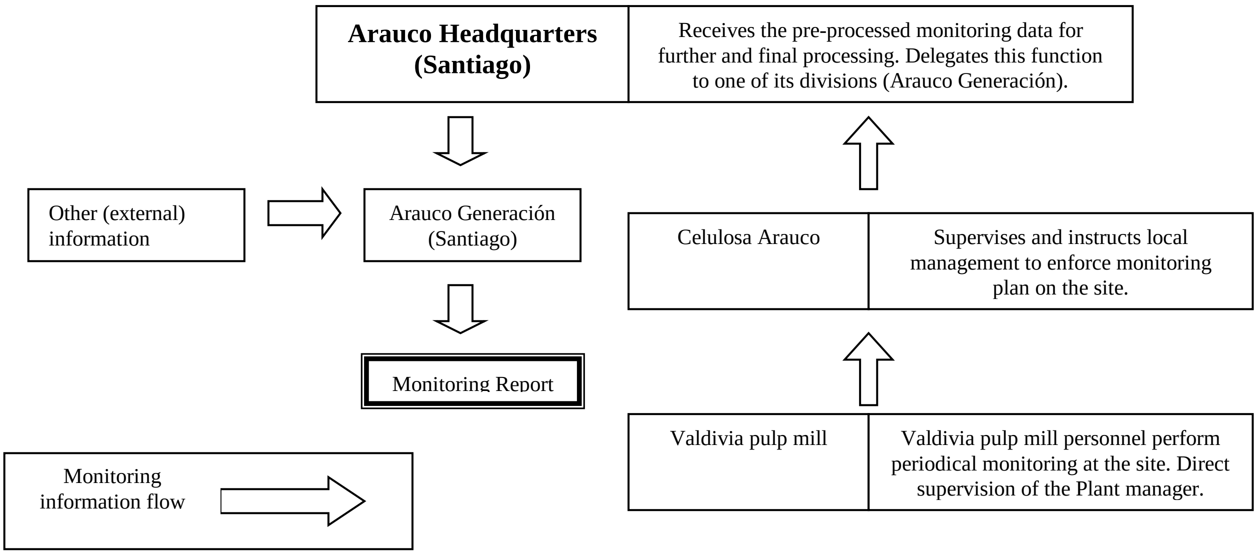
Not applicable in the case of this project activity.

B.7.3. Other elements of monitoring plan

The project proponent 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 an accurate and conservative manner. According to the monitoring methodology (page 51/63 of the ACM0006 Version 05), 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 Valdivia power plant project activity. The system will use the same principles of the ISO 9001 version 2000 norm and will be incorporated to the plant's management information system. To ensure the quality and integrity of the management system, Arauco Generación personnel will perform periodic internal audits.

Monitoring information flow of Valdivia Power Plant project activity



Arauco 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 Generación S.A. in Santiago for further and final processing (table formats, reports, etc.). With the information at this level, Arauco will be in condition to certify the emission reduction of the Valdivia project activity periodically (i.e. once every year).

Finally, since the Valdivia mill is a modern plant and counts with very high quality, security and environmental standards[31], 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 mill.

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

Date: 01/04/2009
Contact person: Arauco Bioenergía S.A.
Salutation: Mr.
Last name: Rodríguez
Middle name Arnoldo
First name: Christian
Organization: CELULOSA ARAUCO Y CONSTITUCIÓN S.A:

[31] At present, the Valdivia pulp mill counts with ISO 9001, ISO 14,001 and Custody Chain certification. The pulp mill administration is currently working on OHSSAS 18,001 certification.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

01/02/2002.

This is the date in which the purchase of the recovery boiler (a major equipment of the pulp mill) was formalized.

C.1.2. Expected operational lifetime of project activity

Minimum of 30 years, considered from 14/05/2004, which is the date in which the project activity started operating.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

The proposed project activity will use a renewable crediting period; therefore section C.2.1 will be completed below.

C.2.2. Start date of crediting period

01/07/2008.

C.2.3. Length of crediting period

Seven (7) years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The impacts of the project that were identified in the EIA are the following:

- **Solid and Liquid Wastes:** The operation of the plant will generate sewage water that will be treated in a sewage treatment plant in accordance with the Chilean regulations. The project will consume all the biomass that will be generated by the plant. Very low amounts of residues, like ashes, plastics and other industrial waste will be send to a landfill, also according with the Chilean regulations. Pulp mill effluents will receive tertiary treatment, which is the most advanced and effective technology available in the world today.

- **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 the impacts addressed above, were mentioned and resolved during the environmental impact assessment procedure.

All these statements were duly reviewed and confirmed by the Designated National Authority (CONAMA) when the proposed project activity went through the Host Country Approval process. In that instance, the DNA reviewed all the different environmental permits related to the project activity and found them to be in accordance with all national environmental regulations.

No transboundary impacts are considered for this project.

D.2. Environmental impact assessment

The project complies with the specific applicable regulations of the host country with regards to Environment Impact Assessment (EIA). The EIA follows the regulations for EIA System set in Chile by the Supreme Decree N 30/97 of the Ministry General Secretariat of the Presidency, Regulation for the Environmental Impact Assessment System and its modifications set in Supreme Decree N 95/2001, and the Act N 19,300 on the Environmental Framework.

The project proponent submitted an Environmental Impact Assessment (EIA) for the pulp mill, in which the project activity is realized, in order to comply with the Chilean regulation. The EIA was approved in October 30, 1998 by Resolution Nº 279/98.

The pulp mill where the proposed CDM project activity is located went through a thorough examination process by the local environmental authorities and received all the relevant authorizations in order to operate in accordance with the outstanding environmental legislation.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

In addition to the legal requirements imposed by the Environmental Impact System procedure, such as, publications in local newspapers and community meetings, Arauco invested a significant amount of effort, time and resources to explain to the local authorities and the local community the characteristics and implications of the Valdivia project. This was a long process, in which all the different aspects of the construction of a pulp mill were detailed addressed and dealt with. It began in 1995, year in which the idea of building a pulp mill was presented to the local community and lasted until 2004, the date in which the Valdivia mill was finished and started operating.

In addition to the formal consultation process, Arauco implemented a “free phone line” in order to permanently receive and consider any comment about the operation of the Valdivia mill (and its other industrial facilities as well) from the local community / stakeholders.

The Stakeholders involvement was organized through the following channels:

1. Technical staff of Arauco met with local community and authorities in order to discuss all economic, technical, social and environmental aspects of the Valdivia project. This was done with the commune of San José de la Mariquina and the surrounding communities in the Valdivia province. The conclusions of those meetings were compiled in a document that was distributed to the communities and local authorities.

2. Meetings with the communities of the Valdivia province and the management of the Company: the meetings were announced through leaflets, letters, local press, announcements in local radios, and television. Again the conclusions of those meetings were distributed to all stakeholders.

3. Presentation of the project (the EIA) to different institutions and organizations: Local universities, corporations of different nature and research centers.

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

5. The associated CDM project activity (which is part of the Valdivia project) was also announced in different CDM seminars in Chile.

As stated above, all comments were compiled in documents that were distributed back to all stakeholders. All those comments were taken into account and accommodated in accordance with the characteristics of the project and the local authorities requests.

E.2. Summary of comments received

The comments related to the project activity were related to the emissions of the project and waste management. For the emissions issue, the company emphasized their commitments to comply with all the requirements imposed by the local authorities.

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

E.3. Report on consideration of comments received

All clarifications done by the authorities were clarified and incorporated in due time. This allowed the environmental approval of the project, as stated in Section D and E.

SECTION F. Approval and authorization

The whole process related to the EIA approval, stakeholders and authorities comments and how they were incorporated in the process of approval of the EIA can be follow at the web through the Environmental Impact Assessment System dedicated link by CONAMA, at: www.e-seia.cl.

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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	Región 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.
Last name	Patrickson
Middle name	Albert
First name	Christian
Department	Development Department
Mobile	56-9158 3483
Direct fax	56-2-4623857
Direct tel.	56-2-4623795
Personal e-mail	cpatrickson@arauco.cl

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	Región Metropolitana
Postcode	---
Country	Chile
Telephone	56-2- 462 3888
Fax	56-2-462 7003
E-mail	christian.rodriguez@arauco.cl
Website	www.arauco.cl
Contact person	Arauco Bioenergía S.A.
Title	CDM Portfolio manager.
Salutation	Mr.
Last name	Rodríguez
Middle name	Arnoldo
First name	Christian
Department	Development Department.
Mobile	56-2-68323737
Direct fax	56-2-4623857
Direct tel.	56-2-4623888
Personal e-mail	christian.rodriguez@arauco.cl

Appendix 2: Affirmation regarding public funding

Public Funding:

The financial plans for the Project do not involve public funding.

Appendix 3: Applicability of selected methodology and standardized baseline.

DEVIATION REQUEST OF THE ACM0006 (Version 05)

The following document presents a description of the deviation request of the ACM0006 (Version 05) that is being requested for the validation and registration of the “Valdivia biomass power plant” CDM project activity.

The deviation request consists in the simultaneous application of baseline scenarios Nº3 and Nº4 of the ACM0006 (Version 05) to one CDM project activity: the “Valdivia biomass power plant” CDM project activity. The PDD of the proposed project activity is attached together with this document. The deviation request is pertinent, since the ACM0006 (Version 05) explicitly mentions in page 6/64 that only one baseline scenario can be applied to a single CDM project activity.

According to Table Nº2, page 8/63 of the ACM0006 (Version 05), the two baseline scenarios that would be simultaneously applied to the proposed project activity are cited in the following table below:

Scenario	PROJECT TYPE	Baseline scenario			Description of the situation
		Power	Biomass	Heat (if relevant)	
3	Greenfield power project	P4	(B1 or B2 or B3 and B4)	H4	The project activity involves the installation of a new biomass residue fired cogeneration plant at a site where no power was generated prior to the implementation of the project activity. The power generated by the project plant is fed into the gird or would in the absence of the project activity be purchased from the grid. The biomass residues would in the absence of the project activity (a) be used for heat generation in boilers at the project site and (b) be dumped or left to decay or burnt in an uncontrolled manner without utilizing it for energy purposes. This may apply, for example, where the quantity of biomass residues that was not needed for heat generation was dumped, left to decay or burnt in an uncontrolled manner prior to the project implementation. The heat generated by the new cogeneration plant would in the absence of the project activity be generated in boilers using the biomass residues that are fires in the cogeneration plant.

4		P2 and P4	B4	H2	The project activity involves the installation of a new biomass residue fired power plant at a site where no power was generated prior to the implementation of the project activity. In the absence of the project activity, a new biomass residue fired power plant (in the following referred to as “reference plant”) would be installed instead of the project activity at the same site and with the same thermal firing capacity but with a lower efficiency of electricity generation as the project plant (e.g. by using a low-pressure boiler instead of a high-pressure boiler). The same type and quantity of biomass residues as in the project plant would be used in the reference plant. Consequently, the power generated by the project plant would in absence of the project activity be generated (a) in the reference plant and –since power generation is larger in the project plant than in the reference plant – (b) partly in power plants in the grid. In case of cogeneration projects, the following conditions apply: The reference plant would also be a cogeneration plant; the heat generated by the project plant would in absence of the project activity be generated in the reference plant; the efficiency of heat generation in the project plant is smaller or the same compared to the reference plant).

1.0 Brief description of the proposed project activity

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

- CDM project initiative Nº1: The installation of a biomass (sawdust and bark) power boiler in a new pulp mill that generates high-pressure steam used to cogenerate surplus power to the grid. The biomass boiler that would have been installed in a baseline situation would have had a lower biomass firing capacity and would have generated saturated (low pressure) steam, not suitable to cogenerate electric power in the mill.

- CDM project initiative Nº2: The construction of a new pulp mill with a high electric power efficiency, so as to make it a net power exporter to the grid. The higher efficiency is possible due to the installation of a high steam pressure of the recovery boiler and two high-capacity turbogenerators. As in the previous initiative, these efficiency improvements allow the pulp mill to cogenerate surplus power to the grid, but in this case, without increasing the amount of biomass (black liquor, dry basis) that would be fired in the recovery boiler in a baseline scenario.

Both CDM project initiatives were implemented at the same time, during the construction phase of the new pulp mill facility. The two project initiatives share the same turbogenerators, through which heat is obtained (extractions) and power is generated (generator). The new pulp mill facility is a cogeneration power plant. For more details about the proposed project activity, please see section A of the attached PDD.

The request for deviation proposes that:

- Baseline scenario Nº3 of the ACM0006 (Version 05) is applicable to CDM project initiative Nº1,

- Baseline scenario Nº4 of the ACM0006 (Version 05) is applicable to CDM project initiative Nº2.

2.0 Applicability check of the chosen baseline scenarios to the proposed CDM project initiatives:

Baseline scenario Nº3 to CDM project initiative Nº1:

- "The project activity involves the installation of a new biomass residue fired power plant at a site where no power was generated prior the implementation of the project activity." This is precisely the case with the proposed project initiative, since there was no power generation before the implementation of this project initiative (or project activity).

- "The power generated by the project plant is fed in to the grid or would in the absence of the project activity be purchased from the grid." The proposed project initiative aims at generating surplus power to the grid, therefore it will only claim CDM credits for the surplus electric power generated and displaced from the grid.

- "The biomass residues would in the absence of the project activity (a) be used for heat generation in boilers at the project site and (b) be dumped or left to decay or burnt in an uncontrolled manner without utilizing it for energy purposes. This may apply, for example, where the quantity of biomass residues that was not needed for heat generation was dumped, left to decay or burnt in an uncontrolled manner." This is precisely the situation in this case, since in the absence of this project initiative, there would be a low-pressure boiler that would burn a lower amount of the same type of biomass residues than would be burned in the project boiler. Furthermore, in Chile there are a lot of biomass residues from forest related industries (i.e. sawmill, panelboard, forestry, pulp, etc.) that are burned or left to decay without using them for energy purposes. For more details, please see pages 10 to 13 and 64 to 66 of the PDD.

- "The heat generated by the new cogeneration plant, would in the absence of this project initiative, be generated in boilers using the biomass residues that are fired in the cogeneration plant." This is precisely the case with the baseline situation of this project initiative: there would be a lower firing capacity biomass power boiler that would only generate steam to the process and not high-pressure steam to generate power. For more details, please see the baseline pulp mill configuration in the PDD, in pages 10 to 13.

According to the above, the baseline for the additional power generation, the additional biomass type combusted and the steam generated in this boiler would be:

P4: The generation of power in existing and / or new grid –connected power plants.
B1: The biomass residues are dumped or left to decay under mainly aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.
H4: The generation of heat in boilers using the same type of biomass residues.

Baseline scenario Nº4 to CDM project initiative Nº2:

- "The proposed project initiative involves the installation of a new biomass residue fired power plant at a site where no power was generated prior the implementation of the project activity." This is precisely the case with the proposed project initiative, since there was no power generation before implementing this project initiative (or project activity).

- "In the absence of this project initiative, a new biomass residue fired power plant (in the following referred to as "reference plant") would be installed instead of the project activity at the same site and with the same thermal firing capacity but with a lower efficiency of electricity generation as the project plant". This is precisely the case with project initiative Nº2, since basically due to the higher steam-data of the recovery boiler; the pulp mill is capable of generating surplus power to the grid. The reference power plant would have only been able (in the best of the cases) to generate the heat and power required by the pulp mill, but not surplus power to the grid.

- "The same type and quantity of biomass residues as in the project plant would be used in the reference plant" This is precisely the case in this project initiative. The pulp mill has a determined capacity and can process a certain amount of wood to produce pulp. The pulp production process generates a certain amount of black liquor, which is used to produce energy inside the mill. The proposed project initiative increases the energy efficiency of the mill and therefore allows it to generate surplus power to the grid but using the same amount of biomass (black liquor, dry basis) that would be used by a baseline pulp mill (or reference plant).

- The power generated by the project plant would in the absence of the project initiative be generated:
    - In the reference plant. Since pulp mills in Chile tend to be self-sufficient in electric power generation, the reference plant considered for the baseline would be a self-sufficient pulp mill in thermal and electric power generation. This is conservative.
    - Partly in power plants in the grid. The proposed project activity would generate surplus power to the grid and therefore would displace electricity from the grid.

- Since this project initiative (and the proposed project activity) is a cogeneration power plant then:
    - "The reference plant is also a cogeneration plant." This is the case with the proposed baseline pulp mill design. Please see section A.4.3 of the PDD.
    - "The heat generated by the project plant would in the absence of the project initiative, be generated in the reference plant." This is the norm with Kraft pulp mills in the world and the proposed baseline pulp mill design. Please see section A.4.3 of the PDD.
    - "The efficiency of heat generation in the project plant is smaller or the same compared to the reference plant." According to the definition in page 3/64 of the ACM0006 (Version 05), the heat efficiency of the project plant is 66% while the heat generation efficiency of the reference plant would be 87%. For more details, please see section A.4.3 of the PDD.

According to the above, the baseline for the additional power generation, the biomass type combusted and the steam generated in this boiler, would be the following:

P4: The generation of power in existing and / or new grid –connected power plants.
B4: The biomass residues are used for heat and/or electricity generation at the project site.
H2: The proposed project activity (installation of a cogeneration power plant), fired with the same type of biomass residues but with a different efficiency of heat generation (e.g. an efficiency that is common practice in the relevant industry sector).

In the following sections of this document, it will be explained how the equations and procedures of the baseline scenarios Nº3 and Nº4 of the ACM0006 (Version 05) would be applied to the corresponding project initiatives, and the deviations that would need to be done.

3.0 Emission reductions calculation

The net emission reductions from the project are calculated through the following equation:

$$ER_y = ER_{electricity,y} + BE_{biomass,y} – PE_y - L_y$$

Where:

ER_y = Emission reductions of the project activity during the year y (tCO_2/yr).
$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year y (tCO_2/yr).
$BE_{biomass,y}$ = Baseline emissions due to anthropogenic sources of biomass residues during year y (tCO_2e/yr).
PE_y = Project emissions during the year y (tCO_2/yr).
L_y = Leakage emissions during the year y (tCO_2/yr).

This is equation Nº1 of the ACM0006 (Version 05), without the $ER_{heat,y}$ term, since the proposed project activity does not claim credits due to displacement of heat. This equation is applied in the context of the implementation of CDM project initiatives Nº1 and Nº2, and its application does not imply a change or deviation in the methodology, other than involving two baseline scenarios instead of one.

<u>3.1 Project emissions calculation</u>

Project emissions are calculated through the following equation:

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} * PE_{Biomass,CH4,y}$$

Where:

PET_y = CO_2 emissions during the year y due to transport of the biomass residues to the project plant (tCO_2/yr).
$PEFF_y$ = CO_2 emissions during the year y due to fossil fuels co-fired by the generation facility or other fossil fuel consumption at the project site that is attributable to the project activity (tCO_2/yr).
$PE_{EC,y}$ = CO_2 emissions during the year y due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr).
GWP_{CH4} = Global Warming Potential for methane valid for the relevant commitment period.
$PE_{Biomass,CH4,y}$ = CH_4 emissions from the combustion of biomass residues during the year y (tCH_4/yr).

This is equation Nº2 of the ACM0006 (Version 05). This equation is applied in the context of the implementation of CDM project initiatives Nº1 and Nº2, and its application does not imply a change or a deviation in the methodology, other than involving two baseline scenarios instead of one.

<u>a) Carbon dioxide emissions from combustion of fossil fuels for transportation of biomass residues to the project plant (PETy)</u>

The proposed project activity contemplates the use of two types of biomass fuel residues: a mix of sawdust and bark from forest / industrial operations (CDM Project Initiative Nº1) and black liquor from the pulping process (CDM project initiative Nº2). Since the proposed project activity (through the CDM project initiative Nº1) contemplates an additional consumption of the first type of biomass residues, the

transportation of the additional residues to the plant will be accounted for by using the following equations:

$$PET_y = N_y * AVD_y * EF_{km,CO2,y}$$

or

$$PET_y = \frac{\sum_k BF_{k,y}}{TL_y} * AVD_y * EF_{km,CO2,y}$$

Where:

PET_y =	CO_2 emissions during year y due to transport of the biomass residues to the project plant (tCO_2/yr).
Ny =	Number of truck trips during the year y.
AVD_y =	Average round trip distance (from and to) between the biomass residue fuel supply sites and the site of the project plant during year y (km).
$EF_{km,CO2,y}$ =	Average CO_2 emission factor for the trucks measured during the year y (tCO_2/km).
BFk,y =	Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or liter).
TL_y =	Truck average biomass transportation capacity (ton).

These are equations Nº3 and Nº4 of the ACM0006 (Version 05). These equations are applied in the context of the implementation of CDM project initiative Nº1 and their application do not imply a change or a deviation in the methodology.

It must be noted that the project emissions related to this source will only be accounted for the additional consumption of biomass from forest / industrial operations due to the implementation of project initiative Nº1. The calculation of the additional biomass is accomplished by using equation (30) in page 39 of the ACM0006 (Version 05):

$$BF_{PJ,k,y} = BF_{k,y} - \frac{Q_{projectplant,y}}{\varepsilon_{boiler} * NCV_k}$$

Where:

$BF_{PJ,k,y}$ =	Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (tons of dry matter or liter).
$BF_{k,y}$ =	Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or liter).
$Q_{project\ plant,y}$ =	Quantity of heat generated in the cogeneration project plant from firing biomass residues during year y (GJ).
ε_{boiler} =	Energy efficiency of the boiler that would be used in the absence of the project activity.

In this case, the same conditions and requirements stated in the baseline scenario Nº3 apply to the biomass type related to this baseline scenario (i.e. leakage monitoring for this biomass type).

The equation above is applied in the context of the implementation of CDM project initiative Nº1 and its application does not imply a change or deviation in the methodology.

It must be noted that though the above equation is perfectly applicable to project initiative Nº1, the quantity of heat from the power boiler destined to the process ($Q_{project\ plant,y}$) cannot be directly monitored and measured in this case, since the process heat is obtained from the turbogenerator extractions and the turbogenerators receive high-pressure steam from the power boiler and the recovery boiler simultaneously and indistinctively. However, this variable can be calculated using some auxiliary variables that can be directly monitored and measured in the project plant. The following equation shows how this can be accomplished:

$$Q_{project\ plant,y} = \quad [(\text{HP Steam PB})/(\text{HP Steam PB} + \text{HP Steam RB})] * \text{Process heat}$$

Where:

HP Steam PB = Total high-pressure steam generated in the power boiler (tons/time unit).
HP Steam RB = Total high-pressure steam generated in the recovery boiler (tons/time unit).
Process heat = Total heat consumed in the pulping process (GJ/time unit).

Each of these variables will be constantly monitored and measured in the project plant.

This calculation procedure leads to a lower amount of additional biomass used to cogenerate power than the amount that can be obtained from the energy/mass balances in pages 10 to 13 of the PDD. This translates into lower emission reductions from methane avoidance, keeping the calculation conservative.

The calculation procedure above is incorporated in section "B.7.1 Data and Parameters monitored", under variable $Q_{project\ plant,y}$ of the attached PDD.

b) Carbon dioxide emissions from on-site consumption of fossil fuels ($PEFF_y$)

CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFF_y = \sum (FF_{project\ plant,\ i,y} + FF_{project\ site,\ i,y}) * NCV_i * COEF_i$$

Where:

$FF_{project\ plant,i,y}$ = Quantity of fossil fuel type i combusted in the biomass residue fired power plant during the year y (mass or volume unit per year).
$FF_{project\ site,\ i,y}$ = Quantity of fossil fuel type i combusted at the project site for other purposes that are attributable to the project activity during the year y (mass or volume unit per year).
NCV_i = Net calorific value of fossil fuel type i (GJ / mass or volume unit).
$COEF_i$ = CO_2 emission factor for fossil fuel type i (tCO_2/GJ).

The calculation above considers fossil fuel consumption attributable to the implementation of the project activity only (CDM project initiatives Nº1 and 2). In the case of the proposed project activity, virtually all the emissions attributed to this source, will correspond to fossil fuel consumption in the power boiler and (eventually) the recovery boiler. The application of the equation above does not imply a change or a deviation in the methodology, other than involving two baseline scenarios instead of one.

c) Carbon dioxide emissions from electricity consumption ($PE_{EC,y}$)

This project emission source is considered, but not though the equation (7) of the baseline methodology. Given that the proposed project activity will only claim credits on the net increased electric power generation of the project pulp mill compared to a reference pulp mill, all the electric power consumed internally at the project plant (including the one related to the project activity) will be deducted from the gross power generation of the project plant.

This does not imply a deviation of the methodology; it is just a characteristic of the proposed project activity and the chosen baseline scenario for electric power generation.

d) Methane emissions from combustion of biomass residues ($PE_{Biomass,CH4,y}$)

Since this source is included in the project boundary, emissions are calculated using the following equation:

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} * \sum BF_{k,y} * NCV_k$$

Where:

$BF_{k,y}$ =	Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or liter).
NCV_k =	Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter).
$EF_{CH4,BF}$ =	CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ).

In this case, a default value from Tables 4 and 5 of the ACM0006 (Version 05) will be used instead of a measured emission factor.

This is equation Nº8 of the ACM0006 (Version 05). This equation is used in the context of CDM project initiative Nº1, which implies the use of additional biomass to cogenerate power. This biomass, in the absence of the CDM project initiative Nº1, would have been dumped or left to decay. The application of this equation does not imply a change or deviation in the methodology.

3.2 Baseline emissions calculation

a) Emission reductions due to displacement of electricity

Emissions are calculated using equation Nº9 of the ACM0006 (Version 05):

$$ER_{electricity,y} = EG_y * EF_{electricity,y}$$

Where:

$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year y (tCO_2/yr).
EG_y = Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y (MWh).
$EF_{electricity,y}$ = CO_2 emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh).

Determination of $EF_{electricity,y}$

This is done exactly as described in the ACM0006 (Version05). For more details about how this coefficient is calculated, please see pages 38 to 42 of the PDD.

The $EF_{electricity,y}$ is calculated in the context of the two CDM project initiatives, since both initiatives involve the displacement of electricity from the grid. There is no change or deviation in the application of the methodology in this section, other than involving two baseline scenarios instead of one.

Determination of $EG_{,y}$

As presented in the deviation request, in this case, the additional net electric power generation of the prospective CDM project activity (involving CDM project initiatives Nº1 and Nº2, simultaneously), would be determined by following the indications of baseline scenario Nº4, using formula Nº14, which is used with some minor modifications. These modifications are highlighted in red below:

$$EG_y = EG_{project\ plant} - \varepsilon_{el,\ other\ plant(s)} * (1/3.6) * \sum (BF_{k,y} * NCV_k)$$

Where:

EG_y = Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during year y (MWh). In this case, the calculation would include the net quantity of increased electricity generation derived from implementing CDM project initiatives Nº1 and Nº2, simultaneously.
$EG_{project\ plant}$ = Net quantity of electricity generated in the project plant during year y (MWh). In this case, the project plant would incorporate the net quantity of increased electric generation capacity derived from implementing CDM project initiatives Nº1 and Nº2, simultaneously.
$\varepsilon_{el,\ other\ plant(s)}$ = Average net energy efficiency of electricity generation in (the) other power plant(s) that would use the biomass residues fired in the project plant in the absence of the project activity ($MWh_{el}/MWh_{biomass}$). In this case, the baseline power plant electric efficiency calculation considers a business-as-usual pulp mill (reference plant), in which the project initiatives Nº1 and Nº2 are not implemented. The calculation considers all the biomass consumption and power generation that would take place in the baseline plant. This ensures consistency with equation 14 of the ACM0006 (Version 06). For more details, please see sections A.4.3 and B.6.2 of the attached PDD.

$BF_{k,y}$ = Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or litter). In this case, the project plant would combust a higher amount of biomass from forest operations (CDM project initiative Nº1) but the same amount of black liquor (CDM project initiative Nº2) than the baseline plant (reference plant). This variable includes both types of biomass fired in the project plant.

NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter of GJ/liter). In this case, the NCV for each type of biomass would be monitored and considered in the calculation: the NCV of biomass from forest operations (CDM project initiative Nº1) and the NCV of black liquor (CDM project initiative Nº2).

Here is where the changes derived from implementing the requested deviation to the ACM0006 (Version 05) occur. These changes are made to calculate the electricity displaced from the grid due to the simultaneous implementation of the two CDM project initiatives in the project plant.

Note that the baseline plant (or reference plant) would:

- Use the same amount of biomass (black liquor, dry basis), in the context of CDM project initiative Nº2.
- Use a higher amount of biomass (black liquor, dry basis and sawdust and bark mix), in the context of the CDM project activity that involves both CDM project initiatives Nº1 and Nº2.

Note that the way in which this equation is modified reflects well the additional electric power generation derived from implementing the two CDM project initiatives in the project plant:

1. The biomass from the pulping process (black liquor, dry basis) remains the same in the baseline and project scenario, so there is no deviation in the way equation Nº4 is normally applied.

2. The biomass from forest operations is higher in the project scenario than in the baseline scenario. This is considered in the baseline pulp mill efficiency calculation, since it considers all the biomass (from the pulping process and from forest operations) consumed in the pulp mill and all the electric power generation in the baseline pulp mill. The additional biomass from forest operations calculated using equation Nº 30 of the ACM0006 (Version 05) provides a conservative estimate (considering the energy / mass balances of the real / baseline pulp mill in section A.4.3 of the PDD) of the amount of biomass that effectively goes into additional power generation at the mill.

b) Emission reductions due to uncontrolled burning of anthropogenic sources of biomass residues

Since this project activity involves the baseline scenarios Nº3 and Nº4, only the additional biomass consumed under scenario Nº3 can be credited with emission reductions. As shown before, the additional biomass under this scenario is determined using equation (30) in page 39 of the ACM0006 (Version 05). The emission reductions associated to this source are then calculated using equation (34) of the ACM0006 (Version 05):

$$BE_{Biomass,y} = GWP_{CH4} * \sum BF_{PJ,k,y} * NCV_k * EF_{burning,CH4,k,y}$$

Where,

$BE_{biomass,y}$ = Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year y (tCO_2e/yr).
GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4).
$BF_{PJ,k,y}$ = Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (tons of dry matter or liter).
NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter)
$EF_{burning,CH4,k,y}$ = CH_4 emission factor for uncontrolled burning of the biomass residue type k during the year y (tCH_4/GJ).

To determine the CH_4 emission factor for uncontrolled burning of biomass, the project proponent conducted a local measurement.

The equation above is applied in the context of the implementation of CDM project initiative Nº1 and its application does not imply a change or deviation in the methodology.

3.3 Leakage emissions

According to the ACM0006 (Version 05), leakage emissions must be monitored for biomass used under scenario Nº3 (mix of bark and sawdust). To do so, the project proponent will use option L2, which requires to establish that the quantity of available biomass residue of type k in the region is at least 25% larger than the quantity of biomass residues of type k that are utilized.

Though the possibility of leakage in the proposed project activity is very low, in case it occurs, leakage emissions will be calculated according to equation (35) in page 44 of the ACM0006 (Version 05).

$$L_y = EF_{CO2,LE} * \sum BF_{PJ,k,y} * NCV_k$$

Where,

L_y = Leakage emissions during the year y (tCO_2/yr).
$EF_{CO2,LE}$ = CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/GJ).
$BF_{PJ,k,y}$ = Incremental quantity of biomass residue type k used as a result of the project activity in the project plant during the year y (ton of dry matter or litter).
k = Types of biomass residues for which leakage effects could not be ruled out with one of the approaches L_1, L_2 or L_3 above.
NCV_k = Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter).

The calculation of leakage is done in the context of the CDM project initiative Nº1 and its application does not imply a change or deviation in the methodology.

As can be seen above, the simultaneous application of the chosen baseline scenarios to the proposed CDM project activity would imply very minor modifications to the way in which the ACM0006 (Version 05) must be applied. The way in which the proposed project activity would be implemented, would allow enforcing the monitoring procedures established by each baseline scenario clearly and without conflict.

Appendix 4: Further background information on ex ante calculation of emission reductions

Electric efficiency of the baseline pulp mill design for the Valdivia power plant

Calculation of the average net energy efficiency of electricity based on updated energy/mass balance (with drier) plant:

According to ACM0006 (Version 05), the net electric efficiency is calculated as follow:

Reference plant electric efficiency calculation		
Baseline electric power generation[32](a)	(GWh/y)	528.6
Black-liquor consumption[33] (b)	(tDS/y)	1,245,180
Biomass from forest operations[34] (c)	(BDt/y)	65,148
Black liquor net calorific value (dry basis) (d)[35]	(TJ / 000 tDS)	11.66
Biomass from forest operations net calorific value (dry basis)[36] (e)	(TJ / 000 ton)	18.0
$\varepsilon_{el,other\ plant(s)}$ (a) / [(b)*(d)+(c)*(e) /3600]	(MWh_{el}/MWh_{bio})	12.127%

The net electric efficiency of the reference pulp mill would be 12.127%, which results to be slightly higher, and thereby more conservative from the emission reduction calculation than the original value of 12.09% used for the reference pulp mill, this can be explained as follows:

The updated value of the baseline electric power generation 528.6 (GWh/y) resulted to be marginally higher than the original value of 527.1 (GWh/y). This can be explained because the installed capacity of power consumption of the biomass drier was added to the reference plant.

According to the ACM0006 (ver.05) the electric efficiency of the reference plant is listed as a parameter which is fixed ex-ante, and so for its calculation the Project Participant used ex-ante (not monitored) values for the parameters (i.e. black-liquor, biomass from forest operations and corresponding NCVs).

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[32] This value considers a 100% self-sufficient reference pulp mill in electric-power generation. The value of 528.6(GWh/y) resulted to be marginally higher than the original value of 527.1(GWh/y) presented in this PDD. The new value was determined as a weighted average calculation: [62.5 (MW)*65% + 62.7(MW)*35%], where 62.5(MW) and 62.7(MW) corresponds to the electric power consumption of the reference plant using pine and euca campaign, respectively. These values resulted from the updated energy/mass balance (with drier), performed by KSH consulting. The applied factors of 65%/35% corresponds the number of days producing pulp from pine and euca, which corresponds to normal operation of the pulp mill.

[33] This value is the original value presented in this PDD. This was determined as a weighted average calculation: [3,674(tDS/d)*352days*65% + 3,280(tDS/d)*352days*35%], where black-liquor amounts of 3,674(tDS/d) and 3,289(tDS(d) are the operational loads of black-liquor under pine and euca campaign that would be burned in the recovery boiler. These loads of black-liquor were weighted average based on number of days producing pine (65%) and euca pulp (35%).

[34] This value was determined as a weighted average calculation: [0(BDt/d)*352days*65% + 187,968(BDt/d)*352days*35%], where biomass residues from forest operations resulted zero for pine campaign as pulp mill would be self-sufficient in term of power generation by only consuming black-liquor under pine campaign. The loads of black-liquor were weighted average based on number of days producing pine (65%) and euca pulp (35%).

[35] Ex-ante data (not monitored) is used in the electric efficiency calculation of the reference plant.

[36] Ex-ante data (not monitored) is used in the electric efficiency calculation of the reference plant.

The new value of 12.127% for the net electric efficiency of the reference plant will be used by the Project Participant for estimate emission reduction calculation in this PDD and emission reduction calculations in future monitoring periods.

Estimated electric efficiency of a conventional pulp mill project in Chile

Owner of this new pulp mill line	Relevant competitor of Arauco in Chile.	
Pulp mill type	New Eucalyptus pulp mill line.	
Annual capacity	(ADt/yr)	780,000
Starting date of construction	(Date)	September, 2004
Ending date of construction	(Date)	November, 2006
Starting date of operation (estimated)	(Date)	January, 2007

Electric power deficit / Total power consumption	(%)	**7.53%**
Electric efficiency of the new pulp mill line	(%)	**9.75%**

Sources: Environmental Impact Assessment studies of the new pulp mill project and AF-Celpap studies.

SIC GRID DATA FOR COMBINED MARGIN CALCULATION

Operating Margin data and calculation

DATA OF POWER PLANTS USED IN THE OM CALCULATION
(SOURCE: CDEC-SIC)

				ESTIMATION FOR 2007		
POWER PLANT	**POWER OUTPUT (MW)**	**PLANT TYPE**	**FUEL TYPE**	**ENERGY (GWh/yr)**	**FUEL CONSUMPTION**	**UNIT**
Abanico	136.0	Run of the river	Hydro	229	0	
Aconcagua	72.9	Run of the river	Hydro	439	0	
Alfalfal	178.0	Run of the river	Hydro	886	0	
Antilhue	100.0	Open cycle	Diesel	0	0	(Ton/yr)
Antilhue new 1	50.3	Open cycle	Diesel	136	31,280	(Ton/yr)
Antilhue new 2	51.0	Open cycle	Diesel	136	31,280	(Ton/yr)
Antuco	320.0	Reservoir	Hydro	1,967	0	
Arauco	33.0	Biomass / Steam	Biomass	38	0	
Bocamina	128.0	Coal / Steam	Coal	460	169,470	(Ton/yr)
Bocamina TG	23.6	Open cycle	Diesel	0	0	(Ton/yr)
Cabrero	260.0	Open cycle	Diesel	0	0	(Ton/yr)
Candelaria (Open cycle) 1	125.3	Open cycle	Natural Gas	65	20,862	(Mm^3-stdr./yr)
Candelaria (Open cycle) 1 Diesel	125.3	Open cycle	Diesel	0	0	(Ton/yr)
Candelaria (Open cycle) 2	128.6	Open cycle	Natural Gas	78	25,034	(Mm^3-stdr./yr)
Candelaria (Open cycle) 2 Diesel	128.6	Open cycle	Diesel	0	0	(Ton/yr)
Canutillar	172.0	Reservoir	Hydro	1,172	0	
Capullo	12.0	Run of the river	Hydro	62	0	
Celco	20.0	Biomass / Steam	Biomass	100	0	
Chacabuquito	25.0	Run of the river	Hydro	169	0	
Cholguán	13.0	Biomass / Steam	Biomass	62	0	
Cipreses	105.9	Reservoir	Hydro	477	0	
Colbún+Mach	569.0	Reservoir	Hydro	3,202	0	
Constitución	8.7	Biomass / Steam	Biomass	60	0	
Coronel	45.7	Open cycle	Natural Gas	256	66,539	(Mm^3-stdr./yr)
Coronel Diesel	45.7	Open cycle	Diesel	33	6,204	(Ton/yr)
Curillinque	89.0	Run of the river	Hydro	620	0	
D. de Almagro	23.8	Open cycle	Diesel	1	351	(Ton/yr)
El Indio TG	12.0	Open cycle	Diesel	0	0	(Ton/yr)
El Toro	450.0	Reservoir	Hydro	2,104	0	
Florida	28.0	Run of the river	Hydro	122	0	
Guacolda I	152.0	Coal / Steam	Coal / Petcoke	1,187	484,069	(Ton/yr)
Guacolda II	152.0	Coal / Steam	Coal / Petcoke	1,185	478,889	(Ton/yr)
Horcones TG	24.3	Open cycle	Natural Gas	0	0	(Mm^3-stdr./yr)
Huasco TG Diesel	58.0	Open cycle	Diesel	0	0	(Ton/yr)
Huasco TG IFO	58.0	Open cycle	IFO 180	1	253	(Ton/yr)
Huasco TV	16.0	Coal / Steam	Coal	44	29,890	(Ton/yr)
Isla	68.0	Run of the river	Hydro	497	0	
L. Verde TG	17.0	Open cycle	Diesel	10	9,596	(Ton/yr)
L. Verde TV	49.0	Coal / Steam	Coal	185	156,910	(Ton/yr)
Laja	8.7	Biomass / Steam	Biomass	60	0	
Licantén	5.5	Biomass / Steam	Biomass	29	0	
Loma Alta	40.0	Run of the river	Hydro	276	0	
Los Molles	18.0	Run of the river	Hydro	54	0	
Los Quilos	39.3	Run of the river	Hydro	261	0	
Los Robles	72.0	Open cycle	Diesel	0	0	(Ton/yr)
Maitenes	29.0	Run of the river	Hydro	127	0	
Mampil	49.0	Run of the river	Hydro	173	0	
Nehuenco	368.4	Combined cycle	Natural Gas	0	0	(Mm^3-stdr./yr)
Nehuenco (Open cycle)	250.0	Open cycle	Diesel	0	0	(Ton/yr)
Nehuenco 9B	108.0	Open cycle	Natural Gas	10	3,209	(Mm^3-stdr./yr)
Nehuenco 9B Diesel	108.0	Open cycle	Diesel	0	74	(Ton/yr)
Nehuenco Diesel	368.4	Combined cycle	Diesel	1,515	308,943	(Ton/yr)
Nehuenco II	390.4	Combined cycle	Natural Gas	3,018	653,288	(Mm^3-stdr./yr)
Nehuenco II (Open cycle)	250.0	Open cycle	Natural Gas	0	0	(Mm^3-stdr./yr)
Nueva Aldea 1	13.0	Biomass / Steam	Biomass	56	0	
Nueva Aldea 2	10.0	Open cycle	Diesel	36	10,828	(Ton/yr)
Nueva Aldea 3	20.0	Biomass / Steam	Biomass	83	0	
Nueva Renca	379.0	Combined cycle	Natural Gas	1,374	272,989	(Mm^3-stdr./yr)
Nueva Renca Diesel	379.0	Combined cycle	Diesel	904	182,123	(Ton/yr)
P. de Azúcar	156.0	Open cycle	Diesel	0	0	(Ton/yr)
Pangue	467.0	Reservoir	Hydro	2,175	0	
Pehuenche	566.0	Reservoir	Hydro	2,907	0	
Petropower	75.0	Petcoke / Steam	Petcoke	455	169,498	(Ton/yr)
Peuchén	77.0	Run of the river	Hydro	291	0	
Pilmaiquén	39.0	Run of the river	Hydro	262	0	
Pullinque	48.0	Run of the river	Hydro	224	0	
Puntilla	14.0	Run of the river	Hydro	115	0	
Ralco	690.0	Reservoir	Hydro	3,058	0	
Rapel	378.0	Reservoir	Hydro	1,051	0	
Renca	97.0	Diesel / Steam	Diesel	13	4,778	(Ton/yr)
Rucúe	178.4	Run of the river	Hydro	1,322	0	
S. Fco. Mostazal	25.7	Open cycle	Diesel	43	13,380	(Ton/yr)
San Antonio	156.0	Open cycle	Natural Gas	0	0	(Mm^3-stdr./yr)
San Ignacio	37.0	Run of the river	Hydro	243	0	
San Isidro	379.0	Combined cycle	Natural Gas	478	94,703	(Mm^3-stdr./yr)
San Isidro Diesel	379.0	Combined cycle	Diesel	848	151,015	(Ton/yr)
San Pedro	68.0	Open cycle	Diesel	0	0	(Ton/yr)
Sauz+Szito	88.8	Run of the river	Hydro	525	0	
Taltal (I and II)	244.9	Open cycle	Natural Gas	962	291,662	(Mm^3-stdr./yr)
Taltal II Diesel	120.0	Open cycle	Diesel	21	5,824	(Ton/yr)
Valdivia	61.0	Biomass / Steam	Biomass	398	0	
Ventanas 1	120.0	Coal / Steam	Coal	700	290,376	(Ton/yr)
Ventanas 2	220.0	Coal / Steam	Coal	1,305	530,074	(Ton/yr)
Volcán+Queltehues	62.6	Run of the river	Hydro	456	0	
Generadores Saesa	N.A.	Diesel engines	Diesel	0	0	(Ton/yr)
Others	4.1	N.A.	Hydro	0	0	
LosVientos_TG	120.8	Open Cycle	Diesel	115	0	(Ton/yr)
Campanario CA	125.0	Open Cycle	Diesel	29	0	(Ton/yr)
Coya	25.0	Run of the river	Hydro	0	0	
Quilleco	70.0	Run of the river	Hydro	435	0	
San Isidro 2 Open Cycle	240.0	Open Cycle	Diesel	64	0	(Ton/yr)
Chiburgo	19.4	Run of the river	Hydro	84	0	
Hornitos	55.0	Run of the river	Hydro	90	0	
Palmucho	32.0	Run of the river	Hydro	24	0	
TOTAL				**47,679**		

(green bar) Denotes registered CDM project activity.

OPERATING MARGIN CALCULATION

(ACCORDING TO THE ACM0002 (VERSION 06), Simple Adjusted OM method

		2007
Total emissions from non-low cost / must run power plants	(tCO_2/yr)	10,816,791
Total emissions from low-cost / must-run power plants	(tCO_2/yr)	515,824
Total energy generated in the SIC	(GWh/yr)	42,478
Total energy by non-Low cost / must run power plants	(GWh/yr)	15,243
Total energy by low cost / must run power plants	(GWh/yr)	27,234
Factor λ	(number)	0.0086
Operating Margin	**(tCO_2/GWh)**	**703.7**

Notes:
- Low cost / must run units present very low GHG emissions, since they are basically hydro plants and very few biomass plants.
- Registered CDM plants are not included in the OM factor calculation.

Build Margin data and calculation

BUILD MARGIN CALCULATION THE YEAR THE EMISSION ABATEMENT OCCUR
(SOURCE: CDEC-SIC)

Calculation excludes CDM plants (if any), plants that have been moved and retired plants at the calculation date.

	POWER OUTPUT (MW)	PLANT TYPE	FUEL TYPE	START OPERATION	TOTAL GEN IN 2007 (GWh)	(tCO_2/GWh)
Palmucho	32.0	Run of the river	Hydro	Dic-07	24	0
Hornitos	55.0	Run of the river	Hydro	Oct-07	90	0
Chiburgo	19.4	Run of the river	Hydro	Jun-07	84	0
Quilleco	70.0	Run of the river	Hydro	Abr-07	435	0
San Isidro 2 Open Cycle	240.0	Open Cycle	Diesel	Abr-07	64	988
Campanario CA	125.0	Open Cycle	Diesel	Ene-07	29	988
Coya	25.0	Run of the river	Hydro	Ene-07	0	0
LosVientos_TG	120.8	Open Cycle	Diesel	Ene-07	115	988
Nueva Aldea 2	10.0	Open cycle	Diesel	May-06	36	951
Antilhue new 2	51.0	Open cycle	Diesel	Sep-05	136	727
Candelaria (Open cycle) 1 Diesel	125.3	Open cycle	Diesel	May-05	0	988
Candelaria (Open cycle) 1	125.3	Open cycle	Natural Gas	May-05	65	644
Candelaria (Open cycle) 2 Diesel	128.6	Open cycle	Diesel	May-05	0	988
Candelaria (Open cycle) 2	128.6	Open cycle	Natural Gas	May-05	78	644
Coronel	45.7	Open cycle	Natural Gas	May-05	256	522
Antilhue new 1	50.3	Open cycle	Diesel	Ene-05	136	727
Horcones TG	24.3	Open cycle	Natural Gas	Sep-04	0	711
Ralco	690.0	Reservoir	Hydro	Sep-04	3,058	0
Valdivia	61.0	Biomass / Steam	Biomass	May-04	398	0
Licantén	5.5	Biomass / Steam	Biomass	Abr-04	29	0
Nehuenco II	390.4	Combined cycle	Natural Gas	Abr-04	3,018	434
Nehuenco II (Open cycle)	250.0	Open cycle	Natural Gas	May-03	0	644
S. Fco. Mostazal	25.7	Open cycle	Diesel	Jul-02	43	977
Chacabuquito	25.0	Run of the river	Hydro	Jul-02	169	0
Nehuenco 9B Diesel	108.0	Open cycle	Diesel	Jun-02	0	584
Nehuenco 9B	108.0	Open cycle	Natural Gas	Jun-02	10	619
Mampil	49.0	Run of the river	Hydro	Abr-00	173	0

TOTAL GEN. PER YEAR	(GWh / yr)		42,679
20% OF GEN. PER YEAR	(GWh / yr)		8,536
5 MOST RECENT PLANT GEN	(GWh / yr)		696

EMISSION FACTOR 5 PLANTS	(tCO_2/GWh)		90.7
EMISSION FACTOR 20% GEN	(tCO_2/GWh)		239.5

BUILD MARGIN	(tCO_2/GWh)		239.5

COMBINED MARGIN CALCULATION

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)

		2007
Operating Margin	(tCO_2/GWh)	703.7
Build Margin	(tCO_2/GWh)	239.5
Combined Margin	**(tCO_2/GWh)**	**471.6**

Appendix 5: Further background information on monitoring plan

Sustainable origin of the biomass from forest operations used in the Valdivia power plant

Implications of the DNA approval of the Valdivia 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, if 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 Valdivia mill project 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 Valdivia mill 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,[37] 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[38].

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

[37] 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.
[38] See CONAF web page, www.conaf.cl, Legislation, Control of forest legislation.

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 Valdivia 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 questionable origin. For that reason, the Valdivia plant management has the following controls in place:

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

Since the Chilean law penalizes the purchase of illegal products, it is in the Valdivia 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 Valdivia biomass power plant is located in the X 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[39].

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.

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

INFLUENCE AREA OF THE VALDIVIA POWER PLANT

Communes	Country region
Gorbea	IX
Villarrica	IX
Licanray	IX
Molco Alto	IX
Lastarria	IX
Loncoche	IX
La Paz	IX
Molco	IX
Nueva Imperial	IX
Victoria	IX
Pitrufquén	IX
Lautaro	IX
Osorno	X
San José de la Mariquina	X
Los Lagos	X
Lanco	X
Malalhue	X
Río Bueno	X
Paillaco	X
Valdivia	X
La Unión	X
Neltume	X
Futrono	X
Mafil	X
Panguipulli	X

The information in the table above will be used to determine the biomass availability index (according to criteria L2 of the ACM0006 (Version 05)), in the Valdivia power plant influence area.

Appendix 6: Summary of post registration changes

Version 05 26/03/2013	Version 10 13/10/2015
	The form of the PDD was changed according VVS.
Section A.1. A.1. Purpose and general description of project activity.	Section A.1. A footnote was added in order to clarify that design of the pulp mill is the same in the baseline and project case and that the pulp mill has an environmental permit to operate. The pulp mill has an environmental permit to operate below the cap of 550,000 (ADt/y). It must be noticed that this cap has nothing to do with the design production capacity of the plant. In this regard, according to the energy/mass balances informed in the registered PDD, the pulp mill was designed for a pulp production capacity of 728,640 (Adt/y) defined for the reference and project case plant. The design production capacity is determined as follows: [2,200(ADt/y)*35%+ 2,000(ADt/y)*65%]*352days, where the 2,200(ADt/y) and 2,000(ADt/y) corresponds to euca and pine pulp production, respectively obtained from the energy/mass balances informed originally informed in the PDD. From 352 days of normal operation 65% of the time the plant would operate under pine and 35% of the time under euca campaign.
Section A.3. Technologies and/or measures.	Table 1: Detailed description of the Valdivia biomass power plant project: Essential characteristics of the installed belt drier were described in this table. The baseline and project case energy/mass balances were updated with the drier. The updated energy/balances are: Valdivia pulp mill configuration without electric power generation capacity. Valdivia pulp mill configuration with electric power generation capacity
A.4. Parties and project participants	Inversiones Celco SL was not contemplated. The Party involved United Kingdom of Great Britain and Northern Ireland was contemplated. As PP Celulosa Arauco y Constitución S.A. was contemplated.
Section B.2	Under the headline **“The implementation of the project shall not increase the biomass production in the facility”** the following paragraph was added to clarify This corresponds to an environmental permits to operate under 550,000 (ADt/y) and do not corresponds to the design capacity of the plant informed as 728,640 (ADt/y) in the original energy and mass balances of this PDD. The following footnote was added to explain how the design capacity was determined:

	The design production capacity is determined as follows: [2,200(ADt/y)*35%+2,000(ADt/y)*65%]*352days, where the 2,200(ADt/y) and 2,000(ADt/y) correspond to the euca and pine pulp production, respectively obtained from the energy/mass balances informed originally informed in the PDD From 352 days of normal operation 65% of the time the plant would operate under pine and 35% of the time under euca campaign.
Section B.6.2	Section B.6.2 Data and parameters fixed ex ante was updated as follows: **GWP $_{CH4}$:Global Warming Potential for CH4** In section Purpose of data was added: Calculation of baseline emissions. **$\varepsilon_{el, other plant(s)}$:** Average net energy efficiency of electricity generation in (the) other power plant(s) that would use the biomass fired in the project plant in the absence of the project activity. The calculation of the baseline average net energy efficiency of electricity was adjusted using updated reference plant energy/mass balance based on actual performance. As a result, the original value of 12.09% is replaced with the value 12.127%. The net electric efficiency of the reference pulp mill would be 12.127%, which results to be slightly higher, and thereby more conservative from the emission reduction calculation, than using the original value of 12.09% used for the reference pulp mill. The new value of the reference plant was calculated using ex-ante data (not monitored data), in accordance with the ACM0006 (ver05) which state this is a fixed ex-ante (not monitored) parameter. **Additional electric power consumption of the project mill (GWh/time unit)**: the original value of 4.22% is replaced with the value 4.59%.The additional power consumption due to project activity would be 4.59%, which results to be higher, and thereby more conservative from the emission reduction calculations, than the original value of 4.22% used. This difference can be explained because of the installed capacity of the biomass drier. (Refer to ex-ante emission reduction calculation for detailed information)
Section B.6.3.	Section B.6.3. Ex ante calculation of emission reductions were updated: Project emissions were presented for the whole crediting period: 1. Carbon dioxide emissions from biomass residues transportation to the power plant. 2. Carbon dioxide emissions from on-site consumption of fossil fuels. 4. Methane emissions from combustion of biomass residues Baseline emissions were presented from the whole crediting period from 2009 to 2016. 1. Net quantity of increased electricity (EG_y) calculation. 2. Baseline emissions due to burning of anthropogenic sources of biomass

	residues Net emission savings of the project activity were presented for the whole crediting period. The following parameter were updated in the calculation of the parameter **εel, other plant(s):** <u>Baseline electric power generation (GWh/y)</u> The updated value of the baseline electric power generation 528.6 (GWh/y) resulted to be marginally higher than the original value of 527.1 (GWh/y). This can be explained because the installed capacity of power consumption of the biomass drier was added to the reference plant. <u>Global Warming Potential for CH_4 :</u> GWP_{CH4} Applied value of 21 (tCO_{2e}/tCH_4) for the first commitment period from 2009 to 2012. From 2013 to 2016 the applied value was 25(tCO_{2e}/tCH_4).
Section B.6.4.	Section B.6.4. Summary of ex ante estimates of emission reductions were updated:
Section B.7.1.	Section B.7.1 Purpose of data and monitored frequency information was added to all parameters stated under this section. **<u>$BF_{k,y}$ (and $BFT_{,k,y}$, see comment below):</u>** For the crediting period (2009-2016) the estimate values applied for biomass types (black-liquor and biomass from forestry) were: Value applied of 944,394 (tDS/yr) of biomass from the pulping process (black liquor, dry basis). Value applied of 171,442 (BDt/yr) of biomass from forest operations (sawdust and bark, dry basis). **<u>Moisture content of the biomass residues:</u>** Annual average value applied of 50% for biomass from forest operations from 2009 to 2016. **AVD_y: Average round trip distance (from and to) between biomass fuel supply sites and the project site**: Annual value applied of 200 km on average (round trip) from 2009 to 2016. **N_y Number of truck trips for the transportation of biomass:** Annual average value applied of 5,555 round trips per year from 2009 to 2016. **TL_y: Average truckload of the trucks used for the transportation of biomass from forest operations to the pulp mill Biomass from forest operations:** Value applied of 25 (ton/truck) on average from 2009 to 2016.

	$EF_{CO2,FF,i}$ CO_2 emission factor for fossil fuel type i: Annual values applied from 2009 to 2016: 0.07407 (tCO_2/GJ) for Diesel. 0.07737 (tCO_2/GJ) for Fuel Oil. **$FF_{project\ plant,i,y}$ Quantity of fossil fuel type i combusted in the biomass residue fired power plant during the year y:** Annual values applied during the period 2009-2016: Fuel Oil will be burned in the power boiler: Average amount of 2,072 (ton/yr) for the period (2009-2016). Value applied of 1,453 (ton/yr) of Fuel Oil will be burned in the recovery boiler, from 2009 to 2016. Fuel Oil will be the total consumption related to the project activity (ton/y): 3,525 (ton/yr), from 2009 to 2016. **$FF_{project\ site,i,y}$ Quantity of fossil fuel type i combusted at the project site for other purposes that are attributable to the project activity during the year y:** Annual values applied of diesel (ton/yr) used for on-site biomass from forest operation transportation from 2009 to 2016: 43.8(2009); 44.7(2010); 44.9(2011); 46.0(2012); 45.0(2013) 45.4(2014); 45.4(2015); 45.4(2016). **$EG_{project\ plant,y}$ Net quantity of electricity generated in the project plant during the year y.** Annual value applied of 684,778 (MWh/y) from 2009 to 2016. 686,5(2009); 684,1(2010); 684,1(2011); 683,3(2012); 684,6(2013); 684,8(2014); 684,8(2015); 684,8(2016). **$Q_{project\ plant,y}$ Net quantity of heat generated from firing biomass in the project mill:** Annual value applied from 2009 to 2016:1,417,177 (GJ/yr). **NCV_i Net calorific value of the fossil fuel type $_i$.** Annual values applied from 2009 to 2016: Diesel: NCVs (GJ/ton): 43,03(2009); 42,91(2010); 42,78(2011);42,52(2012); 43,01(2013); 43,01(2014);43,01(2015); 43,01(2016). Fuel Oil (Bunker): NCVs (GJ/ton): 40,94(2009); 40,67(2010); 40,58(2011); 40,27(2012); 40,67(2013); 40,67(2014); 40,67(2015); 40,67(2016). Note: Values informed above results from the average values taken every six months, taking at least three samples for each measurement.

	Informed values from 2009 to 2013 were obtained from monitored data. Informed values from 2014 to 2016 were estimated values informed in the original PDD. **$NCV_{i,y}$: Net calorific value of biomass type i per mass or volume of biomass.** The Black-liquor NCVs for period (2009-2013) were monitored values: 10,51(2009); 12,12(2010); 12,10(2011); 12,66(2012); 11,80(2013); The Black-liquor NCV of 11.66 (GJ/tDS) is used for period (2014-2014). This is the value informed in the original PDD The biomass NCVs for period (2009-2013) were monitored values 17,29(2009); 17,68(2010); 17,78(2011); 18,26(2012); 17,82(2013) The biomass from forest operations NCV of 18.0 (GJ/tDS) was used from 2014 to 2016. This is the value informed in the original PDD. **EF_y: CO_2 emission factor of the grid in year y:** 2009: 0.6478 tCO_2/MWh. 2010: 0.7186 tCO_2/MWh. 2011: 0.6957 tCO_2/MWh. 2012: 0.6941 tCO_2/MWh. 2013: 0.7658 tCO_2/MWh. 2014: 0.700 tCO_2/MWh (estimate) 2015: 0.500 tCO_2/MWh.(estimate) 2016:0.450 tCO_2/MWh.(estimate) **$EF_{OM,y}$ CO_2 Operating Margin emission in year y:** 2009:0.8651 tCO_2/MWh 2010:0.7261 tCO_2/MWh 2011: 0.6428 tCO_2/MWh 2012: 0.7091 tCO_2/MWh 2013: 0.7310 tCO_2/MWh 2014: (Not available) 2015: (Not available) 2016: (Not available) **$EF_{BM,y}$ $CO_{2\ Build}$ Margin emission factor of the grid in year y:** 2009: 0.4304tCO_2/MWh 2010: 0.7111tCO_2/MWh 2011: 0.7454tCO_2/MWh 2012: 0.6824tCO_2/MWh 2013: 0.8010tCO_2/MWh 2014: (Not available) 2015: (Not available.) 2016: (Not available)

	$F_{i,y}$ Amount of each fossil fuel consumed by each power source / plant. The values used were calculated using annual data from 2009 to 2013 from official sources. From 2014 to 2016 data was not available. **$GEN_{j/k/n,y}$ Electricity generation of each power source / plant j, k or n.** The values used were calculated using annual data from 2009 to 2013 from official sources. From 2014 to 2016 data was not available. **Identification of power source / plant for the OM:** The values used were calculated using annual data from 2009 to 2013 from official sources. From 2014 to 2016 data was not available. $\lambda_{y:}$ **Fraction of time during which low-cost / must-run sources are on the margin.** Values for this parameter were calculated using annual data from 2009 to 2013 obtained from official sources. From 2014 to 2016 data was available at the moment this PDD was updated.
Section B.7.2	Section B.7.2 It was included: "Not applicable in the case of this project activity."
Section B.7.3	Section B.7.3
Annex 1	Appendix 1: Organization: INVERSIONES CELCO SL was excluded. An additional contact person was included under Organization: CELULOSA ARAUCO Y CONSTITUCIÖN S.A:
Annex 4	Appendix 4: Appendix 4: Further background information on ex ante calculation of emission reductions. It was updated the calculation of the electric efficiency of reference plant and reasons were given to not use this calculation real data of fuels consumed in the boilers.
Annex 5	Appendix 5 It was included a "Simplified line diagram of the instrument" of the current Revised Monitoring plan,

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History of the document

Version	Date	Nature of revision
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.

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