CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

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SECTION A. General description of project activity

A.1 Title of the project activity:

- Title of the project activity: Nueva Aldea Biomass Power Plant Phase 1 (Nueva Aldea Power Plant Phase 1).
- Version number of the document: Version Nº2.
- Date of the document: 05 January 2006.

A.2. Description of the project activity:

The proposed project activity consists in the construction and operation of a new 30MW biomass cogeneration power plant located inside a new forestry complex by Arauco: the Nueva Aldea Industrial Complex or the Nueva Aldea Project.

The proposed project activity is designed to use own and third party biomass for steam and electric power generation. Biomass from industrial and forestry operations in Chile is normally dumped in piles for natural decay. The project activity is presented by Celulosa Arauco y Constitución S.A. (from now on, Arauco), a leading forestry and pulp-producing company in the world.

The Nueva Aldea Industrial Complex is built in two phases.

Phase 1, that consists in the construction of:

- A sawmill.
- A plywood mill.
- A log-processing mill.
- A biomass cogeneration power plant.

Phase 2 that consists in the construction of:

- A new 856,000 tons per year of bleached kraft pulp mill.

The new cogeneration power plant is integrated with the rest of the mills of Phase 1. Approximately 60% of the electric power generated by the new power plant will be destined to serve the needs of the Nueva Aldea Industrial Complex in Phase 1. The remainder 40% of the electric power generation will be sold to free (unregulated) customers of Arauco Generación[1] and to the spot market in the Interconnected Central System (SIC grid).

[1] Arauco Generación S.A. is a subsidiary of Celulosa Arauco y Constitución S.A.. Arauco Generación provides administration services to Arauco in the areas of engineering and electric power generation.

It must be noted that since the common practice in the Sawmill and Plywood industries[2] does not include the cogeneration of electric power, the entire net electric power generation capacity of the new power plant in Phase 1 represents a net increase of clean energy in the SIC, and therefore considered part of the proposed project activity.

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

Considering that Phases 1 and 2 are electrically interconnected, the power surplus of Phase 2 would have been more than enough to provide electric power to the industrial facilities in Phase 1. However, when the Arauco management evaluated the Nueva Aldea Industrial Complex, it considered the abundance of biomass in the area, the CDM potential and decided to build a new on-site biomass cogeneration power plant. This decision involved installing a high-pressure boiler and a steam turbine, which meant going clearly beyond the traditional practice in the Sawmill and Plywood industries. Considering the higher cost of this alternative compared to the conventional solution, the decision of building such Power Plant relied on the possibility of not depending on the SIC for electric power, on selling excess power to the grid, on supplying electric power to other mills within the Arauco Group and on the potential benefits from being a CDM project activity.

The proposed project activity will assists Chile's sustainable growth by providing electricity to the Nueva Aldea Industrial Complex and to the SIC through biomass power generation, which is a clean and renewable energy source. Furthermore, this Project accomplishes an additional greenhouse (GHG) reduction benefit derived from a reduced disposal or uncontrolled burning of biomass, which results into lower methane emissions.

The Nueva Aldea project activity participants believe that biomass power generation constitutes a sustainable source of power generation that brings clear advantages to mitigate global warming. Using the available natural resources in a rational way, the Nueva Aldea Phase 1 project activity helps to 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 Plywood and Sawmill industries, but to all forest-related industries. It is worthy to highlight, however, that none of the wood panel mills in Chile (and very few –if any- in the world) has this additional power generation capacity, making the Nueva Aldea Power Plant Phase 1 quite unique and particular in its type. Although this technological improvement is consistent with the internal policies of efficient energy usage

[2] The log-processing mill does not really constitute an industry in Chile, however it is not the common practice in these mills to have a cogeneration unit in-site either. For simplicity, this PDD will only address the common practice in the sawmill and plywood mills in Chile.

of Arauco; it must be recognized as an initiative that goes far beyond the common practice of the Sawmill / Plywood mill industries in Chile.

A.3. Project participants:

Name of Party involved(*) ((host) indicates a host Party)	Private and / or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes / No)
Chile (Host)	Celulosa Arauco y Constitución S.A.	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: *When the PDD is filled in support of a proposed new methodology (forms CDM-NBM and CDM-NMM),* at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

Chile ratified the Kyoto Protocol on August 26, 2002.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Chile (South America).

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

VIII Region of Bío-Bío, Province of Ñuble.

A.4.1.3. City/Town/Community etc:

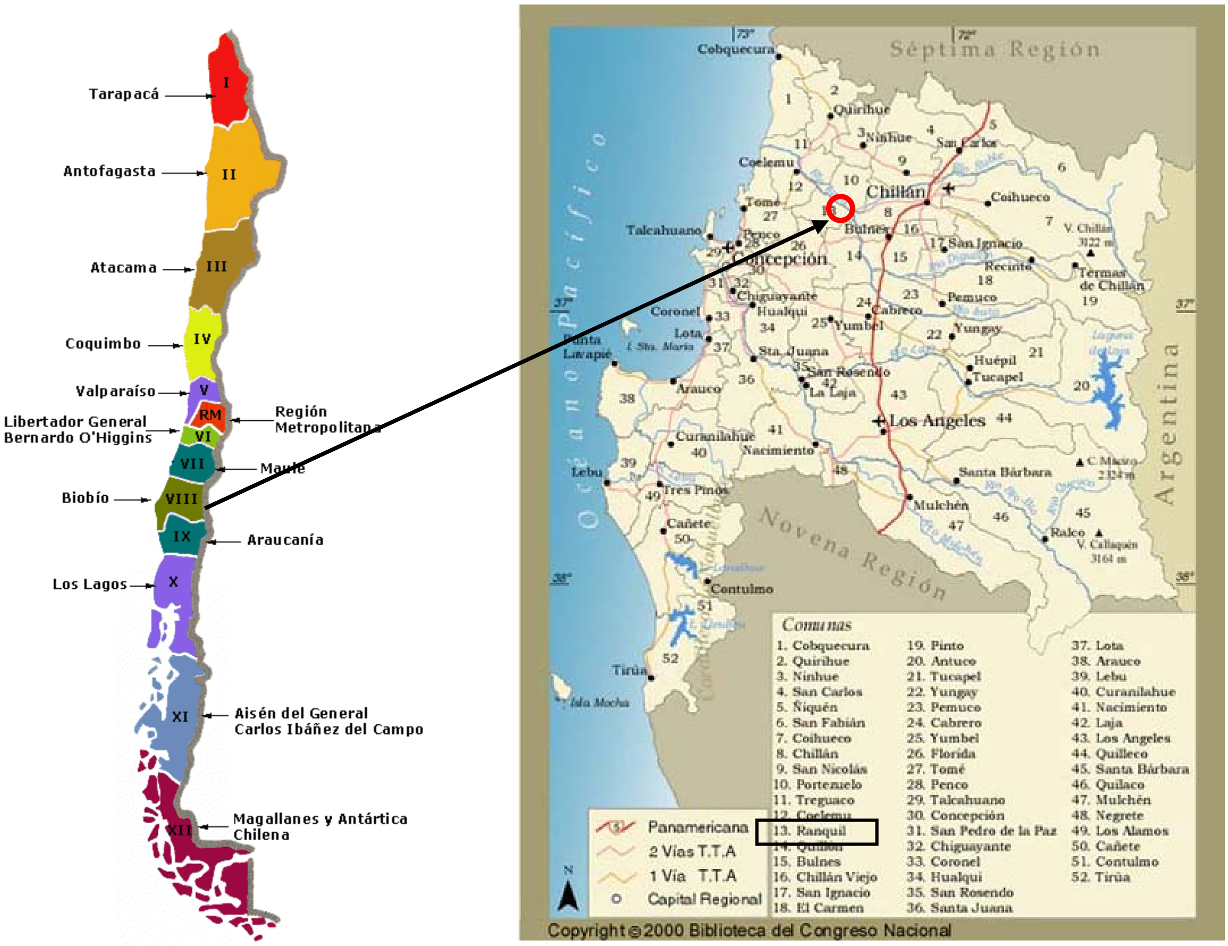
Ránquil (Nueva Aldea area).

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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

The Bío-Bío Region holds 12,4% of the total Chilean population of 15 million inhabitants, the second most populated after the Metropolitan Region. Its economy relies basically on exports of steel and pulp, wood, fish meal and frozen products.

<u>Figure 1: Geographical location of the Nueva Aldea project activity (Comuna Ránquil).</u>



The overview of the Nueva Aldea Industrial Complex, where the Nueva Aldea project activity is located, is shown in figure 2.

Figure 2: Nueva Aldea Industrial Complex overview

A.4.2. Category(ies) of project activity:

The Nueva Aldea Power Plant Phase 1 is a renewable energy supply side grid-connected project activity, which corresponds to sectoral scope Nº1 of the UNFCCC sectoral scope list for project activities. It involves reduction of emissions of greenhouse gases in the energy sector; more specifically, reduction of GHG emissions sources from fuel combustion in energy industries, according to the list of sector / source categories indicated in Annex A of the Kyoto Protocol.

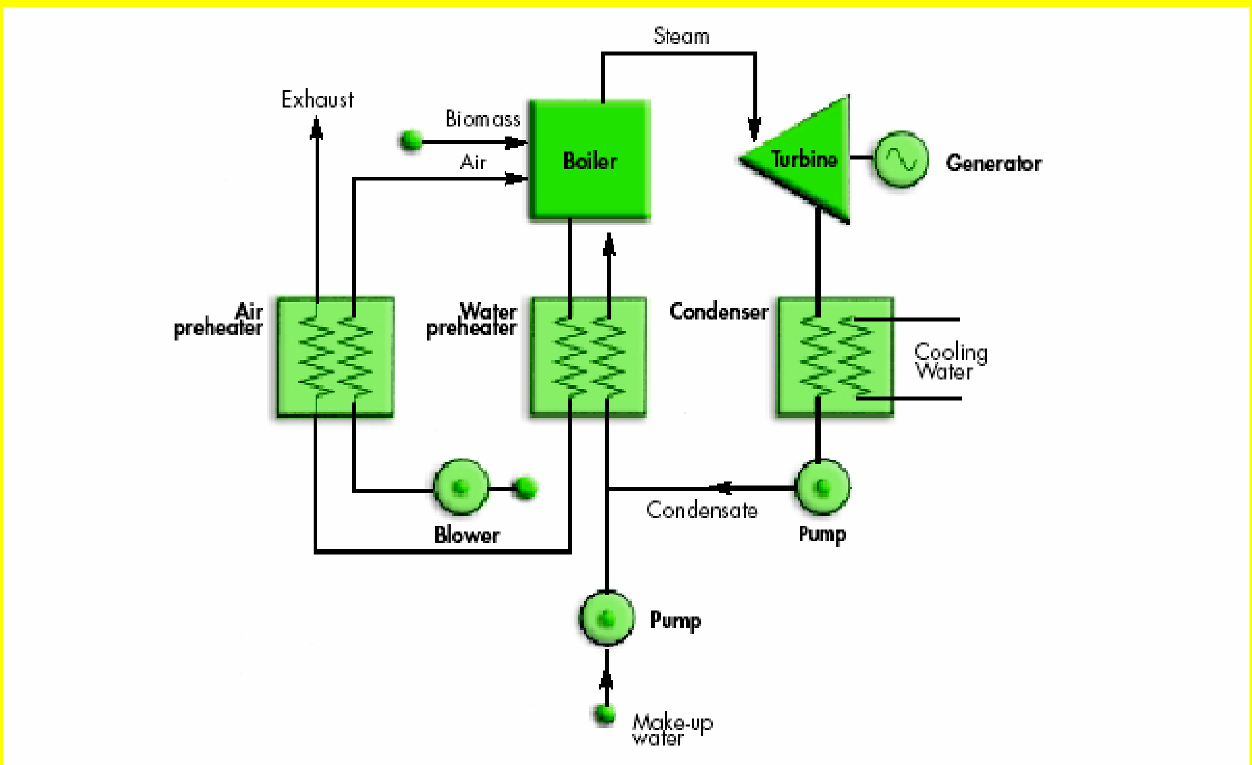
A.4.3. Technology to be employed by the project activity:

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 Nueva Aldea Power Plant Phase 1 was built in conjunction with the Nueva Aldea Industrial Complex Phase 1, the best way to outline and describe the equipments related to the project activity is to

describe how the power plant would have been built if it had maintained the conventional "business as usual" design, without electric power generation capacity. To do so, Arauco requested the same consulting company who designed the real project to design a project alternative which did not include the electric power generation capacity option. The differences between these two project alternatives are presented and described below:

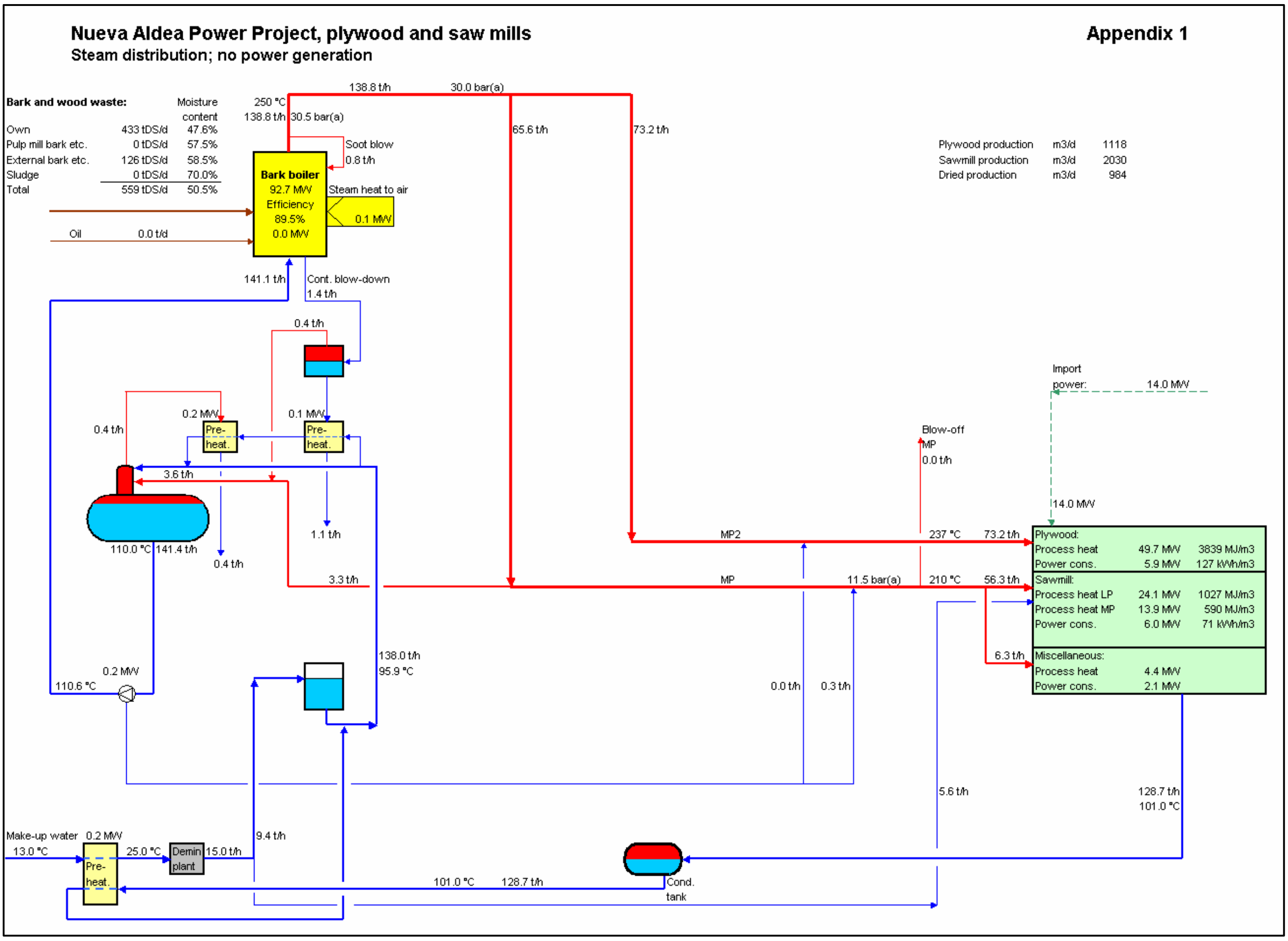
- There would have been no turbogenerator in the Power Plant.
- There would have been no or only a very small cooling tower.
- There would have been a smaller boiler installed of 150 t/hr. of nominal capacity on biomass.
- The boiler would have generated saturated or near-saturated steam at 25 / 30 bar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

It must be noted that the alternative BAU Nueva Aldea Phase 1 Industrial Complex would have had the same output as the real Complex (with CDM project activity) and would have contemplated the installation of a power boiler designed (i.e. dimensioned) to generate the same amount of process-steam the mills in Phase 1 would have required. The BAU Nueva Aldea Phase 1 project would have contemplated the construction of standard modern new mills, and as such; they would have included the installation of standard equipments used in the corresponding industries. The differences between the two project alternatives presented above are exclusively derived from the on-site electric power generation capacity of the project alternative with CDM project activity.

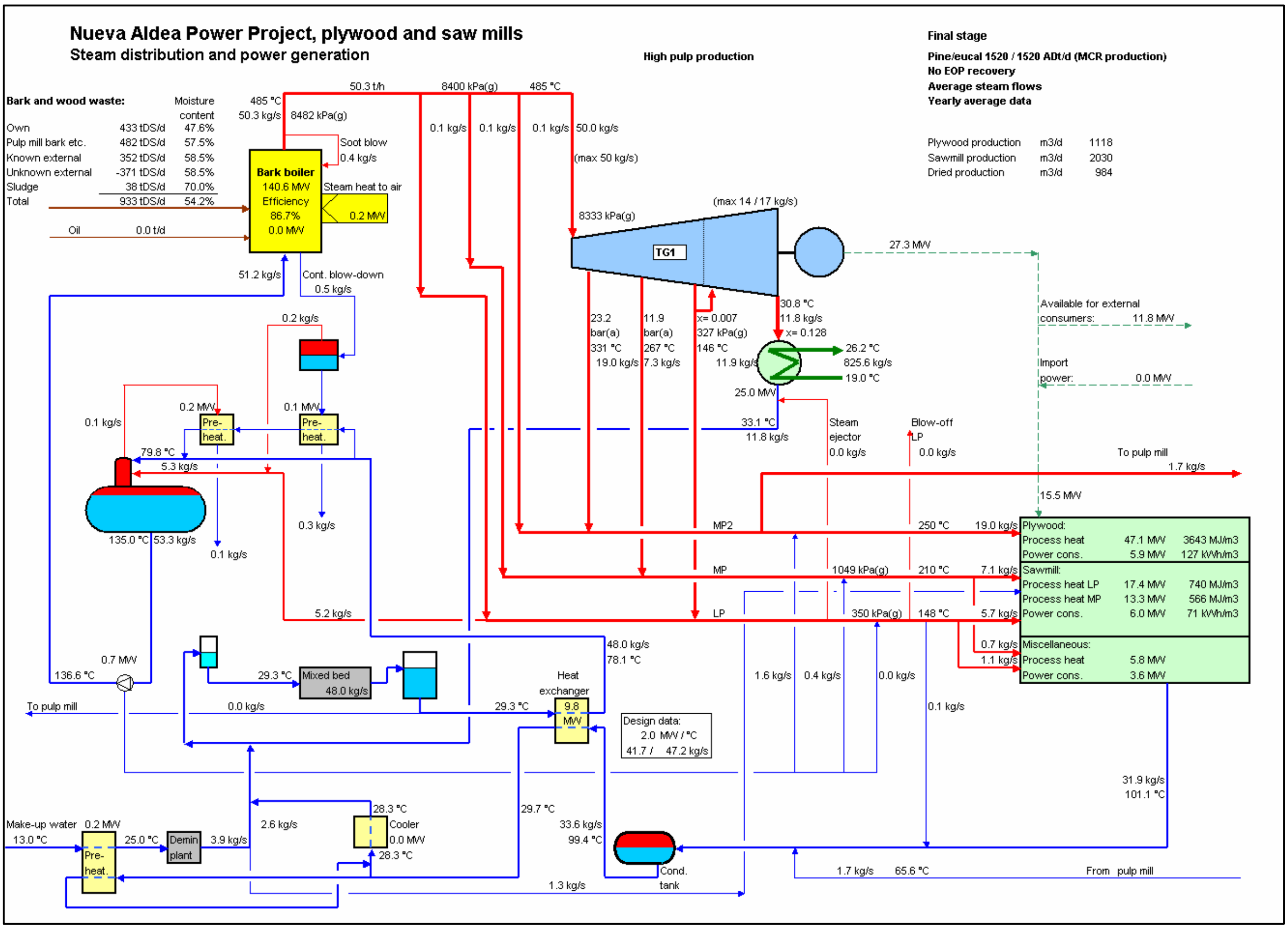
The following diagrams below show the energy / mass balances of the conventional BAU power plant and the real power plant. As mentioned above, the energy / mass balances of the two project alternatives show the same steam flows consumptions for the Nueva Aldea Phase 1 mills. The high-pressure steam generation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

These diagrams (and energy / mass flow calculations) will be used later in this PDD to calculate the additional biomass / fossil fuels related to the implementation of the CDM project activity.

<u>Nueva Aldea Power Plant Phase 1 configuration without electric power generation capacity</u>



Nueva Aldea Power Plant Phase 1 configuration with electric power generation capacity



The steam pipe from the Nueva Aldea Power Plant in Phase 1 to the Pulp Mill in Phase 2 only provides low pressure steam (19 bar) for pulp mill start-ups. During normal operation, the steam flow in this pipe line is negligible (only to keep the pipe hot). The Pulp Mill in Phase 2 is completely self-sufficient in steam and electric power generation.

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

The Project will reduce anthropogenic GHG emissions by replacing fossil fuel-based electricity with GHG-free biomass CHP power generation. In addition, the Project will assist Chile with greenhouse gas (GHG) reduction by curbing methane emissions from biomass degradation derived from wood-related industries (sawmills, wood panel mills and forest companies). The Project will generate about 720,239 tCO_2eq for the first 7-year crediting period, an average of 103,000 CERs annually.

The Project differs from any of a small number of undertakings hitherto seen in Chile for biomass power generation. While other projects rely on one large source of fuel for the supply of all or nearly all of the biomass used at their power plants, the Project sources a significant part of its consumption requirements (40%) form a great number of small providers (mostly local sawmills), for whom large-scale and efficient biomass power generation is not feasible. Without the Project, the biomass at these mills would continue to be dumped.

The Project does not quantify any leakage effect related to biomass availability, because there is enough biomass available to satisfy all the requirements of the different consumers in the influence area of the Power Plant. This is principally guaranteed by the provision of Arauco's own biomass, and especially, by additional biomass sources from thinning, pruning and harvesting operations of the forest industry.

Although the most recent modification of the Chilean electric legislation[3] have tried to spur investment in the electric power sector, modifications introduced in years 1998-1999 and stricter environmental regulations have slowed down investment in the electric industry in the last years. This, together with a relative slow down of the Chilean (and the world's) economy has translated into low investments in new power generation capacity addition in the SIC.

The node price, the price at which all generators sell their power to distribution companies and small customers (less than 0,5 MW) is regulated and fixed by a governmental entity, the CNE[4]. The arrival of cheap natural gas from Argentina during the 90s, marked the development of the SIC capacity towards natural gas combined cycle technology. Since such technology has lower capital costs and shorter payback periods than new hydropower and renewable energy technologies, the private-sector investment criteria favored the combined cycle power plants to other alternatives. This cheaper technology translated into a lower node price signal by the National Authority, making the development of other conventional technologies less attractive and the development of renewable energy technologies financially unviable. Now, with the recent upturn of the Chilean economy, the lack of investment in the electric power sector will become more evident, which will hopefully contribute to reverse the low trend of investment in the industry.

Despite the better economic perspectives mentioned above; financial, operational and other barriers still represent significant obstacles for the implementation of renewable energy projects in Chile. According to

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[3] Short Law I, approved in January 20th, 2004 and Short Law II, approved in May 2005.

[4] CNE stands for "Comisión Nacional de Energía" or National Energy Commission, a public institution that sets the electric power prices for regulated customers.

a recent study by the OECD[5], Chile has considerable renewable energy potential, but current barriers and lack of incentives prevent renewable energy sources to become more widely developed. In absence of adequate incentives and national plans, the price levels are simply not compatible (i.e. do not reflect the associated positive externalities) with the diversification of the energy matrix towards more renewable sources. This can be observed in the following table taken from the OECD report:

Energy prices in selected OECD countries, 2002[a]

	Electricity		Oil		Natural Gas	
	Industry (USD/KWh)	Homes (USD/KWh)	Industry (USD/ton)	Homes (USD/000lt)	Industry (USD/10^7Kcal)	Homes (USD/10^7Kcal)
Chile	0.055	0.083	204.6	332.2	216.4	481.3
Canada	..	..	179.2	316.0	125.3	236.2
Mexico	0.056	0.092	117.6	..	122.7	..
France	0.037	0.105	175.6	343.3	171.9	425.6
Poland	0.049	0.084	131.1	356.4	173.1	336.9
Spain	0.048	0.114	184.5	348.4	165.5	496.9
United Kingdom	0.052	0.105	203.1	238.8	146.4	317.0
OECD	0.062[d]	0.102[d]	205.7	364.7	162.0	348.7
Chilean price / OECD price (%)	*87[d]*	*82[d]*	*99*	*91*	*134*	*138.0*
Argentina	0.020	0.035	143.7	215.6	53.0	86.7
Bolivia	0.043	0.055	403.4	327.6	69.9	265.3
Brazil	0.036	0.084	130.3	180.2	98.3	81.2

a) USD = United States dólar at current exchange rate.
b) High sulfur content oil.
c) Light fuel oil.
d) 2001 data.
Source: Latin American Energy Organization; Organization for the Economic Cooperation and Development (OECD); (OIE).

To illustrate the above, during 2004 the Argentinean Government imposed restrictions to its natural gas exports to Chile. As a result, the Chilean national authorities established strong incentives to companies to have diesel as a back-up fuel for their power plants (combined cycles), and decided to reconsider coal and liquefied natural gas as primary energy sources to diversify the energy matrix in Chile. There were also some incentives that favored the development of small (< 20 MW) non-conventional renewable power generation initiatives. As a result, some power plants started operating with diesel and some new coal and liquefied natural gas plants appeared in the expansion plan for the SIC, but no small scale renewable initiatives. This indicates that though the measures for renewable small scale power generation pointed in the right direction, they were clearly not enough to make these type of initiatives a viable option in Chile, as they are in other more developed countries.

An incentive to Arauco, the investor, to pursue this energy sourcing development path is the higher status associated with CDM designation. The proposed project activity will publicly highlight its participant's environmental commitment, in a moment in which the Chilean authorities concern for the environment has become more evident. When registered with the CDM Executive Board, the Project will be one of the first CDM projects in Chile. Project participants, particularly Arauco, will also benefit from pioneering

[5] OECD Environmental Performance Reviews – Chile, 2005. The Spanish version of this report can be freely downloaded from the CONAMA web page: http://www.conama.cl. CONAMA is the national environmental authority and Chilean DNA.

the learning experience for the CDM process, opening a new and very attractive option for future project developments, both in Chile and South America.

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

Chosen crediting period:	Three 7-year crediting periods (21 years)
Years	**Annual estimation of emission reductions in tons of CO_2eq**
2005	73,817
2006	98,312
2007	106,463
2008	109,769
2009	130,907
2010	100,486
2011	100,486
2012	107,737
2013	107,737
2014	107,737
2015	107,737
2016	107,737
2017	107,737
2018	107,737
2019	107,737
2020	107,737
2021	107,737
2022	107,737
2023	107,737
2024	107,737
2025	107,737
Total estimated reductions	**2,228,558**
Total number of crediting years	21
Annual average over the crediting period of estimated reductions (tCO_2eq/yr)	106,122

A.4.5. Public funding of the project activity:

The financial plans for the proposed project activity did not involve public funding. The investment made in Nueva Aldea Industrial Project Phase 1 (including the Power Plant Phase 1) was financed with Arauco's own resources.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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

"Consolidated baseline methodology for grid-connected electricity generation from biomass residues", ACM0006.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The Nueva Aldea Power Plant Phase 1 project activity is a biomass cogeneration power plant which generates electricity and thermal energy[6] from renewable sources and avoids methane emissions from biomass natural decay.

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 electric power, approach a) seems to be the applicable option in selecting the baseline scenario for Nueva Aldea project activity.

According to the chosen baseline methodology, the Nueva Aldea Power Plant Phase 1 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 Nueva Aldea Power Plant Phase 1 will source approximately 50% to 60% of its biomass requirement from the Nueva Aldea Complex operations. The rest will be sourced from local sawmills in the area. In both cases, it will be biomass (sawdust and bark) from sustainable forest operations. Some fossil fuel may be co-fired in the power boiler in winter, when the biomass is too wet.

- **The implementation of the project shall not increase the biomass production in the facility:** The biomass generated in the Nueva Aldea Industrial Complex Phase 1 is determined by the input

[6] In this case, the thermal energy is assumed to be part of the baseline scenario, since a big scale sawmill and / or plywood mill normally uses biomass to generate thermal energy required in its process.

capacity of the sawmill and plywood mill, which have already been established and 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:** There is a biomass storage place at the Nueva Aldea Power Plant Phase 1, however the storage time of the biomass is not meant to surpass one week (40,000 m^3st max). If the biomass is stored for more time (over a year), the NCV decreases to a point in which it becomes inconvenient to use it as fuel in the Power Boiler of the Power Plant (i.e. lower combustion temperature, steam enthalpy drops and turbogenerator goes off-line).

- **No significant energy quantities, except for transportation for the biomass, is required to prepare the biomass residues for fuel combustion:** This is exactly the case with the Nueva Aldea Power Plant Phase 1 project activity.

B.2. Description of how the methodology is applied in the context of the project activity:

B.2.1 Electricity generation baseline

Within the SIC system, over 60% of the energy produced corresponds to hydro-generated energy. To account for this large portion of low-cost / must run resources, the Project Developer chose to determine the CO_2 emission factor by calculating the Operating and Build Margin coefficients of the SIC grid.

The Operating Margin was calculated using official and publicly available data and adjusted to include some hydropower on the margin. This was done using the Simple Operating Margin calculation methodology with Low-Cost / Must-Run Adjustment method (b) described in the electricity baseline calculation section of the approved methodology for biomass chosen. The Build Margin was also calculated using the same algorithm proposed in the approved methodology. By using a combination of these two emission factors, the Combined Margin, it was possible to estimate the emission factor of the SIC and therefore estimate "what would have happened otherwise", in terms of GHG emissions.

The following table below shows the key information for determining the electric power baseline:

Key information		Sources
Nº of biomass cogeneration power plants in Chile (SIC grid).	8 (including Arauco CDM biomass project activities).	CDEC-SIC
Energy procurement normal (BAU) practice in the wood panel industry (big-scale facilities only).	– Thermal power: On-site thermal power generation (biomass power boilers). – Electric power: Local grid supply.	Arauco, Environmental National Authority EIA/EIS project database, industry consulting companies and industry publications.
Nº of biomass cogeneration power plants in the SIC expansion plan for the next 10 years.	0	CNE node price reports.
Power plants connected to the SIC grid (grid to which the proposed project activity is connected):	Will be provided as part of the baseline information in	CDEC-SIC, CNE node price reports.

– Power output. – Electric power generation / load factor per year. – Category: Renewable / fossil fuel based. – Fuel type.	Annex 3 of this PDD.	
Most recent power plants built in the SIC grid and future power plant expansion plan.	16 most recent power plants built and connected to the SIC grid (December 2004 backwards). For more details, see Annex 3 of this PDD.	CDEC-SIC, CNE node price reports.
Fossil fuel data: – Coal – Natural Gas – Petcoke – Diesel – IFO-180 – Fuel Oil Nº6	Net calorific values: – 25-26 TJ/000ton – 35.8 TJ/MMm^3 – 31.2 TJ/000ton – 42.7 TJ/000ton – 40.2 TJ/000ton – 40.2 TJ/000ton Carbon content and % of carbon oxidized for each fuel was obtained from the IPCC Workbook and Reference Manuals (Table 1.2 and 1.6 respectively)..	IPCC default values, CDEC-SIC, CNE node price reports and fuel distribution companies.
Fuel density – Diesel – Fuel Oil Nº6	Density: – 0.97 (Kg/lt). – 0.93 (Kg/lt).	Local fuel distribution companies.

B.2.2 Unused biomass baseline

Chile has an important forestry and wood industry that generates significant amounts of biomass each year. A small portion of that biomass is used as fuel to source thermal power requirement of 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 Arauco estimation, the total biomass generated in Chile during 2005 is presented in the following table:

Biomass sources	2005 figures in (m^{3}st/yr)
Biomass from industrial operations	14.184.000
Biomass from thinning, pruning and harvesting ops.	9.003.000
Total biomass available	**23.187.000**

Source: Arauco.

Currently there is some demand for biomass from industrial operations (mainly steam generation in big scale sawmills and some isolated examples of small-scale electric power generation). However, there is

practically no use for biomass generated from forestry operations (thinning, pruning and harvesting operations), which is mostly left on the ground for natural decay and / or sometimes burned in the open air to avoid the risk of fires in new forest plantations.

As there are no circumstances to suggest that the large surplus of biomass will decrease in the foreseeable future, the methodology deems the baseline to be emissions from uncontrolled open-air burning of the equivalent amount of biomass that the Project will consume. It must be noted that this is a highly conservative assumption, since when biomass is 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 given the GWP of methane as GHG. By assuming open-air burning of all currently unused biomass and excluding from the baseline methane emission from decaying biomass, the Project's PDD understates baseline emissions and keeps the baseline conservative.

The following table below shows the key information for determining the biomass baseline:

Key information		Sources
Biomass (bark and sawdust) uses	There are some industrial uses for this type of biomass, however the supply is such that a significant portion is dumped and / or burned in the open- air.	Arauco sawmills, panel board mills and pulp mills (procurement departments), national studies and research (INFOR, CONAMA), direct site visits.
Biomass (bark and sawdust) supply / demand	The supply is significantly higher than the demand within the influence area of the project activity.	Arauco sawmills, panelboard mills and pulp mills (biomass power plants procurement departments).
Biomass dump sites / piles	Presence of biomass dump sites within the influence area of the project activity.	Arauco personnel site visits.
Biomass fuel data: Net calorific value Bark Sawdust Humidity range (mix)	 – 20.8 TJ/000ton (dry basis) – 18.9 TJ/000ton(dry basis) – 50% to 60%	Nueva Aldea Power Plant
Methane emission factor for uncontrolled burning.	– 300 (Kg/TJ)	Revised IPCC manual, Reference manual, table 1.7
Methane emission factor for controlled burning.	– 15 (Kg/TJ)	Revised IPCC manual, Reference manual, table 1.16

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

The most likely future scenario for the electricity sector in Chile contemplates an increase in the GHG emission factor of the electricity delivered to the SIC grid from an increase in the consumption of fossil fuels, mainly natural gas and coal, in accordance with the deliberate effort of the Chilean government to diversify the nation's hydro-dominated grid generation capacity towards other cheap energy sources.

Therefore, initiatives for producing electricity from a non-GHG emitting source, such as Nueva Aldea Power Plant Phase 1, leads to the avoidance in use or delay in the construction of a fossil-fuel plant with the same capacity as the proposed power plant that would operate in the SIC grid at the margin. In this way, anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the Nueva Aldea Power Plant Phase 1.

To test whether the project is additional or not, the chosen baseline methodology includes the "Tool for the demonstration and assessment of additionality" developed by the Meth Panel and approved by the CDM Executive Board in its 16th meeting. 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, economic and institutional barriers biomass cogeneration projects such as the Nueva Aldea Power Plant Phase 1 face in Chile. Further changes and incentives are still needed in all of these areas to unlock the considerable potential that biomass cogeneration has in Chile.

Step 0: Preliminary screening based on the starting date of the project activity

The Nueva Aldea Power Plant Phase 1 was built during 2003 / 2004 and started its operation at the beginning of 2005. Given that the project proponent of the Nueva Aldea Power Plant Phase 1 wishes to have the crediting period starting prior to the registration of the project activity, the following evidence must be provided:

a) Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity:

   - The most clear evidence that the starting date of the project activity complies with the above requirements is the date in which the construction of the project actually began. For the Nueva Aldea Phase 1 project, the first contract for the construction of the Power Plant , was signed in September 29th, 2003.

b) Provide evidence that incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and / or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity.

   - Arauco explicitly considered the postulates and incentives from the CDM in 1999, when 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. The company maintained the reforestation program to the point in which it was no longer feasible to continue doing it without the economic incentives of the CDM.

   - Arauco also considered the CDM in the implementation of other prior biomass cogeneration initiatives such as the Trupan Power Plant (2001). The Trupan Power Plant is similar to the

Nueva Aldea Power Plant, presented in this PDD. The evidence that supports the biomass cogeneration initiatives of Arauco can be found in some studies carried out by different subsidiaries within the Arauco Group. However, in the last years Arauco has adopted the CDM principles (i.e. sustainable development), as part of its Environmental Corporate Policy and has consistently applied this policy throughout all the areas in which the company participates (forest management, hardboard / MDF / plywood panels, sawmills, pulp, etc.).

- Arauco explicitly mentioned the CDM incentives in the EIS (Environmental Impact Study) of the Nueva Aldea project. The EIS is an official and public study, that is mandatory by the Chilean Environmental Regulation for all projects of a certain scale in Chile.

- During 2003, and considering the very few (if any) approved methodologies for biomass cogeneration projects suitable for Arauco cogeneration project types, Arauco decided to develop its own CDM competencies, and started to develop a new baseline methodology for its biomass cogeneration projects. The first methodology drafts and 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 in October 28th 2004, and got the approval of the methodology by the Executive Board by the end of February 2005[7]. The successful development of this methodology demonstrates Arauco serious commitment with the CDM and its intention to continue developing biomass power cogeneration initiatives in the future.

<u>Step 1: Identification of alternatives to the project activity</u>

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

<u>1.1. Power Generation alternatives.</u>

Plausible electric power generation alternatives for the Nueva Aldea Phase 1 include:

1.1 Conventional sawmill / plywood mill boiler, without power generation capacity: This is the standard practice in the Sawmill / Plywood mill / MDF panel wood mill industries in Chile and in the world. The

[7] 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.

technology for these plants is proven and fully developed. In fact, Arauco has 14 sawmills and 7 wood processing plants and only the ones related to the CDM (Trupan and Nueva Aldea) have been deliberately designed with electric power generation in mind; the rest must obtain the electric power from the local grid.

1.2 Conventional sawmill / plywood mill, with a conventional fossil fuel power unit as back-up: This alternative is similar to the previous one, in that the sawmills / plywood mills would consume electric power from the grid on a regular basis, however in this case the consumption is backed with a 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 represents a good business, since the low price of a used / new fossil fuel power back-up units can be rapidly repaid solely on the basis of the firm power revenues (i.e. the unit does not have to operate to repay the investment, just be available to the system); third, it can generate surplus power to the grid when the spot price of electricity is sufficiently high. 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.

1.3 Sawmill / plywood mill with on-site electric power generation at lower efficiency or at a later stage, not undertaken as a CDM project activity: As the 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 industries either. It would face similar barriers as the proposed project and therefore, would most likely not happen without the incentives of the CDM. In addition, a less efficient biomass power plant would have slightly lower investment cost than the more efficient counterpart and would certainly not be able to generate as much electric power as the more efficient plant. This would make the project less attractive from a financial point of view and therefore less viable. No such project has been implemented in sawmills, plywood mills or MDF board mills in Chile (or very few –if any- in the world) up to date.

1.4 Sawmill / plywood mil boiler with additional electric power generation capacity based on fossil fuels: Fossil fuels are considerably more expensive than biomass, however biomass generation capacity including fuel preparation is extremely more expensive than fossil fuel capacity. In the Nueva Aldea Phase 1 project, this alternative could be implemented by installing a power boiler with additional high pressure steam generation capacity based on fossil fuel. The additional steam could be piped to the pulp mill in Phase 2, where it could be used for additional electric power generation using one of the two 70MW turbogenerators that will be installed in the pulp mill. This alternative has been used (to some extent) by the project proponent in its Arauco mill.

As can be seen, all the alternatives presented above are plausible, credible and realistic. Most of them correspond to the BAU practice in the relevant industry. Many of them have been even implemented by Arauco in other facilities. They fully comply with the current Chilean environmental regulation, since once the relevant permits are obtained by the corresponding national authorities (CONAMA, COREMA, SNS, etc.) they can operate without any restriction.

Considering the business as usual practice in the relevant industries (i.e. sawmill and plywood mill) 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 electric power would have been generated if the proposed project activity had not been implemented is the construction of a conventional sawmill / plywood mill complex without on-site electric power generation. Such mill would have had to source its energy requirements from the local grid. This simplified power plant would have complied with all outstanding legal and environmental regulations in Chile, as the alternative more

sophisticated plant currently does. A description as well as a schematic of the alternative power plant has already been presented in section A.4.3 of this PDD.

1.2. Biomass usage alternatives.

The Nueva Aldea Phase 1 project activity uses biomass from forestry-related operations, namely bark and sawdust (wood). Though the project activity does make the distinction between these two types of biomass, in Chile the alternative scenario for biomass use is greatly simplified by the fact that the supply of biomass that can be used as fuel for the Nueva Aldea Power Plant Phase 1 is higher than the demand for such biomass. Ultimately, all biomass from industrial and / or forestry operations that is not utilized for some kind of power generation or as raw material, is simply left in piles for natural decay, and in some very special cases, burned in the open air. This is the baseline scenario for bark, sawdust (wood) and biomass from forestry operation (a combination of bark and wood).

According to the above, the proposed baseline scenario for the additional biomass consumed by the proposed project activity, is that such biomass would be dumped, left to decay or burned in an uncontrolled manner without utilizing it for energy purposes.

According to Table 1 of the baseline methodology, the baseline scenario that would apply to the proposed project activity is shown below:

Combination of baseline scenarios for the Nueva Aldea Power Plant Phase 1 project activity

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

Step 2: Investment analysis

The project proponent will show the additionality of the project through Step 3 (Barrier Analysis), since it provides a more general and less circumstantial assessment of biomass cogeneration projects in Chile, such as the Nueva Aldea biomass Power Plant Phase 1.

Nevertheless, the financial analysis for the Nueva Aldea Power Plant Phase 1 project activity shows a clear case of additionality compared to other conventional "business as usual" alternatives presented in the preceding section.

The following table shows the main financial indicators of the Nueva Aldea Power Plant with electric power generation capacity (real Power Plant) and a conventional Plant without electric power generation capacity (as described in Option 1.1 in Step 1). In both cases, similar operational[8] and financial criteria were used.

[8] Though operational parameters between the two power plants are similar, they are not exactly the same. These differences –however- do not invalidate the conclusion presented in Step 2.

NUEVA ALDEA PHASE 1 POWER PLANT FINANCIAL COMPARISON

		Baseline case scenario	Proposed project scenario
		Conventional Plant	Power Plant with cogeneration capacity
Initial investment	(MUS$)	16,020	38,277
Net Present Value	(MUS$)	4,915	-5,542
Discount rate	(%)	12.0%	12.0%
Internal Rate of Return	(%)	16.9%	9.4%

The conventional project solution can become even more attractive than the one presented above if a fossil fuel power back-up unit is installed nearby the Nueva Aldea Complex facility (as described in Option 1.2 in Step 1). A second-hand power back-up unit can currently be acquired at competitive prices and become a good business opportunity based mainly on firm power revenues. The positive NPV related to this additional investment[9] would be added to the NPV of the conventional project alternative presented in the table above, making this new project alternative even more convenient than the proposed CDM project activity.

This brief analysis shows that from a financial perspective, the proposed project activity is clearly not the most attractive project alternative for the Nueva Aldea Phase 1 project.

Step 3: Barrier analysis

The Nueva Aldea Phase 1 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 mentioned and analyzed below.

3.1. Barriers that prevent a wide spread implementation of this activity

Investment barriers: The higher investment risk results from adding a cogeneration power unit in a plant that has not been designed to operate with that kind of technology. No (or very few) sawmills and plywood mills have been implemented with additional and integrated electric power generation capacity up to date. From this perspective, the Nueva Aldea Power Plant Phase 1 clearly represents a technological breakthrough. This innovation implies higher operational risks, which ultimately translates into a higher financial risk for the Nueva Aldea project.

This higher risk constitutes a significant barrier for the execution of the proposed project activity. Particularly considering that Arauco is part of the Angelini Group, a conservative conglomerate in Chile, whose core business is the production of forestry-related products for exports and not the generation and

[9] From 50 to 100 KUS$ of net present value per installed MW, depending on the fuel and purchase price of the power back-up unit.

commercialization of electric power. In fact, in the last years the Angelini Group had taken steps oriented more towards a divestiture in the electric power sector. During 2001, the Angelini Group sold Saesa and Frontel, two electric power distribution companies in the IX and X Regions of Chile respectively.

In addition to the above, in Chile there is a higher risk exposure for being a big (visible) player in the electric power generation industry. As a member of the CDEC-SIC dispatch center, Arauco is exposed to fines applied to power generators applied by the national authority. According to the law, these fines are applied in proportion to the installed capacity of each electric power company. The problem is that many times (in reality, always), these fines are applied to ALL CDEC-SIC members, regardless of whether a particular company had or did not have anything to do with the system failure (i.e. black-out). In case of Arauco, the company has never been responsible for a system failure, nevertheless it had been finned by the national authority almost every time a system failure had occurred. This higher risk exposure prevent companies whose core business is not power generation, from investing in power cogeneration projects.

Being Chile one of the most important forestry-products producing countries in the world, only one other company apart from Arauco currently generates electric power from biomass sources, but it does so in a much smaller scale.

Technological barriers: Though Arauco has some experience with steam turbines and power generation in pulp mills, building the Nueva Aldea Power Plant Phase 1 meant installing higher steam pressure system (85 bar) integrated with a sawmill and plywood mills, which are normally not designed to work with high pressure steam. This is not a minor issue, since if the cogeneration unit (turbogenerator) goes off line, a considerable amount of high-pressure steam might be deviated from the turbogenerator to the process. This steam can cause serious imbalances in the sawmill / plywood mill production processes and can compromise the life span of the equipment, which is normally not designed to deal with the high level of superheating of the steam required to generate electric power in the facility. This is not the case with modern pulp mills, which have a more flexible process configuration, are designed to deal with higher levels of steam superheating. Therefore they can absorb high-pressure steam fluctuations in a better way. In other words, the integration of a cogeneration unit with a sawmill / plywood mill implies major design and operational considerations that would not be present in a conventional mill.

Given there are no (or very few) sawmills and plywood mills with integrated power cogeneration capacity in Chile, there is a lack of skilled and trained manpower to operate these type of facilities. This also constitutes a technological barrier relevant to the project activity (also a barrier in the prevailing practice).

Finally, it must also be noted that much of the engineering used to build these type of plants is subcontracted abroad, usually from northern European countries (Finland and Sweden), which are leaders in energy efficiency and renewable (biomass) energy generation technologies. This is clearly in line with the CDM postulates.

Barriers due to the prevailing practice: As previously stated, the Nueva Aldea Power Plant Phase 1 uses a proven technology to generate electric power, however the implementation of such technology integrated with a sawmill / plywood mill clearly departs from the conventional practice in the industry. For that reason, the project is one of a few of its kind Chile[10], and in the world. The operation of such a plant

[10] The only similar project in Chile is the Trupan Power Plant, owned by Paneles Arauco, a subsidiary of Arauco. That Power Plant was also presented as a CDM project activity.

requires (additional) qualified personnel, who must respond to both internal electric power demands of the Complex and to the daily CDEC-SIC dispatch programs. This last point is relevant, given that there are very few trained and experienced operators who know how to run a big-scale biomass cogeneration facility and at the same time, are familiar with electric power generation in the SIC in Chile.

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

Barriers to entry to the electric power industry: Most of the above paragraphs have dealt with barriers related to the sawmill and wood-panel industry. However, the proposed project also faces significant barriers in the electric power industry, some of which 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 plant registers peek power consumption during peek power time, the consuming plant not only has to pay for the electricity (MWh) consumed during these periods, 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 system is not operational even for a short period of time a year, the industrial customer must pay the demand charge all year long.

The coordination with other generating / distribution / transmission companies also constitute another barrier for cogeneration power plants such as the Nueva Aldea Power Plant Phase 1. To be able to sell electric power to the SIC grid and obtain the benefits of a power generating company, Arauco must be part of the CDEC-SIC, the dispatch center for 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 becomes more complicated when an industrial facility must not only consumes power from the grid but injects power to

the grid. Sometimes the systems 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) startup delays[11].

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

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

- There is a lack of awareness of the multiple benefits of decentralized energy and therefore, the considerable potential to develop micro power plants in the south of the country remains to be exploited. According to several studies, Chile has considerable electric power generation potential in small-hydraulic, wind and biomass renewable sources.
- Regulations for the electric sector are mostly oriented around centralized large-scale and conventional power generation.
- Relatively low price for electricity (node price) does not make the development of non-conventional energy sources economically feasible.
- Unlike some European countries who favor this type of power generation technology, there are no national objectives or tax incentives for cogeneration or renewable energy promotion policies in Chile. The current initiatives that have been implemented to give non-conventional renewable power generation a more favorable treatment, still do not reflect all the positive externalities related to these type of technologies, and therefore do not make them financially attractive.

3.2. Barriers that do not prevent a wide spread implementation of at least one baseline scenario alternative

It can be easily shown that none of the barriers mentioned above would prevent the wide implementation of most of the 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 Nueva Aldea Phase 1 project activity would have used a conventional (business as usual) plant configuration, the sawmill and ply wood mill would have sourced their thermal requirements with low-pressure steam, and their electric power needs through the SIC grid. Therefore, there would have been no additional operational risks and the project risk would have not differed from that of the conventional mills in the corresponding industries.

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[11] Given that it 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.

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

Investment barriers would not prevent other conventional baseline case scenarios either, such as to generate electric power through fossil-fuel power units or to use fossil fuels in biomass power boilers for additional steam generation. As was mentioned before, these solutions have actually been implemented by Arauco in other projects.

Technological barriers: The same argument mentioned above applies in this case, since in a conventional sawmill / plywood mill, there are no additional and / or different risks 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 the conventional power generation alternatives presented in Step 1 constitute 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 sawmill and plywood industry that would prevent the utilization of alternative fossil fuel power units for electric or thermal power generation other than the ones that could be found in the corresponding industries.

Barriers to entry to the electric power industry: Given that the proposed baseline scenario would not contemplate 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 technology, they would be less restrictive.

Most of the barriers and low incentives for renewable energy sources presented in this section have been addressed by the OECD Environmental Performance Review study for Chile, published early in 2005[13].

Given that the identified barriers do compromise the viability of the proposed project activity and do not affect in any particular way the baseline case scenario, the proposed project activity presents a clear case for additionality from a barrier perspective analysis.

Step 4: Common practice analysis,

[13] Please see pages 19, 59, 63 and 65.

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 of becoming a 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 Nueva Aldea Phase 1 proposed project activity is the Arauco mill. Nevertheless, as will be shown, there are clear distinctions that make the proposed project activity different from the Arauco mill cogeneration initiative.

The Arauco mill: The Arauco pulp mill facility has three biomass power boilers (only one is high pressure, 60 bar) which are primarily used to supplement the thermal and electric power to the pulp mill (2 pulp lines). The mill has a maximum steam surplus of 70 tvap/hr at 60 bar (summer), which is used to generate additional electric power (10MW average) and middle pressure steam to some local customers nearby the mill. Despite the concept is similar to the one used by the proposed project activity, the following differences can be noted:

- The scale of the additional power generation capacity is considerable smaller compared to the one of the proposed project activity. In fact, the Arauco mill configuration (power boilers, turbogenerators, etc.) was not designed to be a net power exporter to the SIC.

- The power boiler design parameters are not optimized to obtain maximum power from the existing turbogenerators (i.e. lower steam pressure). During winter the maximum high pressure steam surplus lowers to 40 tvap/hr, so to maintain the surplus high pressure steam generation capacity, the biomass fuels are supplemented with considerable amounts of fossil fuels (natural gas or diesel). This also translates into some penalties for the pulp mill process (i.e. not enough steam for the recovery boiler soot blowing, lower efficiency of steam usage, etc.).

- The biomass cogeneration unit is integrated to a pulp mill facility instead of a sawmill or plywood mill facility. Pulp mills normally use higher pressure steam in their processes than sawmill and plywood mills. High pressure steam can be more easily managed in pulp mills than in sawmills or plywood mills.

Other Arauco cogeneration initiatives are even smaller in scale, correspond to a different context and therefore are not comparable with the proposed project activity.

4.1.2 Other company's initiatives:

A relevant competitor in the pulp industry in Chile is currently installing a biomass (bark) power boiler (150 tvap/hr at 60 bar) inside one of its pulp mills. 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 power generation capacity inside the pulp mill to make it (and other company's interconnected pulp mills in the region) self-sufficient in electric power generation.

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.

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 Nueva Aldea Power Plant Phase 1 (i.e. <50 tvap/hr, saturated or near saturated steam at 45 bar, <10 MW, etc.).

As was said in the Step 3, the Nueva Aldea Power Plant Phase 1 is probably the only big-scale biomass cogeneration initiative that is integrated to sawmill and plywood mill in Chile. The most relevant features that distinguish this biomass cogeneration power plant from other initiatives are:

- The scale of the biomass cogeneration facility: 210 tvap/hr (process and turbogenerator) and 30 MW of electric power output.

- Design parameters of the power boiler: super heated steam at 85 bar and 485ºC, which have been chosen exclusively to maximize electric power generation at the facility. The Nueva Aldea Power Plant Phase 1 has been designed to generate surplus power to the grid.

- The context in which the power plant is built. As was previously mentioned, the electric power needs of the Nueva Aldea Phase 1 (approximately 15 MW) would have been more than served by the power surplus generated by the Nueva Aldea Phase 2 (pulp mill) project. This clearly makes the entire cogeneration initiative in Phase 1 redundant.

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 in:

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

		2000	2001	2002	2003	2004
Total power generation (Chile)	(GWh)	39,586	41,286	42,353	45,239	48,871
Biomass power generation in Chile	(GWh)	612	387	374	429	649
Biomass / total generation in Chile	(%)	1.5%	0.9%	0.9%	0.9%	1.3%
Nº of biomass power plants (SIC and in Chile)	(Number)	4	4	4	5	7
Total Number of power plants in the SIC	(Number)	53	50	52	53	63

Source: CDEC-SIC Annual Reports and INE 2003 Energy Annual Report.
Note: Biomass power generation include all type of biomass. 2003 and 2004 include 2 Arauco CDM biomass cogeneration project activities.

From the table above, it is possible to see the low participation of biomass in the total electric power generation in Chile. To reinforce this argument, the last node price report issued by the CNE considered renewable energy sources in new power plants developments for the next 10 years. The proposed plan considered geothermal and new run of the river generating units, but no new biomass capacity whatsoever. This clearly shows that biomass cogeneration capacity is not the common practice in the

electric power generation sector in Chile. Unlike developed countries in northern Europe, there is no National Plan in Chile to promote the use of biomass power plants.

Sawmill industry: In 1998, the sawmill industry in Chile consisted in 1,545 sawmills:

CLASIFICATION	PRODUCTION RANGE (m^3/yr)	Nº OF SAWMILLS
Very big scale	> 50,000	17
Big scale	20,001 to 50,000	22
Middle scale	10,001 to 20,000	31
Small scale	5,001 to 10,000	42
Very small scale	< or = 5,000	922
Paralyzed		511
TOTAL		**1,545**

Source: INFOR, Statistical Bulletin Nº70.

According to a CONAMA study for the sawmill industry in Chile[14], the typical process flow chart of a well-established sawmill includes an artificial drying stage of the sawn timber. It must be mentioned that this stage is applied to only 35.7% of the total sawn timber produced in Chile. In addition, only the "Very big scale" sawmills are capable of implementing this process, and they do it only in 42.9% of their total output Artificial drying is accomplished using two techniques. The first one uses traditional drying chambers in which the wood is dried at approximately 70ºC and ambient pressure. The energy required to heat the chamber is normally generated by a saturated steam boiler fueled by the wood residues from the same saw-milling process. The other option consists in vacuum drying, in which the wood is dried in a vacuum chamber at ambient temperature. This system is more efficient than the previous one, but implies the consumption of electric power supplied from the grid. On-site electric power generation from biomass sources is not considered (even hardly mentioned) as normal practice in this industry.

Plywood mill industry: The production process requires heat and pressure for the pressing, bonding and drying the wood layers that conform the plywood board. Since the process requires sawn timber (layers) as an input, it is usual to find plywood mills integrated with sawmills. As in the previous case, no high pressure steam is required in the manufacturing process, so the generation of electric power does not constitute a common practice in this industry either. In fact, there are no examples of biomass cogeneration facilities integrated with a plywood mill facility of any scale in Chile.

Other comparable industries: MDF panel board industry: Like Sawmills and Plywood mills, MDF mills also require low pressure steam for its processes. MDF panel board mills are not designed to operate with high pressure steam, so on-site power generation is not considered a normal practice either. In Chile there is only one cogeneration initiative comparable to the proposed project activity: the Trupan Cogeneration Power Plant, owned by Paneles Arauco. This initiative has also been implemented as a CDM project activity.

[14] "Guía para el control y prevención de la contaminación industrial, Rubro Aserraderos y Procesos de la Madera", CONAMA, December 2000.

Other related industries: Pulp mills: Though cogeneration is widely used in the pulp mill 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 power boiler to supplement internal 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 be a net electric power exporter to the grid to which it is connected. Currently there are examples of both old and new (under construction) pulp mills in Chile that still have to import electric power from the grid.

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

- The Nueva Aldea Power Plant Phase 1 cogeneration project is one of the first of its type in Chile (and one of very few –if any- in the world).

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

- Similar initiatives in other related industries (pulp mill industry) are observed, however there are sufficient differences between the industries and the context under which the cogeneration initiatives are implemented that make them non comparable.

For these reasons, the Nueva Aldea Power Plant Phase 1 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.

Step 5: Impact of CDM Registration

The approval and registration of the Nueva Aldea Power Plant Phase 1 as a CDM activity will report significant benefits to the Nueva Aldea Industrial Complex. 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 any other company in Chile that decides to follow Arauco’s lead in biomass cogeneration in the future.

There are multiple benefits and incentives derived from having this project approved by the CDM Executive Board:

- 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 most importantly in the international context. This point is extremely sensitive to Arauco, given that approximately 85% 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 a project by the CDM would acknowledge the effort Arauco is doing 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 MMUS$ 15 to MMUS$ 20 (depending on the project context), which is significant. The barriers that must be overcome to implement such project are not minor either and in the long run would translate into a higher operational exposure and ultimately into additional costs. The revenue that would come from the sale of the CERs would contribute to mitigate these extra costs and make CDM projects more attractive not only for Arauco, but also for companies that could benefit from 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 early 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. As was mentioned in a previous section of this PDD, the investment in new power units has been low in the last 5 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 (not yet dimensioned) geothermal resources in the central and south part of the country, which have not been exploited at all. From this perspective, the CDM registration of Nueva Aldea Power Plant Phase 1 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 (40% 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.

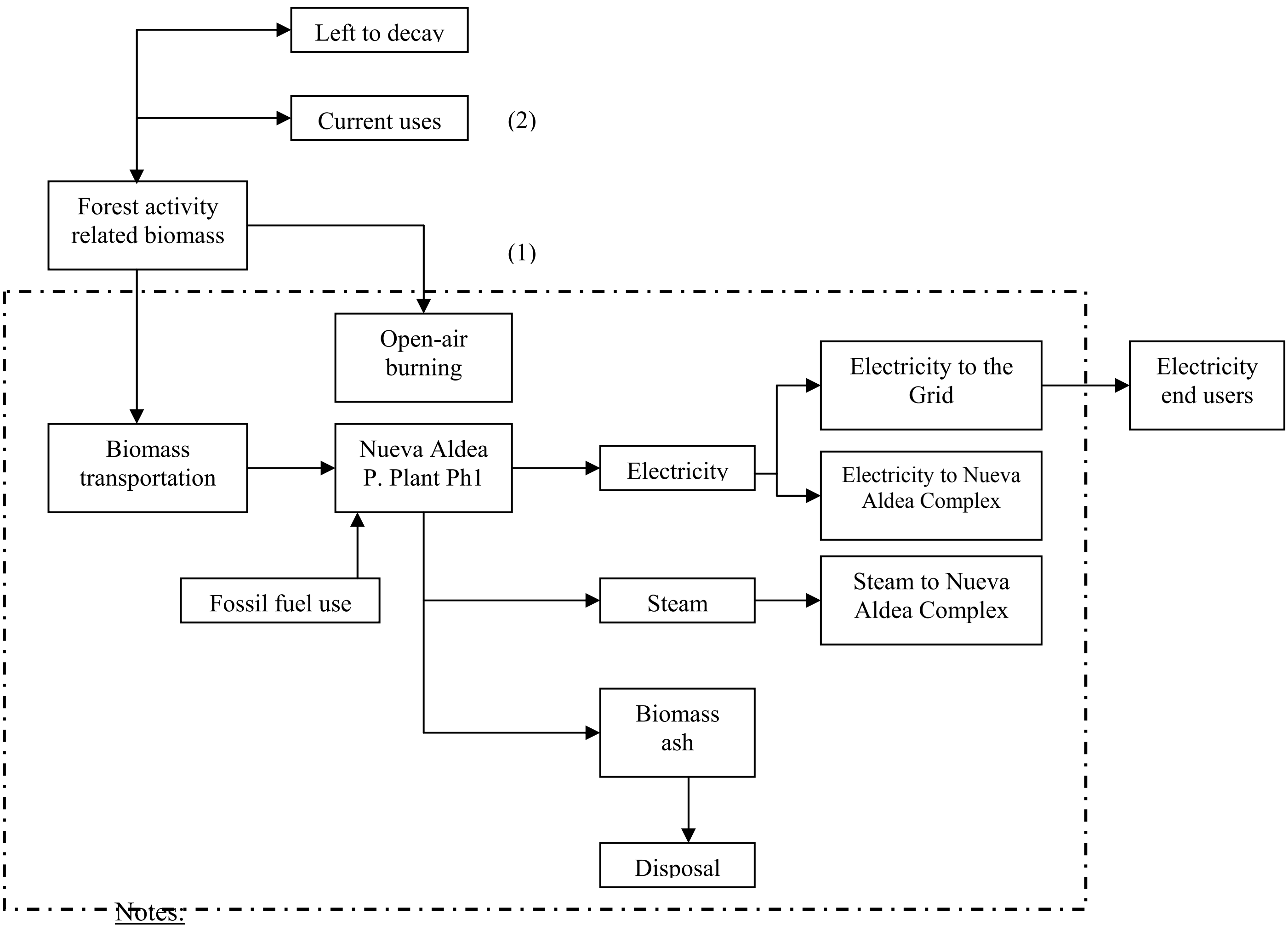
B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The definition of the project boundary related to the baseline methodology is applied to the project activity in the following way:

<u>Baseline energy grid:</u> For the Nueva Aldea Power Plant Phase 1, the SIC grid system in Chile is considered as a boundary, since it is the system to which the new power plant is connected and therefore the one that receives all the biomass-based produced electricity.

<u>Biomass cogeneration plant:</u> The Nueva Aldea Power Plant Phase 1 located in the Nueva Aldea Industrial Complex site is considered as boundary, since it comprises the whole site where the cogeneration facility is located.

For more clarity, the following picture represents the project boundary of the project activity:



<u>Notes:</u>

(1) The dotted lines indicate the Project's boundaries.
(2) For the reasons mentioned in Section E.2, this item is viewed as outside the Project boundaries.

Direct on-site emissions for the project activity are:

- CH_4 emissions from controlled combustion of additional biomass in the power boiler.
- CO_2 emissions from the combustion of additional supplementary fossil fuel in the power boiler.

- CO_2 emissions from additional fossil fuel consumption from on-site biomass transportation to the power plant.

Direct off-site emissions for the project activity are:

- CO_2 emissions from additional fossil fuel consumption from off-site biomass transportation to the Nueva Aldea Industrial Complex.

No significant source of indirect on or off-site emissions associated with the Project was identified.

The project boundary encompasses the following emission sources to account for the displacement of baseline emissions by the project activity:

- Open-air burning of biomass.
- Grid electricity generation.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

B.5.1 Date of baseline completion:

24/10/2005.

B.5.2 Name of person / entity determining the baseline:

As stated before, Arauco is the project participant responsible for the technical services related to GHG emission reductions, and is therefore, the entity that determined the baseline.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

29/09/2003.

C.1.2. Expected operational lifetime of the project activity:

Minimum of 25 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/01/2005.

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

C.2.1.2. Length of the first crediting period:

Seven (7) years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not chosen.

C.2.2.2. Length:

Not chosen.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

The monitoring methodology applied for this project activity corresponds to the one of the approved baseline methodology for biomass cogeneration plants ACM0006. The name of the applied monitoring methodology is:

"Consolidated monitoring methodology for grid-connected electricity generation from biomass residues"

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The monitoring methodology, as well as the baseline methodology used for this project activity was originally developed by Arauco for the Trupan Power Plant project activity. The methodology was then consolidated by the Meth Panel into a broader and more flexible methodology, which is now presented as the methodology applied for the proposed project activity.

The chosen monitoring methodology involves, where possible, direct measurements of the variables required to monitor baseline and project emissions. Commercial data is collected and saved for the purpose of verifying the measured data. Where direct measurements are not possible, commercial data is used as the primary data, with an appropriate quality control measure.

The methodology is straightforward and accurate in its approach. By obtaining actual data pertinent to the project activity and by ensuring an appropriate quality control measure for every piece of data collected, it allows for the most accurate calculation of GHG emission reductions associated with the project activity. Where the collection of the relevant data is possible, as is the case for this Project, this approach is the most appropriate.

All data collected as part of the monitoring (baseline, project and leakage emissions), will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number.	Data variable.	Source of data.	Data unit.	Measured (m), calculated (c) or estimated (e).	Recording Frequency.	Proportion of data to be monitored.	How will the data be archived? (electronic/ paper).	Comment.
1. $BF_{i,y}$	Quantity of biomass of type i combusted in the project plant.	Power Plant's procurement department.	m^3 st or BDT (bone-dry ton or dry ton).	Measured and calculated.	Continuously.	100%	Electronic.	The quantity of biomass combusted will be collected separately for each type of biomass. Data will be archived 2 years following the end of the crediting period.
2. NCVi	Net calorific value of biomass fuel type i.	Power Plant's procurement department.	GJ/mass or volume	Measured or calculated.	Annually.	100%	Electronic.	Net calorific value will be determined separately for all types of biomass. Net calorific values will be based on measurements or reliable local or national data. Data will be archived 2 years following the end of the crediting period.
3. EF_{CH4}	Methane emission factor for combustion of biomass in the project plant.	Project site or IPCC manual.	Kg CH_4/TJ	Calculated.	Annually.	100%	Electronic.	Methane emission factor will be measured at the project site or obtained from the last version of the IPCC manual. Data will be archived 2 years following the end of the crediting period.
4. AVD_y	Average	Power Plant's	km	Measured.	Continuously.	100%	Electronic.	Distances traveled by trucks will be continuously

	return trip distance between biomass fuel supply sites and the project site..	procurement department.						monitored and recorded. If biomass is supplied from different sites, determined as the mean value of km traveled by trucks that supply the biomass plant. Data will be archived 2 years following the end of the crediting period.
5. TL_y	Average truck load of the trucks used for transportation of biomass.	Power Plant's procurement department.	m^3 st or BDT	Measured.	Regularly.	100%	Electronic.	This parameter will be monitored regularly by the chief operator of the Power Plant. Data will be archived 2 years following the end of the crediting period.
6. $EF_{km,CO2}$	Average CO_2 emission factor for transportation of biomass with trucks.	Project site or IPCC manual.	tCO_2/km	Measured or calculated.	Annually.	100%	Electronic.	The project proponent will calculate this parameter from local truck subcontractors information. If not possible, default values from the IPCC will be used. Data will be archived 2 years following the end of the crediting period.
7. $COEF_{CO2,i}$	Emission factors.	Power Plant's procurement department and IPCC manual.	tCO_2/mass or volume	Measured or calculated.	Annually.	100%	Electronic.	These emission factors will be applied to fuel consumption for transportation and on-site fuel consumption. Measurements or local / national data will be used if possible and available. Otherwise, default IPCC values will be used. Data will be archived 2 years following the end of the crediting period.
8. OF_y	On-site use of transport fuel.	Power Plant's procurement	kg	Measured.	Continuously.	100%	Electronic.	On-site fossil fuel consumption will be continuously monitored and recorded. The data

		department.						will be checked with purchase receipts. Data will be archived 2 years following the end of the crediting period.
9. FF_y	Fossil fuel used in Power Boiler.	Power Plant's procurement department.	kg	Measured and calculated.	Continuously.	100%	Electronic.	Any type of fossil fuel consumption in the Power Plant will be continuously monitored and recorded. The data will be checked with purchase receipts. Data will be archived 2 years following the end of the crediting period.

Note: For simplicity, total quantities of biomass and fossil fuels will be monitored at the project site, however, only additional quantities of biomass and fossil fuels will be used to calculate baseline and project emissions. For a description on how the additional biomass and fossil fuel consumption will be determined, please see description below and Annex 3 of this PDD.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The anthropogenic emissions by sources of GHGs of the project activity in year y ($EM_{P,y}$) can be determined as follows:

$$EM_{P,y} = P_{E1,y} + P_{E2,y} + P_{E3,y} + P_{E4,y}$$

Where:

$EM_{P,y}$: Total project activity emissions (tCO_2eq/yr).
$P_{E1,y}$: Project emissions from biomass controlled burning in the Power Plant (tCO_2eq/yr).
$P_{E2,y}$: Project emissions from biomass transportation to the biomass Power Plant (tCO_2/yr).
$P_{E3,y}$: Project emissions from biomass transportation within the Power Plant site (tCO_2/yr).
$P_{E4,y}$: Project emissions from fossil fuel consumption in the Plant's power boiler (tCO_2/yr).

D.2.1.2.1 Emissions from biomass controlled burning in the Power Plant's power boiler:

Consistent with IPCC Guidelines[15], CO_2 emission from biomass combustion at the Nueva Aldea Power Plant Phase 1, being the release of the CO_2 absorbed on a sustainable basis by forest that is replanted every year (forest companies replant the surfaces they harvest[16]). The same treatment is not extended to methane emissions. When biomass is combusted in a well-controlled environment at the Nueva Aldea Power Plant Phase 1, methane emissions are small in quantity but still not zero.

$$P_{E1,y} = GWP_{CH4} \cdot EF_{Biomass,CH4} \cdot \sum_i BF_{i,y} \cdot NCV_{Biomass,i}$$

Where:

P_{E1} : Project emissions from biomass controlled burning (tCO_2eq/yr).
GWP_{CH4} : Global Warming Potential of methane (21 tCO_2eq/tCH_4).
$EF_{Biomass,CH4}$: Biomass methane emission factor (tCH_4/TJ).
$BF_{i,y}$: Biomass of type i used by the project activity (BDT/yr).
$NCV_{Biomass,i}$: Net calorific value of biomass of type i (TJ/BDT).

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[15] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, p.6.1 Please also see Revised 1996 IPCC Guidelines for National Greenhouse Inventories, Workbook and IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, P.5.5

[16] Chilean Law D.L. 701 obliges forest companies to reforest the areas that have been harvested, unless the area is not suitable for forest activity. Such cases constitute less than 1% of cases.

D.2.1.2.2 Emissions from biomass transportation to the Power Plant:

Transporting biomass from the suppliers to the Nueva Aldea Power Plant Phase 1 is normally done by trucks, which result in direct off-site GHG emissions. The emissions related to biomass transportation to the Power Plant in year *y* can be calculated as follows:

$$P_{E2,y} = \frac{\sum_i BFw_{i,y}}{TL_y} * AVD_y * EF_{km,CO2}$$

Where:

$P_{E2,y}$: Project emissions from biomass transportation to the biomass Power Plant (tCO_2/yr).
$BFw_{i,y}$: Biomass of type *i* (wet) used by the project activity (wet ton/yr).
TL_y : Truck average biomass transportation capacity (ton).
AVD_y : Average distance from biomass suppliers to the Power Plant (km).
$EF_{km,CO2}$: CO_2 emission factor for the transportation fuel (tCO_2/km).

D.2.1.2.3 Emissions from biomass transportation within the Nueva Aldea Power Plant Phase 1 site:

Within the Nueva Aldea site, diesel-fuelled dump trucks and bulldozers will transport the biomass to the power boiler area. As in the previous case, such transportation also generates project-related GHG emissions, which for year *y* can be estimated as follows:

$$P_{E3,y} = \sum_i OF_{i,y} \cdot COEF_{CO2,i}$$

Where:

$P_{E3,y}$: Project emissions from biomass transportation within the Power Plant site (tCO_2/yr).
$OF_{i,y}$: Fossil fuel of type *i* used for on-site transportation of biomass (kg/yr).
$COEF_{CO2,i}$: CO_2 emission factor for the transportation fuel of type *i* (tCO_2/kg).

D.2.1.2.4 Emissions from fossil fuel consumption in the Power Plant's power boiler:

Having a larger power boiler, with higher biomass combustion capacity and higher steam pressure generation capacity than the baseline case boiler implies a higher consumption of fossil fuel for start-ups and for maintaining the power boiler temperature, especially in winter time, when the biomass has a

higher humidity. This additional consumption of fossil fuels in the power boiler generates GHG emissions, which for a year *y* can be estimated as follows:

$$P_{E4,y} = \sum_i FF_{i,y} \cdot COEF_{CO2,i}$$

Where:

$P_{E4,y}$: Project emissions from fossil fuel consumption in the Plant's power boiler (tCO_2/yr).
$FF_{i,y}$: Fossil fuel of type *i* used in the power boiler related to the project activity (kg/yr).
$COEF_{CO2,i}$: CO_2 emission factor for the fossil fuel of type *i* used in the power boiler (tCO_2/kg).

For the Nueva Aldea Power Plant Phase 1 project activity, the following considerations must be taken:

- According to the chosen baseline methodology, the project proponent will monitor the consumption and net calorific values of each type of biomass consumed in the power plant. However, given that the amounts of each type of biomass remain constant in time (homogeneous biomass mix); this PDD will consider the biomass mix and the corresponding weighted average net calorific value for emission reduction calculations.

- As previously mentioned in D.2.1.1, only the additional quantities of biomass and fossil fuels will be considered to calculate the baseline and project emissions. The additional biomass is the biomass that is related to the implementation of the CDM project activity. It will be calculated using the following rationale:

  From the energy / mass balances of the baseline and the real power plant configuration (see section A.4.3 of this PDD) it is possible to obtain the biomass flows and the electric power generation for both cases. Since the only difference between the two project alternatives is the generation of electric power, it is reasonable to assume that the higher consumption of biomass of the CDM power plant is exclusively due to its electric power generation capacity[17]. With this in mind and using the data from the energy / mass balances in the two project scenarios, it is possible to calculate a coefficient that relates the electric power generating capacity (steady-state operation) and the additional biomass per time unit that is consumed by the power plant with electric power generation capacity. This coefficient will be fixed for the whole crediting period of the project activity[18]. With this coefficient and assuming a relation of direct proportionality between the power generated by the power plant and the amount of additional biomass consumed by the power plant per time unit, it is possible to calculate the amount of additional biomass based on the gross electric power generated by the power plant in a certain period of time. Given that the energy of the power plant is a variable which will be permanently monitored by the project proponent, the additional biomass calculation will always be based on directly monitored and reliable data.

[17] This is also because the steam requirements of the Nueva Aldea Phase 1 mills would have been the same with or without CDM project activity.

[18] This is conservative, since it assumes new equipment efficiencies and a high steady-state plant factor during the whole duration period of the project activity. Lower efficiencies and plant factors would lead to higher consumption rates of biomass, which would translate into higher net methane emissions from biomass uncontrolled burning.

The calculation of the additional biomass allows to calculate the biomass that would have been used under the baseline scenario since it would just be the difference between the total biomass consumption monitored of the real power plant and the additional biomass consumption calculated.

With the calculation of the additional biomass, that is, the biomass related to electric power generation, it is then possible to calculate the additional amount of fossil fuel that is related to the electric power generation and therefore to the CDM project activity. This is done by also assuming a relation of direct proportionality between the amount of biomass consumption in the power boiler and the fossil fuel consumption in the power plant used for biomass transportation and co-firing in the power boiler. The assumption of direct proportionality between the fossil fuel and the biomass consumption in a power boiler was successfully contrasted with real figures in other different-sized Arauco power boilers, and therefore considered appropriate to estimate the amount of fossil fuel associated to the CDM project activity.

The additional biomass and fossil fuel consumption is then used to calculate the baseline and project emissions of the Nueva Aldea Phase 1 CDM project activity.

A step-by-step approach on how to calculate the additional biomass is presented in Annex 3 of this PDD, as well as the actual calculation of the additional biomass for the first three years of operation of the Nueva Aldea Phase 1 Power Plant.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number.	Data variable.	Source of data.	Data unit.	Measured (m), calculated (c), estimated (e).	Recording Frequency.	Proportion of data to be monitored.	How will the data be archived? (electronic/ paper).	Comment.
10. EG_y (EG_h if dispatch data OM is used)	Net quantity of electricity displaced by the project activity from the grid.	Project proponent (Power plant meters).	MWh	Measured.	Continuously.	100%	Electronic.	EG_y is the net electricity generated by the project activity displaced from the grid. This variable will be checked with the injection to the grid and the internal electric power consumption of the Industrial Complex. These variables will be also monitored and backed with commercial invoices whenever possible. Data will be archived 2 years following the end of the crediting period.
11. EF_y	CO_2 emission factor of the grid.	Relevant dispatch center, electric power companies' public information, host country government official information and IPCC values.	tCO_2/MWh	Calculated.	Yearly.	100%	Electronic.	Calculated as a weighted sum of the OM and BM emission factors. Data will be archived 2 years following the end of the crediting period.

12. $EF_{OM,y}$	CO_2 Operating Margin emission factor of the grid.	Relevant dispatch center, electric power companies' public information, host country government official information and IPCC values.	tCO_2/MWh	Calculated.	Yearly.	100%	Electronic.	Calculated as indicated in the chosen baseline methodology. Data will be archived 2 years following the end of the crediting period.
13. $EF_{BM,y}$	CO_2 Build Margin emission factor of the grid.	Relevant dispatch center, electric power companies' public information, host country government official information and IPCC values.	tCO_2/MWh	Calculated.	Yearly.	100%	Electronic.	Calculated as indicated in the chosen baseline methodology. Data will be archived 2 years following the end of the crediting period.
14. $F_{i,y}$	Amount of each fossil fuel consumed by each power source / plant.	Relevant dispatch center, electric power companies' public information and host country official information.	Mass or volume.	Measured.	Yearly.	100%	Electronic.	This information will not be directly measured. It will be obtained from the relevant dispatch center, electric power companies or the latest official statistics publicly available. Data will be archived 2 years following the end of the crediting period.
15. $COEF_i$	CO_2 emission coefficient of each fuel type i consumed by the electric power generators in the relevant grid.	Relevant dispatch center, electric power companies' public information and host country official information.	tCO_2/ (mass or volume unit).	Measured or calculated.	Yearly.	100%	Electronic.	Plant or country-specific values to calculate $COEF_i$ are preferred to IPCC default values. Data will be archived 2 years following the end of the crediting period.

16. $GEN_{j/k/n,y}$	Electricity generation of each power source / plant j/k or n.	Relevant dispatch center, electric power companies' public information and host country official information.	MWh/yr	Measured.	Yearly.	100%	Electronic.	This information will not be directly measured. It will be obtained from the relevant dispatch center, electric power companies or the latest official statistics publicly available. Data will be archived 2 years following the end of the crediting period.
17.	Identification of power source / plant for the OM calculation.	Relevant dispatch center, electric power companies' public information and host country official information.	Text.	Estimated.	Yearly.	100% of set of plants.	Electronic.	Identification of plants (j, k, or n) to calculate the Operating Margin emission factors. Data will be archived 2 years following the end of the crediting period.
18.	Identification of power source / plant for the BM calculation.	Relevant dispatch center, electric power companies' public information and host country official information.	Text.	Estimated.	Yearly.	100% of set of plants.	Electronic.	Identification of plants (m) to calculate the Build Margin emission factors. Data will be archived 2 years following the end of the crediting period.
19. λ_y	Fraction of time during which low-cost / must-run sources are on the margin.	Relevant dispatch center, electric power companies' public information and host country official information.	Number.	Calculated.	Yearly.	100%	Electronic.	Factor accounting for number of hours per year during which low-cost / must-run sources are on the margin. Data will be archived 2 years following the end of the crediting period.

20.a $GEN_{j/k/ll,y}$ IMPORTS	Electricity imports to the project electricity system.	Relevant dispatch center and host country official information.	KWh	Calculated.	Yearly.	100%	Electronic.	Obtained from the latest local statistics. If local statistics are not available, IEA statistics are used to determine imports. If there are no imports in the relevant system, the monitoring of this variable does not apply. Data will be archived 2 years following the end of the crediting period.
20.b $COEF_{i,jy}$ IMPORTS	CO_2 emission coefficient of fuels used in connected electricity systems (if imports occur).	Relevant dispatch center, electric power companies' public information and host country official information.	tCO_2/ (mass or volume unit).	Calculated.	Yearly.	100%	Electronic.	Obtained from the latest local statistics. If local statistics are not available, IPCC default values are used to calculate the coefficients. If there are no imports in the relevant system, the monitoring of this variable does not apply. Data will be archived 2 years following the end of the crediting period.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Since the baseline scenario is that the current practice continues, i.e., the biomass is disposed and not utilized to generate electric power, emission reductions result from the avoidance of biomass open-air burning and the displacement of electric power generated with fossil fuels. According to this, the baseline emissions for year *y* can be calculated according to the following formula:

$$BL_{E,y} = BL_{E1,y} + BL_{E2,y}$$

Where:

$BL_{E,y}$: Total baseline emissions (tCO_2eq/yr).
$BL_{E1,y}$: Baseline emissions from avoided biomass disposal (tCO_2eq/yr).
$BL_{E2,y}$: Baseline emissions from grid electricity displacement (tCO_2/yr).

D.2.1.4.1 Baseline emissions from avoided biomass disposal:

The emissions from avoided biomass disposal are calculated assuming a conservative baseline scenario; that is, that the biomass is burned in the open-air. According to this, the emissions from avoided biomass disposal used by the project activity in year *y* can be calculated as:

$$BL_{E1,y} = GWP_{CH4} \cdot \sum_i BF_{i,y} \cdot NCV_{Biomass,i} \cdot EF_{burning,CH4,i}$$

Where:

$BL_{E1,y}$: Emissions from avoided biomass disposal (tCO_2eq/yr).
GWP_{CH4} : Global Warming Potential of methane (21 tCO_2eq/tCH_4).
$BF_{i,y}$: Biomass of type *i* used by the project activity (BDT/yr).
$NCVi$: Net calorific value of biomass fuel type i (GJ/mass or volume, BDT).
$EF_{CH4burning,i}$: CH_4 emission factor for uncontrolled burning of biomass type i (tCH_4/TJ).

Consistent with D.2.1.2 , only the additional biomass related to the project activity will be considered for estimating baseline emissions due to avoided biomass disposal and therefore, susceptible for being credited with CERs. Also, the biomass mix and the corresponding weighed average net calorific value will be used to calculate these baseline emissions.

D.2.1.4.2 Baseline emissions from grid-electricity displacement:

Emission reductions from grid-electricity displacement are achieved through the displacement of electricity generated by the power plants connected to the relevant grid system. The formulae presented here are taken directly from the Consolidated baseline methodology for grid-connected electricity generation from biomass residues, therefore only the basic formulae and algorithms are presented here.

The emission factor for the displaced energy, ($EF_{electricity,y}$), is calculated as a function of the build margin ($EF_{BM,y}$) and the operating margin ($EF_{OM,y}$) emission factor of the corresponding grid system:

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

For the purpose of determining the build margin (BM) and operating margin (OM) emission factors, as described below, a (regional) **project electricity system** is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly, a **connected electricity system**, e.g. national or international, is defined as a (regional) electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

The details for calculating the Operating and Build margins ($EF_{OM,y}$, $EF_{BM,y}$) can be found in the baseline methodology chosen for the proposed project activity.

Calculation of baseline emissions due to displacement of electricity

Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{electricity,y}$) with the net electricity generation of the project activity.

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

Where:

$BE_{electricity,y}$: Baseline emissions due to displacement of electricity during the year y (tCO_2/yr).
$EF_{electricity,y}$: CO_2 baseline emission factor for the electricity displaced due to the project activity in during the year y (tCO_2/MWh).
EG_y: Net quantity of electricity generated in the power plant during the year y (MWh/yr).

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

This option was not chosen.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

This option was not chosen.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
21	Amount of biomass of type i fired in all grid-connected power plants in the region / country.	Host country official data (Dispatch center, statistics, relevant industry official publications, etc.).	BDT or other mass / volume unit.	Measured (obtained from dispatch center official data).	Annually.	100%	Electronic.	This information will be obtained from official information. If it is not available, the data will be calculated or estimated using official information. Data will be archived 2 years following the end of the crediting period.
22	Quantity of biomass of type i that is available in surplus in the region / country.	Host country official data (Dispatch center, statistics, relevant industry official publications, etc.).	BDT or other mass / volume unit.	Measured (obtained from official data).	Yearly.	100%	Electronic.	This information will be obtained from official information. If it is not available, the data will be calculated or estimated using official information. The quantity of surplus supply is the difference between available biomass and biomass used for other purposes than grid-connected electricity generation. Data will be archived 2 years following the end of the crediting period.

Note: As stated in the chosen baseline and monitoring methodology for the proposed project activity, leakage emissions will be calculated and deducted only if the Nueva Aldea Phase 1 project activity causes other biomass-fuel consumers change to fossil fuels because of insufficient biomass supply. To do so, a "biomass surplus index" indicator will be annually calculated and monitored. If the indicator shows enough quantity of biomass available, leakage will be assumed to be

zero. Other leakage emissions are not apparent from the project activity, since all detectable GHG emission sources have been included inside the project activity boundary, and are therefore, considered as project emissions. These are duly monitored and accounted for in the net emission saving calculation of the Nueva Aldea Phase 1 project activity.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The main source of potential leakage is that the project diverts biomass from other users and thereby increases fossil fuel use in the surrounding area. According to the baseline methodology applied to this project activity, there are two alternatives to estimate leakage emissions:

Alternative A: Demonstrate that the biomass consumption of the power plant will not result in increased fossil fuel consumption elsewhere. To do so, the baseline methodology presents three options:

1. Show that biomass is not used at all, but burned or left for decay and that this situation would continue without the implementation of the project activity.
2. Show that there is a considerable surplus of biomass in the area, which is not utilized.
3. Show that biomass suppliers in the area are not able to sell all their biomass in the project area.

If the project proponent can prove the abundance of biomass through any of these options, leakage is assumed to be zero.

$L_y = 0$

It will be shown in subsequent sections of this PDD, that the Nueva Aldea Phase 1 project activity does not increase the consumption of fossil fuels due to the diversion of biomass from other users in the power plant area and therefore, leakage can be assumed to be zero.

Alternative B: If the project proponent is not able to demonstrate that the biomass consumption of the power plant will not result in increased fossil fuel consumption elsewhere, then leakage must be monitored and deducted from the net project emissions. Leakage effects in year *y* are given by:

$$L_y = COEF_{CO2,j} \cdot \sum_i BN_i \cdot NCV_i - \frac{Q_y}{\varepsilon_{boiler}}$$

Where:

L_y : Leakage emissions during the year *y* (tCO_2eq/yr).
$COEF_{CO2,j}$: CO_2 emission coefficient of the most carbon intensive fuel used in the country (tCO_2/TJ).
BN_i : Quantity of biomass type *i* that cannot be ruled out as a source of leakage (volume or mass unit).
NCV_i : Net calorific value of the biomass type *i* (GJ/volume or mass units).
Q_y : Is the net quantity of heat generated in the cogeneration project plant during the year *y* in GJ.
ε_{boiler} : Is the energy efficiency of the boiler that would be used in the absence of the project activity.

Leakage emissions are calculated for each type of biomass. For further details, please refer to the leakage section of the Consolidated baseline methodology for grid-connected electricity generation from biomass residues, applied to this project activity.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

From the equations in sections D.2.1.2, D.2.1.4 and D.2.3.2, the total net emission reductions from the project activity during a given year *y* can be calculated as follows:

Project Activity Net Emission savings = Baseline Emissions – Project Activity Emissions – Leakage

or

$$PNE_y = BL_{E,y} - EM_{P,y} - L_y$$

or

$$PNE_y = (BL_{E1,y} + BL_{E2,y}) - (P_{E1,y} + P_{E2,y} + P_{E3,y} + P_{E4,y}) - L_y$$

Where:

$BL_{E1,y}$: Baseline emissions from avoided biomass disposal (tCO_2eq/yr).
$BL_{E2,y}$: Baseline emissions from grid electricity displacement (tCO_2/yr).

$P_{E1,y}$: Project emissions from biomass controlled burning in the Power Plant (tCO_2eq/yr).
$P_{E2,y}$: Project emissions from biomass transportation to the biomass Power Plant (tCO_2/yr).
$P_{E3,y}$: Project emissions from biomass transportation within the Power Plant site (tCO_2/yr).
$P_{E4,y}$: Project emissions from fossil fuel consumption in the Power Plant (tCO_2/yr).

L_y : Are the leakage emissions (tCO_2/yr).

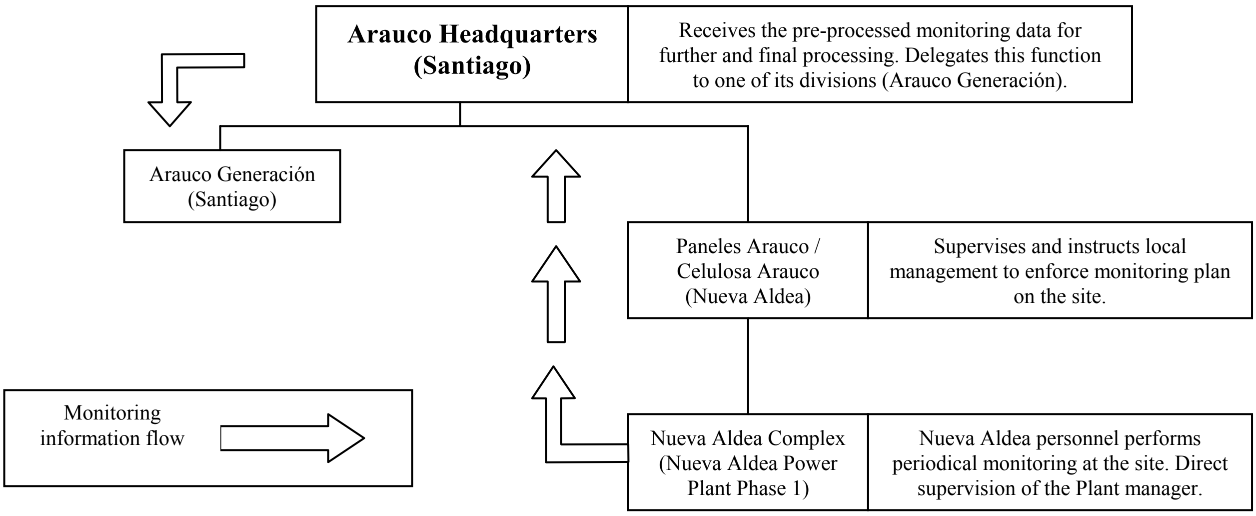
D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	Low	Any direct measurements with mass or volume meters at the plant site should be cross-checked with an annual energy balance that is based in purchased quantities and stock changes.
2	Low	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.
3, 6, 7, 15, 21.b	Low (CO_2) / Medium (CH_4)	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.
4	Low	Check consistency of distance record provided by the truckers by comparing recorded distances with other information from other sources (e.g. maps).
5	Low	Average truck load capacity will be calculated and checked regularly during the year.
8, 9	Low	The consistency of metered fuel consumption should be checked with purchase receipts.
10	Low	The electricity meters will undergo maintenance / calibration subject to appropriate industry standards. The accuracy of the meter readings for electricity sold to the grid will be verified by receipts issued by the purchasing power company and / or the corresponding dispatch center. The consistency of metered net electricity generation should be cross-checked with receipts from sales (if available) and the quantity of biomass fired (e.g. check whether the electricity generation divided by the quantity of biomass fired results in a reasonable efficiency that is comparable to previous years).
11, 12, 13, 14, 15, 16, 17, 18, 19, 20a, 20b	Low	Calculation of the CO_2 emission coefficient for grid electricity involves the use of official data released by the power generating company and / or indirectly by the corresponding dispatch center (if available and possible). Quality control of this data is beyond the control of the project operators. However, if the data are considered unreasonable, they may be replaced by more accurate data according to methods verified by the DOE:
21, 22	Medium	Where possible, supplementary data sources and expert judgment should be used to support findings.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

The project proponent, Arauco, 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.

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

Monitoring information flow of Nueva Aldea Power Plant Phase 1 project activity



D.5 Name of person/entity determining the monitoring methodology:

Arauco is the project participant responsible for the technical services related to GHG emission reductions, and is therefore, on behalf of Paneles Arauco, the author of this document, and all its contents. Arauco is, therefore, the entity that determined the methodology proposed in section D of this document.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

According to section D.2.1.2, the anthropogenic emission by sources of GHG of the Nueva Aldea Phase 1 project activity in a year *y*, can be determined as follows:

$$EM_{P,y} = P_{E1,y} + P_{E2,y} + P_{E3,y} + P_{E4,y} \quad (1)$$

Where:

$EM_{P,y}$: Total project activity emissions (tCO_2eq/yr).
$P_{E1,y}$: Project emissions from biomass controlled burning in the Power Plant (tCO_2eq/yr).
$P_{E2,y}$: Project emissions from biomass transportation to the biomass Power Plant (tCO_2/yr).
$P_{E3,y}$: Project emissions from biomass transportation within the Power Plant site (tCO_2/yr).
$P_{E4,y}$: Project emissions from fossil fuel consumption in the Plant's power boiler (tCO_2/yr).

As previously indicated in this PDD, only the additional biomass and fossil fuel consumptions will be considered to calculate the net project activity GHG emission savings. Annex 3 shows the additional biomass and fossil fuel amounts that were used to calculate the net emission savings of the proposed project activity. It also shows the biomass mix composition and the weighted average net calorific value that was used for the calculations below.

For better clarity, this PDD will present direct on-site project emissions and off-site project emissions separately.

E.1.1 Direct on-site emissions

E.1.1.1 GHG emissions from biomass combustion in the Power Boiler

According to the IPCC Guidelines[19], the methane emission factor for wood / wood waste combustion in industrial stoker boiler is 15 Kg/TJ. Considering that the Nueva Aldea Phase 1 Power Plant is equipped with a fluidized bed boiler, which is far more efficient than a stoker boiler, the proposed "conservativeness factor" for the correction of the methane emission factor is 1.02, the lowest from the ones proposed by the baseline methodology.

As a result of the project activity, the Nueva Aldea power boiler will burn 116,008 BDT of additional biomass per year with a net calorific value of 19.5 TJ/ 000 ton BDT for the mix. Based on these parameters, the biomass combustion at the Nueva Aldea Power Plant Phase 1 will result in the following methane emissions:

---

[19] 1996 Revised IPCC Guidelines, Reference Manual, Table 1-16.

Data/estimates:

(1) Biomass burned in the Power Boiler (related to the project activity)	116,008 (BDT/yr)
(2) Biomass net calorific value	19.5 (TJ/000dry ton)
(3) Biomass methane emission factor (controlled burning)	15.0 (KgCH_4/TJ)
(4) Conservativeness factor	1.02
(5) Global Warming Potential of CH_4	21

Calculations:

(6) Total emissions	**(1)*(1ton/1,000kg)*(2)*(1ton/1,000kg)*(3)*(4)*(5)**	**725 (tCO_2eq/yr)**

E.1.1.2 GHG emissions from diesel combustion in the power boiler

It was estimated that 72 additional tons of diesel per year would be required to operate the Power Plant power boiler compared to what would have been required if a smaller, low-pressure boiler had been built for the Nueva Aldea Industrial Complex in Phase 1 (baseline case). This calculation considers the estimated number of start-up operations per year and the fuel that would be required to increase the combustion efficiency during winter operation, when the biomass is extremely wet.

Based on the IPCC Guidelines, the following data was gathered and calculations performed:

Data/estimates:

(1) Additional fossil fuel (diesel) used in the Nueva Aldea power boiler	72 (ton/yr)
(2) Fossil fuel net calorific value	42.7 (TJ/000ton)
(3) Fossil fuel carbon content	20.2 (tC/TJ)
(4) Fraction of carbon oxidized	99.0 (%)
(5) CO_2 / C conversion factor	3.66 (tCO_2/tC)

Calculations:

(6) Fossil fuel CO_2 emission factor (GWP corrected)	(2)*(3)*(4)*(5)	3,136 (tonCO_2/000 ton fuel)

According to this, the total GHG emission from fossil fuel consumption in the power boiler are:

(7) Total emissions	**(1)*(6) / (1000 ton CO_2)**	**225 (tCO_2/yr)**

While GHG emission from this source is expected to be minimal in size, it is included in the calculations of project emissions. At current prices, fossil fuel is several times more expensive than biomass as fuel. Therefore, there are strong economic disincentives to use fossil fuel, except when absolutely necessary. For this reason, the Project expects its use of fossil fuel to be small in quantity.

E.1.1.3 GHG emissions from transporting biomass within the Power Plant site

Within the Nueva Aldea Power Plant Phase 1 site, diesel-fuelled bulldozers will transport the biomass to the power boiler biomass feeding lines. The power plant will directly measure the fuel consumption of these trucks, which will be exclusively used for on-site biomass transportation.

The additional fossil fuel needed for on-site transportation of biomass (i.e. related to the project activity), can be easily estimated by scaling the total fossil fuel consumption for the total biomass on-site transportation to the biomass related to the project activity. Using the same data and emission factor as in E.1.1.2, the total GHG emission from transporting biomass within the power plant site are the following:

Data/estimates:

(1) Additional fossil fuel (diesel) used for biomass on-site transportation	34.8 (ton/yr)
(2) Fossil fuel CO_2 emission factor (GWP corrected)	3,136 (tonCO_2/000 ton fuel)

Calculations:

(3) Total emissions	**(1)*(2) / (1000 ton CO_2)**	**109 (tCO_2/yr)**

E.1.2 Direct off-site emissions

E.1.2.1 GHG emissions from biomass transportation to the Power Plant

Transporting biomass from the selling points (i.e. local sawmills) to the Nueva Aldea Power Plant Phase 1 by trucks results in direct off-site emissions. For simplicity, the calculation below uses the number of truck trips per year, the average distance per trip and the IPCC default emission factor for heavy load transportation truck to calculate the off-site transportation emissions. This algorithm is provided in the chosen baseline methodology as one of the two options available to calculate the off-site transportation emissions of a biomass cogeneration project activity.

Data/estimates:

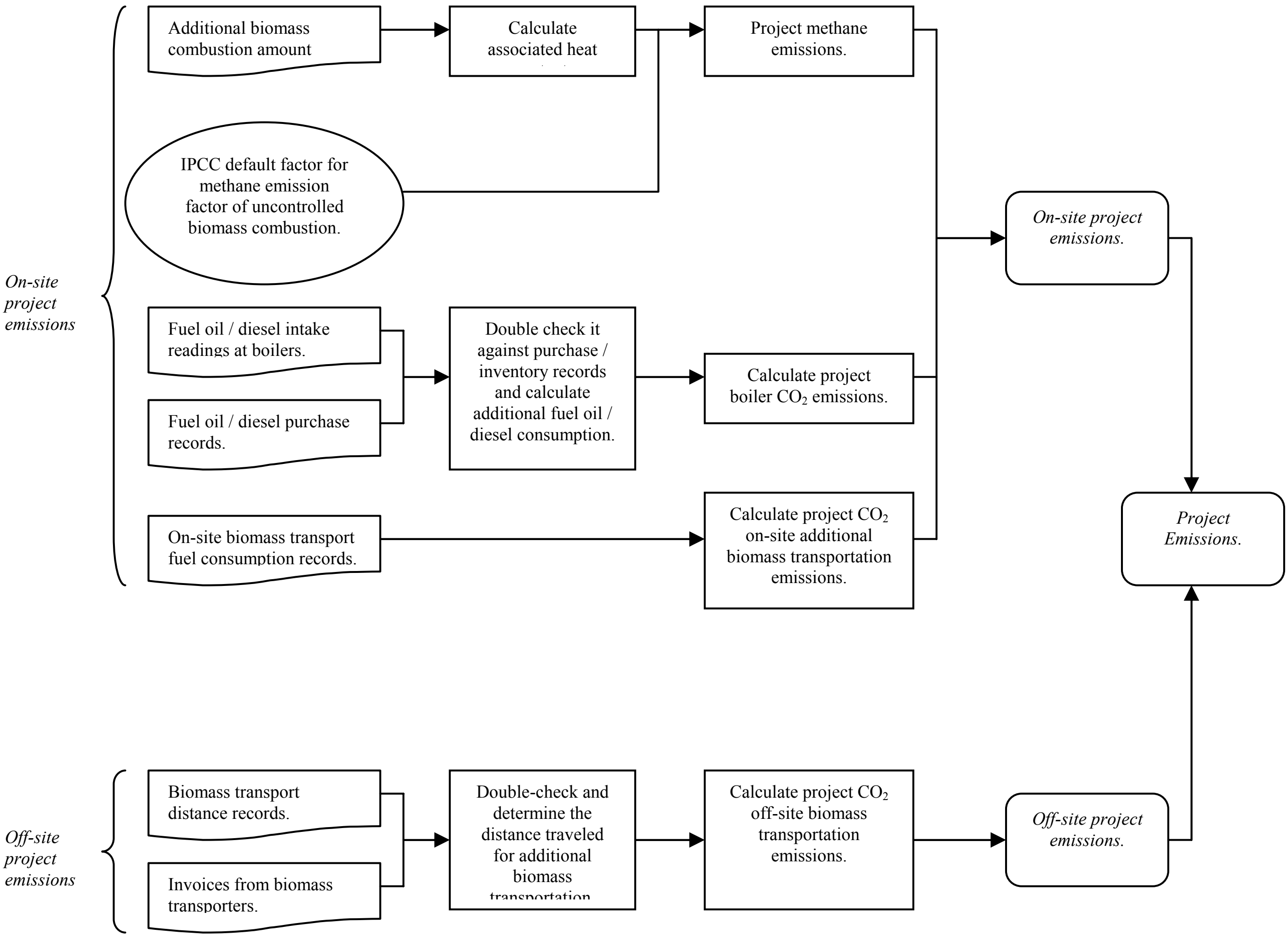
(1) Biomass used by the project activity (dry)	116,008 (BDT/yr)
(2) Biomass average humidity	55%
(3) Approximate load for 1 trip[20]	30 (ton/truck)
(4) Average distance between supplying mills and the Nueva Aldea Power Plant[20]	87.5 (km)
(5) Emission factor for heavy truck transportation[21]	1.011 (kgCO_2/km)

[20] Nueva Aldea's data.

Calculations:

(6) Biomass used by the project activity (wet)	(1)/[1 – (2)]	257,796 (wet ton/yr)
(7) Number of trips needed for the Plant per year	(6) / (3)	8,593 (trips/yr)
(8) Total distance traveled[22]	(4)*(7)*2	1,503,807 (km/yr)
(9) Total emissions	**(5)*(8)*(1ton/1,000kg)**	**1,520 (tCO_2/yr)**

E.1.3 Summary of estimation process of Nueva Aldea Power Plant project emissions:



[21] IPCC Guidelines P.1.75. The IPCC Guidelines provide several carbon emission factors for large trucks. This PDD uses the Moderate Control index for the US Heavy Duty Diesel Vehicle.

[22] For conservatism, it is assumed that trucks need to make return journeys without picking up other loads.

E.2. Estimated leakage:

One factor which needs close examination with regard to leakage is whether 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.

Currently there are two sources of biomass in the South part of the country (from VI to X Regions) that can that supply the same type of biomass to a power plant such as the Nueva Aldea Power Plant:

1. Biomass from industrial operations, consisting basically in biomass generated by local sawmills (bark and sawdust). Currently, part of this biomass is normally used to generate thermal energy of the sawmills that produce it and another fraction is sold to other facilities for other industrial uses. However a considerable surplus still remains, which is normally piled (natural decay) or sometimes burned in the open-air.

Figure 5: Biomass from industrial operations

2. Biomass from harvesting, pruning and thinning operations in managed forest lands. Currently this biomass finds 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 for natural decay or sometimes burned (to prevent future fires in new forest plantations).

Figure 6: Biomass from forest operations

Currently, biomass is used in the following ways:

1. Sawdust:
   (a) Raw material at local panel mills. Small demand and some generate their own biomass.
   (b) Thermal power generation at sawmills. Small demand and they generate their own biomass.
   (c) Electric power generation at some power plants (very few cases). Most have exclusivity biomass supply contract with some nearby sawmills.

2. Bark:
   (a) Fuel for thermal power generation in some sawmills.

3. Biomass from forestry operations: Bark and wood mix.
   (a) The demand for this biomass type is negligible compared to the supply.

In all cases, the demand is considerably lower than the supply, therefore the surplus is left for piling and natural decay or open-air burning.

Leakage therefore 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 a new biomass Power Plant and they switch to fossil fuels 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[23], these suppliers will use their biomass to serve their own energy needs in the very first place. Only then, they are willing to sell the surplus biomass to nearby factories and Power Plants. As was said in E.1.1.2, the biomass is many times 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, burn it or sell it to a nearby factory or power plant (if there exist). For these reasons, this type of leakage is highly unlikely.

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 VIII 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 Nueva Aldea area, which is shown in the following table:

[23] By the time this PDD was written, the oil price was over US$ 60 per barrel.

NUEVA ALDEA POWER PLANT SUPPLY / DEMAND SITUATION

(2005 figures)

Biomass supply

Biomass from industrial operations	(m^3st/yr)	3,860,802
Biomass from forest operations	(m^3st/yr)	1,258,096
Total biomass supply	**(m^3st/yr)**	**5,118,898**

Biomass demand

Total biomass demand	**(m^3st/yr)**	**2,809,800**

Biomass ratio indicators

These indicators are calculated according the L2 criteria of the ACM0006.

Biomass from industrial operations/Total biomass demand	(number)	1.37
Biomass from forest operations/Total biomass demand	(number)	0.45
Total biomass supply/Total biomass demand	**(number)**	**1.82**

Notes:

The Nueva Aldea Power Plant is the only biomass power plant within the influence area determined by the following city zones: Coelemu, Cauquenes, San Javier-Talca, Concepción and Arauco.

The distances of other biomas power plants are:

-Trupan: 110 km It has a dedicated and different biomass supply area.

-Laja: 115 km Sources ALL its biomass needs through Maderas S.A. Sawmill and has biomass surplus.

According to the information above (approach L2, leakage section of the Baseline methodology), the Nueva Aldea Power Plant Phase 1 counts with sufficient biomass locally and has not caused other biomass plants in the area to switch from biomass to fossil fuels so far. This can be easily confirmed, since the Laja Power Plant (a biomass power plant in the region) is a zero marginal cost power plant, which indicates low biomass fuel costs instead of more expensive fossil fuel costs. Besides, this power plant has a exclusive biomass supply contract with Maderas S.A., a local sawmill, by which the power plant provides thermal and electric power to the sawmill, and in return, the sawmill provides the biomass. Another biomass cogeneration initiative in the area is Arauco's Trupan Power Plant, a prospective CDM cogeneration project, for which the required surplus of biomass in a *different and dedicated supply* area has already been established.

The following picture (March, 2005) shows a biomass disposal site in the VIII Region currently used by some of the Nueva Aldea Power Plant Phase 1 biomass suppliers.

The use of this disposal sites, together with others not shown here due to space limitations, constitute evidence that prove that current biomass suppliers in the region are not able to sell all their biomass they generate during the year (approach L3, leakage section of the Baseline methodology).

Finally, it must be noted that Arauco owns the majority of the managed forest lands in the VIII Region. This makes Arauco an important supplier of bark and sawdust in the area (i.e. Arauco sawmills) and the main potential supplier of forest operations biomass for the Nueva Aldea Power Plant Phase 1. 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 of significance is anticipated for the Nueva Aldea Power Plant Phase 1 project activity. Therefore the leakage for the proposed project activity is zero:

$$L_{Py} = 0 \qquad (2)$$

The supply / demand status within the Nueva Aldea Power Plant Phase 1 influence area will be periodically monitored as indicated in the chosen baseline and monitoring methodologies applied to this project activity.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Given that no leakage of significance is anticipated, E.3 equals E.1.:

$$Project\ Activity\ Emissions_{\ y} = EM_{P,y} + L_{Py}$$

But from (2):

$$L_{Py} = 0$$

Then:

$$Project\ Activity\ Emissions_{\ y} = EM_{P,y} \qquad (3)$$

The expected emissions from the project activity are summarized in the following table:

Table Nº 3: Nueva Aldea project emissions

		Year $_y$
On-site project emissions	(tCO_2eq/yr)	1,059
Off-site project emissions	(tCO_2/yr)	1,520
Total project emissions	**(tCO_2eq/yr)**	**2,579**

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

E.4.1 Unused biomass baseline emissions

In Chile, low demand for biomass makes its disposal a serious problem for sawmills (water, air pollution) and forest companies (forest fires). Part of this biomass is used as fuel in some mills or as raw material in the panel board industry. However, a significant portion of it is either left in piles for natural decay. Since according to the chosen methodology open-air burning is the baseline alternative that can be chosen in this situation, this PDD assumes that biomass would be burned in the open-air if not used by the Project.

It must be noted that this is a very conservative assumption, since in reality, most of the unused biomass is left in piles to natural decay rather than burned. When biomass is left to decay, it will release more of the carbon it contains as methane than when it is burned in the open air. This results in significantly higher GHG emissions given the large global warming potential of methane. By assuming open-air burning of all currently unused biomass and excluding from the baseline methane emission from decaying biomass, the Project's PDD understates baseline emissions and keeps the baseline conservative. In open-air burning, most of the carbon contained in the biomass is released in the form of CO_2. However, a small amount is released as methane. Given methane's potency for global warming, the baseline analysis addresses the amount of carbon released as methane in open-air burning.

Given that by the date this PDD was written, there were no measurements for uncontrolled burning of biomass in the open-air available, this PDD chooses the most conservative factor for correcting the methane emission factor for combustion of biomass in agriculture or forestry, which is suggested in the baseline methodology for the Nueva Aldea Phase 1 project activity. Nevertheless, the project proponent may attempt a CH_4 emission factor measurement for uncontrolled biomass burning in the future, in order to have a more fair (and accurate) emission coefficient for the baseline scenario. According to this, the amount of methane released by open-air burning in the absence of the Project is estimated as follows:

Data/estimates:

(1) Additional biomass used as fuel (dry)	116,008 (BDT/yr)
(2) Biomass net calorific value	19.5 (TJ/000dry ton)
(3) Methane emission factor for combustion of biomass in agriculture or forestry	300.0 (KgCH$_4$/TJ)
(4) Conservativeness factor	0.73
(5) Global warming potential of methane	21

Calculations:

(6) Annual methane released	**(1)*(1ton/1,000kg)*(2)*(1ton/1,000kg)*(3)*(4)*(5)**	**10,378 (tCO$_2$eq/yr)**

E.4.2 Electricity generation baseline emissions

The proposed baseline methodology considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario. In this case, the Nueva Aldea Power Plant Phase 1 is connected to the SIC Chilean grid.

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 (the system is basically a long 220KV double / simple circuit transmission line with some higher capacity and alternative circuits in some segments) the SIC does not present important transmission limitations. This has been further reassured by the “Short Law”, which mandates 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. It must also be said that the SIC has no interconnection with any other interconnected system within Chile or with any other country[24] in the region.

Emission reductions of the proposed project activity are achieved through the displacement of a fossil-fuelled plant at the margin of the SIC grid, with the same capacity of the Nueva Aldea Power Plant Phase

[24] The interconnection between the SIC (center and south of Chile) and the SING (north of Chile) has been a largely debated project, which up to now has proven to be unprofitable and therefore, not viable.

1, and producing electricity with the emissions factor calculated as the chosen methodology describes as the electricity baseline emission factor $EF_{electricity,y}$.:

$$EF_{electricity,y} = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y} \quad (4)$$

It is therefore necessary to calculate electricity baseline emission factor $EF_{electricity,y}$ of the SIC Chilean grid, which operates independently in Chile, in order to determine the emission reductions to be achieved by the Nueva Aldea Power Plant Phase 1. This implies to calculate the corresponding Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$) for the SIC grid to which the Nueva Aldea Power Plant Phase 1 is connected.

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

The new proposed baseline methodology 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 chosen methodology 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 option (c) are presented below:

- 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 easily and readily available to third parties (even CDEC members). 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 every minute) 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 procedure and compromises transparency in the OM calculation process.

- To have a better idea of what Dispatch data analysis would imply, the Project Developer decided to simulate the monitoring procedure for one week. The conclusion was that with the current quality of information available, the cost (in man-hours and / or specialized software development) to gather and process all the information required, the viability of the project would be compromised.

- Finally, a simplified dispatch data analysis was simulated (monthly instead of hourly) for an entire year and the results obtained were similar to the results obtained using the simple adjusted

OM[25] method. Considering that similar results were obtained with a much more simple, transparent and easy to implement method, it was decided to choose option (b), the Simple adjusted method, to calculate the OM.

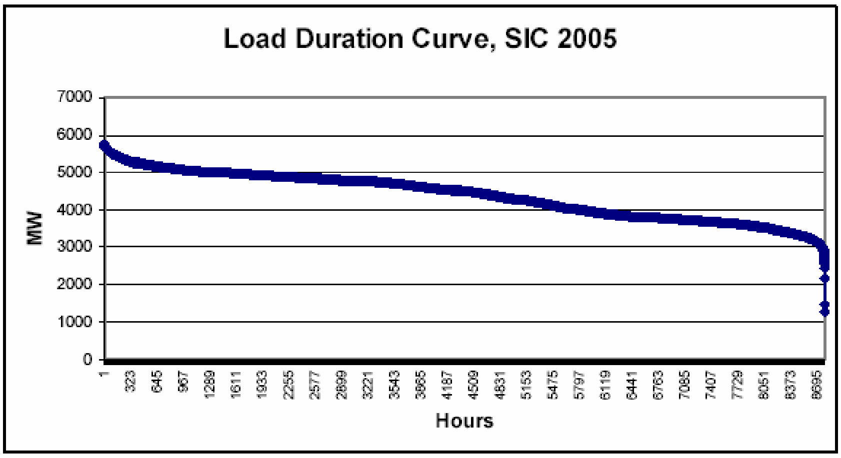
The Simple Adjusted OM method requires to identify low cost must run resources (*k*) from other power sources (*j*):

$$EF_{OM,simpleadjusted,y} = (1-\lambda_y)\cdot \frac{\sum_{i,j} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum_{i,k} F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \qquad (5)$$

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. For the OM calculation in this PDD, the project proponent will estimate the OM in 2005, based on a realistic estimate of the electric power generation situation for 2005.



Note: The load duration curve for 2005 was estimated from the real 2004 load duration curve.

From 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 2005:

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[25] The Simple OM method was discarded since the low operating cost / must run resources constitute more than 50% (actually 62% with 2004 figures) of the total grid generation, and the proposed methodology establishes a limit of less than 50% to use the Simple OM.

$$\lambda_y = \lambda_{2005} = 0.001$$

$$\lambda_{2005} = 0.001$$

The rest of the parameters of equation (5), were calculated as follows for the year 2005:

$$\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j} = 10{,}072{,}207(tCO_2 / yr)$$

- The Plant emission factors for the operating units in the SIC was 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 1996 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 2005.

$$\sum_{j} GEN_{j,y} = 14{,}601(GWh / yr)$$

- 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 2005.

$$\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k} = 0(tCO_2 / yr)$$

- Since in Chile low operating cost and must-run resources include only hydraulic energy and very few biomass plants, the total emissions for this part of the equation are zero.

$$\sum_{k} GEN_{k,y} = 23{,}464(GWh / yr)$$

- 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 2005.

Replacing the above values in equation (5), the operating margin results:

$$EF_{OM,simpleadjusted,y} = (1-0.001)\cdot\frac{10,072,207}{14,601} + 0.001\cdot\frac{0}{23,464} = 689.12(tCO_2/GWh)$$

$$EF_{OM,simpleadjusted,y} = 689.12(tCO_2/GWh)$$

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

According to the methodology, there are two options to calculate the Build Margin. Option 1, in which the Build Margin is calculated ex-ante for the first crediting period and Option 2, in which the Build Margin is calculated ex-post during the first crediting period. For subsequent periods, the project proponent must calculate the Build Margin ex-ante, as stated in Option 1.

In each of these options, the Project Proponent must select a sample group of m power plant that comprises the larger annual generation from either:

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise the 20% of the system generation (in MWh) and that have been built most recently.

For this project activity, the project proponent will choose Option 2; that is, the project proponent will monitor the Build Margin ex-post for the first crediting period. For subsequent periods, the Build Margin will be calculated ex-ante.

According to 2005 projections in the power sector, the most likely group of plants that will account for the largest generation in 2005 will be the last ones built and responsible for the 20% of the (projected) total generation in 2005. These plants will then be considered to calculate (estimate) the Build Margin for 2005:

$$EF_{BM,y} = 251.4(tCO_2/GWh)$$

As in the Operating Margin calculation case, the Build Margin calculation also considered official CDEC-SIC data and / or other official data if available. In cases data was not available, IPCC default factors were used.

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} established in the proposed methodology, it is possible to calculate $EF_{electricity,y}$ from the equation (4):

$$EF_{electricity,y} = 0.5*689.12 + 0.5*251.4 = 470.23 \ (tCO_2/GWh)$$

Using the value of the electricity baseline emission factor $EF_{electricity,y}$ calculated above and the expected electric energy to be produced by the Nueva Aldea Power Plant Phase 1, the total grid emission reductions can be calculated as follows:

Data/estimates:

(1) Combined margin for the SIC grid	470.23 (tCO_2/GWh)
(2) Gross electric power output	29 (MW)
(3) Additional internal electric power consumption of Nueva Aldea Power Plant	1.5 (MW)
(4) Average load factor for energy export to the grid[26]	80.0%

Calculations:

(5) Power Plant net power output	(2)-(3)	27.5 (MW)
(6) Total energy displaced from the grid	(5)*(4)*8,760 (hr/yr)/1,000 (GWh/MWh)	192.7 GWh/yr
(7) Total grid emission savings	**(1)*(6)**	**90,624 tCO_2/yr**

The following observations must be noted in the above calculation:

- To calculate the net electric power generation of the Nueva Aldea Power Plant Phase 1, only the additional internal power plant electric power consumption was subtracted (1.5MW), not the total internal electric power consumption of the real power plant (3.6MW). The reason for this is that in the baseline scenario, there would have also been a power plant (that would have only generated steam), which would have had an internal electric power consumption of 2.1MW. For more details, please see Baseline information in Annex 3 of this PDD.

- The Nueva Aldea Power Plant Phase 1 has a total net capacity of 28 MW, however only 13 MW are injected to the grid and the remaining 15 MW are consumed in the Nueva Aldea Complex (Phase 1). Despite this, the emission calculation was done considering the total power output (28 MW), since if the power plant had not been built (baseline case), it would have been necessary to buy 15MW from the SIC grid and the 13MW of excess clean power would have not been available in the SIC.

[26] Average load factors were calculated using official CDEC-SIC data and Nueva Aldea data.

E.4.4 Baseline emission summary

The following flowchart summarizes the process of baseline emissions estimation, while the table below shows the total baseline emission savings.

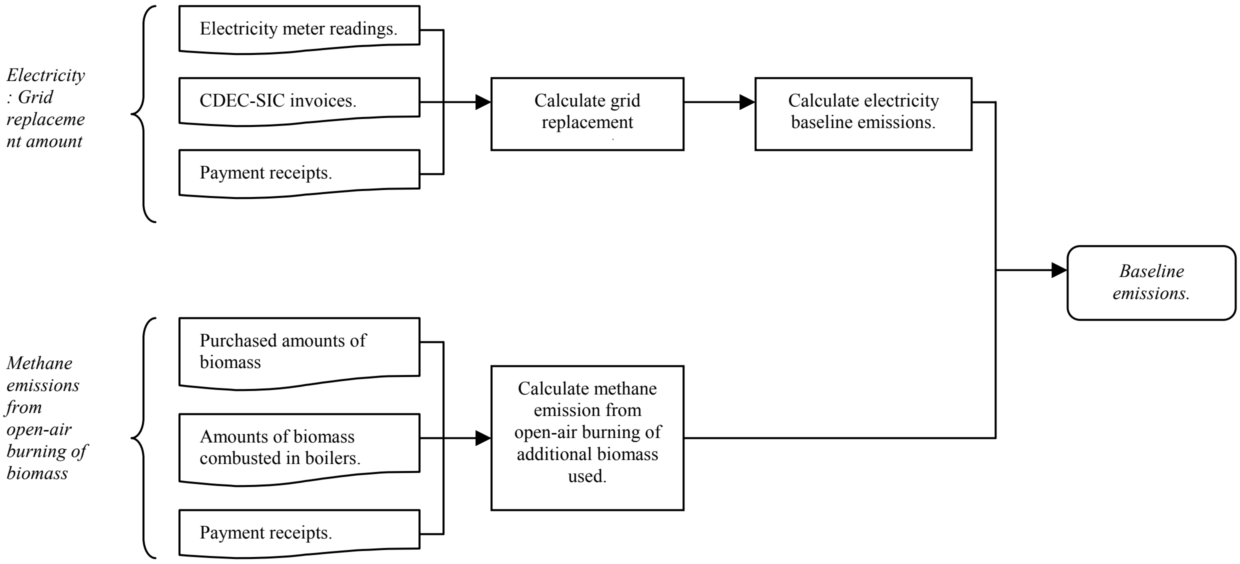

Table Nº 4: Nueva Aldea Phase 1 project activity total baseline emission savings

		Year $_y$
Grid emission savings	(tCO_2/yr)	90,624
Methane emission savings	($tCOeq_2$/yr)	10,378
Total baseline emission savings	**(tCO_2eq/yr)**	**101,002**

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

The proposed project activity is expected to achieve 720,239[27] tCO_2eq of net emission reductions during the first 7-year crediting period.

Table Nº 5: Nueva Aldea Phase 1 project activity net emission savings

		Year $_y$
Total baseline emissions savings	(tCO_2/yr)	101,002
Total project emissions	(tCO_2eq/yr)	-2,579
NET EMISSION SAVINGS PER YEAR	**(tCO_2eq/yr)**	**98,423**

[27] This estimation considers an OM and BM projection for the first 7-year crediting period.

Note: In this case, year *y* corresponds to 2005 emission reduction savings, assuming steady-state operation parameters.

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

Table Nº 6: GHG emission reductions by sources of Nueva Aldea project activity

Years	Estimation of project activity emission reductions in tons of CO_2 eq	Estimation of baseline emission reductions in tons of CO_2 eq	Estimation of leakage in tons of CO_2 eq	Estimation of project activity emissions in tons of CO_2 eq
2005	73,817	75,751	0	-1,934
2006	98,312	100,709	0	-2,398
2007	106,463	108,860	0	-2,398
2008	109,769	112,167	0	-2,398
2009	130,907	133,305	0	-2,398
2010	100,486	102,883	0	-2,398
2011	100,486	102,883	0	-2,398
2012	107,737	110,135	0	-2,398
2013	107,737	110,135	0	-2,398
2014	107,737	110,135	0	-2,398
2015	107,737	110,135	0	-2,398
2016	107,737	110,135	0	-2,398
2017	107,737	110,135	0	-2,398
2018	107,737	110,135	0	-2,398
2019	107,737	110,135	0	-2,398
2020	107,737	110,135	0	-2,398
2021	107,737	110,135	0	-2,398
2022	107,737	110,135	0	-2,398
2023	107,737	110,135	0	-2,398
2024	107,737	110,135	0	-2,398
2025	107,737	110,135	0	-2,398
Total 3 cred. periods	**2,228,558**	**2,278,443**	**0**	**-49,885**

Total 1st cred. period	**720,239**	**736,559**	**0**	**-16,319**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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

- **Solid and Liquid Wastes:** The operation of the Plant (i.e. sawmill, plywood mill) will generate sewage water that will be treated in a Sewage treatment Plant in accordance with the Chilean regulations. The Project will consume all the biomass that will be generated by the Plant. Very low amounts of residues, like ashes, plastics and other industrial waste will be send to a landfill, also according with the Chilean regulations.

- **Atmospheric emissions:** The emissions are related to noise and particulate material. Both of them are treated with state of art technology that put them below the emission limit factor required by the Chilean regulations.

All those impacts were mentioned and resolved during the environmental impact assessment procedure.

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

All these statements are confirmed by the endorsement of the project given by the Designated National Authority (CONAMA), in its Host country approval process. In that instance the DNA reviewed all the different environmental permits related to the project and found them to be in accordance with all national environmental regulations.

No transboundary impacts are considered for this Project.

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

The project complies with the specific applicable regulations of the host country in regard to Environment Impact Assessment (EIA). The EIA follows the regulations for EIA System set in Chile by the Supreme Decree N 30/97 of the Ministry General Secretariat of the Presidency, Regulation for the Environmental Impact Assessment System and its modifications set in Supreme Decree N 95/2001, and the Act N 19300 on the Environmental Framework.

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

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

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

SECTION G. Stakeholders' comments

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

The Stakeholders involvement was organized through the following channels:

1. Technical staff of the Company met with local community and authorities in order to discuss all the technical aspects of the Project: this was done with the community of Coelemu and Ranquil. The conclusions of those meetings were compiled in a document that were distributed to the communities and local authorities.

2. Meetings with the communities of Ranquil, Coelemu, Trehuaco and Quillón and the management of the Company: the meetings were announced through leaflets send to each house and announcements in local radios. Again the conclusions of those meetings were distributed to all stakeholders.

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

4. The Project was also announced in different CDM seminars in Chile.

G.1. Brief description how comments by local stakeholders have been invited and compiled:

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.

G.2. Summary of the comments received:

The comments related to the project activity were related to the emissions of the project and waste management.

For the emissions issue, the company emphasized their commitments to comply with all the requirements imposed by the local authorities.

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

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

G.3. Report on how due account was taken of any 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 F and G.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	**CELULOSA ARAUCO Y CONSTITUCIÓN S.A.**
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Represented by:	
Title:	Operations Manager of Arauco Generación S.A.
Salutation:	Mr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Public Funding:

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

Annex 3

BASELINE INFORMATION

BASELINE DATA OF NUEVA ALDEA POWER PLANT PHASE 1

NUEVA ALDEA POWER PLANT BASELINE INFORMATION

(**Source:** Nueva Aldea Project, Arauco)

		(1)	(2)	(Δ = 1 – 2)
		Real project	**Baseline project**	**CDM project**
Electric power				
On-site gross electric power generation	(MW)	29.0	0.0	29.0
Power plant internal consumption	(MW)	-3.6	-2.1	-1.5
On-site net electric power generation	**(MW)**	**25.4**	**-2.1**	**27.5**
Biomass consuption (mix)	**(m^3 stereo/yr)**	**2,104,795**	**1,387,785**	**717,010**
On-site fossil fuel consumption				
Power boiler back-up (Diesel)	(Ton/yr)	210.2	138.6	71.6
Biomass transportation (Diesel)	(Ton/yr)	81.5	46.7	34.8
Total on-site fossil fuel consuption	**(Ton/yr)**	**291.7**	**185.3**	**106.4**
Off-site fossil fuel consumption Biomass transportation (Diesel)	CO_2 fossil fuel emissions calculated based on project activity additional biomass consuption and transportation to the power plant.			

Biomass types		**NCV (dry basis)**	**Mix composition**
Sawdust	(TJ / 000 ton)	18.9	70%
Bark	(TJ / 000 ton)	20.8	30%
Biomass mix	(TJ / 000 ton)	19.5	100%

Additional biomass will be calculated in the following way:

1. From the real and baseline energy / mass balances in steady-state operation of the Nueva Aldea Phase 1 Power Plant, the following factor will be calculated:

Electric power generation factor: Electric power generation capacity (MW) / (Biomass consumption with CDM project – Biomass consumption without CDM project (cubic meters))

2. The gross (monitored) electric power generation per month (MWh/month) of the Nueva Aldea Power Plant will be divided by the factor calculated in (1). This will result in an estimation of the “additional” biomass that was consumed by the power plant to generate electric power. The rest of the biomass consumed in the Power Plant will be considered biomass that would have been consumed in a baseline scenario.

3. The baseline biomass consumption will be calculated subtracting the additional biomass calculated in 2 to the total (measured) biomass consumption per month.

Additional fossil fuel (i.e. in the power boiler and for biomass transportation) will be calculated proportional to the biomass consumption in the Nueva Aldea power boiler in the following way:

Additional fossil fuel = Total fossil fuel * (additional biomass consumed/total biomass consumed)

ADDITIONAL BIOMASS CALCULATION DETAIL FOR NUEVA ALDEA PHASE 1

From the energy / mass balance in page 11 of the Nueva Aldea P1 PDD, the following information can be drawn:

Gross electric power generation capacity	(MW)	27.3
Biomass consumption with CDM project	(BDt/day)	933

From the energy / mass balance in page 10 of the Nueva Aldea P1 PDD, the following information can be drawn:

Gross electric power generation capacity	(MW)	0.0
Biomass consumption with CDM project	(BDt/day)	559

1. Electric power generation factor calculation for Nueva Aldea P 1

Gross electric power generation capacity	(MW)	27.3	
Biomass consumption with CDM project	(BDt/h)	38.9	
Biomass consumption with CDM project	(mt^3 stereo/h)	240.3	
Biomass consumption without CDM project	(BDt/h)	23.3	
Biomass consumption without CDM project	(mt^3 stereo/h)	144.0	
Conversion factor	(BDt/m^3 stereo)	0.1618	Calculation based on 2004 Nueva Aldea data.
Electric power generation factor for Nueva Aldea PI	**(MW/m^3 stereo)**	**0.283**	

2. Additional biomass calculation from gross monitored biomass consumption in Nueva Aldea P1

		2005	2006	
Total gross power generation	(GWh/yr)	152.4	203.2	This information will be directly monitored.
Additional biomass consuption	**(m^3 stereo/yr)**	**537,757**	**717,010**	This information will be calculated.

3. Baseline biomass consumption in Nueva Aldea P1

		2005	2006	
Total biomass consumption in the power boiler	(m^3 stereo/yr)	1,680,000	2,104,795	This information will be directly monitored.
Baseline biomass consuption	**(m^3 stereo/yr)**	**1,142,243**	**1,567,038**	This information will be calculated.

BASELINE SIC-GRID DATA
(SOURCES: CDEC-SIC/CNE)

POWER PLANT	POWER OUTPUT (MW)	PLANT TYPE	(ENERGY IN GWh) 2005	2006
Abanico	136.0	Run of the river	324.0	338.8
Aconcagua	72.9	Run of the river	424.0	438.9
Alfalfal	178.0	Run of the river	854.3	895.2
Antilhue	100.0	Open cycle	0.0	0.0
Antilhue new	47.0	Open cycle	15.5	29.5
Antuco	320.0	Reservoir	1,711.0	1,529.4
Arauco	33.0	Biomass / Steam	63.5	85.9
Bocamina	128.0	Coal / Steam	710.7	681.1
Bocamina TG	23.6	Open cycle	0.0	0.0
Cabrero	260.0	Open cycle	0.0	0.0
Candelaria (Open cycle)	250.0	Open cycle	5.4	66.6
Canutillar	172.0	Reservoir	1,002.5	1,076.6
Capullo	12.0	Run of the river	64.9	61.4
Celco	20.0	Biomass / Steam	90.2	98.8
Chacabuquito	25.0	Run of the river	164.1	168.4
Cholguán	13.0	Biomass / Steam	83.7	86.2
Cipreses	105.9	Reservoir	421.5	462.2
Colbún+Mach	569.0	Reservoir	2,733.6	3,039.5
Constitución	8.7	Biomass / Steam	59.0	59.4
Curillinque	89.0	Run of the river	565.9	591.0
D. de Almagro	23.8	Open cycle	0.5	1.2
El Indio TG	12.0	Open cycle	0.0	0.0
El Toro	450.0	Reservoir	1,743.4	994.1
Florida	28.0	Run of the river	120.2	121.0
Guacolda I	152.0	Coal / Steam	1,154.1	1,079.0
Guacolda II	152.0	Coal / Steam	1,154.9	1,072.0
Horcones TG	24.3	Open cycle	47.3	69.7
Huasco TG Diesel	58.0	Open cycle	0.0	0.0
Huasco TG IFO	58.0	Open cycle	0.9	0.8
Huasco TV	16.0	Coal / Steam	1.7	7.4
Isla	68.0	Run of the river	449.9	473.9
Itata	13.0	Biomass / Steam	67.7	90.2
L. Verde TG	17.0	Open cycle	2.3	9.2
L. Verde TV	49.0	Coal / Steam	47.0	32.2
Laja	8.7	Biomass / Steam	52.4	59.4
Licantén	5.5	Biomass / Steam	22.6	24.0
Loma Alta	40.0	Run of the river	251.0	263.3
Los Molles	18.0	Run of the river	46.3	53.8
Los Quilos	39.3	Run of the river	256.1	260.3
Los Robles	72.0	Open cycle	0.0	0.0
Maitenes	29.0	Run of the river	126.1	127.0
Mampil	49.0	Run of the river	172.1	194.9
Nehuenco	368.4	Combined cycle	453.5	661.2
Nehuenco (Open cycle)	250.0	Open cycle	15.7	86.6
Nehuenco 9B	108.0	Open cycle	9.5	13.8
Nehuenco 9B Diesel	108.0	Open cycle	0.0	0.3
Nehuenco Diesel	368.4	Combined cycle	108.4	188.6
Nehuenco II	390.4	Combined cycle	2,998.9	3,014.0
Nehuenco II (Open cycle)	250.0	Open cycle	0.0	0.0
Nueva Renca	379.0	Combined cycle	2,165.8	2,464.7
Nueva Renca Diesel	379.0	Combined cycle	415.3	518.8
P. de Azúcar	156.0	Open cycle	0.0	0.0
Pangue	467.0	Reservoir	1,937.3	2,211.9
Pehuenche	566.0	Reservoir	2,624.1	2,873.1
Petropower	75.0	Petcoke / Steam	426.9	450.3
Peuchén	77.0	Run of the river	290.8	331.9
Pilmaiquén	39.0	Run of the river	260.1	260.6
Pullinque	48.0	Run of the river	229.7	232.3
Puntilla	14.0	Run of the river	115.8	116.1
Ralco	690.0	Reservoir	2,703.6	3,085.8
Rapel	378.0	Reservoir	943.7	1,079.8
Renca	97.0	Diesel / Steam	0.0	5.6
Rucúe	178.4	Run of the river	1,033.3	944.4
S. Fco. Mostazal	25.7	Open cycle	1.9	11.1
Saesa TG	50.0	Open cycle	264.3	357.5
San Antonio	156.0	Open cycle	0.0	0.0
San Ignacio	37.0	Run of the river	204.5	230.1
San Isidro	379.0	Combined cycle	951.2	764.6
San Isidro Diesel	379.0	Combined cycle	356.0	467.6
San Pedro	68.0	Open cycle	0.0	0.0
Sauz+Szito	88.8	Run of the river	521.0	520.9
Taltal (I and II)	244.9	Open cycle	930.6	1,020.5
Taltal II Diesel	120.0	Open cycle	0.0	0.0
Valdivia	61.0	Biomass / Steam	269.7	349.0
Ventanas 1	120.0	Coal / Steam	482.1	542.9
Ventanas 2	220.0	Coal / Steam	1,237.5	1,084.9
Volcán+Queltehues	62.6	Run of the river	447.9	454.1
Others	4.1	N.A.	12.8	16.9
COYA	25.0	Run of the river	0.0	97.2
SAN IGNACIO TG	18.0	Open cycle	0.0	6.7
CAMPANARIO CA	260.0	Open cycle	0.0	0.0
CAMPANARIO DIESEL	260.0	Open cycle	643.5	1,013.5
TOTAL			**38,065.8**	**40,119.6**

SIC GRID FOSSIL FUEL CO_2 EMISSION DATA

COAL, BOCAMINA

Net calorific value	(TJ / 000 ton)	26.0
Carbon content	(tC / TJ)	25.8

COAL, HUASCO

Net calorific value	(TJ / 000 ton)	25.2
Carbon content	(tC / TJ)	25.8

COAL, VENTANAS, RENCA AND L.VERDE

Net calorific value	(TJ / 000 ton)	25.7
Carbon content	(tC / TJ)	25.8

COAL, GUACOLDA

Net calorific value	(TJ / 000 ton)	25.3
Carbon content	(tC / TJ)	26.0

PETCOKE, GUACOLDA AND PETROPOWER

Net calorific value	(TJ / 000 ton)	31.2
Carbon content	(tC / TJ)	27.5

DIESEL

Net calorific value	(TJ / 000 ton)	42.7
Carbon content	(tC / TJ)	20.2

IFO 180 (RESIDUAL OIL)

Net calorific value	(TJ / 000 ton)	40.2
Carbon content	(tC / TJ)	21.1

NATURAL GAS

Net calorific value	(TJ / MM m3)	35.8
Carbon content	(tC / TJ)	15.3

Sources:
- Direct company information.
- Revised 1996 IPCC Guidelines for national greenhouse gases.
- CNE node price reports.
- Arauco Generación
- Local fuel distribution companies.

OPERATING MARGIN CALCULATION

		2005	2006
Total emissions from non-low cost / must run power plants	(tCO_2/yr)	10,072,207	10,838,120
Total emissions from low-cost / must-run power plants	(tCO_2/yr)	0	0
Total energy generated in the SIC	(GWh/yr)	38,066	40,120
Total energy by non-Low cost / must run power plants	(GWh/yr)	14,601	15,722
Total energy by low cost / must run power plants	(GWh/yr)	23,464	24,398
Factor λ	(number)	0.0010	0.0010
Operating Margin	**(tCO_2/GWh)**	**689.12**	**688.68**

Notes:
- Low cost / must run units present no GHG emissions, since they are basically hydro plants and very few biomass plants.
- Lambda factor is almost 0 for these years.

BUILD MARGIN CALCULATION THE YEAR THE EMISSION ABATEMENT OCCUR FOR THE 1st CREDITING PERIOD

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 2005 (GWh)	TOTAL GEN IN 2006 (GWh)	(tCO_2/GWh)	LOAD FACTOR
QUILLECO	70.0	Run of the river	Hydro	Abr-07	0.0	0.0	0.0	58.8%
CAMPANARIO CA	260.0	Open cycle	Natural Gas	Abr-07	0.0	0.0	**745.0**	23.1%
SAN IGNACIO TG	18.0	Open cycle	Diesel	May-06	0.0	6.7	929.1	9.9%
COYA	25.0	Run of the river	Hydro	Abr-06	0.0	97.2	0.0	58.8%
Candelaria (Open cycle)	250.0	Open cycle	Diesel	Jul-05	5.4	66.6	929.1	9.9%
Saesa TG	50.0	Open cycle	Natural Gas	May-05	264.3	357.5	519.4	23.1%
Itata	13.0	Biomass / Steam	Biomass	Abr-05	67.7	90.2	0.0	62.3%
Antilhue new	47.0	Open cycle	Diesel	Ene-05	15.5	29.5	929.1	9.9%
Horcones TG	24.3	Open cycle	Natural Gas	Sep-04	47.3	69.7	707.2	23.1%
Ralco	690.0	Reservoir	Hydro	Sep-04	2,703.6	3,085.8	0.0	46.6%
Valdivia	61.0	Biomass / Steam	Biomass	May-04	269.7	349.0	0.0	62.3%
Licantén	5.5	Biomass / Steam	Biomass	Abr-04	22.6	24.0	0.0	62.3%
Nehuenco II	390.4	Combined cycle	Natural Gas	Abr-04	2,998.9	3,014.0	402.3	62.1%
Nehuenco II (Open cycle)	250.0	Open cycle	Natural Gas	May-03	0.0	0.0	633.4	23.1%
Cholguán	13.0	Biomass / Steam	Biomass	Jun-03	83.7	86.2	0.0	62.3%
S. Fco. Mostazal	25.7	Open cycle	Diesel	Jul-02	1.9	11.1	967.0	9.9%
Chacabuquito	25.0	Run of the river	Hydro	Jul-02	164.1	168.4	0.0	58.8%
Nehuenco 9B	108.0	Open cycle	Natural Gas	Jun-02	9.5	13.8	**670.8**	23.1%
Mampil	49.0	Run of the river	Hydro	Abr-00	172.1	194.9	0.0	41.0%
Taltal (I and II)	244.9	Open cycle	Natural Gas	Feb-00	930.6	1,020.5	**585.6**	27.1%
Peuchén	77.0	Run of the river	Hydro	Ene-00	290.8	331.9	0.0	40.5%
Nehuenco	368.4	Combined cycle	Natural Gas	Ene-99	453.5	661.2	**609.7**	55.3%

TOTAL GEN. PER YEAR	**(GWh / yr)**		**38,065.8**	**40,119.6**
20% OF GEN. PER YEAR	**(GWh / yr)**		**7,613.2**	**8,023.9**
5 MOST RECENT PLANT GEN	**(GWh / yr)**		**400.3**	**618.2**

EMISSION FACTOR 5 PLANTS	**(tCO_2/GWh)**		**475.1**	**410.5**
EMISSION FACTOR 20% GEN	**(tCO_2/GWh)**		**251.4**	**248.8**

BUILD MARGIN	**(tCO_2/GWh)**		**251.4**	**248.8**

Note:
-These emission factors are estimations based on the CNE future expansion plan for the SIC grid.

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)

		2005	2006
Operating Margin	(tCO_2/GWh)	689.12	688.68
Build Margin	(tCO_2/GWh)	251.35	248.76
Combined Margin	**(tCO_2/GWh)**	**470.23**	**468.72**

Annex 4

MONITORING PLAN

Please refer to section D of this PDD.