

# **MONITORING REPORT**

## **Nueva Aldea Biomass Power Plant Phase 1**

**CDM Registration Reference Number: 0258**

### **VERSION 01**

#### **Monitoring period:**

**From: October 01, 2008**

**To: December 31, 2009**



**Celulosa Arauco y Constitución S.A.**

**July, 2010**

**SUMMARY TABLE**

|   |   |
|---|---|
| Name of the CDM project activity:                                     | Nueva Aldea Biomass Power Plant Phase 1                 |
| CDM registration reference number:                                    | 0258  |
| Starting date of the project activity:                                | 29/09/2003  |
| Starting date of the first crediting period:                          | 01/01/2005  |
| Length of the first crediting period:                                 | Seven (7) years.  |
| Maximum length of the crediting period:                               | 3 x Seven (7) years                                     |
| Period covered by the current monitoring report:                      | 01 October 2008 – 31 December 2009 (both days included) |
| <b>Total net emission reductions claimed in the monitored period:</b> | <b>233,820 tCO<sub>2</sub>eq</b>                        |

## 1. Project description and current status

### Project description

The project activity consists in a new 30 MW biomass cogeneration power plant located inside of an industrial complex by Arauco: the Nueva Aldea Industrial Complex. The Nueva Aldea Industrial Complex was built in two stages, and this project activity is part of the first stage.

The first stage of the Nueva Aldea Industrial Complex considered the construction of:

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

The project activity is designed to use own and third party biomass for electric power generation that would have otherwise been left in piles to natural decay. The project is presented by Celulosa Arauco y Constitución S.A. (from now on, Arauco) a leading forestry and pulp-producing company in South America.

The new cogeneration power plant is integrated to the rest of the mills in Phase 1. Approximately 60% of the electricity generated by the new power plant is destined to serve the power needs of the Nueva Aldea Industrial Complex Phase 1 mills. The remaining 40% of the electricity is sold mainly in the spot market and to some direct customers of Arauco Generación<sup>1</sup>.

When the Arauco management evaluated the Nueva Aldea Phase 1 Industrial Complex, it considered the surplus of biomass residues available in the area and the possibilities offered by the CDM. As a result, Arauco decided to install a new biomass cogeneration power plant instead of the traditional low-pressure boiler used for heat generation. Considering the higher operational complexity and cost associated to the more sophisticated alternative, the decision of building such power plant relied on the possibility of not depending on the SIC grid for electric power, on selling surplus power to the grid and on the benefits from being a CDM project activity.

The Nueva Aldea Phase 1 power plant project activity assists Chile's sustainable growth by providing electricity to the Nueva Aldea Complex and to the SIC grid through biomass power generation. Without the Nueva Aldea Phase 1 power plant, not only there would be no clean energy injection to the SIC, but the Complex itself would have to source its electric power requirements from the grid. In addition, this project accomplishes an additional greenhouse gas reduction benefit derived from a reduced disposal and/or uncontrolled burning of biomass residues, which results into significantly lower methane emissions.

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<sup>1</sup> Arauco Generación S.A. is a subsidiary of Arauco and provides administration services in the power generation business area.

The Project Proponent believes that biomass power generation constitutes a sustainable source of power generation that brings clear advantages to mitigating global warming. Using the natural resources in an efficient and rational way, the Nueva Aldea Phase 1 project activity helps to enhance the development of renewable energy sources in Chile, in particular the use of biomass generated as a by-product of the forestry industry, which has a significant potential in the country. The project activity is a good example of how to incorporate energy efficient technologies to the forest industry.

It is worthy to highlight that very few sawmills and wood panel mills in Chile (and probably in the world) have on-site power generation capacity, making the Nueva Aldea Biomass Power Plant Phase 1 quite unique and particular in its type.

### Baseline methodology

The baseline methodology applied to this project activity is:

*“Consolidated baseline methodology for grid-connected electricity generation from biomass residues”, ACM0006. (Version 01)*

And the baseline scenario applied to this project activity is baseline scenario N° 3.

### Documentation

The project was validated by DNV and registered on March 31, 2006. The Project Design Document, validation report, request for registration and registration approval are available on the UNFCCC website: <http://cdm.unfccc.int/Projects/registered.html>.

### Deviations approved by the Executive Board for the monitored period

The monitoring plan establishes that biomass residues combusted in the project plant must be measured. In this case, however, it was not possible to measure 100% of the biomass combusted in the power plant, since a small portion of the biomass generated inside the Nueva Aldea Phase 1 Complex was calculated based on measured values (e.g. measured production information). As a result, the Project Proponent presented the corresponding request for deviation on the monitoring plan, which was approved by the Executive Board in July, 2010. An explicit reference to this deviation is mentioned in this monitoring report below.

### Implementation and current status

The Nueva Aldea Biomass Power Plant Phase 1 project activity has been completed and operated just as described in the registered CDM PDD.

### Sustainability, economic and social well-being

The Nueva Aldea Biomass Power Plant Phase 1 reduces greenhouse gas emissions by replacing fossil fuel-based electricity generation and by avoiding methane emission due to biomass residues natural decay and/or uncontrolled burning.

The project promotes sustainable development by:

- Fostering the diversification of electricity generation towards renewable energy sources in the country.
- Using clean, efficient and top of the line technology to generate power, thus, conserving natural resources and the environment.
- Becoming a benchmark of an efficient and renewable energy generation project in the country. This encourages the development of modern and more efficient generation of electricity and thermal energy throughout the country using renewable biomass sources.

## 2. Monitored parameters

All parameters needed to make the emission reduction calculations have been monitored according to the monitoring plan. The following table below provides information about the monitored data for the project and baseline emission data variables. Note that:

- 2008 values correspond to October to December year data.
- 2009 values correspond to full year data.

### Project activity monitored data

| ID number.     | Data variable.  | 2008 value   | 2009 value  | Monitoring systems and procedures  |
|----------------|---|--|---|--|
| 1. $BF_{i,y}$  | Quantity of biomass type i combusted in the project plant.              | 91,723 (BDt) <sup>2</sup>  | 354,554 (BDt)   | <p>The biomass residues are transported to the power plant by trucks and are measured (weight and volume) at the entrance of the power plant.</p> <p>Biomass residues generated internally are partly measured and partly calculated based on measured data. Since this constitute a deviation from the corresponding monitoring plan, the Project Proponent presented a request for deviation, which was approved by the EB in 2010.</p> <p>It must be noted that the Project Proponent already installed the missing meters required to measure (not calculate) all the biomass that is burned in the power plant.</p> <p>This variable is monitored continuously.</p> |
| 2. $NCV_i$     | Net calorific value of biomass fuel type i.                             | 17.97 (GJ/dry ton)   | 17.98 (GJ/dry ton)  | <p>The net calorific value of the biomass residues used in the power plant is measured in reputed external laboratories and according to proper industry standards.</p> <p>This variable is monitored once a year.</p>   |
| 3. $EF_{CH_4}$ | Methane emission factor for combustion of biomass in the project plant. | <p>15 (Kg <math>CH_4</math>/TJ), without conservativeness factor adjustment.</p> <p>15.3 (Kg <math>CH_4</math>/TJ), adjusted with a conservativeness factor of 1.02.</p> | <p>15 (Kg <math>CH_4</math>/TJ) without conservativeness factor adjustment.</p> <p>15.3 (Kg <math>CH_4</math>/TJ), adjusted with a conservativeness factor of 1.02.</p> | <p>The Project Proponent chose the default emission factor for controlled burning of biomass residues provided by the ACM0006 (Version 01).</p> <p>The reasons for which the 1.02 conservativeness factor was chosen can be found in page N° 56, section E.11 of the registered PDD. For further details about this emission factor, see the “Additional data” section of this Monitoring</p>  |

<sup>2</sup> BDt stands for “Bone dry ton” which means dry ton.

|   |  |                                  |                                   | Report.   |
|---|--|----------------------------------|-----------------------------------|---|
| 4. $AVD_y$  | Average return trip distance between biomass fuel supply sites and the project site. | 129 (km)                         | 153 (km)                          | <p>Distances from biomass suppliers to the Plant were continuously monitored and recorded.</p> <p>This variable is monitored continuously and reported monthly for the calculation of the emission reductions.</p>  |
| 5. $TL_y$   | Average truck load of the trucks used for transportation of biomass.                 | 25.2 (ton/truck)                 | 26.0 (ton/truck)                  | <p>Truck loads from transport subcontractors are measured using calibrated weight-bridges at the entrance of the Nueva Aldea Phase 1 complex.</p> <p>This variable is regularly monitored and reported on a monthly basis for the calculation of the emission reductions.</p> |
| 6. $EF_{km,CO_2}$   | Average $CO_2$ emission factor for transportation of biomass with trucks.            | 1.451 ( $tCO_2/km$ )             | 1.375 ( $tCO_2/km$ )              | <p>Average fuel consumption per kilometer was obtained from the transportation subcontractors, which was then used to calculate the corresponding <math>CO_2</math> emission factor.</p> <p>This variable was monitored once a year.</p>                                      |
| 7. $F_{Trans,i,y}$ (in the PDD, this variable appears as $OF_{i,y}$ )       | Fuel consumption of fuel type i used for transportation of biomass.                  | 12,415 (lt.) of diesel.          | 54,626 (lt.) of diesel.           | <p>This variable is obtained from the transportation subcontractors.</p> <p>This variable is monitored continuously.</p>  |
| 8. $COEF_{CO_2,i}$  | $CO_2$ emission factor for the fuel type i.  | Diesel: 3.172 ( $tCO_2/ton$ )    | Diesel: 3.012 ( $tCO_2/ton$ )     | <p>The emission factor was determined using the net calorific value, carbon content and fraction of carbon oxidized of the corresponding fossil fuel.</p> <p>These emission factors were determined annually.</p>   |
| 9. $FF_{project\ plant,i,y}$ (in the PDD, this variable appears as $FF_y$ ) | On-site fossil fuel consumption of fuel type i for co-firing in the project plant.   | Diesel consumption: 18,309 (lt.) | Diesel consumption: 176,932 (lt.) | <p>Fossil fuel consumption in the power boiler is measured by dedicated meters. Note that only the fossil fuel attributed to the project activity is reported here.</p> <p>This variable is continuously monitored.</p>   |
| 10. $EG_{project\ plant,y}$   | Net quantity of electricity generated in the project plant during the year y.        | 54.6 (GWh)                       | 204.7 (GWh)                       | <p>The electricity generated by the project plant is continuously measured using dedicated meters.</p> <p>This variable is continuously monitored.</p>  |

|                 |  |   |  |   |
|-----------------|--|---|--|---|
| 11. $Q_y$       | Net quantity of heat generated from firing biomass in the project plant.   | 604,303 (GJ)  | 2,142,963 (GJ)   | <p>The net quantity of heat generated from firing biomass residues in the project plant is measured using dedicated meters.</p> <p>This variable is continuously monitored.</p>   |
| 12. $EF_y$      | CO <sub>2</sub> emission factor of the grid.   | 664.98 (tCO <sub>2</sub> /GWh)  | 636.74 (tCO <sub>2</sub> /GWh)   | <p>This emission factor is calculated using equation N° 10 of the ACM0002 (Version 04), as the average of the OM and BM emission factors.</p> <p>The calculation of this emission factor is in the Annex of this Monitoring Report.</p>   |
| 13. $EF_{OM,y}$ | CO <sub>2</sub> Operating Margin emission factor of the grid.  | 860.2 (tCO <sub>2</sub> /GWh)   | 837.0 (tCO <sub>2</sub> /GWh)  | <p>This emission factor is calculated using equation N° 4 of the ACM0002 (Version 04), according the simple adjusted OM method. Full year data was used to calculate each emission factor.</p> <p>The calculation of this emission factor is in the Annex of this Monitoring Report.</p>  |
| 14. $EF_{BM,y}$ | CO <sub>2</sub> Build Margin emission factor of the grid.  | 469.7 (tCO <sub>2</sub> /GWh)   | 436.4 (tCO <sub>2</sub> /GWh)  | <p>This emission factor is calculated using equation N° 9 of the ACM0002 (Version 04). In this case, the BM was calculated for each year (ex-post) and in each case, the weighted average of the emission coefficients of the most recent power plants responsible for 20% of the total power generation each year was used. Full year data was used to calculate each emission factor.</p> <p>The calculation of this emission factor is in the Annex of this Monitoring Report.</p> |
| 15. $F_{i,y}$   | Amount of each fossil fuel consumed by each power source / plant.  | See the Annex at the end of this Monitoring Report.   | See the Annex at the end of this Monitoring Report.  | This information was directly obtained from the CDEC-SIC Dispatch Center or directly from the electric power companies themselves.  |
| 16. $COEF_i$    | CO <sub>2</sub> emission coefficient of each fuel type $i$ consumed by the electric power generators in the relevant grid. | <p>Units in (tCO<sub>2</sub>/000ton) except Nat. Gas (tCO<sub>2</sub>/MMm<sup>3</sup>)</p> <p>Coal: 2,814<br/> Petcoke: 2,857<br/> Diesel: 3,378<br/> Nat. Gas: 2,193<br/> IFO 180: 3,401</p> | <p>Units in (tCO<sub>2</sub>/000ton) except Nat. Gas (tCO<sub>2</sub>/MMm<sup>3</sup>)</p> <p>Coal: 2,814<br/> Petcoke: 2,857<br/> Diesel: 3,378<br/> Nat. Gas: 2,193<br/> IFO 180: 3,401<br/> Butane: 3,195<br/> Propane: 3,195</p> | This factor was calculated using IPCC default values (Carbon content and fraction of carbon oxidized) and local national data (Net calorific values of the corresponding fossil fuels).   |
| 17.             | Electricity  | See the Annex at  | See the Annex at   | This information was directly obtained from the   |



|                                    |   |  |  |  |
|------------------------------------|---|--|--|--|
| $GEN_{j/k/n,y}$                    | generation of each power source / plant j/k or n.   | the end of this Monitoring Report.   | the end of this Monitoring Report.   | CDEC-SIC Dispatch Center.  |
| 18.                                | Identification of power source / plant for the OM calculation.  | See the Annex at the end of this Monitoring Report.                                | See the Annex at the end of this Monitoring Report.                                | This information was directly obtained from the CDEC-SIC Dispatch Center.                        |
| 19.                                | Identification of power source / plant for the BM calculation.  | See the Annex at the end of this Monitoring Report.                                | See the Annex at the end of this Monitoring Report.                                | This information was directly obtained from the CDEC-SIC Dispatch Center.                        |
| 20. $\lambda_y$                    | Fraction of time during which low-cost / must-run sources are on the margin.  | 0  | 0.00022831050  | This factor was calculated from information directly obtained from the CDEC-SIC Dispatch Center. |
| 21.a<br>$GEN_{j/k/l,y}$<br>IMPORTS | Electricity imports to the project electricity system.  | Does not apply, since there is no interconnection with other transmission systems. | Does not apply, since there is no interconnection with other transmission systems. | This information was directly obtained from the CDEC-SIC Dispatch Center.                        |
| 21.b<br>$COEF_{i,j,y}$<br>IMPORTS  | CO <sub>2</sub> emission coefficient of fuels used in connected electricity systems (if imports occur).                 | Does not apply, since there is no interconnection with other transmission systems. | Does not apply, since there is no interconnection with other transmission systems. | This information was directly obtained from the CDEC-SIC Dispatch Center.                        |
| 22. $BF_{i,y}$                     | Amount of biomass type i for which leakage could not ruled out using one of the approaches in the baseline methodology. | 0 (BDt)  | 0 (BDt)  | The project did not cause any leakage effect during the monitored period.                        |
| 23.                                | Amount of biomass of type i fired in all grid-  | See table on the leakage section of this Monitoring Report.                        | See table on the leakage section of this Monitoring Report.                        | Leakage effects were duly considered following the L2 criteria of the ACM0006 (Version 01).      |

|                              |   |   |   |   |
|------------------------------|---|---|---|---|
|                              | connected power plants in the region / country.   |   |   |   |
| 24.                          | Amount of biomass of type i that is available in surplus in the region / country.   | See table on the leakage section of this Monitoring Report. | See table on the leakage section of this Monitoring Report. | Leakage effects were duly considered following the L2 criteria of the ACM0006 (Version 01).                       |
| 25.<br>COEF <sub>CO2,j</sub> | CO <sub>2</sub> emission factor of the most carbon intensive fuel in the calculation of the combined margin with methodology ACM0002. | Units in (tCO <sub>2</sub> /000ton)<br><br>IFO 180: 3,401   | Units in (tCO <sub>2</sub> /000ton)<br><br>IFO 180: 3,401   | This variable was not used, since the project activity did not cause any leakage effects in the monitored period. |

Other monitored data:

| ID number. | Data variable.   | Additional comments  |
|------------|------------------|--|
| 26.        | Biomass moisture | Biomass moisture is constantly measured at the Nueva Aldea Complex, using proper calibrated meters.  |
| 27.        | Biomass origin   | All biomass fuels used in the Nueva Aldea biomass power plant Phase 1 fully comply with the Chilean law. This ensures the renewable origin of the biomass. |

To perform the emission reduction calculation, the Project Proponent monitored the following additional data:

Additional data:

|   |  |
|---|--|
| BDt / m <sup>3</sup> st   | This factor was monitored each month to determine the amount of bone-dry ton (BDt) of biomass from humid volumetric quantities of biomass (cubic meters). To do so, the volume, the biomass humidity and the weight of the biomass were used and monitored at the plant.   |
| CH <sub>4</sub> emission factor for uncontrolled burning of biomass                   | <p>According to the baseline methodology ACM0006 (Version 01), page 33, the Project Proponent may undertake measurements or use referenced default values to calculate the CH<sub>4</sub> baseline emissions from uncontrolled burning of biomass. Given that by the time the PDD was written there were no local measurements available, the validator indicated the Project Proponent to use the IPCC default factor corrected by the lowest conservativeness factor (Table N°4, page 34 of the ACM0006 Version 01). This generated extremely conservative CH<sub>4</sub> baseline emissions for the project activity, since when the biomass residues are burned in piles in the open air, the combustion occurs under very low oxygen conditions and therefore is very inefficient. Inefficient combustion leads to high CH<sub>4</sub> emissions. As a result, the Project Proponent explicitly mentioned in page 67 of the registered PDD and in page A39 of the validation report that a local CH<sub>4</sub> measurement would be attempted in the future in order to have a more accurate and fair estimation of the baseline emissions from this source.</p> <p>During September 2006, the Project Proponent hired the U.S. Forest Service of Missoula, USA to conduct a local measurement of the CH<sub>4</sub> emission factor for uncontrolled burning of biomass in the nearby area of the Power Plant. The result of this measurement indicated a CH<sub>4</sub> emission factor for uncontrolled burning of the same type of biomass used in the Nueva Aldea Power Plant Phase 1 of 740.5 (Kg CH<sub>4</sub>/TJ), with an associated standard deviation of 162.2 (Kg CH<sub>4</sub>/TJ). According to Table 4 of the ACM0006 (Version 01) baseline methodology, this led to a conservativeness factor of 0.94<sup>3</sup>, resulting in an adjusted CH<sub>4</sub> baseline emission factor for uncontrolled burning of biomass of 696.1 (Kg CH<sub>4</sub>/TJ).</p> <p>The conservativeness and appropriateness of this measured factor has been subsequently ratified by other (new) measurements carried out by the Project Proponent for other CDM project activities in the region. The emission factor used in this case is lower than the same emission factor measured under very conservative conditions.</p> |
| CH <sub>4</sub> emission factor for controlled burning of biomass in the power boiler | The Project Proponent requested the U.S. Forest Service of Montana to carry out a CH <sub>4</sub> emission factor measurement for controlled burning of biomass in two fluidized bed boilers, similar to the one used in the Nueva Aldea Phase 1 power plant (in fact, one of the boilers was the Nueva Aldea Phase 1 boiler). The results of the measurements indicated that the CH <sub>4</sub> concentration in the flue gases (in ppm) was actually lower than the concentration of CH <sub>4</sub> found in the clean air. In other words, the combustion of the biomass residues in a fluidized bed boiler was so efficient, that actually withdrew CH <sub>4</sub> from the clean air <sup>4</sup> . Considering this result and that the Project Proponent is using a positive (15.3 (Kg CH <sub>4</sub> /TJ)) IPCC default factor for controlled burning of biomass to calculate this project emission source, this calculation is extremely conservative.  |
| ε <sub>boiler</sub>   | <p>This is the energy efficiency of the boiler that would be used in the absence of the project activity. This parameter is used in equation 24 of the ACM0006 (Version 01).</p> <p>The efficiency of the boiler that would have been installed in the absence of the project activity is 85%. This efficiency value was determined based on the efficiency calculation of a real low-pressure boiler installed in one of the Arauco industrial facilities. The efficiency was calculated in accordance with the ASME PTC 4.1 standard and was further validated by an expert opinion from a highly reputed consulting company, in the field of heat and power generation.</p>   |

<sup>3</sup> A 95% confidence interval was calculated to determine the corresponding uncertainty range for the sample mean.

<sup>4</sup> According to the final measurement report, the flue gases of the power boiler presented lower concentration of CH<sub>4</sub> (0.55 ppm) than clean air levels (1.7 ppm to 2 ppm). Therefore, the combustion process in power generation resulted in a net loss of CH<sub>4</sub> from the air used.

|                                      |   |              |              |
|--------------------------------------|---|--------------|--------------|
| Density of fossil fuels used on-site | Density values for each year were obtained from reputed laboratories. |              |              |
|                                      |   | 2008         | 2009         |
|                                      | Diesel  | 0.84 (kg/lt) | 0.84 (kg/lt) |

## Leakage

Though there are no official studies in the country about the supply / demand situation of forest biomass in the relevant area, the Project Proponent performed annual studies for 2008 and 2009 using official bulletins from INFOR<sup>5</sup> as well as other (whenever available) official sources to calculate the biomass supply and demand situation in the Nueva Aldea Biomass Power Plant Phase 1 influence area<sup>6</sup>. This study was part of the monitoring plan of the Nueva Aldea Phase 1 project activity and was carried out according approach L2 of the baseline methodology.

A detailed Excel spreadsheet with the monitored data and the calculation of the forest biomass supply / demand situation each year was provided to the DOE to establish the quality and validity of the data sources and the accuracy of the calculated numbers. The following table provides the final results of such study:

### SUPPLY / DEMAND SITUATION

(According to the "L2" criteria to establish leakage in the ACM0006 baseline methodology)

#### NUEVA ALDEA PHASE 1 INFLUENCE AREA SUPPLY / DEMAND SITUATION

|                                    |                             |                  |                  |
|------------------------------------|-----------------------------|------------------|------------------|
| <b>Biomass supply</b>              |                             | <b>2008</b>      | <b>2009</b>      |
| <b>Total supply</b>                | <b>(m<sup>3</sup>st/yr)</b> | <b>6,052,432</b> | <b>9,813,641</b> |
| <b>Biomass demand</b>              |                             |                  |                  |
| <b>Total demand</b>                | <b>(m<sup>3</sup>st/yr)</b> | <b>3,211,235</b> | <b>6,402,091</b> |
| <b>Total supply / total demand</b> | <b>(number)</b>             | <b>1.8848</b>    | <b>1.5329</b>    |

According to the table above, it is clear that the quantity of available biomass in the influence area of the project activity is greater than the 25% threshold established in option L2 of the consolidated baseline methodology. This result is consistent with the fact that in the last years the existing biomass power plant in the Nueva Aldea Phase 1 project influence area continue to operate without restriction and that new biomass based projects are being considered in the area<sup>7</sup>.

From the above analysis, it is possible to conclude that the Nueva Aldea Biomass Power Plant Phase 1 has not caused a biomass supply shortage in its influence area and therefore, has not caused other biomass consumers to switch from biomass fuels to fossil fuel sources. For these reasons, the associated leakage is considered to be zero.

$$L_y = 0$$

<sup>5</sup> INFOR stands for "Instituto Nacional Forestal" or "National Forestry Institute" in English.

<sup>6</sup> The Nueva Aldea Biomass Power Plant Phase 1 influence area is clearly defined in page 63 of the registered PDD.

<sup>7</sup> Including some prospective CDM biomass projects.

### Biomass sources

The Nueva Aldea Biomass Power Plant Phase 1 sources a small portion (less than 10%) of its biomass fuels from nearby sawmills. As established in the revised monitoring plan, the Project Proponent ensures that all the biomass received at the plant comes from legal sources, which automatically implies that it is biomass that comes from sustainably managed forests. This is accomplished by the monitoring of variable N° 27.

Each time a biomass supplier delivers biomass fuels to the Nueva Aldea Biomass Power Plant Phase 1, the supplier must sign a reception bill in which the supplier declares to know and comply with the outstanding Chilean forest law. This law mandates that all harvested forest plantations must be replanted; therefore it guarantees the sustainable source of the biomass fuels (as well as the source of any other products from the forest industry). The law also establishes that the purchase of products that come from illegally managed forestlands is also considered illegal in Chile.

The Chilean forest law is stringent and effectively monitored by the corresponding authority. Failing to comply with the law may imply hefty penalties for the transgressors in some cases. For these reasons all the Arauco industrial facilities tend to be very selective in choosing their suppliers and have tight quality controls in the reception of the raw-materials.

### Quality assurance

Quality control and quality assurance mechanisms for the monitored data were implemented as mentioned in the registered PDD. The following table provides the corresponding information for the monitored period.

| Data                  | Uncertainty level                                  | QA/QC procedures implemented during the monitored period.  |
|-----------------------|--|--|
| 1                     | Low  | <p>All instruments involved in the measurement of biomass flows received maintenance and calibration according to the manufacturer's manual and / or proper industry standards. Since the Nueva Aldea Complex (as well as most of Arauco facilities) uses the SAP systems, there are periodic and continuous consistency checks between the information that is loaded in SAP and the receipts from all suppliers including biomass. This is necessary not only to ensure the accuracy of the information used to calculate the Nueva Aldea Phase 1 net emission reductions, but also to ensure the good quality of the information used for accounting and tax-reporting purposes. This further ensures the good quality of the information used to calculate the emission reductions of the Nueva Aldea Phase 1 project.</p> <p>In addition to the above, the Project Proponent carried out energy balances on a periodic basis as a consistency crosschecking measure. All biomass values were consistent with the efficiency of the power plant.</p> |
| 2                     | Low  | <p>During the monitored period, the NCV of the biomass type combusted in the power boiler was measured each year, presenting minimum differences from one year to another. Comparisons with corresponding IPCC default values also validated and confirmed the measured values.</p>  |
| 3, 6, 8, 16, 21.b, 25 | Low (CO <sub>2</sub> ) / Medium (CH <sub>4</sub> ) | <p>Local values were used whenever possible. In cases in which they were not available, IPCC factors were used instead.</p>  |
| 4                     | Low  | <p>Since the location of each biomass supplier is known (practically 100% of the third party biomass comes from permanent type sawmills in the nearby area), distances were obtained from the transportation subcontractors and verified in regional roadmaps.</p>   |
| 5                     | Low  | <p>Trucks that transport the biomass are all of known (recorded) sizes. This variable was obtained from measured data (weight and volume of the cargo). Electronic weighbridges in which the measurements were performed receive periodic calibration and maintenance.</p>   |
| 7, 9                  | Low  | <p>Fuel meters received periodic maintenance and calibration and the consistency of metered fuel consumption was checked with purchase dispatch bills.</p>   |
| 10                    | Low  | <p>Electricity meters received periodic maintenance and calibration as per instructed by the equipment manufacturer. In addition, the Nueva Aldea Phase 1 administration performed periodic (monthly) consistency checks in the substation electric bus where the Nueva Aldea Biomass Power Plant Phase 1 connects to the SIC grid.</p> <p>Finally, the plant manager also performed consistency checks between the total energy generated by the cogeneration plant (heat and power) and the amount of fuels combusted in the power plant during the monitored period. All values proved to be consistent and in line with the energy efficiency of the power plant.</p>  |

|                                     |        |  |
|-------------------------------------|--------|--|
| 11                                  | Low    | Heat quantities are directly measured by dedicated steam flow meters and pressure / temperature meters. The associated uncertainty is very low, since these parameters are key to the production processes of the Nueva Aldea Complex and therefore, receive periodic maintenance according to proper industry standards.                  |
| 12, 13, 14, 15, 17, 18, 19, 20, 21a | Low    | As mentioned in the PDD, the quality control of this data is beyond the control of the project operator. However, the Project Proponent calculated this emission coefficient from official and publicly available data from the CDEC-SIC Dispatch Center.  |
| 22, 23, 24                          | Medium | The biomass surplus index was calculated using as much official information as possible. Practical consistency checks were performed whenever it was feasible (i.e. low cost biomass power plants in the influence area continue being low cost-must run power units after the Nueva Aldea Biomass Power Plant Phase 1 started operating). |
| 26.                                 | Low    | The measured data is constantly compared with historic data in order to avoid or minimize errors.  |
| 27                                  | Low    | In most cases, the Nueva Aldea Phase 1 biomass suppliers have some kind of sustainability certification (i.e. Certfor) or have signed supply contracts explicitly declaring to comply with the outstanding forest Chilean law which guarantees a sustainable origin of the biomass sold to the Nueva Aldea plant.                          |

In addition to the above, the Project Proponent developed a dedicated information system designed exclusively to guarantee the quality of the information related to the Nueva Aldea Phase 1 CDM project activity. During 2006/2007, this system was successfully incorporated to the Nueva Aldea's ISO-14,001 / OHSAS 18,001 systems.



### 3. Emission reductions

#### 3.1 Calculation formulas

As presented in the PDD and according to the baseline methodology, the net emission reduction calculation formula for the Nueva Aldea Phase 1 project is:

$$\text{Project Activity Net Emission savings} = \text{Baseline Emissions} - \text{Project Activity Emissions} - \text{Leakage}$$

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 grid electricity displacement (tCO<sub>2</sub>/yr).

$BL_{E2,y}$  : Baseline emissions from avoided biomass disposal (tCO<sub>2</sub>eq/yr).

$P_{E1,y}$  : Project emissions from biomass controlled burning in the Power Plant (tCO<sub>2</sub>eq/yr).

$P_{E2,y}$  : Project emissions from biomass transportation to the biomass Power Plant (tCO<sub>2</sub>/yr).

$P_{E3,y}$  : Project emissions from biomass transportation within the Power Plant site (tCO<sub>2</sub>/yr).

$P_{E4,y}$  : Project emissions from fossil fuel consumption in the Power Plant (tCO<sub>2</sub>/yr).

$L_y$  : Are the leakage emissions (tCO<sub>2</sub>/yr).

### 3.2 Emission reduction calculation

Please note the following:

1. The baseline and project emissions calculations below may present some minor imprecision due to some decimal rounding.
2. Since the emission reduction calculation for the project activity was done monthly, the calculation below (carried out for the entire monitored period) had to consider weighted averages for some variables.

#### Baseline emissions

##### 1. Baseline emissions due to electricity displacement

In this case, the electricity displaced from the grid corresponds to the net quantity of electricity generation in the project plant ( $EG_y = EG_{\text{projectplant}}$ ). The baseline emissions due to electricity displacement are calculated using equation N° 8 of the ACM0006 (Version 01).

According to the above, the net electricity displaced by the project activity is calculated as follows:

Data:

|   | Units                   | 2008   | 2009   |
|---|-------------------------|--------|--------|
| (1) Combined margin for the SIC grid                  | (tCO <sub>2</sub> /GWh) | 664.98 | 636.74 |
| (2) Net quantity of electricity displaced by the p.a. | (GWh)                   | 54.6   | 204.7  |

Calculations:

|  |                |                                 |                                  |
|--|----------------|---------------------------------|----------------------------------|
| <b>(3) Total grid emission savings</b> | <b>(1)*(2)</b> | <b>36,293 (tCO<sub>2</sub>)</b> | <b>130,360 (tCO<sub>2</sub>)</b> |
|--|----------------|---------------------------------|----------------------------------|

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

To calculate this emission source, it is necessary first to calculate the quantity of biomass residues used as a result of the project activity. In this case, this is done using equation N° 24 of the ACM0006 (Version 01).

Data:

|   | Units                    | 2008    | 2009      |
|---|--------------------------|---------|-----------|
| (1) Total biomass residues combusted.                             | (BDt)                    | 91,723  | 354,554   |
| (2) Net calorific value of biomass (dry basis).                   | (GJ/ton)                 | 17.97   | 17.98     |
| (3) Quantity of heat generated in the cogen. plant.               | (GJ)                     | 604,303 | 2,142,963 |
| (4) Energy efficiency of the baseline boiler.                     | (%)                      | 85%     | 85%       |
| (5) EF <sub>CH<sub>4</sub></sub> for uncontrolled biomass burning | (Kg CH <sub>4</sub> /TJ) | 696.1   | 696.1     |
| (6) CH <sub>4</sub> global warming potential                      | (number)                 | 21      | 21        |

Calculations:

|  |                                    |                                 |                                 |
|--|------------------------------------|---------------------------------|---------------------------------|
| (7) Biomass combusted in the baseline                  | (3)/[(2)*(4)]                      | 39,571 (BDt)                    | 140,197 (BDt)                   |
| (8) Incremental biomass use                            | (1)-(7)                            | 52,152 (BDt)                    | 214,358 (BDt)                   |
| <b>(9) CH<sub>4</sub> avoidance baseline emissions</b> | <b>[(8)*(2)/1,000,000]*(5)*(6)</b> | <b>13,696 (tCO<sub>2</sub>)</b> | <b>56,347 (tCO<sub>2</sub>)</b> |

Total baseline emissions

| Baseline emission sources                          | 2008                              | 2009                               |
|--|-----------------------------------|------------------------------------|
| Baseline emissions due to electricity displacement | 36,293 (tCO <sub>2</sub> )        | 130,360 (tCO <sub>2</sub> )        |
| Baseline emissions due to methane avoidance        | 13,696 (tCO <sub>2</sub> eq)      | 56,347 (tCO <sub>2</sub> eq)       |
| <b>Total baseline emissions</b>                    | <b>49,989 (tCO<sub>2</sub>eq)</b> | <b>186,707 (tCO<sub>2</sub>eq)</b> |

Project emissions1. Carbon dioxide emissions from biomass residues transportation to the power plant

This emission source is calculated using equation N° 4 of the ACM0006 (Version 01).

Data:

|  | Units                  | 2008  | 2009   |
|--|------------------------|-------|--------|
| (1) Biomass brought from 3 <sup>rd</sup> parties related to the p. plant (dry) | (BDt)                  | 7,946 | 31,868 |
| (2) Biomass average humidity (wet basis) (See note)                            | (%)                    | 52.9% | 52.9%  |
| (3) Approximate load for 1 trip  | (ton)                  | 25.2  | 26.0   |
| (4) Average round trip   | (km)                   | 129   | 153    |
| (5) Emission factor for heavy truck transportation (See note)                  | (tCO <sub>2</sub> /km) | 1.451 | 1.375  |

Note: Since this parameter is reported monthly, an average was used for simplicity.

Calculations:

|                               |  |                              |                              |
|-------------------------------|--|------------------------------|------------------------------|
| (6) Biomass transported (wet) | $(1)/[1 - (2)]$  | 16,588 (wet ton)             | 67,342 (wet ton)             |
| (7) Number of trips needed    | $(6) / (3)$  | 660 (trips)                  | 2,594 (trips)                |
| (8) Total distance traveled   | $(4)*(7)$  | 85,385 (km)                  | 395,673 (km)                 |
| <b>(9) Total emissions</b>    | <b><math>(5)*(8)*(1\text{ton}/1,000\text{kg})</math></b> | <b>124 (tCO<sub>2</sub>)</b> | <b>544 (tCO<sub>2</sub>)</b> |

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

This emission source is calculated using equation N° 6 of the ACM0006 (Version 01). The project activity implies additional fossil fuel consumption due to:

- Fossil fuel consumption is due to operational reasons associated to additional biomass consumption (e.g. biomass too wet in winter, etc.).
- Fossil fuel consumption due to on-site additional biomass transportation.

### Data:

|   | Units                   | 2008   | 2009    |
|---|-------------------------|--------|---------|
| (1) Additional diesel consumption in the Power Boiler         | (lt.)                   | 18,309 | 176,932 |
| (2) Additional diesel consumption for on-site biomass transp. | (lt.)                   | 12,415 | 54,626  |
| (3) Diesel density  | (kg/lt)                 | 0.84   | 0.84    |
| (4) Diesel CO <sub>2</sub> emission factor                    | (tCO <sub>2</sub> /ton) | 3,172  | 3,012   |

### Calculations:

|  |                             |                             |                              |
|--|-----------------------------|-----------------------------|------------------------------|
| (5) Diesel in Power Boiler               | $[(1)*(3)/1,000]*(4)$       | 49 (tCO <sub>2</sub> )      | 448 (tCO <sub>2</sub> )      |
| (6) Diesel in on-site biomass transport. | $[(2)*(3)/1,000]*(4)$       | 33 (tCO <sub>2</sub> )      | 138 (tCO <sub>2</sub> )      |
| <b>(7) Total emissions</b>               | <b><math>(5)+(6)</math></b> | <b>82 (tCO<sub>2</sub>)</b> | <b>586 (tCO<sub>2</sub>)</b> |

## 4. Methane emissions from combustion of biomass residues

This emission source is calculated using equation N° 7 of the ACM0006 (Version 01). Since the project activity implies additional biomass from forest operations consumption in the power boiler, the only source of methane emissions attributed to the project activity is the one related to this additional consumption under controlled burning conditions.

### Data:

|   | Units                    | 2008   | 2009    |
|---|--------------------------|--------|---------|
| (1) Biomass related to project activity                         | (BDt)                    | 52,152 | 214,358 |
| (2) Net calorific value of biomass (dry basis).                 | (GJ/ton)                 | 17.97  | 17.98   |
| (3) EF <sub>CH<sub>4</sub></sub> for controlled biomass burning | (Kg CH <sub>4</sub> /TJ) | 15.3   | 15.3    |
| (4) CH <sub>4</sub> global warming potential                    | (number)                 | 21     | 21      |

Calculations:

|                                     |                                    |                              |                                |
|-------------------------------------|------------------------------------|------------------------------|--------------------------------|
| <b>(5) CH<sub>4</sub> emissions</b> | <b>[(1)*(2)*(3)/1,000,000]*(4)</b> | <b>301 (tCO<sub>2</sub>)</b> | <b>1,239 (tCO<sub>2</sub>)</b> |
|-------------------------------------|------------------------------------|------------------------------|--------------------------------|

Total project emissions

| Project emission sources   | 2008                           | 2009                             |
|--|--------------------------------|----------------------------------|
| Project emissions from biomass transportation to the power plant | 124 (tCO <sub>2</sub> )        | 544 (tCO <sub>2</sub> )          |
| Project emissions from on-site consumption of fossil fuels       | 82 (tCO <sub>2</sub> )         | 586 (tCO <sub>2</sub> )          |
| Project emissions from biomass controlled burning                | 301 (tCO <sub>2</sub> eq)      | 1,239 (tCO <sub>2</sub> eq)      |
| <b>Total project emissions</b>                                   | <b>507 (tCO<sub>2</sub>eq)</b> | <b>2,369 (tCO<sub>2</sub>eq)</b> |

Net emission reductions for the monitored period

|                                | 2008                              | 2009                               |
|--------------------------------|-----------------------------------|------------------------------------|
| Baseline emissions             | 49,989 (tCO <sub>2</sub> eq)      | 186,707 (tCO <sub>2</sub> eq)      |
| Project emissions              | -507 (tCO <sub>2</sub> eq)        | -2,369 (CO <sub>2</sub> eq)        |
| Leakage                        | 0 (tCO <sub>2</sub> )             | 0 (tCO <sub>2</sub> )              |
| <b>Net emission reductions</b> | <b>49,482 (tCO<sub>2</sub>eq)</b> | <b>184,338 (tCO<sub>2</sub>eq)</b> |

### Summary of the monthly emission reductions for the monitored period

For the calculation of the net emission reductions of the Nueva Aldea Biomass Power Plant Phase 1 project activity, an Excel spreadsheet with the monitored data and the monthly calculation of the net emission reductions was provided to the DOE for the verification of the calculated numbers. For informative purposes, this monitoring report provides a table that shows the monthly net emission reduction of the project activity:

#### Net emission savings per month

| (Months)                                    | Net emission savings<br>(tCO <sub>2</sub> eq/yr) | Baseline emissions                       |   | Project activity emissions                  |   |  |   | Leakage<br>(tCO <sub>2</sub> /yr) |
|---|--|--|---|---|---|--|---|-----------------------------------|
|   |  | Grid emissions<br>(tCO <sub>2</sub> /yr) | Methane emissions<br>(tCO <sub>2</sub> eq/yr) | Methane in P.B.<br>(tCO <sub>2</sub> eq/yr) | Fossil fuel in P.B.<br>(tCO <sub>2</sub> /yr) | Transport onsite<br>(tCO <sub>2</sub> /yr) | Transport to P. Plant<br>(tCO <sub>2</sub> /yr) |                                   |
| <b>Year 2008</b>                            |  |  |   |   |   |  |   |                                   |
| October                                     | 16,302   | 12,237                                   | 4,176   | 92  | 9   | 10   | 0   | 0                                 |
| November                                    | 17,011   | 11,965                                   | 5,299   | 116   | 36  | 12   | 88  | 0                                 |
| December                                    | 16,169   | 12,092                                   | 4,221   | 93  | 4   | 11   | 36  | 0                                 |
| <b>Total year 2008</b>                      | <b>49,482</b>                                    | <b>36,293</b>                            | <b>13,696</b>                                 | <b>301</b>                                  | <b>49</b>                                     | <b>33</b>                                  | <b>124</b>                                      | <b>0</b>                          |
| <b>Year 2009</b>                            |  |  |   |   |   |  |   |                                   |
| January                                     | 15,663   | 11,600                                   | 4,404   | 97  | 33  | 11   | 200   | 0                                 |
| February                                    | 13,758   | 9,547                                    | 4,392   | 97  | 20  | 10   | 54  | 0                                 |
| March                                       | 15,857   | 10,970                                   | 5,049   | 111   | 17  | 12   | 22  | 0                                 |
| April                                       | 14,759   | 11,018                                   | 3,942   | 87  | 81  | 10   | 23  | 0                                 |
| May   | 15,972   | 11,144                                   | 5,068   | 111   | 84  | 11   | 34  | 0                                 |
| June  | 15,838   | 11,144                                   | 4,872   | 107   | 0   | 12   | 58  | 0                                 |
| July  | 16,499   | 11,416                                   | 5,271   | 116   | 9   | 13   | 50  | 0                                 |
| August                                      | 15,808   | 11,440                                   | 4,535   | 100   | 30  | 12   | 26  | 0                                 |
| September                                   | 14,956   | 10,308                                   | 4,812   | 106   | 12  | 11   | 34  | 0                                 |
| October                                     | 16,326   | 11,489                                   | 4,991   | 110   | 3   | 12   | 30  | 0                                 |
| November                                    | 13,490   | 9,658                                    | 3,945   | 87  | 11  | 13   | 2   | 0                                 |
| December                                    | 15,411   | 10,626                                   | 5,067   | 111   | 147   | 12   | 10  | 0                                 |
| <b>Total year 2009</b>                      | <b>184,338</b>                                   | <b>130,360</b>                           | <b>56,347</b>                                 | <b>1,239</b>                                | <b>448</b>                                    | <b>138</b>                                 | <b>544</b>                                      | <b>0</b>                          |
| <b>4<sup>th</sup> verif (Oct 08-Dec 09)</b> | <b>233,820.5</b>                                 | <b>166,653.3</b>                         | <b>70,042.8</b>                               | <b>1,539.6</b>                              | <b>496.6</b>                                  | <b>171.4</b>                               | <b>668.1</b>                                    | <b>0.0</b>                        |
| <b>Total emissions claimed</b>              | <b>233,820</b>                                   | <b>166,653</b>                           | <b>70,043</b>                                 | <b>1,540</b>                                | <b>497</b>                                    | <b>171</b>                                 | <b>668</b>                                      | <b>0</b>                          |

**Note:** Net emission savings = Baseline emissions - Project activity emissions - Leakage.

According to the project PDD, the estimated emission reductions for the period covered by this monitoring report should have been 158,349 CERs. The monitored emission reductions are 48% higher than the emissions estimated in the registered PDD. This difference can be explained by the following reasons:

- A higher grid emission factor for the year 2008 than the one originally estimated in the PDD. The actual grid emission factor for 2008 was 665.0 (tCO<sub>2</sub>/GWh), while the estimated grid emission factor for 2008 was in the PDD was 528.2 (tCO<sub>2</sub>/GWh). The actual grid emission factor for 2009 was virtually the same as the one estimated in the PDD. The reason for the higher grid emission factor in 2008 was the replacement of

natural gas<sup>8</sup> used for power generation for more carbon-intensive fossil-fuels, such as coal and diesel. This increased the overall GHG emissions in the SIC grid.

- A slightly higher electricity generation of the power plant in the monitored period: 259 (GWh) versus an estimation in the PDD of 241 (GWh). This can be explained due to a slightly higher up-time of the power plant than what was originally estimated in the PDD.
- A higher amount of CH<sub>4</sub> emission in the baseline compared to the baseline emission estimated in the PDD. The actual monitored CH<sub>4</sub> emissions was 70,043 (tCO<sub>2</sub>eq), while the estimated amount of CH<sub>4</sub> emissions estimated in the PDD was 12,972 (tCO<sub>2</sub>eq). There are two reasons that explain this:
  1. A higher CH<sub>4</sub> emission factor for uncontrolled burning of biomass residues than the one originally used in the PDD: 696.1 (Kg CH<sub>4</sub>/TJ) instead of 219 (Kg CH<sub>4</sub>/TJ). The higher CH<sub>4</sub> emission factor was directly measured by the Project Proponent, since the default emission factor originally used in the PDD severely underestimated the CH<sub>4</sub> emissions when burning the biomass residues in the open air. It must be noted though, that the measured methane emission factor used in this case was ratified with subsequent on-site measurements carried out by the Project Proponent under very conservative conditions; therefore the calculation of the baseline emissions using this factor remains conservative.
  2. A higher amount of biomass related to the project activity (e.g. for power generation) than the amount originally calculated in the PDD: 145,011 (BDt) versus 266,509 (BDt). This can be explained due to a change in the calculation methodology of the biomass related to the project activity. In the registered PDD, the Project Proponent used a fixed biomass performance index (from an energy/mass balance) to calculate the biomass related to the project activity instead of using equation N° 24 of the ACM0006 (Version 01). This was subsequently corrected, and a revised Monitoring Plan was approved in order to use equation N° 24 in the future, instead of the biomass performance index.

The combined effect of the reasons mentioned above explains the difference in emission reductions between the monitored results and the estimation done in the PDD.

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<sup>8</sup> Argentina stopped sending natural gas in 2004.

## **ANNEX**



# Nueva Aldea Biomass Power Plant Phase 1



POWER GENERATION IN 2008

| POWER PLANT                      | POWER OUTPUT (MW) | PLANT TYPE       | FUEL TYPE      | LOW COST / MUST RUN | TOTAL GEN 2008 | UNITS SPEC. CONSUM. | SPECIFIC CONSUMPTION |
|----------------------------------|-------------------|------------------|----------------|---------------------|----------------|---------------------|----------------------|
| Abancica                         | 136               | Run of the river | Hydro          | Yes                 | 342            | N.C.                | 0.000                |
| Acocagosa                        | 73                | Run of the river | Hydro          | Yes                 | 439            | N.C.                | 0.000                |
| Altalá                           | 178               | Run of the river | Hydro          | Yes                 | 907            | N.C.                | 0.000                |
| Alcud                            | 3                 | Diesel engines   | Diesel         | No                  | 6              | (kg/kWh)            | 0.242                |
| Antihua new (I and II)           | 50                | Open cycle       | Diesel         | No                  | 0              | (kg/kWh)            | 0.240                |
| Antihua TG                       | 101               | Open cycle       | Diesel         | No                  | 241            | (kg/kWh)            | 0.240                |
| Autuco                           | 320               | Reservoir        | Hydro          | Yes                 | 1,440          | N.C.                | 0.000                |
| Arauco                           | 15                | Biomass / Steam  | Biomass        | Yes                 | 12             | N.C.                | 0.000                |
| Bocamina                         | 125               | Coal / Steam     | Coal           | No                  | 958            | (kg/kWh)            | 0.388                |
| Campanario                       | 118               | Open cycle       | Natural Gas    | No                  | 19             | (m³/std-kWh)        | 0.392                |
| Campanario Diesel                | 118               | Open cycle       | Diesel         | No                  | 221            | (kg/kWh)            | 0.250                |
| Candelaria (Open cycle) 1        | 125               | Open cycle       | Natural Gas    | No                  | 23             | (m³/std-kWh)        | 0.296                |
| Candelaria (Open cycle) 1 Diesel | 125               | Open cycle       | Diesel         | No                  | 264            | (kg/kWh)            | 0.289                |
| Candelaria (Open cycle) 2        | 129               | Open cycle       | Natural Gas    | No                  | 12             | (m³/std-kWh)        | 0.296                |
| Candelaria (Open cycle) 2 Diesel | 129               | Open cycle       | Diesel         | No                  | 278            | (kg/kWh)            | 0.289                |
| Canillán                         | 172               | Reservoir        | Hydro          | Yes                 | 796            | N.C.                | 0.000                |
| Cafate                           | 2                 | Diesel engines   | Diesel         | No                  | 5              | (kg/kWh)            | 0.242                |
| Capillo                          | 12                | Run of the river | Hydro          | Yes                 | 69             | N.C.                | 0.000                |
| Casablanca 2                     | 2                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.231                |
| Casablanca 1                     | 1                 | Diesel engines   | Diesel         | No                  | 4              | (kg/kWh)            | 0.231                |
| Casablanca 2                     | 0                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.278                |
| Celco                            | 13                | Biomass / Steam  | Biomass        | Yes                 | 43             | N.C.                | 0.000                |
| Chacabuco                        | 25                | Run of the river | Hydro          | Yes                 | 177            | N.C.                | 0.000                |
| Chiburga                         | 30                | Run of the river | Hydro          | Yes                 | 98             | N.C.                | 0.000                |
| Choligún                         | 13                | Biomass / Steam  | Biomass        | Yes                 | 90             | N.C.                | 0.000                |
| Cigress                          | 106               | Reservoir        | Hydro          | Yes                 | 480            | N.C.                | 0.000                |
| Colibani-Mach                    | 569               | Reservoir        | Hydro          | Yes                 | 3,234          | N.C.                | 0.000                |
| Colipú                           | 3                 | Diesel engines   | Diesel         | No                  | 8              | (kg/kWh)            | 0.242                |
| Concon                           | 3                 | Diesel engines   | Diesel         | No                  | 7              | (kg/kWh)            | 0.226                |
| Constitución                     | 10                | Biomass / Steam  | Biomass        | Yes                 | 58             | N.C.                | 0.000                |
| Constitución 1                   | 9                 | Diesel engines   | Diesel         | No                  | 11             | (kg/kWh)            | 0.286                |
| Constitución 2                   | 6                 | Diesel engines   | Diesel         | No                  | 11             | (kg/kWh)            | 0.298                |
| Coronel                          | 46                | Open cycle       | Natural Gas    | No                  | 245            | (m³/std-kWh)        | 0.238                |
| Coronel Diesel                   | 46                | Open cycle       | Diesel         | No                  | 74             | (kg/kWh)            | 0.224                |
| Curacani                         | 3                 | Diesel engines   | Diesel         | No                  | 6              | (kg/kWh)            | 0.220                |
| Curanilahue                      | 2                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.000                |
| Curuma                           | 3                 | Diesel engines   | Diesel         | No                  | 6              | (kg/kWh)            | 0.220                |
| Cumlínque                        | 89                | Run of the river | Hydro          | Yes                 | 604            | N.C.                | 0.000                |
| D. de Almagro                    | 24                | Open cycle       | Diesel         | No                  | 58             | (kg/kWh)            | 0.353                |
| Degan                            | 36                | Diesel engines   | Diesel         | No                  | 68             | (kg/kWh)            | 0.219                |
| El Rincón                        | 0                 | Run of the river | Hydro          | Yes                 | 3              | N.C.                | 0.000                |
| El Tiro                          | 460               | Reservoir        | Hydro          | Yes                 | 1,206          | N.C.                | 0.000                |
| Esperanza 1                      | 2                 | Diesel engines   | Diesel         | No                  | 5              | (kg/kWh)            | 0.218                |
| Esperanza 2                      | 2                 | Diesel engines   | Diesel         | No                  | 4              | (kg/kWh)            | 0.228                |
| Esperanza TG                     | 18                | Open cycle       | Natural Gas    | No                  | 4              | (m³/std-kWh)        | 0.241                |
| Eyzaguirre                       | 2                 | Run of the river | Hydro          | Yes                 | 9              | N.C.                | 0.000                |
| Florida                          | 28                | Run of the river | Hydro          | Yes                 | 155            | N.C.                | 0.000                |
| FPD                              | 12                | Biomass / Steam  | Biomass        | Yes                 | 77             | (kg/kWh)            | 0.286                |
| Generadores Saena                | N.A.              | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.000                |
| Guaucala 1                       | 152               | Coal / Steam     | Coal / Petcoke | No                  | 1,245          | (kg/kWh)            | 0.373                |
| Guaucala 2                       | 152               | Coal / Steam     | Coal / Petcoke | No                  | 1,295          | (kg/kWh)            | 0.389                |
| Hormones Diesel                  | 24                | Open cycle       | Natural Gas    | No                  | 7              | (kg/kWh)            | 0.377                |
| Hormones TG                      | 24                | Open cycle       | Natural Gas    | No                  | 0              | (m³/std-kWh)        | 0.377                |
| Huasco TG Diesel                 | 64                | Open cycle       | Diesel         | No                  | 0              | (kg/kWh)            | 0.342                |
| Huasco TG IFO                    | 64                | Open cycle       | IFO 180        | No                  | 160            | (kg/kWh)            | 0.378                |
| Huasco TV                        | 16                | Open cycle       | Coal           | No                  | 0              | (kg/kWh)            | 0.000                |
| Isla                             | 68                | Run of the river | Hydro          | Yes                 | 454            | N.C.                | 0.000                |
| L. Verde TG                      | 19                | Open cycle       | Diesel         | No                  | 39             | (kg/kWh)            | 0.280                |
| L. Verde TV                      | 65                | Open cycle       | Coal / Steam   | No                  | 247            | (kg/kWh)            | 0.168                |
| Laja                             | 10                | Biomass / Steam  | Biomass        | Yes                 | 54             | N.C.                | 0.000                |
| Las Vegas                        | 2                 | Diesel engines   | Diesel         | No                  | 6              | (kg/kWh)            | 0.231                |
| Lebu                             | 2                 | Diesel engines   | Diesel         | No                  | 4              | (kg/kWh)            | 0.242                |
| Licanán                          | 6                 | Biomass / Steam  | Biomass        | Yes                 | 11             | N.C.                | 0.000                |
| Loma Alta                        | 40                | Run of the river | Hydro          | Yes                 | 256            | N.C.                | 0.000                |
| Los Molles                       | 18                | Run of the river | Hydro          | Yes                 | 68             | N.C.                | 0.000                |
| Los Monos                        | 3                 | Run of the river | Hydro          | Yes                 | 16             | N.C.                | 0.000                |
| Los Osillos                      | 39                | Run of the river | Hydro          | Yes                 | 262            | N.C.                | 0.000                |
| Los Saucos                       | 3                 | Diesel engines   | Diesel         | No                  | 5              | (kg/kWh)            | 0.242                |
| Los Ventos TG                    | 125               | Open cycle       | Diesel         | No                  | 351            | (kg/kWh)            | 0.255                |
| Madones                          | 29                | Run of the river | Hydro          | Yes                 | 137            | N.C.                | 0.000                |
| Mampí                            | 49                | Run of the river | Hydro          | Yes                 | 163            | N.C.                | 0.000                |
| Maulé                            | 6                 | Diesel engines   | Diesel         | No                  | 5              | (kg/kWh)            | 0.288                |
| Maulé Pátria                     | 9                 | Diesel engines   | Diesel         | No                  | 21             | (kg/kWh)            | 0.282                |
| Nehuenco                         | 368               | Combined cycle   | Natural Gas    | No                  | 0              | (m³/std-kWh)        | 0.198                |
| Nehuenco (Open cycle)            | 250               | Open cycle       | Diesel         | No                  | 98             | (kg/kWh)            | 0.000                |
| Nehuenco 9B                      | 108               | Open cycle       | Natural Gas    | No                  | 98             | (m³/std-kWh)        | 0.338                |
| Nehuenco 9B Diesel               | 108               | Open cycle       | Diesel         | No                  | 137            | (kg/kWh)            | 0.292                |
| Nehuenco Diesel                  | 368               | Combined cycle   | Diesel         | No                  | 312            | (kg/kWh)            | 0.160                |
| Nehuenco II                      | 390               | Combined cycle   | Natural Gas    | No                  | 190            | (m³/std-kWh)        | 0.198                |
| Nehuenco II (Open cycle)         | 250               | Open cycle       | Natural Gas    | No                  | 40             | (m³/std-kWh)        | 0.242                |
| Nehuenco II Diesel               | 376               | Combined cycle   | Diesel         | No                  | 2,203          | (kg/kWh)            | 0.166                |
| Nueva Aldea 1                    | 13                | Biomass / Steam  | Biomass        | Yes                 | 107            | N.C.                | 0.000                |
| Nueva Aldea 2                    | 10                | Open cycle       | Diesel         | No                  | 0              | (kg/kWh)            | 0.280                |
| Nueva Aldea 3                    | 20                | Biomass / Steam  | Biomass        | Yes                 | 210            | N.C.                | 0.000                |
| Nueva Renca                      | 379               | Combined cycle   | Natural Gas    | No                  | 1              | (m³/std-kWh)        | 0.219                |
| Nueva Renca Diesel               | 379               | Combined cycle   | Diesel         | No                  | 1,502          | (kg/kWh)            | 0.176                |
| Oñes                             | N.A.              | Open cycle       | Hydro          | Yes                 | 60             | N.C.                | 0.000                |
| Pangua                           | 467               | Reservoir        | Hydro          | Yes                 | 1,789          | N.C.                | 0.000                |
| Pehuente                         | 566               | Reservoir        | Hydro          | Yes                 | 2,754          | N.C.                | 0.000                |
| Petropower                       | 75                | Petcoke / Steam  | Petcoke        | Yes                 | 494            | (kg/kWh)            | 0.373                |
| Pichuán                          | 77                | Run of the river | Hydro          | Yes                 | 243            | N.C.                | 0.000                |
| Pitmanquén                       | 39                | Run of the river | Hydro          | Yes                 | 244            | N.C.                | 0.000                |
| Pullique                         | 48                | Run of the river | Hydro          | Yes                 | 320            | N.C.                | 0.000                |
| Puntaque                         | 9                 | Diesel engines   | Diesel         | No                  | 16             | (kg/kWh)            | 0.262                |
| Purulla                          | 14                | Run of the river | Hydro          | Yes                 | 149            | N.C.                | 0.000                |
| Quellón                          | 5                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.242                |
| Quillico                         | 70                | Run of the river | Hydro          | Yes                 | 263            | N.C.                | 0.000                |
| Ralco                            | 690               | Reservoir        | Hydro          | Yes                 | 2,573          | N.C.                | 0.000                |
| Rapel                            | 378               | Reservoir        | Hydro          | Yes                 | 1,034          | N.C.                | 0.000                |
| Renca                            | 97                | Diesel / Steam   | Diesel         | No                  | 12             | (kg/kWh)            | 0.285                |
| Rucúe                            | 178               | Run of the river | Hydro          | Yes                 | 886            | N.C.                | 0.000                |
| S. Fco. Mostazal                 | 26                | Open cycle       | Diesel         | No                  | 33             | (kg/kWh)            | 0.310                |
| San Ignacio                      | 37                | Run of the river | Hydro          | Yes                 | 213            | N.C.                | 0.000                |
| San Isidro                       | 379               | Combined cycle   | Natural Gas    | No                  | 795            | (m³/std-kWh)        | 0.278                |
| San Isidro 2 Diesel              | 248               | Combined cycle   | Diesel         | No                  | 1,547          | (kg/kWh)            | 0.237                |
| San Isidro 2                     | 248               | Combined cycle   | Natural Gas    | No                  | 1              | (m³/std-kWh)        | 0.278                |
| San Isidro Diesel                | 379               | Combined cycle   | Diesel         | No                  | 590            | (kg/kWh)            | 0.179                |
| Sauce Andes                      | 1                 | Run of the river | Hydro          | Yes                 | 8              | N.C.                | 0.000                |
| Sauceal 50 Hz                    | 77                | Run of the river | Hydro          | Yes                 | 490            | N.C.                | 0.000                |
| Sauceal 60 Hz                    | 77                | Run of the river | Hydro          | Yes                 | 0              | N.C.                | 0.000                |
| Saucealito                       | 12                | Run of the river | Hydro          | Yes                 | 85             | N.C.                | 0.000                |
| Talalt (I and II)                | 245               | Open cycle       | Natural Gas    | No                  | 104            | (m³/std-kWh)        | 0.331                |
| Talalt Diesel                    | 120               | Open cycle       | Diesel         | No                  | 333            | (kg/kWh)            | 0.279                |
| Talalt II Diesel                 | 120               | Open cycle       | Diesel         | No                  | 603            | (kg/kWh)            | 0.270                |
| Traiguén                         | 2                 | Diesel engines   | Diesel         | No                  | 3              | (kg/kWh)            | 0.242                |
| Valdivia                         | 61                | Biomass / Steam  | Biomass        | Yes                 | 219            | N.C.                | 0.000                |
| Verdanas 1                       | 118               | Coal / Steam     | Coal           | No                  | 942            | (kg/kWh)            | 0.391                |
| Verdanas 2                       | 220               | Diesel engines   | Coal           | No                  | 1,634          | (kg/kWh)            | 0.373                |
| Volcán                           | 13                | Run of the river | Hydro          | Yes                 | 101            | N.C.                | 0.000                |
| Quelhué                          | 49                | Run of the river | Hydro          | Yes                 | 359            | N.C.                | 0.000                |
| Canada                           | 18                | Wind             | Wind           | Yes                 | 31             | N.C.                | 0.000                |
| Palmucho                         | 32                | Run of the river | Hydro          | Yes                 | 225            | N.C.                | 0.000                |
| Hormitas                         | 55                | Run of the river | Hydro          | Yes                 | 256            | N.C.                | 0.000                |
| Ojos de Agua                     | 9                 | Run of the river | Hydro          | Yes                 | 19             | N.C.                | 0.000                |
| Oñes                             | 2                 | Diesel engines   | Diesel         | No                  | 28             | (kg/kWh)            | 0.225                |
| Picullá                          | 3                 | Open cycle       | Diesel         | No                  | 3              | (kg/kWh)            | 0.270                |
| Pucurao                          | 3                 | Run of the river | Hydro          | Yes                 | 33             | N.C.                | 0.000                |
| Quinter                          | 3                 | Open cycle       | Diesel         | No                  | 3              | (kg/kWh)            | 0.262                |
| Totoral                          | 3                 | Open cycle       | Diesel         | No                  | 3              | (kg/kWh)            | 0.270                |
| Chilós                           | 0                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.289                |
| Ouelón II                        | 10                | Diesel engines   | Diesel         | No                  | 4              | (kg/kWh)            | 0.222                |
| Coyá                             | 35                | Run of the river | Hydro          | Yes                 | 43             | N.C.                | 0.000                |
| Colmito                          | 55                | Open cycle       | Diesel         | No                  | 3              | (kg/kWh)            | 0.259                |
| Los Pinos                        | 97                | Open cycle       | Diesel         | No                  | 7              | (kg/kWh)            | 0.204                |
| Chupaca                          | 3                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.000                |
| Shreling                         | 0                 | Diesel engines   | Diesel         | No                  | 0              | (kg/kWh)            | 0.217                |
| Liray                            | 19                | Run of the river | Hydro          | Yes                 | 27             | N.C.                | 0.000                |
| Cancas                           | 17                | Diesel engines   | IFO 180        | No                  | 0              | (kg/kWh)            | 0.235                |
| Santa Lilia                      | 138               | Open cycle       | Diesel         | No                  | 0              | (kg/kWh)            | 0.258                |
| TOTAL                            |                   |                  |                |                     | 41,808         |                     |                      |

POWER GENERATION IN 2009

| POWER PLANT                  | POWER OUTPUT (MW) | PLANT TYPE       | FUEL TYPE          | LOW COST / MUST RUN | TOTAL GEN 2009 | UNITS SPEC. CONSUM. | SPECIFIC CONSUMPTION |
|------------------------------|-------------------|------------------|--------------------|---------------------|----------------|---------------------|----------------------|
| Los molles                   | 18                | Run of the river | Hydro              | Yes                 | 483            | N.C.                | 0.000                |
| Sauce Andes                  | 1                 | Run of the river | Hydro              | Yes                 | 7.4            | N.C.                | 0.000                |
| Acocagosa                    | 73                | Run of the river | Hydro              | Yes                 | 489.7          | N.C.                | 0.000                |
| Los Osillos                  | 39                | Run of the river | Hydro              | Yes                 | 250.7          | N.C.                | 0.000                |
| Florida                      | 28                | Run of the river | Hydro              | Yes                 | 143.2          | N.C.                | 0.000                |
| Madones                      | 29                | Run of the river | Hydro              | Yes                 | 130.5          | N.C.                | 0.000                |
| Altalá                       | 178               | Run of the river | Hydro              | Yes                 | 893.8          | N.C.                | 0.000                |
| Quelhué                      | 49                | Run of the river | Hydro              | Yes                 | 343.0          | N.C.                | 0.000                |
| Purulla                      | 14                | Run of the river | Hydro              | Yes                 | 148.0          | N.C.                | 0.000                |
| Volcán                       | 63                | Run of the river | Hydro              | Yes                 | 102.7          | N.C.                | 0.000                |
| Los Monos                    | 4                 | Run of the river | Hydro              | Yes                 | 19.1           | N.C.                | 0.000                |
| Sauceal 50Hz                 | 89                | Run of the river | Hydro              | Yes                 | 472.4          | N.C.                | 0.000                |
| Sauceal 60Hz                 | N.A.              | Run of the river | Hydro              | Yes                 | 0.0            | N.C.                | 0.000                |
| Saucealito                   | 12                | Run of the river | Hydro              | Yes                 | 81.9           | N.C.                | 0.000                |
| Cumlínque                    | 89                | Run of the river | Hydro              | Yes                 | 616.7          | N.C.                | 0.000                |
| San Ignacio                  | 37                | Run of the river | Hydro              | Yes                 | 201.8          | N.C.                | 0.000                |
| Loma Alta                    | 40                | Run of the river | Hydro              | Yes                 | 271.8          | N.C.                | 0.000                |
| Rucúe                        | 178               | Run of the river | Hydro              | Yes                 | 1,016.9        | N.C.                | 0.000                |
| Pullique                     | 48                | Run of the river | Hydro              | Yes                 | 230.0          | N.C.                | 0.000                |
| Pitmanquén                   | 39                | Run of the river | Hydro              | Yes                 | 248.9          | N.C.                | 0.000                |
| Capillo                      | 12                | Run of the river | Hydro              | Yes                 | 64.9           | N.C.                | 0.000                |
| Pichuán                      | 77                | Run of the river | Hydro              | Yes                 | 269.1          | N.C.                | 0.000                |
| Mampí                        | 49                | Run of the river | Hydro              | Yes                 | 177.3          | N.C.                | 0.000                |
| Chacabuco                    | 25                | Run of the river | Hydro              | Yes                 | 161.1          | N.C.                | 0.000                |
| Autuco                       | 320               | Reservoir        | Hydro              | Yes                 | 1,610.9        | N.C.                | 0.000                |
| Abancica                     | 136               | Run of the river | Hydro              | Yes                 | 346.4          | N.C.                | 0.000                |
| Isla                         | 68                | Run of the river | Hydro              | Yes                 | 446.3          | N.C.                | 0.000                |
| Colibani-Mach                | 569               | Reservoir        | Hydro              | Yes                 | 2,776.1        | N.C.                | 0.000                |
| Eyzaguirre                   | 2                 | Run of the river | Hydro              | Yes                 | 8.3            | N.C.                | 0.000                |
| Quillico                     | 70                | Run of the river | Hydro              | Yes                 | 414.4          | N.C.                | 0.000                |
| El Rincón                    | 0                 | Run of the river | Hydro              | Yes                 | 2.1            | N.C.                | 0.000                |
| Chiburga                     | 30                | Run of the river | Hydro              | Yes                 | 82.7           | N.C.                | 0.000                |
| Palmhucho                    | 39                | Run of the river | Hydro              | Yes                 | 246.1          | N.C.                | 0.000                |
| Hormitas                     | 55                | Run of the river | Hydro              | Yes                 | 269.6          | N.C.                | 0.000                |
| Pucurao                      | 5                 | Run of the river | Hydro              | Yes                 | 41.0           | N.C.                | 0.000                |
| Ojos de agua                 | 9                 | Run of the river | Hydro              | Yes                 | 37.1           | N.C.                | 0.000                |
| Coyá                         | 35                | Run of the river | Hydro              | Yes                 | 91.6           | N.C.                | 0.000                |
| Run of the river             | 15                | Run of the river | Hydro              | Yes                 | 122.0          | N.C.                | 0.000                |
| EL Manzano                   | 5                 | Run of the river | Hydro              | Yes                 | 26.7           | N.C.                | 0.000                |
| Palu                         | 5                 | Run of the river | Hydro              | Yes                 | 3.6            | N.C.                | 0.000                |
| Talalt                       | N.A.              | Open cycle       | Hydro              | Yes                 | 0.0            | N.C.                | 0.000                |
| Talalt 2 Diesel              | 126               | Open cycle       | Natural Gas        | No                  | 63.8           | (m³/std-kWh)        | 0.320                |
| Talalt 1                     | 245               | Open cycle       | Natural Gas        | No                  | 116.6          | (m³/std-kWh)        | 0.320                |
| Talalt Diesel                | 130               | Open cycle       | Diesel             | No                  | 118.8          | (kg/kWh)            | 0.320                |
| D. Almagro                   | 24                | Open cycle       | Natural Gas        | No                  | 24.3           | (kg/kWh)            | 0.356                |
| Guacailín 1                  | 152               | Coal / Steam     | Coal / Pelletco    | No                  | 1,265.0        | (kg/kWh)            | 0.400                |
| Guacailín 2                  | 152               | Coal / Steam     | Coal / Pelletco    | No                  | 1,277.0        | (kg/kWh)            | 0.400                |
| Guacailín 3                  | 135               | Coal / Steam     | Coal               | No                  | 721.7          | (kg/kWh)            | 0.350                |
| Elástico TV                  | 16                | Coal / Steam     | Coal               | No                  | 8.0            | (kg/kWh)            | 0.350                |
| Huasco TO                    | 69                | Open cycle       | Diesel             | No                  | 0.6            | (kg/kWh)            | 0.362                |
| Huasco TO FO                 | 68                | Open cycle       | FO / Diesel        | No                  | 22.8           | (kg/kWh)            | 0.362                |
| Yedo TV                      | 10                | Open cycle       | Natural Gas        | No                  | 18.9           | (kg/kWh)            | 0.362                |
| Los Ventos TO                | 121               | Open cycle       | Diesel             | No                  | 154.7          | (kg/kWh)            | 0.369                |
| Yedo                         | 988               | Combined cycle   | Natural Gas        | No                  | 111.9          | (kg/kWh)            | 0.369                |
| Nahuelbuto DB Diesel         | 369               | Combined cycle   | Diesel             | No                  | 842.3          | (kg/kWh)            | 0.161                |
| Nahuelbuto TO B2             | 100               | Open cycle       | Natural Gas        | No                  | 10.0           | (kg/kWh)            | 0.161                |
| Nahuelbuto TO 98             | 388               | Open cycle       | Diesel             | No                  | 17.2           | (kg/kWh)            | 0.388                |
| Nahuelbuto H                 | 390               | Combined cycle   | Natural Gas        | No                  | 12.8           | (m³/std-kWh)        | 0.198                |
| Nahuelbuto H Diesel          | 376               | Combined cycle   | Natural Gas        | No                  | 1,526.0        | (kg/kWh)            | 0.198                |
| San Isidro                   | 370               | Combined cycle   | Natural Gas        | No                  | 296.6          | (m³/std-kWh)        | 0.200                |
| San Isidro Diesel            | 370               | Combined cycle   | Diesel             | No                  | 66.6           | (kg/kWh)            | 0.200                |
| San Isidro ONL               | 300               | Combined cycle   | Natural Gas        | No                  | 68.4           | (m³/std-kWh)        | 0.200                |
| San Isidro H                 | 370               | Combined cycle   | Natural Gas        | No                  | 1,415          | (kg/kWh)            | 0.200                |
| San Isidro H Diesel          | 370               | Combined cycle   | Diesel             | No                  | 119.0          | (kg/kWh)            | 0.200                |
| San Isidro H ONL             | 370               | Combined cycle   | Natural Gas        | No                  | 1,071.0        | (m³/std-kWh)        | 0.200                |
| Ventana 1                    | 120               | Coal / Steam     | Coal               | No                  | 80.0           | (kg/kWh)            | 0.370                |
| Ventana 2                    | 220               | Coal / Steam     | Coal               | No                  | 270.9          | (kg/kWh)            | 0.372                |
| Nueva Ventana                | 240               | Coal / Steam     | Coal               | No                  | 122.8          | (kg/kWh)            | 0.372                |
| Ventana 3                    | 49                | Coal / Steam     | Coal               | No                  | 20.3           | (kg/kWh)            | 0.372                |
| Nueva Petorca                | 379               | Combined cycle   | Natural Gas        | No                  | 19.0           | (kg/kWh)            | 0.372                |
| Nueva Petorca Diesel         | 379               | Combined cycle   | Diesel             | No                  | 18.8           | (m³/std-kWh)        | 0.372                |
| Renca                        | 97                | Diesel / Steam   | Diesel             | No                  | 0.3            | (kg/kWh)            | 0.363                |
| Constitución                 | 9                 | Biomass / Steam  | Biomass            | Yes                 | 86.2           | N.C.                | 0.000                |
| Constitución A               | 9                 | Biomass / Steam  | Biomass            | Yes                 | 48.3           | N.C.                | 0.000                |
| Pitcomera                    | 75                | Petcoke / Steam  | Petcoke            | Yes                 | 483.0          | (kg/kWh)            | 0.000                |
| Pitcomera                    | 126               | Coal / Steam     | Coal               | Yes                 | 46.3           | (kg/kWh)            | 0.000                |
| Bocanegra                    | 138               | Coal / Steam     | Coal               | No                  | 819.1          | (kg/kWh)            | 0.401                |
| Arcauco                      | 33                | Biomass / Steam  | Biomass            | Yes                 | 11.0           | N.C.                | 0.000                |
| Arcauco Fco. Mostaza         | 26                | Open cycle       | Diesel             | No                  | 2.2            | (kg/kWh)            | 0.000                |
| Arcauco TV                   | 13                | Biomass / Steam  | Biomass            | Yes                 | 76.4           | N.C.                | 0.000                |
| Bocanegra                    | 138               | Biomass / Steam  | Biomass            | Yes                 | 29.3           | (kg/kWh)            | 0.000                |
| Bocanegra                    | 61                | Biomass / Steam  | Biomass            | Yes                 | 258.7          | N.C.                | 0.000                |
| Arcauco TV                   | 24                | Open cycle       | Diesel             | No                  | 11.7           | (kg/kWh)            | 0.988                |
| Arcauco TV                   | 24                | Open cycle       | Natural Gas        | No                  | 0.0            | (kg/kWh)            | 0.988                |
| Hormones Diesel              | 46                | Open cycle       | Diesel             | No                  | 1.5            | (kg/kWh)            | 0.988                |
| Arcauco                      | 46                | Open cycle       | Natural Gas        | No                  | 0.0            | (kg/kWh)            | 0.988                |
| TO_Central Diesel            | 46                | Open cycle       | Diesel             | No                  | 23.6           | (kg/kWh)            | 0.226                |
| Nueva Adela                  | 13                | Biomass / Steam  | Biomass            | Yes                 | 10.3           | N.C.                | 0.000                |
| Nueva Adela 3                | 20                | Biomass / Steam  | Biomass            | Yes                 | 266.7          | N.C.                | 0.000                |
| Candelilla 1                 | 129               | Open cycle       | Natural Gas        | No                  | 28.9           | (kg/kWh)            | 0.277                |
| Candelilla 2                 | 125               | Open cycle       | Diesel             | No                  | 68.4           | (kg/kWh)            | 0.277                |
| Candelilla 3                 | 129               | Open cycle       | Natural Gas        | No                  | 28.9           | (kg/kWh)            | 0.277                |
| Lebu                         | 2                 | Diesel engines   | Diesel             | No                  | 1.8            | (kg/kWh)            | 0.242                |
| Lebu                         | 3                 | Diesel engines   | Diesel             | No                  | 2.0            | (kg/kWh)            | 0.242                |
| Los Saucos                   | 2                 | Diesel engines   | Diesel             | No                  | 4.0            | (kg/kWh)            | 0.242                |
| Trigüen                      | 3                 | Diesel engines   | Diesel             | No                  | 4.0            | (kg/kWh)            | 0.242                |
| Trigüen                      | 3                 | Diesel engines   | Diesel             | No                  | 0.6            | (kg/kWh)            | 0.242                |
| Quellón                      | 3                 | Diesel engines   | Diesel             | No                  | 2.2            | (kg/kWh)            | 0.242                |
| Quellón                      | 3                 | Diesel engines   | Diesel             | No                  | 1.4            | (kg/kWh)            | 0.242                |
| Campanario Gas 1             | 66                | Open cycle       | Natural Gas        | No                  | 0.0            | (m³/std-kWh)        | 0.319                |
| Campanario Gas 2             | 66                | Open cycle       | Natural Gas        | No                  | 0.0            | (m³/std-kWh)        | 0.319                |
| Campanario Gas 3             | 66                | Open cycle       | Natural Gas        | No                  | 0.0            | (m³/std-kWh)        | 0.319                |
| Campanario Diesel 1          | 66                | Open cycle       | Diesel             | No                  | 4.0            | (kg/kWh)            | 0.319                |
| Campanario Diesel 2          | 66                | Open cycle       | Diesel             | No                  | 32.6           | (kg/kWh)            | 0.319                |
| Campanario Diesel 3          | 66                | Open cycle       | Diesel             | No                  | 86.7           | (kg/kWh)            | 0.319                |
| Casablanca                   | 1                 | Diesel engines   | Diesel             | No                  | 1.0            | (kg/kWh)            | 0.231                |
| Casablanca 2                 | 0                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.279                |
| Curuma                       | 2                 | Diesel engines   | Diesel             | No                  | 1.5            | (kg/kWh)            | 0.279                |
| Curuma                       | 2                 | Diesel engines   | Diesel             | No                  | 1.9            | (kg/kWh)            | 0.279                |
| Curuma                       | 2                 | Diesel engines   | Diesel             | No                  | 1.9            | (kg/kWh)            | 0.279                |
| PPC - PPC 2                  | 12                | Biomass / Steam  | Biomass            | Yes                 | 77.7           | N.C.                | 0.000                |
| Constitución 1               | 9                 | Diesel engines   | Diesel             | No                  | 0.8            | (kg/kWh)            | 0.266                |
| Constitución 2               | 9                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.266                |
| Matina                       | 9                 | Diesel engines   | Diesel             | No                  | 6.4            | (kg/kWh)            | 0.266                |
| Matina                       | 9                 | Diesel engines   | Diesel             | No                  | 7.0            | (kg/kWh)            | 0.266                |
| Esperanza 1                  | 2                 | Diesel engines   | Diesel             | No                  | 1.5            | (kg/kWh)            | 0.341                |
| Esperanza 2                  | 18                | Diesel engines   | Diesel             | No                  | 0.5            | (kg/kWh)            | 0.341                |
| Esperanza TV                 | 2                 | Open cycle       | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.341                |
| Organo                       | 34                | Open cycle       | Diesel             | No                  | 42.4           | (kg/kWh)            | 0.214                |
| Organo                       | 2                 | Open cycle       | Diesel             | No                  | 51.5           | (kg/kWh)            | 0.229                |
| Organo                       | 3                 | Open cycle       | Diesel             | No                  | 2.4            | (kg/kWh)            | 0.226                |
| Quintay                      | 3                 | Open cycle       | Diesel             | No                  | 2.0            | (kg/kWh)            | 0.226                |
| Quintay                      | 3                 | Open cycle       | Diesel             | No                  | 3.0            | (kg/kWh)            | 0.226                |
| Chilca                       | 9                 | Diesel engines   | Diesel             | No                  | 0.7            | (kg/kWh)            | 0.269                |
| Chilca                       | 10                | Diesel engines   | Diesel             | No                  | 15.0           | (kg/kWh)            | 0.269                |
| Colmu                        | 55                | Open cycle       | Diesel             | No                  | 5.2            | (kg/kWh)            | 0.266                |
| Los pinos                    | 92                | Open cycle       | Diesel             | No                  | 108.4          | (kg/kWh)            | 0.199                |
| Chuscha                      | 3                 | Diesel engines   | Diesel             | No                  | 2.4            | (kg/kWh)            | 0.266                |
| Chuscha 2                    | 18                | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.210                |
| Chuscha                      | 3                 | Diesel engines   | Diesel             | No                  | 0.2            | (kg/kWh)            | 0.266                |
| Cenizas                      | 17                | Diesel engines   | Diesel             | No                  | 46.9           | (kg/kWh)            | 0.226                |
| Starla Luma                  | 186               | Open cycle       | Diesel             | No                  | 9.6            | (kg/kWh)            | 0.266                |
| Los Esposes                  | 90                | Diesel engines   | Diesel             | No                  | 48.9           | (kg/kWh)            | 0.266                |
| Los Esposes                  | 90                | Diesel engines   | Diesel             | No                  | 28.7           | (kg/kWh)            | 0.221                |
| Los Esposes + Luanes         | 90                | Diesel engines   | Diesel             | No                  | 1.2            | (kg/kWh)            | 0.221                |
| Bionar                       | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.222                |
| Elmundo 1                    | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.222                |
| Elmundo 2                    | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.222                |
| Elmundo 3                    | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.222                |
| Newcom Diesel                | 15                | Open cycle       | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.222                |
| Newcom Butano                | 15                | Open cycle       | Butane Gas         | No                  | 2.7            | (kg/kWh)            | 0.448                |
| Newcom Propano               | 15                | Open cycle       | Propane Gas        | No                  | 0.0            | (m³/std-kWh)        | 0.438                |
| Newcom Gas Natural           | 15                | Open cycle       | Natural Gas        | No                  | 0.0            | (m³/std-kWh)        | 0.438                |
| Newcom Mezcla Butano/Propano | 15                | Open cycle       | Butane/Propane Gas | No                  | 0.0            | (m³/std-kWh)        | 0.438                |
| Waltis                       | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.221                |
| Waltis 2                     | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.221                |
| Multiport 1                  | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.221                |
| Multiport 2                  | 2                 | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.221                |
| Tierra Aménica               | 142               | Diesel engines   | Diesel             | No                  | 23.7           | (kg/kWh)            | 0.298                |
| Constitución                 | N.A.              | Open cycle       | Natural Gas        | No                  | 7.1            | (kg/kWh)            | 0.342                |
| Constitución GNL             | N.A.              | Open cycle       | Natural Gas        | No                  | 15.2           | (m³/std-kWh)        | 0.323                |
| Constitución Petcoke         | 75                | Diesel engines   | Diesel             | No                  | 0.0            | (kg/kWh)            | 0.323                |
| El Píñon                     | 80                | Diesel engines   | Diesel             | No                  | 11.4           | (kg/kWh)            | 0.217                |
| San Lorenzo de B. De         | 80                | Diesel engines   | Diesel             | No                  | 0.6            | (kg/kWh)            | 0.233                |
| San Pedro                    | N.A.              | Diesel engines   | Natural Gas        | No                  | 9.8            | (kg/kWh)            | 0.233                |
| Temperífico                  | 86                | Diesel engines   | Diesel             | No                  | 5.3            | (kg/kWh)            | 0.226                |
| Temperífico                  | 40                | Reservoir        | Hydro              | Yes                 | 145.3          | N.C.                | 0.000                |
| Rapel                        | 172               | Reservoir        | Hydro              | Yes                 | 72.4           | N.C.                | 0.000                |
| Constituir                   | 172               | Reservoir        | Hydro              | Yes                 | 91.4           | N.C.                | 0.000                |
| Reservoir                    | 108               | Reservoir        | Hydro              | Yes                 | 48.2           | N.C.                | 0.000                |
| Pichuenco                    | 565               | Reservoir        | Hydro              | Yes                 | 2,229.9        | N.C.                | 0.000                |
| Reservoir                    | 67                | Reservoir        | Hydro              | Yes                 | 213.9          | N.C.                | 0.000                |
| Reservoir                    | 60                | Reservoir        | Hydro              | Yes                 | 312.8          | N.C.                | 0.000                |
| Canca                        | 18                | Wind             | Wind               | Yes                 | 37.4           | N.C.                | 0.000                |
| Wind 2                       | 8                 | Wind             | Wind               | Yes                 | 19.4           | N.C.                | 0.000                |
| Lebu (Central)               | 46                | Wind             | Wind               | Yes                 | 3.2            | N.C.                | 0.000                |
| Wind (Central)               | 46                | Wind             | Wind               | Yes                 | 4.0            | N.C.                | 0.000                |
| Matia (Reserva)              | 3                 | Wind             | Wind               | Yes                 | 6.1            | N.C.                | 0.000                |

### OPERATING MARGIN CALCULATION, 2008

|   |                              | 2008          |
|---|------------------------------|---------------|
| Total emissions from non-low cost / must run power plants | (tCO <sub>2</sub> /yr)       | 14,541,473    |
| Total emissions from low-cost / must-run power plants     | (tCO <sub>2</sub> /yr)       | 526,164       |
| Total energy generated in the SIC                         | (GWh/yr)                     | 41,808        |
| Total energy by non-Low cost / must run power plants      | (GWh/yr)                     | 16,904        |
| Total energy by low cost / must run power plants          | (GWh/yr)                     | 24,903        |
| Factor λ  | (number)                     | 0.0000000     |
| <b>Operating Margin</b>                                   | <b>(tCO<sub>2</sub>/GWh)</b> | <b>860.23</b> |

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

### OPERATING MARGIN CALCULATION, 2009

|   |                              | 2009          |
|---|------------------------------|---------------|
| Total emissions from non-low cost / must run power plants | (tCO <sub>2</sub> /yr)       | 13,171,928    |
| Total emissions from low-cost / must-run power plants     | (tCO <sub>2</sub> /yr)       | 514,544       |
| Total energy generated in the SIC                         | (GWh/yr)                     | 41,752        |
| Total energy by non-Low cost / must run power plants      | (GWh/yr)                     | 15,733        |
| Total energy by low cost / must run power plants          | (GWh/yr)                     | 26,019        |
| Factor λ  | (number)                     | 0.0002283105  |
| <b>Operating Margin</b>                                   | <b>(tCO<sub>2</sub>/GWh)</b> | <b>837.04</b> |

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

### BUILD MARGIN CALCULATION, 2008

|                                  | POWER OUTPUT<br>(MW) | PLANT TYPE       | FUEL TYPE   | START<br>OPERATION | CDM<br>PROYECT | TOTAL GEN<br>IN 2008<br>(GWh) | (tCO <sub>2</sub> /GWh) |
|----------------------------------|----------------------|------------------|-------------|--------------------|----------------|-------------------------------|-------------------------|
| Santa Lidia                      | 136.00               | Open cycle       | Diesel      | 09-Dic-08          | No             | 0.5                           | 864.7                   |
| Cenizas                          | 16.50                | Diesel engines   | IFO 180     | 21-Oct-08          | No             | 0.1                           | 800.3                   |
| Lircay                           | 19.04                | Run of the river | Hydro       | 08-Oct-08          | No             | 26.7                          | 0.0                     |
| Skretting                        | 0.00                 | Diesel engines   | Diesel      | 30-Jun-05          | No             | 0.0                           | 733.3                   |
| Chuyaca                          | 2.50                 | Diesel engines   | Diesel      | 26-Nov-08          | No             | 0.1                           | 705.0                   |
| Los Pinos                        | 97.00                | Open cycle       | Diesel      | 23-Sep-08          | No             | 7.1                           | 689.1                   |
| Chiloé                           | 0.00                 | Diesel engines   | Diesel      | 01-Jul-08          | No             | 0.1                           | 908.0                   |
| Quellón II                       | 10.00                | Diesel engines   | Diesel      | 01-Ago-08          | No             | 3.6                           | 749.5                   |
| Coya                             | 34.80                | Run of the river | Hydro       | 01-Jul-08          | No             | 43.5                          | 0.0                     |
| Colmito                          | 55.00                | Open cycle       | Diesel      | 01-Ago-08          | No             | 2.6                           | 874.9                   |
| Ojos de Agua                     | 9.00                 | Run of the river | Hydro       | 01-Jun-08          | Yes            | 0.0                           | 0.0                     |
| Puclaro                          | 0.00                 | Run of the river | Hydro       | 01-May-08          | Yes            | 0.0                           | 0.0                     |
| Totoral                          | 3.00                 | Open cycle       | Diesel      | Abr-2008           | No             | 3.4                           | 912.0                   |
| Quintay                          | 3.00                 | Open cycle       | Diesel      | Abr-2008           | No             | 3.2                           | 912.0                   |
| Placilla                         | 3.00                 | Open cycle       | Diesel      | Abr-2008           | No             | 3.0                           | 912.0                   |
| Olivos                           | 1.94                 | Open cycle       | Diesel      | 01-Feb-08          | No             | 28.3                          | 761.0                   |
| Hornitos                         | 55.00                | Run of the river | Hydro       | 30-Sep-07          | Yes            | 0.0                           | 0.0                     |
| Palmucho                         | 32.00                | Run of the river | Hydro       | 29-Sep-07          | No             | 225.1                         | 0.0                     |
| Canela                           | 18.20                | Wind             | Wind        | 31-Ago-07          | No             | 30.7                          | 0.0                     |
| Esperanza TG                     | 17.90                | Open cycle       | Diesel      | 22-Ago-07          | No             | 3.6                           | 1,152.8                 |
| Maule                            | 6.00                 | Diesel engines   | Diesel      | 23-Jul-07          | No             | 5.2                           | 1,005.2                 |
| Chiburgo                         | 19.50                | Run of the river | Hydro       | 19-Jul-07          | No             | 98.9                          | 0.0                     |
| Monte Patria                     | 9.00                 | Diesel engines   | Diesel      | 12-Jul-07          | No             | 17.1                          | 951.5                   |
| Constitución 2                   | 5.70                 | Diesel engines   | Diesel      | 07-Jul-07          | No             | 0.0                           | 1,005.2                 |
| Punitaqui                        | 9.00                 | Diesel engines   | Diesel      | 06-Jul-07          | No             | 18.1                          | 951.5                   |
| Constitución 1                   | 9.00                 | Diesel engines   | Diesel      | 06-Jul-07          | No             | 10.8                          | 1,005.2                 |
| Degan                            | 36.00                | Diesel engines   | Diesel      | 04-Jul-07          | No             | 68.3                          | 738.7                   |
| Esperanza 1                      | 1.70                 | Diesel engines   | Diesel      | 29-Jun-07          | No             | 4.5                           | 737.7                   |
| FPC                              | 11.60                | Biomass / Steam  | Biomass     | 27-Jun-07          | No             | 77.2                          | 0.0                     |
| Esperanza 2                      | 1.50                 | Diesel engines   | Diesel      | 27-Jun-07          | No             | 4.5                           | 764.4                   |
| Curanilahue                      | 2.10                 | Diesel engines   | Diesel      | 27-Jun-07          | No             | 0.0                           | 0.0                     |
| Horcones Diesel                  | 24.30                | Open cycle       | Diesel      | 20-Jun-07          | No             | 6.8                           | 1,157.7                 |
| Nehuenco II Diesel               | 376.10               | Combined cycle   | Diesel      | 15-May-07          | No             | 2202.9                        | 561.7                   |
| Quilleco                         | 70.00                | Run of the river | Hydro       | 30-Apr-07          | Yes            | 0.0                           | 0.0                     |
| San Isidro 2 Diesel              | 248.30               | Combined cycle   | Diesel      | 23-Apr-07          | No             | 1646.9                        | 801.0                   |
| San Isidro 2                     | 248.30               | Combined cycle   | Natural Gas | 23-Apr-07          | No             | 1.0                           | 610.5                   |
| El Rincón                        | 0.30                 | Run of the river | Hydro       | 23-Apr-07          | No             | 2.5                           | 0.0                     |
| Concon                           | 2.72                 | Diesel engines   | Diesel      | 23-Apr-07          | No             | 7.2                           | 762.7                   |
| Las Vegas                        | 2.32                 | Diesel engines   | Diesel      | 20-Apr-07          | No             | 6.1                           | 780.6                   |
| Curaura                          | 2.50                 | Diesel engines   | Diesel      | 20-Apr-07          | No             | 5.9                           | 776.3                   |
| Casablanca 2                     | 0.48                 | Diesel engines   | Diesel      | 20-Apr-07          | No             | 0.1                           | 939.2                   |
| Casablanca 1                     | 1.30                 | Diesel engines   | Diesel      | 20-Apr-07          | No             | 4.1                           | 781.1                   |
| Casablanca                       | 1.78                 | Diesel engines   | Diesel      | 20-Apr-07          | No             | 0.0                           | 781.1                   |
| Campanario Diesel                | 118.00               | Open cycle       | Diesel      | 21-Mar-07          | No             | 221.3                         | 845.8                   |
| Campanario                       | 118.00               | Open cycle       | Natural Gas | 21-Mar-07          | No             | 18.9                          | 859.4                   |
| Eyzaguirre                       | 1.50                 | Run of the river | Hydro       | 12-Mar-07          | No             | 8.7                           | 0.0                     |
| LosVientos_TG                    | 125.00               | Open cycle       | Diesel      | 03-Ene-07          | No             | 380.8                         | 861.4                   |
| Los Sauces                       | 2.50                 | Diesel engines   | Diesel      | 03-Ene-07          | No             | 4.7                           | 816.1                   |
| Nueva Aldea 3                    | 20.00                | Biomass / Steam  | Biomass     | 10-Sep-06          | Yes            | 0.0                           | 0.0                     |
| Nueva Aldea 2                    | 10.00                | Open cycle       | Diesel      | 01-May-06          | No             | 0.0                           | 978.9                   |
| Candelaria (Open cycle) 1 Diesel | 125.30               | Open cycle       | Diesel      | 16-May-05          | No             | 263.5                         | 974.6                   |
| Candelaria (Open cycle) 1        | 125.30               | Open cycle       | Natural Gas | 16-May-05          | No             | 22.8                          | 649.9                   |
| Coronel Diesel                   | 45.70                | Open cycle       | Diesel      | 01-May-05          | No             | 73.9                          | 758.1                   |
| Coronel                          | 45.70                | Open cycle       | Natural Gas | 01-May-05          | No             | 0.7                           | 521.0                   |
| Candelaria (Open cycle) 2 Diesel | 128.60               | Open cycle       | Diesel      | 01-May-05          | No             | 278.0                         | 974.6                   |
| Candelaria (Open cycle) 2        | 128.60               | Open cycle       | Natural Gas | 01-May-05          | No             | 12.4                          | 649.9                   |
| Nueva Aldea 1                    | 13.00                | Biomass / Steam  | Biomass     | 01-Apr-05          | Yes            | 0.0                           | 0.0                     |
| Antilhue TG                      | 101.30               | Open cycle       | Diesel      | 07-Ene-05          | No             | 241.1                         | 809.4                   |
| Antilhue new (I and II)          | 50.30                | Open cycle       | Diesel      | 07-Ene-05          | No             | 0.0                           | 809.4                   |
| Ralco                            | 690.00               | Reservoir        | Hydro       | 01-Sep-04          | No             | 2572.6                        | 0.0                     |

|                         |            |          |
|-------------------------|------------|----------|
| TOTAL GEN. PER YEAR     | (GWh / yr) | 41,807.7 |
| 20% OF GEN. PER YEAR    | (GWh / yr) | 8,361.5  |
| 5 MOST RECENT PLANT GEN | (GWh / yr) | 34.5     |

|                          |                         |       |
|--------------------------|-------------------------|-------|
| EMISSION FACTOR 5 PLANTS | (tCO <sub>2</sub> /GWh) | 159.1 |
| EMISSION FACTOR 20% GEN  | (tCO <sub>2</sub> /GWh) | 469.7 |

|              |                         |       |
|--------------|-------------------------|-------|
| BUILD MARGIN | (tCO <sub>2</sub> /GWh) | 469.7 |
|--------------|-------------------------|-------|

# Nueva Aldea Biomass Power Plant Phase 1



## BUILD MARGIN CALCULATION, 2009

|                              | POWER OUTPUT<br>(MW) | PLANT TYPE       | FUEL TYPE      | START<br>OPERATION | CDM<br>PROYECT | TOTAL GEN IN<br>2009 (GWh) | (tCO <sub>2</sub> /GWh) |
|------------------------------|----------------------|------------------|----------------|--------------------|----------------|----------------------------|-------------------------|
| Totoral (édica)              | 46.00                | Wind             | Wind           | 2009               | No             | 4.01                       | 0.00                    |
| Monte Redondo                | 74.00                | Wind             | Wind           | 2009               | No             | 6.07                       | 0.00                    |
| Quintero GNL                 | N.A.                 | Open cycle       | Natural Gas    | 2009               | No             | 15.19                      | 745.46                  |
| Canela 2                     | 60.00                | Wind             | Wind           | 2009               | No             | 19.40                      | 0.00                    |
| Quintero                     | 240.00               | Open cycle       | Natural Gas    | 2009               | No             | 7.10                       | 745.46                  |
| Tapihue                      | N.A.                 | Diesel engines   | Natural Gas    | 2009               | No             | 0.78                       | 620.47                  |
| Tempopacifico                | 96.00                | Diesel engines   | Diesel         | 2009               | No             | 5.26                       | 760.02                  |
| Nueva Ventanas               | 240.00               | Coal / Steam     | Coal           | 2009               | No             | 122.65                     | 1055.10                 |
| Trufil Trufil                | N.A.                 | Run of the river | Hydro          | 2009               | No             | 0.00                       | 0.00                    |
| San Lorenzo de D. De Almagro | 60.00                | Diesel engines   | Diesel         | 2009               | No             | 0.63                       | 1139.34                 |
| San Isidro GNL               | 350.00               | Combined cycle   | Natural Gas    | 2009               | No             | 694.27                     | 636.20                  |
| Louisiana Pacific            | 2.90                 | Diesel engines   | Diesel         | 2009               | No             | 0.00                       | 747.18                  |
| El Peñón                     | 80.00                | Diesel engines   | Diesel         | 2009               | No             | 11.43                      | 732.99                  |
| Pehui                        | 1.00                 | Run of the river | Hydro          | 2009               | No             | 3.63                       | 0.00                    |
| San Gregorio + Linares Norte | 0.80                 | Diesel engines   | Diesel         | 2009               | No             | 0.23                       | 709.35                  |
| Newen Diesel                 | 15.00                | Open cycle       | Diesel         | 2009               | No             | 0.00                       | 979.58                  |
| Newen Propano                | 15.00                | Open cycle       | Propane Gas    | 2009               | No             | 0.75                       | 1394.24                 |
| Newen Gas Natural            | 15.00                | Open cycle       | Natural Gas    | 2009               | No             | 0.93                       | 723.54                  |
| Newen Mezcla Butano/Propano  | 15.00                | Open cycle       | Butane/Propane | 2009               | No             | 0.00                       | 1423.28                 |
| Watts                        | 2.64                 | Diesel engines   | Diesel         | 2009               | Yes            | 0.00                       | 747.18                  |
| Multieport I                 | 1.60                 | Diesel engines   | Diesel         | 2009               | No             | 0.00                       | 747.18                  |
| Multieport II                | 1.60                 | Diesel engines   | Diesel         | 2009               | No             | 0.00                       | 747.18                  |
| Tierra Amarilla              | 142.00               | Diesel engines   | Diesel         | 2009               | No             | 23.65                      | 807.31                  |
| Teno                         | 50.00                | Diesel engines   | Diesel         | 2009               | No             | 2.08                       | 732.99                  |
| Newen Butano                 | 15.00                | Open cycle       | Butane Gas     | 2009               | No             | 2.74                       | 1452.33                 |
| Lebu (Cristoro)              | 2.76                 | Wind             | Wind           | 2009               | No             | 3.15                       | 0.00                    |
| Guacolda 3                   | 135.00               | Coal / Steam     | Coal           | 2009               | No             | 721.70                     | 984.76                  |
| Biomar                       | 2.40                 | Diesel engines   | Diesel         | 2009               | No             | 0.00                       | 749.55                  |
| Eagon                        | 2.40                 | Diesel engines   | Diesel         | 2009               | No             | 0.00                       | 747.52                  |
| Salmofood I                  | 1.60                 | Diesel engines   | Diesel         | 2009               | No             | 0.00                       | 776.91                  |
| Salmofood II                 | 1.60                 | Diesel engines   | Diesel         | 2009               | No             | 0.02                       | 743.13                  |
| Campanario Diesel 2          | 56.00                | Open cycle       | Diesel         | 2009               | No             | 32.58                      | 834.33                  |
| Campanario Diesel 3          | 56.00                | Open cycle       | Diesel         | 2009               | No             | 66.71                      | 827.57                  |
| Chuyaca 2                    | 17.50                | Diesel engines   | Diesel         | 2009               | No             | 0.08                       | 709.35                  |
| Trapén                       | 90.00                | Diesel engines   | Diesel         | 2009               | No             | 47.80                      | 732.99                  |
| Los Espinos                  | 96.00                | Diesel engines   | Diesel         | 2009               | No             | 26.65                      | 746.51                  |
| EL Manzano                   | 4.70                 | Run of the river | Hydro          | 2009               | No             | 26.69                      | 0.00                    |
| Santa Lidia                  | 136.00               | Open cycle       | Diesel         | 2008               | No             | 9.60                       | 874.86                  |
| Chuyaca                      | 2.50                 | Diesel engines   | Diesel         | 2008               | No             | 2.43                       | 624.23                  |
| Cenizas                      | 16.50                | Diesel engines   | Diesel         | 2008               | No             | 46.94                      | 776.91                  |
| Lircay                       | 19.04                | Run of the river | Hydro          | 2008               | Yes            | 0.00                       | 0.00                    |
| Los pinos                    | 92.10                | Open cycle       | Diesel         | 2008               | No             | 108.44                     | 844.09                  |
| Quellon II                   | 10.00                | Diesel engines   | Diesel         | 2008               | No             | 15.48                      | 749.88                  |
| Colmito                      | 55.00                | Open cycle       | Diesel         | 2008               | No             | 5.20                       | 1006.60                 |
| Coya                         | 34.80                | Run of the river | Hydro          | 2008               | No             | 91.61                      | 0.00                    |
| Chilad                       | 9.00                 | Diesel engines   | Diesel         | 2008               | No             | 0.69                       | 909.64                  |
| Ojos de agua                 | 9.00                 | Run of the river | Hydro          | 2008               | Yes            | 0.00                       | 0.00                    |
| Puclaro                      | 5.20                 | Run of the river | Hydro          | 2008               | Yes            | 0.00                       | 0.00                    |
| Totoral                      | 3.00                 | Open cycle       | Diesel         | 2008               | No             | 2.40                       | 771.77                  |
| Quintay                      | 3.00                 | Open cycle       | Diesel         | 2008               | No             | 3.03                       | 771.77                  |
| Placilla                     | 3.00                 | Open cycle       | Diesel         | 2008               | No             | 2.94                       | 771.77                  |
| Olivos                       | 1.90                 | Open cycle       | Diesel         | 2008               | No             | 51.92                      | 769.11                  |
| Skretting                    | 2.70                 | Diesel engines   | Diesel         | 2008               | No             | 0.00                       | 743.13                  |
| Palmucho                     | 32.00                | Run of the river | Hydro          | 2007               | No             | 244.10                     | 0.00                    |
| Hornitos                     | 55.00                | Run of the river | Hydro          | 2007               | Yes            | 0.00                       | 0.00                    |
| Canela                       | 18.20                | Wind             | Wind           | 2007               | Yes            | 0.00                       | 0.00                    |
| Esperanza TG                 | 17.90                | Open cycle       | Diesel         | 2007               | No             | 0.01                       | 763.26                  |
| Maule                        | 5.70                 | Diesel engines   | Diesel         | 2007               | No             | 0.32                       | 952.56                  |
| Chiburgo                     | 19.50                | Run of the river | Hydro          | 2007               | No             | 82.72                      | 0.00                    |
| Monte Patria                 | 8.60                 | Diesel engines   | Diesel         | 2007               | No             | 6.41                       | 951.54                  |
| Constitución 1               | 8.60                 | Diesel engines   | Diesel         | 2007               | No             | 0.77                       | 1005.25                 |
| Punitaqui                    | 8.60                 | Diesel engines   | Diesel         | 2007               | No             | 7.82                       | 951.54                  |
| Degan                        | 34.20                | Diesel engines   | Diesel         | 2007               | No             | 42.42                      | 721.38                  |
| Esperanza 1                  | 1.70                 | Diesel engines   | Diesel         | 2007               | No             | 1.48                       | 1151.98                 |
| Esperanza 2                  | 1.50                 | Diesel engines   | Diesel         | 2007               | No             | 0.87                       | 737.72                  |
| FPC + FPC 2                  | 11.60                | Biomass / Steam  | Biomass        | 2007               | No             | 77.66                      | 0.00                    |
| Horcones Diesel              | 24.30                | Open cycle       | Diesel         | 2007               | No             | 1.48                       | 1147.42                 |
| Nehuenco II Diesel           | 376.10               | Combined cycle   | Diesel         | 2007               | No             | 1525.76                    | 560.81                  |
| Quileco                      | 70.00                | Run of the river | Hydro          | 2007               | Yes            | 0.00                       | 0.00                    |
| El Rincón                    | 0.30                 | Run of the river | Hydro          | 2007               | No             | 2.15                       | 0.00                    |
| San Isidro II                | 370.00               | Combined cycle   | Natural Gas    | 2007               | No             | 115.96                     | 445.09                  |
| San Isidro II Diesel         | 370.00               | Combined cycle   | Diesel         | 2007               | No             | 1415.14                    | 657.03                  |
| Concon                       | 2.20                 | Diesel engines   | Diesel         | 2007               | No             | 1.92                       | 774.61                  |
| San Isidro II GNL            | 370.00               | Combined cycle   | Natural Gas    | 2007               | No             | 271.23                     | 445.09                  |
| Casablanca 1                 | 1.30                 | Diesel engines   | Diesel         | 2007               | No             | 1.04                       | 781.14                  |
| Casablanca 2                 | 0.48                 | Diesel engines   | Diesel         | 2007               | No             | 0.00                       | 939.18                  |
| Las Vegas                    | 2.20                 | Diesel engines   | Diesel         | 2007               | No             | 1.48                       | 928.91                  |
| Curaua                       | 2.40                 | Diesel engines   | Diesel         | 2007               | No             | 1.65                       | 924.18                  |
| Campanario Gas 1             | 56.00                | Open cycle       | Natural Gas    | 2007               | No             | 0.00                       | 699.69                  |
| Campanario Diesel 1          | 56.00                | Open cycle       | Diesel         | 2007               | No             | 4.95                       | 881.62                  |
| Eyzaguirre                   | 2.10                 | Run of the river | Hydro          | 2007               | No             | 8.27                       | 0.00                    |
| Los Vientos TG               | 120.80               | Open cycle       | Diesel         | 2007               | No             | 154.70                     | 894.77                  |
| Los Sauces                   | 2.40                 | Diesel engines   | Diesel         | 2007               | No             | 4.05                       | 816.09                  |
| Nueva Aldea 3                | 20.00                | Biomass / Steam  | Biomass        | 2006               | Yes            | 0.00                       | 0.00                    |
| Nueva Aldea 2                | 10.00                | Open cycle       | Diesel         | 2006               | No             | 0.00                       | 979.90                  |
| Candelaria 1                 | 125.30               | Open cycle       | Natural Gas    | 2005               | No             | 21.11                      | 721.08                  |
| Candelaria 1 Diesel          | 125.30               | Open cycle       | Diesel         | 2005               | No             | 68.42                      | 934.27                  |
| TG Coronel                   | 45.70                | Open cycle       | Natural Gas    | 2005               | No             | 3.03                       | 568.48                  |
| TG Coronel Diesel            | 45.70                | Open cycle       | Diesel         | 2005               | No             | 23.45                      | 760.09                  |
| Candelaria 2                 | 126.60               | Open cycle       | Natural Gas    | 2005               | No             | 7.32                       | 721.08                  |
| Candelaria 2 Diesel          | 126.60               | Open cycle       | Diesel         | 2005               | No             | 26.94                      | 934.27                  |
| Nueva Aldea                  | 13.00                | Biomass / Steam  | Biomass        | 2005               | Yes            | 0.00                       | 0.00                    |
| Antihue TG                   | 50.30                | Open cycle       | Diesel         | 2005               | No             | 112.71                     | 1988.20                 |
| Horcones TG                  | 24.30                | Open cycle       | Natural Gas    | 2004               | No             | 0.01                       | 830.90                  |
| Ralco                        | 690.00               | Reservoir        | Hydro          | 2004               | No             | 3128.43                    | 0.00                    |
| TOTAL GEN. PER YEAR          |                      |                  |                |                    |                |                            | 41,751.7                |
| 20% OF GEN. PER YEAR         |                      |                  |                |                    |                |                            | 8,350.3                 |
| 5 MOST RECENT PLANT GEN      |                      |                  |                |                    |                |                            | 51.8                    |
| EMISSION FACTOR 5 PLANTS     |                      |                  |                |                    |                |                            | 320.97                  |
| EMISSION FACTOR 20% GEN      |                      |                  |                |                    |                |                            | 436.44                  |
| BUILD MARGIN                 |                      |                  |                |                    |                |                            | 436.44                  |

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

## **COMBINED MARGIN CALCULATION, 2008**

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)

|                        |                              | <b>2008</b>   |
|------------------------|------------------------------|---------------|
| Operating Margin       | (tCO <sub>2</sub> /GWh)      | 860.23        |
| Build Margin           | (tCO <sub>2</sub> /GWh)      | 469.73        |
| <b>Combined Margin</b> | <b>(tCO<sub>2</sub>/GWh)</b> | <b>664.98</b> |

## **COMBINED MARGIN CALCULATION, 2009**

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)

|                        |                              | <b>2009</b>   |
|------------------------|------------------------------|---------------|
| Operating Margin       | (tCO <sub>2</sub> /GWh)      | 837.04        |
| Build Margin           | (tCO <sub>2</sub> /GWh)      | 436.44        |
| <b>Combined Margin</b> | <b>(tCO<sub>2</sub>/GWh)</b> | <b>636.74</b> |

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