# Monitoring report form
## (Version 05.0)

*Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.*

| MONITORING REPORT | | |
|---|---|---|
| **Title of the project activity** | VALDIVIA BIOMASS POWER PLANT | |
| **UNFCCC reference number of the project activity** | UNFCCC REF. N°: 1787 | |
| **Version number of the monitoring report** | 1 | |
| **Completion date of the monitoring report** | 22nd April, 2015 | |
| **Monitoring period number and duration of this monitoring period** | Monitoring period #5 is from 01/01/2014 to 31/12/2014 (both days included). | |
| **Project participant(s)** | CELULOSA ARAUCO Y CONSTITUCIÓN S.A. | |
| **Host Party** | Chile. | |
| **Sectoral scope(s)** | Scope 1 | |
| **Selected methodology(ies)** | ACM0006 ver. 5 - "Consolidated methodology for generation from biomass residues".<br><br>ACM0002 Ver. 6, "Consolidated methodology for grid-connected electricity generation from renewable sources". | |
| **Selected standardized baseline(s)** | Not applicable | |
| **Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD** | Estimated amount of GHG emission reductions from 01 January of 2014 to 31 December of 2014: **135,548 ($tCO_{2eq}$).** | |
| **Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period** | GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012 | GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards |
| | Not applicable | **87,911 ($tCO_2eq$).** |

# SECTION A. Description of project activity

## A.1. Purpose and general description of project activity

The project activity consists of a 550,000 (ADt/year)[1] pulp mill with a 61 MW of surplus power capacity to the grid. This surplus capacity allows the pulp mill to operate as a grid-connected power plant. The mill is located in the X Region of Chile.

The surplus electric power capacity of the mill is a result of the following initiatives:

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

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

Though modern pulp mills tend to be self-sufficient in heat and electric power generation, the Valdivia pulp mill was deliberately designed to generate a considerable amount of surplus power to the grid. This surplus is generated by burning black liquor in the recovery boiler and biomass from forest operations (from own and third party sources) in a power boiler, both inside the pulp mill facility. All the biomass consumed by the project activity is generated from sustainable forest operations. The additional electric power generation capacity of the pulp mill is a result of particular modifications of the mill that enable it to generate additional power to the grid. Such capacity would have not been available to the grid with a more conventional business-as-usual pulp mill design.

The reduction in greenhouse gas emissions is therefore accomplished through the displacement of grid electricity by carbon neutral surplus electricity generated by the pulp mill. An additional reduction of greenhouse gases is accomplished by the additional consumption of biomass from forest operations (a mix of sawdust and bark) to increase the surplus power generation of the mill. In a baseline scenario, this additional amount of biomass would not be used for energy purposes and would be dumped in piles for natural decay or burned in the open air in an uncontrolled manner.

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

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

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

Relevant dates for the project activity:

| Date | Key events |
|---|---|
| September 2001 | Start date |
| February 2004 | Commissioning date |
| 01/04/2009 to 31/12/2009. | The 1st monitoring period |
| 01/01/2010 to 31/12/2010. | The 2nd monitoring period |
| 01/01/2011 to 31/12/2012 | The 3rd monitoring period |
| 01/01/2013 to 31/12/2013 | The 4th monitoring period |
| 01/01/2014 to 31/12/2014 (both days are included) | The 5th monitoring period |

Total Net emission reductions

From Jan 1st 2014 to Dec 31st 2014: 87,911 ($tCO_2eq$)

## A.2. Location of project activity

The project activity is located in Chile, X Region of Valdivia, commune of San José de la Mariquina, in the province of Valdivia. It is located in km 788 of the 5-Sur highway in the Rucao sector. The Valdivia Region can be directly accessed from Santiago through the 5-Sur or Panamericana Sur highway. The project site is located in the following geographical coordinates 39°33'51'' S and 72°53'41''W.

## A.3. Parties and project participant(s)

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

## A.4. Reference of applied methodology and standardized baseline

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

- ACM0006 (Version 05), “Consolidated methodology for generation from biomass residues”.

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

- ACM0002 (Version 06), “Consolidated methodology for grid-connected electricity generation from renewable sources”.
- “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 02.2)
- “Tool for the demonstration and assessment of additionality” (Version 04)

## A.5. Crediting period of project activity

| | |
|---|---|
| Starting date of the first crediting period | 01/04/2009 |
| End date of the first crediting period | 31/03/2016 |
| Length of the first crediting period | Seven (7) years |
| Maximum length of the crediting period | 3 x Seven (7) years |

## A.6. Contact information of responsible persons/ entities



| | |
|---|---|
| Entity responsible for completing the CDM-MR-FORM: | Arauco Celulosa y Constitución S.A. |
| Contact person: | Christian Rodríguez |
| Mailing address: | Arauco Bioenergía S.A.<br>Av. El Golf 150 Piso 7<br>Las Condes, Santiago<br>Chile |
| Telephone number: | +56 2 2462-3888 |
| E-mail address: | Christian.Rodriguez@arauco.cl |



# SECTION B. Implementation of project activity

## B.1. Description of implemented registered project activity

The project activity has been completed as planned and described in the Project Design Document (PDD). The starting date of the operation of the project activity was 01/04/2009 and it has operated as described in the CDM PDD.

Information on the operation of the project activity during the monitoring period is presented in table below:

| | Out of service day | Back in operation | Number of hours | Comments |
|---|---|---|---|---|
| **Shutdown** | | | | |
| Turbogenerator 2 | 2014-04-11 | 2014-04-15 | 53 | Overload, slow turn, TG2 blocked |
| Turbogenerator 2 | 2014-12-20 | 2014-12-27 | 143 | Leak in steam valve |
| **Maintenance Stoppage** | | | | |
| Turbogenerator 1 | 2014-01-01 | 2014-01-08 | 166 | Programmed maintenance activity |
| General (TG 1 and 2, power boiler, recovery boiler) | 2014-11-08 | 2014-11-23 | 317 | Annual programmed stoppage |

<u>During the monitored period the following instruments were replaced or taken out of service:</u>

| TAG | Old serial number | New serial number | Date replaced |
|---|---|---|---|
| 310-81-1154 | G703.0095 | Not applicable | Out of service 18/08/2014. Not replaced. |
| 352-FT-461 | Transmitter: 0860144486<br>Sensor: <u>0193444</u> | Transmitter: 0860144486<br>Sensor: <u>0269172</u> | 10/11/2014 |
| 365-FT-914 | 6410003178 | 6408013775 | 24/11/2014 |

The sensing element of flowmeter 352-FT-461 was replaced because of low coil insulation and liner pitting. The year's records show that the sensor had to be cleaned with steam several times due to black liquor scaling.

In the case of 365-FT-914, malfunction was detected on November 21, 2014, while the plant was starting to operate again after its annual programmed maintenance stoppage. Priority was given to the start of the boilers, so replacement of this instrument was postponed until November 24.

Instruments with delayed calibration during the monitored period:

| TAG | Calibration due date | Actual calibration date | Days delayed in this MP |
|---|---|---|---|
| 331-WT-005 | 13/11/2013 | 10/04/2014 | 99 |

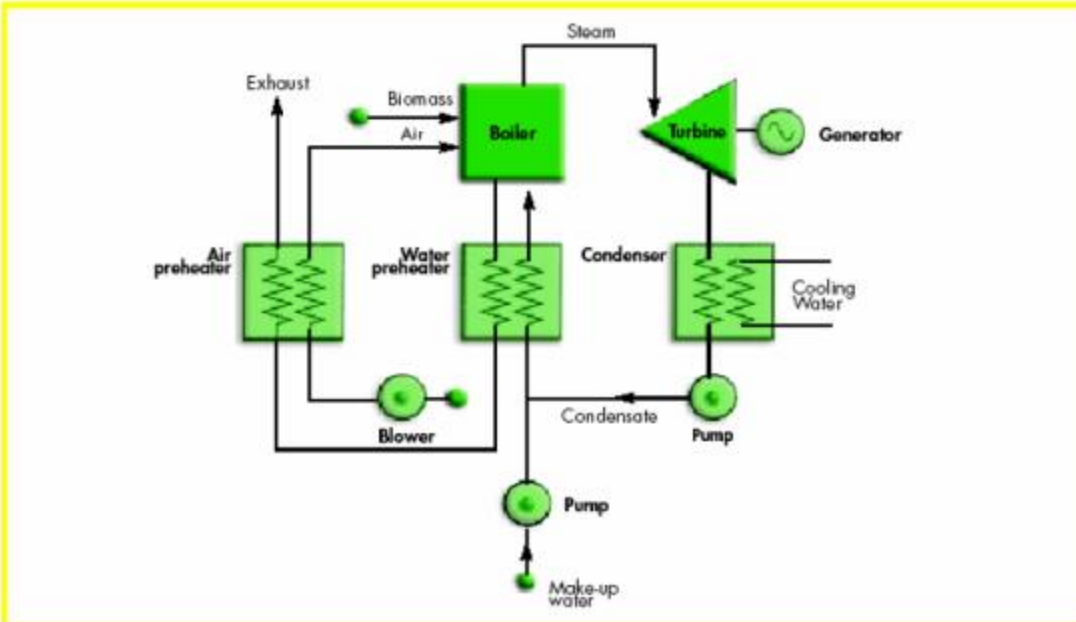
Description of the installed technology and equipment

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

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

Steam turbines are designed as either “backpressure” or “condensing” turbines. CHP applications typically employ backpressure turbines, wherein steam expands to a pressure that is still substantially above ambient pressure. It leaves the turbine still as a vapour and is sent to satisfy industrial heating needs, where it condenses back to water. It is then partially or fully returned to the boiler. Alternatively, if process steam demands can be met using only a portion of the available steam, a condensing extraction steam turbine (CEST) might be used. This design includes the capability for some steam to be extracted at one or more points along the expansion path for meeting process needs (Figure 1). Steam that is not extracted continues to expand to sub-atmospheric pressures, thereby increasing the amount of electricity generated per unit of steam compared to the backpressure turbine. The non-extracted steam is converted back to liquid water in a condenser that utilizes ambient air and/or a cold water source as the coolant.

**Figure 1: Schematic diagram of a biomass-fired steam-Rankine cycle for cogeneration using a condensing-extraction steam turbine.**




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

## B.2. Post registration changes

### B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

Delays in the net calorific value measurements of fossil fuels (i.e. Diesel and Fuel Oil) and biomass residues (i.e. black liquor and biomass residues from forest operations) consumed in the project activity:

According to the monitoring plan, the Project Participant shall determine the net calorific value of the following fuel types: Fossil fuels (i.e. Fuel Oil and Diesel), black liquor and biomass residues from forest operations, at least every six months, taking three samples per measurement. In this case, delays in the sampling of these fuels occurred between the second semester of the previous monitoring period [July 1st, 2013 – December 31st, 2013] and the first semester of this monitoring period [Jan 1st, 2014 – June 30th, 2014].

In order to address these delays in the most conservative way, the Project Participant has performed adjustments to the fuels' net calorific value measurements. The adjustments are described in detail in the following paragraphs:

Adjustment to fossil fuel (i.e. Diesel and Fuel Oil) net calorific values:

As shown in the table below, samples for NCV analysis were taken 18 days late.

| | 2nd semester previous MP | 1st semester this MP | 2nd semester this MP |
|---|---|---|---|
| Sampling dates | 23/07/2013 | 10/02/2014 | 25/07/2014 |
| Delay in this MP | -- | 18 days | none |

The gap would be between January 23rd and Frebruary 9th, 2014. However, to simplify calculations for the adjustment, the IPCC net calorific values at the upper confidence limit were applied for the period from January 1st to February 9th, 2014.

– <u>Carbon dioxide emissions from on-site consumption of fossil fuels, in this case Fuel Oil and Diesel:</u>

According to the last version of the “Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion”, the Project Participant used the following approach for determine $CO_2$ emissions:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \ x \ COEF_{i,y}$$

Where:

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

The $CO_2$ emission coefficient $COEF_{i,y}$ is calculated using approach B of the Tool presented above, which consists in calculating the coefficient based on the net calorific value and $CO_2$ emission factor of fuel type i, as follows:

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

Where:

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

According to the Tool, a higher NCV of fossil fuels results in a higher $COEF_{i,y}$ which leads to higher project emissions due to on-site consumption of fossil fuels. Therefore, the Project Participant has conducted <u>the most conservative adjustment</u> to these fossil fuel measurements considering the upper IPCC values of 41.70(GJ/ton) for Fuel Oil and 43.30(GJ/ton) for Diesel. Results of these adjustments for 2014 are presented in the table below:

| Fossil fuel type | NCV (original) [(a)] (GJ/BDt) | NCV (adjusted) [(b)] (GJ/BDt) |
|---|---|---|
| Fuel Oil | 40.37 | 40.68 |
| Diesel | 42.83 | 42.88 |

The Project Participant would like to note the following:

(a) These values correspond to the average net caloric values obtained from the original measurements of Fuel oil and Diesel conducted per semester during 2014.

(b) The NCV was adjusted using the upper 2006 IPCC values for Fuel oil and Diesel for the period from January 1st to February 9th, 2014. The rationale behind this adjustment is that the first sample would have been valid for the first semester from January 1st to June 30th, had it been taken on its due date (January 23rd). However, because of the sampling delay, the NCV obtained is only considered valid from the sampling date (February 10th) until June 30th (end of first semester). The second sample, taken on July 23rd, had no delay with respect to the first one, so the NCV obtained is considered valid for the whole second semester, from July 1st to December 31st.

Detailed calculations are provided in *Valdivia CP1MP5 adjustments.xlsx.*

– Carbon dioxide emissions from fossil fuel consumption, in this case Diesel, from biomass residues transportation to the power plant.

Equation 4 of the ACM0006 (Version 05): Project emissions due to biomass transportation.

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

Where:

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

In equation 4 of ACM0006 (Version 05) a higher net calorific value results in a higher $COEF_{i,y}$ and thus a higher $EF_{km,CO2,y}$, thereby increasing project emissions. The Project Participant has conducted the most conservative adjustment, in this case to Diesel consumption, considering the upper IPCC value of 43.30 (GJ/ton) for Diesel consumed due to biomass transportation for the period from January 1st to February 9th, 2014. As a result, the emission factor for heavy truck transportation increased from 1.2850 to 1.2867 (kgCO2/km), consequently increasing project emissions from biomass residues transportation to the power plant.

Adjustment to the net calorific value of biomass residues from forest operations:

There was a delay of 16 days as shown in the table below:

| | 2nd semester previous MP | 1st semester this MP | 2nd semester this MP |
|---|---|---|---|
| Sampling dates | 25/07/2013 | 10/02/2014 | 25/07/2014 |
| Delay | -- | 16 days | none |

- Methane emissions from controlled combustion of biomass residues:

Equation 8 of ACM0006 (Version 05) is used to calculate methane emissions due to combustion of biomass residues in the project plant.

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

Where:

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

The controlled biomass burning factor affects project emissions. According to equation 8, a higher net calorific value of biomass residues results in a higher controlled biomass burning factor. For conservativeness reasons, the Project Participant applied the upper 2006 IPCC net calorific value of 31(GJ/BDt) for biomass residues from forest operations for the period from January 1st to February 9th, 2014. This was done considering that the net calorific value of the samples taken on February 10th were valid for the first semester, from Frebruary 10th to June 30th and the net calorific value of samples taken on July 25th was valid from July 1st until December 31st. The average net calorific value that results from this adjustment is higher than the original one. This, in turn, leads to a higher controlled biomass burning factor and therefore, higher project emissions. The values obtained can be seen in the following table:

| Biomass from forest operations | Original | Adjusted |
|---|---|---|
| NCV (GJ/BDt) | 18.24 | 19.57 |
| Controlled biomass burning factor ($tCO_{2eq}$/000ton) | 13.95 | 14.97 |
| Emissions from controlled burning of biomass residues in the power boiler ($tCO_2$/y) | 1,218 | 1,422 |

Detailed calculations are provided in the emission reduction calculation spread sheet.

- <u>Methane emissions due to uncontrolled biomass burning avoidance</u>

Equation 46 of ACM0006 (Version 05) is used to calculate baseline methane emissions associated to the additional biomass consumed due to the project activity.

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

Where:

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

In this case, the emission factor affects the baseline emissions of the project activity. As can be seen from the above equation, a lower net calorific value results in lower baseline emissions. Therefore, the Project Participant considered the lower limit 2006 IPCC value of 7.9 (GJ/BDt) for biomass residues when calculating the methane emission factor for uncontrolled burning of biomass residues from forest operations. This lower limit IPCC value was applied from January 1st to February 9th, 2014.

Results in terms of emission reductions are presented as follows:

| Biomass from forest operations | Original | Adjusted |
|---|---|---|
| NCV (GJ/BDt) | 18.24 | 17.25 |
| $CH_4$ emission factor for uncontrolled burning of biomass from forest operations ($tCO_{2eq}$/000ton) | 399 | 377 |
| Emissions reductions due to uncontrolled biomass burning avoidance ($tCO_{2eq}$/y) | 34,784 | 30,651 |

Detailed calculations are provided in the emission reduction calculation spread sheet.

- Emission reductions due to displacement of electricity
  (adjustment performed to black liquor net calorific value due to a sampling delay)

There was a delay in the sampling of black liquor during the first semester.

| | Pine campaign | | |
|---|---|---|---|
| Sampling dates | 23/07/2013 | 17/02/2014 | 25/07/2014 |
| Delay | -- | 25 days | none |
| | Euca campaign | | |
| Sampling dates | 07/07/2013 | 10/02/2014 | No sampling – No euca processed |
| Delay | -- | 34 days | none |

Equation 14 of ACM0006 (Version 05) is used to calculate the emission reductions due to the displacement of electricity as a result of the project activity.

$$EG_y = EG_{project\ plant,y} = \varepsilon_{el,other\ plant(s)} \cdot \frac{1}{3.6} \sum_k BF_{k,y} \cdot NCV_k$$

Where:

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

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

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

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

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

Adjustment performed to black liquor net calorific value:

In equation 14 of ACM0006 (version 05) a higher black liquor net calorific value results in a lower amount of net increased electricity generation as a result of the project activity, and therefore less emission reductions.

The 2006 IPCC upper confidence limit NCV for black liquor, 23.0 (GJ/tDS), was applied to pine from January 1$^{st}$ to February 16$^{th}$, 2014 and to eucalyptus from January 1$^{st}$ to February 9$^{th}$, 2014.

For the rest of the semester, up to June 30$^{th}$, 2014 measured black liquor NCVs were applied.

From July 1$^{st}$ to December 31$^{st}$, 2014, the net calorific value obtained for pine black liquor on July 25$^{th}$ was used. Since there was no eucalyptus campaign during the second semester, no NCV analysis for eucalyptus black liquor was performed.

Results were as follows:

| Period | Jan 1st – Feb 9th | Feb 10th – Feb 16th | Feb 17th – Feb 28th | Mar 1st – June 30th | July 1st – Dec 31st |
|---|---|---|---|---|---|
| Black liquor (tDS) | 112,852 | 20,459 | 35,072 | 406,898 | 576,820 |
| NCV applied pine black liquor (GJ/tDS) | 23.00 | 23.00 | 11.83 | 11.83 | 12.41 |
| NCV applied euca black liquor (GJ/tDS) | 23.00 | 12.03 | 12.03 | euca not used | No sampling |

As a result of the weighted average calculation of the NCV for 2014 using data presented in table above, the value increased from 12.14 (GJ/tDS) to 13.31 (GJ/tDS).

Consequently, emission reductions were modified in the following way:

| | Original | Adjusted |
|---|---|---|
| Net quantity of increased electricity (MWh/y)* | 161,259 | 105,275 |
| Emissions from electricity displacement ($tCO_2$/y) | 109,003 | 71,161 |

* According to equation 14 of ACM0006 (Version 05)

Detailed calculations are provided in the emission reduction calculation spread sheet.

Considering all adjustments described previously, the total emission reductions claimed for the monitored period have changed as shown below:

| PROJECT EMISSIONS | | Total (original) | Total (adjusted) |
|---|---|---|---|
| Methane emissions from combustion of biomass residues | ($tCO_2$eq/y) | 1,218 | 1,422 |
| Carbon dioxide emissions from biomass residues transportation to the power plant | ($tCO_2$/y) | 1,230 | 1,231 |
| <u>Carbon dioxide emissions from on-site consumption of FF:</u> | | | |
| Fossil fuel consumption due to on-site biomass from forest operations transportation | ($tCO_2$/y) | 160.79 | 174.79 |
| Fossil fuel consumption in the power boiler: | ($tCO_2$/y) | 7,232 | 7,798 |
| Fossil fuel consumption in the recovery boiler | ($tCO_2$/y) | 3,250 | 3,275 |
| TOTAL PROJECT EMISSIONS | ($tCO_2$eq/y) | 13,090 | 13,901 |

Total project emissions increased 6.2% to 13,901 ($tCO_2$eq/y) after applying the most conservative adjustments described above.

| BASELINE EMISSIONS | | Total (original) | Total (adjusted) |
|---|---|---|---|
| Carbon dioxide emissions due to electricity displacement | ($tCO_2$/yr) | 109,003 | 71,161 |
| Methane emissions due to uncontrolled biomass burning avoidance | ($tCO_2$eq/yr) | 34,784 | 30,651 |
| TOTAL BASELINE EMISSIONS | ($tCO_2$eq/yr) | 143,788 | 101,813 |

Total baseline emissions decreased 29% to 101,813 ($tCO_2$eq/y) after applying the most conservative adjustments described above.

Detailed calculations are provided in the emission reduction calculation spread sheet.

As can be seen from the tables above, the adjustments performed due to delays in sampling for net calorific value analysis are translated into a decrease of 33% (from 130,698 to 87,911 ($tCO_2$)) in the total amount of emission reductions claimed for the monitored period.

### B.2.2. Corrections

None

### B.2.3. Changes to start date of crediting period

None

### B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

No

### B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

The Project Participant presented a request for deviation of the baseline methodology during Validation process, so that two compatible baseline scenarios (N°3 and N°4) could be simultaneously applied to the proposed project activity. In this case, the additional net electric power generation of the project activity involving simultaneously scenarios N°3 and N°4, would be determined by following the indications of baseline scenario N°4, using formula N°14, which is used with some minors modifications included in page 120, Annex 3 of the registered PDD.

The approval date of the request for deviation was on December 13, 2007, and details of this approval are included in page 111, Annex 3 of the registered PDD.

### B.2.6. Changes to project design of registered project activity

A biomass dryer started operating on February 5th , 2013. The rationale behind the installation of the biomass dryer was to reduce the moisture content in the fired biomass down to the predicted level in the original PDD and by this to reduce the need for support fuel to sustain a stable combustion and also to improve boiler efficiency.

To date, the new PDD (version 05, completed on 4th March, 2015), which includes this change, is in the process of being approved.

### B.2.7. Types of changes specific to afforestation or reforestation project activity

None

## SECTION C. Description of monitoring system

The Project Participant, Arauco, has implemented monitoring procedures according to the monitoring methodology chosen for this project activity. This monitoring methodology accounts for emission reductions in an accurate and conservative manner.

Arauco is responsible for the operation and the monitoring of the project activity. Arauco counts with on-site personnel (at the project activity site), who are in charge of gathering and registering all the required information described in the monitoring plan. Such duties are incorporated to the personnel's everyday activities to ensure continuity and high-quality standards. Support and consultancy regarding the CDM obligations is provided by Arauco Bioenergía S.A[2]

[2] Arauco Bioenergía S.A. is the new name of Arauco Generación S.A.

Data collection procedures:

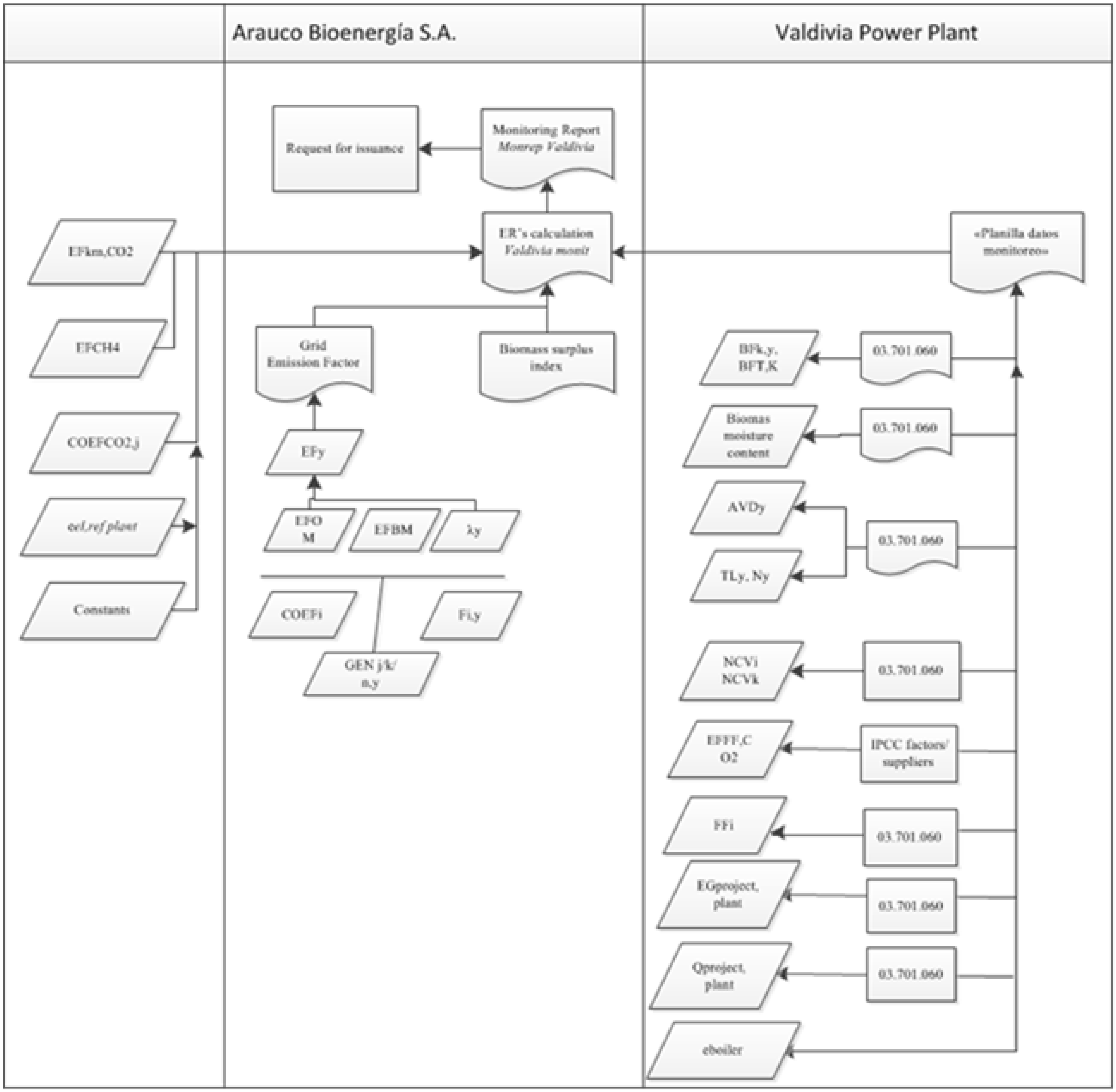
The highest attention is demanded by the parameters that should be continuously monitored by the Project Participant. These parameters are the most important data for the calculation of the achieved emission reduction.

The parameters such as the quantity of biomass residue used ($BF_{k,y}$, $BF_{T,k}$), fossil fuel consumption ($FF_i$), quantity of heat generated ($Q_{projectplant}$) and net quantity of electricity generated data ($EG_{projectplant}$) are monitored continuously, online and fully integrated with the Distributed Control System (DCS) of the Valdivia pulp mill. The data is downloaded by the IP system and inserted automatically in an Excel spread sheet, and finally data is aggregated and reported monthly in the emission reduction calculation sheet.

Biomass truckloads transported to the power plant are weighed by weighbridges installed at the Valdivia plant entrance. Data about return trip distance between biomass fuel supply sites and the project site and data about on-site use of transport fuel are informed by third parties.

The information is partially processed and stored on-site, and is sent to Arauco Bioenergía S.A. in Santiago for further and final processing (table formats, reports, etc.) that allow calculating the resulting emission reductions.

The following diagram describes the monitoring system:




The Project Participant informs that in document of # 03.701.060 is described the proccedure of monitoring the CDM parameters used in the emission reduction calculations.

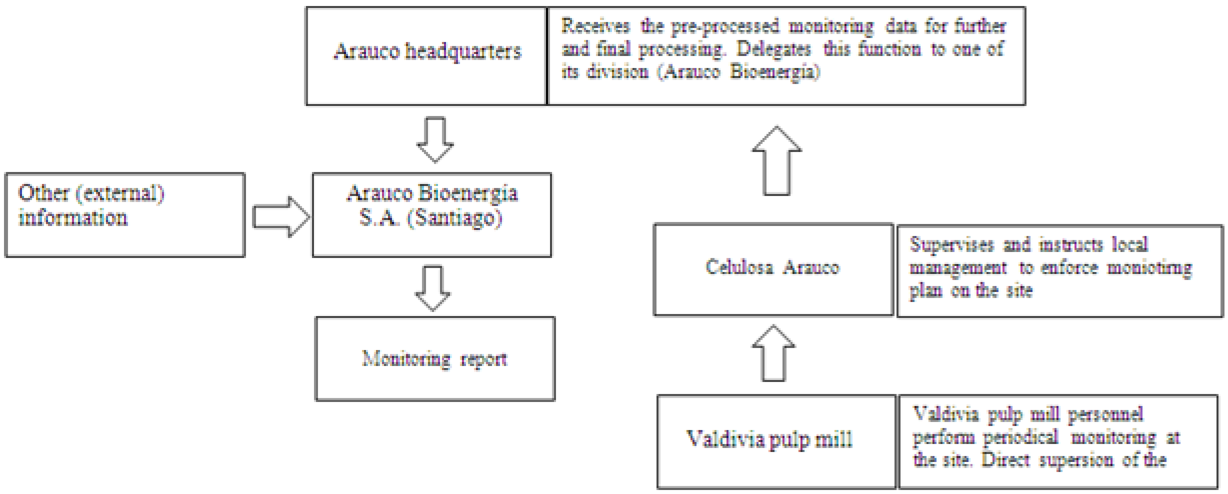
Procedure for emergency case:

In case of unforeseen problems or failures of the data recording system the operating staffs informs the responsible person for the monitoring. In cases where no data are available due to failures of the monitoring equipment the responsible person for the monitoring decides as soon as possible which actions will be undertaken to minimise the amount of not registered GHG emission reduction. Furthermore, procedures in case of failures of monitoring equipment/instruments and IT systems, such as IP21, Lab21, and SRR are described in procedure 03.701.060.

As mentioned in the registered PDD, Arauco Bioenergía S.A. is responsible for gathering and processing all the monitored data for the emission reduction calculation for the monitored period which is normally carried out every year.

The monitoring information flow implemented by Arauco Bioenergia S.A. for the Valdivia CDM project activity is presents as follows:

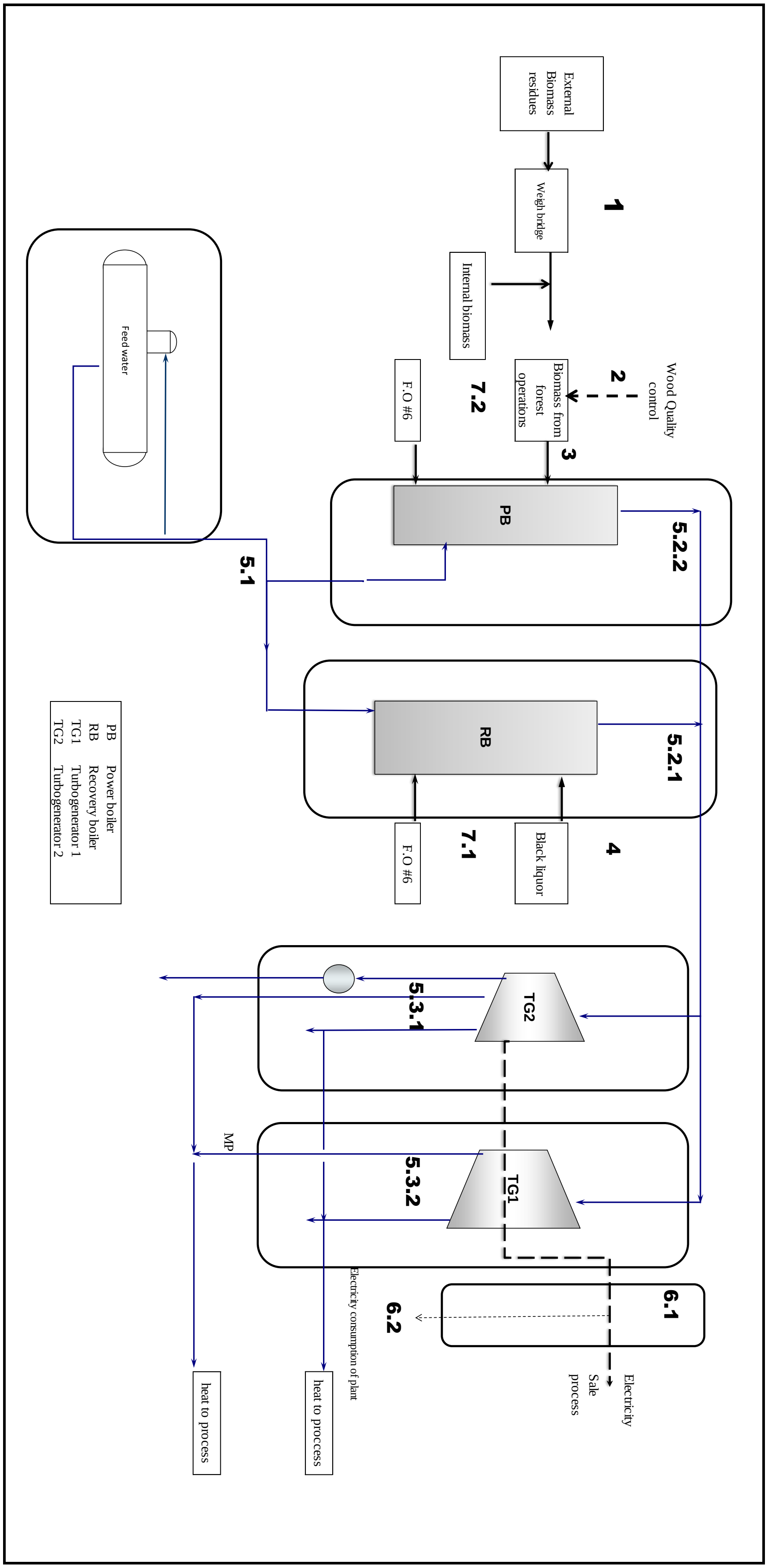
Monitoring information flow of Valdivia Power Plant project activity



Calibration results of monitoring instruments for 2014 are presented in the following table:

| ITEM | INSTRUMENT | VARIABLE | ITEM | MEASURED ERROR GREATER THAN ADMISSIBLE ERROR (YES/NO) | ADJUSTMENT MADE (YES / NO) | |
|---|---|---|---|---|---|---|
| 1 | Weighbridge #1 South | $TL_y$ | 330-WT-050 | YES | YES | |
| | Weighbridge #2 Center | $TL_y$ | 330-WT-051 | NO | NO | |
| | Weighbridge #3 North | $TL_y$ | 330-WT-052 | YES | YES | |
| 2 | Digital Scale | Moisture content of $BF_{k,y}$ | 310-81-1150 | ARE EQUAL | YES | |
| | Digital Scale | Moisture content of $BF_{k,y}$ | 310-81-1151 | ARE EQUAL | YES | |
| | Digital Scale | Moisture content of $BF_{k,y}$ | 310-81-1213 | NO | YES | |
| | Drying Oven ULE 700 (400 - 500 L) | Moisture content of $BF_{k,y}$ | 310-81-1154 | YES | NO | Note 1 |
| | Drying Oven ULE 700 (400 - 500 L) | Moisture content of $BF_{k,y}$ | 310-81-1155 | NO | NO | |
| | Drying Oven ULE 700 (400 - 500 L) | Moisture content of $BF_{k,y}$ | 310-81-1156 | NO | NO | |
| 3 | Weightmeter | $BF_{k,y}$ | 331-WT-005 | NO | NO | |
| 4 | Magnetic Flow Transmitter | $BF_{k,y}$ | 352-FT-461 | NO | NO | |
| | Magnetic Flow Transmitter | $BF_{k,y}$ | 352-FT-462 | NO | NO | |
| | Magnetic Flow Transmitter | $BF_{k,y}$ | 352-FT-463 | NO | NO | |
| | Magnetic Flow Transmitter | $BF_{k,y}$ | 352-FT-464 | NO | NO | |
| | Refractometer | Moisture content of $BF_{k,y}$ | 352DT435A | NO | NO | |
| | Refractometer | Moisture content of $BF_{k,y}$ | 352DT435B | NO | NO | |
| | Temperature Transmitter | Temperature of $BF_{k,y}$ | 352TT430 | NO | NO | |
| 5.1. | Pressure Transmitter | $Q_{project\ plant,y}$ | 362PT980 | NO | NO | |
| | Temperature Transmitter | $Q_{project\ plant,y}$ | 362TT965 | NO | NO | |
| 5.2.1. | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT901 | YES | YES | |
| 5.2.2. | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT902 | YES | YES | |
| 5.3.1. | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT910 | NO | NO | |
| | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT913 | NO | NO | |
| | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT914 | YES | YES | |
| 5.3.2. | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT920 | YES | YES | |
| | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT923 | YES | YES | |
| | Differential Pressure Flow Transmitter | $Q_{project\ plant,y}$ | 365FT924 | NO | NO | |
| 6.1. | Energy Meter | $EG_{project\ plant,y}$ | 368JI203 | NO | NO | |
| | Energy Meter | $EG_{project\ plant,y}$ | 368JI104 | NO | NO | |
| 6.2. | Energy Meter | $EG_{project\ plant,y}$ | 368JI105 | NO | NO | |
| | Energy Meter | $EG_{project\ plant,y}$ | 368JI101 | NO | NO | |
| | Energy Meter | $EG_{project\ plant,y}$ | 368JI102 | NO | NO | |
| | Energy Meter | $EG_{project\ plant,y}$ | 368JI107 | NO | NO | |
| | Energy Meter | $EG_{project\ plant,y}$ | 368JI201 | NO | NO | |
| | Energy Meter | $EG_{project\ plant,y}$ | 368JI205 | NO | NO | |
| 7.1. | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 352FT653 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 352FT657 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 352FT681 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 352FT685 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 352FT823 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| 7.2. | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 363FT507 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 363FT510 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 363FT515 | CALIB NOT REQUIRED | YES(zero adjustment) | |
| | Mass Flow Transmitter | $FF_{project\ plant,i,y}$ | 363FT518 | CALIB NOT REQUIRED | YES(zero adjustment) | |

Note 1 - Removed from service in August 2014 due to malfunction. Therefore, no adjustment made.


External Biomass residues
Weigh bridge
1
Internal biomass
Wood Quality control
2
Biomass from forest operations
3
F.O #6
7.2
Feed water
PB
5.2.2
5.1
RB
5.2.1
F.O #6
7.1
Black liquor
4
PB Power boiler
RB Recovery boiler
TG1 Turbogenerator 1
TG2 Turbogenerator 2
TG2
5.3.1
MP
TG1
5.3.2
6.1
6.2
Electricity consumption of plant
Electricity Sale process
heat to process
heat to proccess

# SECTION D. Data and parameters

## D.1. Data and parameters fixed ex ante or at renewal of crediting period

| **Data / Parameter:** | **$GWP_{CH4}$** |
|---|---|
| Unit: | (tCO2e/tCH4) |
| Description: | Global Warming Potential for CH4. |
| Source of data: | IPCC |
| Value(s) applied): | 25 (tCO2e/tCH4) |
| Choice of data or measurement methods and procedures: | IPCC |
| Purpose of data: | Calculation of baseline emissions. |
| Additional comment: | -- |

| **Data / Parameter:** | **$\varepsilon_{el,reference\ plant}$** |
|---|---|
| Unit: | (%) |
| Description: | Average net energy efficiency of power in the reference power cogeneration plant that would use the biomass residues fired in the project plant in the absence of the project activity. |
| Source of data: | The electric efficiency of the Valdivia baseline mill was calculated from the KSH energy / mass balances |
| Choice of data or measurement methods and procedures: | Please refer to the revised PDD. |
| Value(s) applied): | 11.971 % |
| Purpose of data: | Calculation of baseline emissions. |
| Additional comment: | **---** |

| **Data / Parameter:** | **Additional electric power consumption of the project mill** |
|---|---|
| Unit: | (%) |
| Description: | This is the additional electric power consumption of the project pulp mill with surplus power capacity generation to the grid with respect to a baseline pulp mill, which does not have surplus electric power capacity to the grid. This marginal higher power consumption is derived from the installation of the equipment that enables the project pulp mill to generate additional power (for example: the installation of a higher biomass capacity power boiler in the project mill, compared to the one that would have been installed in a baseline pulp mill). |
| Source of data: | Energy/mass balance performed by KSH Consulting. |
| Choice of data or measurement methods and procedures: | Energy/mass balance performed by KSH Consulting. |

| | |
|---|---|
| Value(s) applied): | Constant 4.59% of the total energy consumed by the pulp mill in the project scenario. |
| Purpose of data: | Calculation of baseline emissions. |
| Additional comment: | This variable is used to determine the net quantity of electricity generated in the project plant during the year. |

| **Data / Parameter:** | **Fuel oil consumption per unit of combusted biomass in the Valdivia mill power boiler** |
|---|---|
| Unit: | (kg of fuel oil/$m^3$st) |
| Description: | This parameter refers to the amount of fuel oil that is normally co-fired in a fluidized bed biomass boiler. It considers normal operational reasons such as start-up operations and the wet condition of biomass in winter. |
| Source of data: | Historic fossil fuel and biomass consumption data from the Valdivia biomass power plant. |
| Choice of data or measurement methods and procedures: | Historic fossil fuel and biomass consumption data from the Valdivia biomass power plant. |
| Value(s) applied): | 3.43 (kg of fuel oil/$m^3$st) |
| Purpose of data: | Calculation of project emissions. |
| Additional comment: | In this case it is used to determine the fossil fuel consumption due to additional consumption of biomass from forest operations (sawdust and bark) in the power boiler. |

### D.2. Data and parameters monitored

| **Data / Parameter:** | **$BF_{k,y}$ (and $BF_{T,k,y}$)** |
|---|---|
| Unit: | Tons of dry mater. |
| Description: | Quantity of biomass residue type k combusted in the project plant during the year y. |
| Measured/ Calculated / Default: | Measured. |
| Source of data: | The project activity combusts two types of biomass residues: Black liquor from the pulping operation and a mix of sawdust and bark from forest operations.<br><br><u>Biomass residues of type: Black liquor</u><br><br>This variable was monitored continuously (online, each five seconds) and fully integrated with the Distributed Control System (DCS) using dedicated flow meters for measuring continuously black liquor flow (l/s) in combination with two (2) refract meters to measure average concentration (%) of solids, and one (1) transmitter to measure black liquor temperature (°C).<br><br>To determine the dry biomass flow (tons of Dry Solids (tDS)), the total wet flow is automatically multiplied by the average concentration (%) of solids (in the DCS) by using the equation shown below.<br><br>Black liquor (tDS/s) = black liquor flow (l/s) * (%) solids*density of black liquor (tDS/l). |

| | |
|---|---|
| | Black liquor flow (tDS/s) to the recovery boiler is transmitted to the pulp mill's DCS. This information is stored in the pulp mill's databases. The Operation Manager collects checks and informs the monitored integrated flow values to the person in charge of calculating emission reductions of the project activity in Arauco Bioenergía S.A.<br><br><u>Biomass residues (mix of sawdust and bark) from forest operations</u><br><br>Biomass from forest operations (in wet tons) combusted in the power boiler is directly monitored via an on-line weighmeter located at the entrance of the power boiler. This instrument transmits the monitored data to the pulp mill Distributed Control System (DCS). As in the previous case, the registered values are integrated collected and informed by the Operation Manager to the person in charge of calculating emission reductions of the project activity in Arauco Bioenergía S.A.<br><br>Please note that according to the approved monitoring plan of the registered PDD (page 79), biomass residues ($BF_{T,k,y}$ ) used in equation Nº4 of ACM0006 (Version 05) correspond to the fraction of $BF_{k,y}$ attributable to the project activity that must be brought by truck from outside the plant. This fraction of $BF_{k,y}$ is also utilized for the calculation of project emissions due to transportation of biomass residues to the power plant. This amount is duly measured (weight and volume) at the entrance of the power plant. |
| Value(s) of monitored parameter: | <u>Black liquor</u>: 1,152,101 tDS<br><br>Note: This value corresponds to the original measurement. However, it must be pointed out that one of the black liquor flow meters displayed erratic measurements, so the Project Participant replaced these measurements by those obtained from the flow meters in the black liquor collection ring. This approach is conservative, as explained in section "Additional Comments."<br><br><u>Biomass residues (mix of sawdust and bark)</u>: 182,632 (BDt or bone dry tons)<br><br>Of 182,632 (BDt), only 87,270 (BDt) correspond to biomass attributable to the project activity that was brought to the power plant by trucks.<br><br>As in the case of black liquor, these values correspond to the original measurements. However, an adjustment was carried out following a conservative approach, for the period during which the weighmeter´s calibration was overdue. (For detailed information refer to section "Additional Comments" under this parameter).<br><br>The Project Participant would like to note that the biomass from forest operations (mix of sawdust and bark) is monitored on a wet basis. Then biomass is adjusted to dry basis using the corresponding moisture content as per required by the baseline methodology. |

| | |
|---|---|
| Monitoring equipment: | Black liquor:<br><br>352FT461<br>Type: Magnetic flow transmitter Rosemount 8742C<br>Accuracy class: +/-0.25%<br>Serial number: Transmitter: 0860144486<br>Sensor: 0193444<br>Calibration frequency: 12 months<br>Calibration dates: 03/12/2013<br>Date of last calibration: 10/11/2014<br>Validity: 09/11/2015<br><br>*Sensor replaced on 10/11/2014 by:*<br><br>352FT461<br>Type: Magnetic flow transmitter Rosemount 8742C<br>Accuracy class: +/-0.25%<br>Serial number: Transmitter: 0860144486<br>Sensor: 0269172<br>Calibration frequency: 12 months<br>Calibration dates: 03/12/2013<br>Date of last calibration: 10/11/2014<br>Validity: 09/11/2015<br><br>*Despite the sensor replacement, there is no change in calibration dates because only the transmitter needs to be calibrated.*<br><br>352FT462<br>Type: Magnetic flow transmitter Rosemount 8732E<br>Accuracy class: +/-0.25%<br>Serial numbers: 0312404<br>Calibration frequency: 12 months<br>Calibration dates: 03/12/2013<br>Date of last calibration: 10/11/2014<br>Validity: 09/11/2015<br><br>352FT463<br>Type: Magnetic flow transmitter Rosemount 8732E<br>Accuracy class: +/-0.25%<br>Serial numbers: 0312403<br>Calibration frequency: 12 months<br>Calibration dates: 03/12/2013<br>Date of last calibration: 10/11/2014<br>Validity: 09/11/2015<br><br>352FT464<br>Type: Magnetic flow transmitter Rosemount 8732E<br>Accuracy class: +/-0.25%<br>Serial numbers:0312399<br>Calibration frequency: 12 months<br>Calibration dates: 03/12/2013<br>Date of last calibration: 10/11/2014<br>Validity: 09/11/2015<br><br>352TT430<br>Type: Temperature Transmitter. ROSEMOUNT 3144PD1A1NAB4M5F5C8C4Q4<br>Accuracy class: +/- 0.21°C |

| | |
|---|---|
| | Serial number: 0618822<br>Calibration frequency: 1 year<br>Calibration dates: 27/11/2013<br>Date of last calibration: 13/11/2014<br>Validity: 12/11/2015<br>352DT435A<br>Type: Refract meter. K-PATENTS IT-RE-GP<br>Accuracy class: +/- 0.1%<br>Serial number: 2002-D42-5099<br>Calibration frequency: 2 Years<br>Calibration dates: 04/11/2013, 06/05/2014<br>Date of last calibration: 05/11/2014<br>Validity: 04/11/2016<br><br>352DT435B<br>Type: Refract meter. K-PATENTS IT-RE-GP<br>Accuracy class: +/- 0.1%<br>Serial number: 2002-D43-5100<br>Calibration frequency: 2 Years<br>Calibration dates: 05/11/2013, 05/05/2014<br>Date of last calibration: 05/11/2014<br>Validity: 04/11/2016<br><br>Biomass residues (mix of sawdust and bark) from forest operations<br><br>331-WT-005<br>Type: Weight meter. RAUTE PRECISION WB910<br>Accuracy class: +/- 0.6kg<br>Serial number: 2472377<br>Calibration frequency: 1 year<br>Calibration dates: 13/11/2012, 10/04/2014<br>Date of last calibration: 16/10/2014<br>Validity: 15/10/2015 |
| Measuring/<br>Reading/<br>Recording frequency: | The measurements of biomass residues of type black liquor are taken continuously (each five seconds) online and fully integrated with the Distributed Control System (DCS). Data of biomass consumption is aggregated and reported monthly in the emission reduction calculation sheet.<br><br>Biomass residues from forestry operations are continuously measured by a proper instrument and the data obtained are fully integrated with the DCS. Data are recorded and aggregated monthly in the emission reduction calculation sheet. |
| Calculation method (if applicable): | Not applicable. |
| QA/QC procedures: | Both biomass types (black liquor and biomass from forest operations) were measured by proper and dedicated meters.<br><br>All meters were calibrated and maintained according to the manufacturer's specifications and/or according to proper industry standards. Maintenances and calibrations were planned according to a specific schedule, which is part of the quality system implemented in the pulp mill.<br><br>Biomass residues (mix of sawdust and bark) from forest operations.<br><br>The mix of biomass residues measured by a dedicated weighmeter was |

| | |
|---|---|
| | cross-checked against the energy/mass balance. Using the monitored data, the energy/mass balance indicated a power boiler efficiency of 69.85%, which is well within the range specified in the power boiler manual [61.99% - 87.31%]. According to this, the monitored value of the biomass residues combusted in the power boiler is acceptable.<br><br>In addition to the above, the measured value of biomass combusted was monthly cross-checked against purchase records, internal biomass production and stock changes (topographic studies). A difference of 8.0% was obtained for the monitored period.<br>Black liquor<br><br>The black liquor consumption measurements (tDS) were cross-checked against the total pulp production in the pulp mill (ADT) and the energy/mass balance of the recovery boiler. Results of this comparison are presented below:<br><br>With the monitored data, the efficiency obtained for the recovery boiler was 67.3%. This value is compared with the average efficiency value of 64.0% specified for this boiler by the manufacturer. The difference is considered a reasonable deviation.<br><br>Additionally, the Project Participant calculated an operational index of 2.09 (tDS/ADT), which also compares very closely with the range of 2.0 +/-0.5. |
| Purpose of data: | Baseline and project emissions calculations. |
| Additional comment: | In September, October and November black liquor flowmeter 352-FT-461 had erratic readings during some days. Flowmeters on the other three walls of the recovery boiler had correct readings. In this situation, the only way to have an alternative reading for total black liquor flow was to take the readings from the feed and return flowmeters in the boiler's collection ring (tags 352-FT-433 for feed flow and 352-FT-445 for return flow). These are usually used for cross-checking purposes. However, the black liquor return line was obstructed and a zero flow reading was set for 352-FT-445 by the maintenance staff. Doing otherwise would have compromised the boiler's operation since this flowmeter's reading directly influences the boiler's air flow balance.<br><br>Therefore, the missing readings were taken directly from flowmeter 352-FT-433 which resulted in black liquor flow readings being higher than real. This is also the most conservative approach since according to equation 14 of ACM0006 v5, a higher amount of dry solids leads to lower emission reductions.<br><br>In the same way, the amount of biomass residues burnt in the power boiler was adjusted according to the weighmeter's maximum permissible error (1%). Calibration of this instrument expired on 13/11/2013. Therefore, adjustments were made from 01/01/2014 until 09/04/2014.<br><br>In order to be conservative, the amount of biomass residues was decreased by 1% during the calibration gap for the calculation of methane emissions due to uncontrolled burning of biomass residues. This lowers baseline emissions.<br><br>In addition, the amount of biomass residues was increased by 1% for the calculation of the net quantity of increased electricity, which resulted in lower net emission reductions (equation 14 of ACM0006 v5). |

| **Data / Parameter:** | **Moisture content of the biomass residues** |
|---|---|
| Unit: | (%) of water content (humid basis). |
| Description: | Moisture content of each biomass residue type k. |
| Measured/<br>Calculated /<br>Default: | Measured. |
| Source of data: | Black liquor: On-site measurements. For more details, please refer to the $BF_{k,y}$ parameter.<br><br>Biomass residues from forestry operations: On-site measurements. |
| Value(s) of monitored parameter: | Black liquor: This biomass type is directly measured in dry-solid terms (tDS).<br><br>Biomass residues from forest operations: 59.2%<br><br>The Project Participant informs that applied values are weight averaged for the monitoring period. |

| | |
|---|---|
| Monitoring equipment: | <u>Black liquor:</u><br><br>The equipment used to measure this parameter was described in full under parameter $BF_{k,y}$.<br><br><u>Biomass residues (mix of sawdust and bark) from forest operations</u><br><br>310-81-1150<br>Type: Digital Scale. METTLER TOLEDO PG12001<br>Accuracy class: +/- 0.1 g<br>Serial number: 1122192799<br>Calibration frequency: 6 Months<br>Calibration dates: 09/10/2013, 07/01/2014, 14/04/2014, 11/07/2014<br>Date of last calibration: 08/10/2014<br>Validity: 07/04/2015<br><br>310-81-1151<br>Type: Digital Scale. METTLER TOLEDO PG12001<br>Accuracy class: +/- 0.1 g<br>Serial number: 1122192802<br>Calibration frequency: 6 Months<br>Calibration dates: 10/10/2013, 13/01/2014, 14/04/2014, 14/07/2014<br>Date of last calibration: 08/10/2014<br>Validity: 07/04/2015<br><br>310-81-1154<br>Type: Drying Oven. MEMMERT ULE700<br>Accuracy class: +/- 1 °C<br>Serial number: G703.0095<br>Calibration frequency: Calibration is not required according to the manufacturer.<br>*This oven went out of service on 18/08/2014 and neither went back into service nor was replaced during this monitoring period.*<br><br>310-81-1155<br>Type: Drying Oven MEMMERT ULE700<br>Accuracy class: +/- 1 °C<br>Serial number: G703.0096<br>Calibration frequency: Calibration is not required according to the manufacturer.<br><br>310-81-1156<br>Type: Drying Oven. MEMMERT ULE700<br>Accuracy class: +/- 1 °C<br>Serial number: G703.0098<br>Calibration frequency: Calibration is not required according to the manufacturer. |
| Measuring/<br>Reading/<br>Recording frequency: | As stated before, black liquor is directly monitored in dry basis.<br><br>Daily samples of biomass residues from forestry operations (mix of sawdust and bark) are taken to determine their moisture content. Moisture content analysis is performed in Valdivia's own laboratory with calibrated digital scales and drying ovens. |
| Calculation method<br>(if applicable): | Not applicable. |

| | |
|---|---|
| QA/QC procedures: | Black liquor:<br><br>Proper instruments were used to measure moisture content. All of them received periodic maintenance and calibration, according to the manufacturer's recommendation. For more details about the calibration of these instruments, please refer to parameter $BF_{k,y}$, QA/QC procedure section.<br><br>In addition to the above, the Project Participant carried out moisture content measurements in the Valdivia laboratory in order to cross-check the dry black liquor flows recorded in the DCS.<br><br>As shown in the table below, a deviation of 0.78% was obtained for 2014 which is deemed a reasonable value. |

| Parameter | Laboratory samples (%) | Measurements recorded in the DCS (%) | Deviation (%) |
|---|---|---|---|
| Annual average moisture content | 25.8 | 25.6 | 0.78% |

| | |
|---|---|
| | Biomass residues (mix of sawdust and bark) from forest operations<br><br>In this case, proper calibration according to the manufacturer of all instruments used to determine moisture content of biomass residues from forestry operations was duly performed during the monitored period. Please refer to page 14 of this Monitoring Report, which presents a table with the corresponding calibration results. |
| Purpose of data: | Baseline emission and project emission calculations. |
| Additional comment: | -- |

| **Data / Parameter:** | **$EF_{CH4,BF}$** |
|---|---|
| Unit: | ($tCH_4/GJ$) |
| Description: | $CH_4$ emission factor for the combustion of biomass residues in the project plant. |
| Measured/ Calculated / Default: | Default. |
| Source of data: | ACM0006 (Version 5), page 25/63, Table 4: "Default $CH_4$ emission factors for combustion of biomass residues". According to the baseline methodology, the chosen factor is corrected for uncertainty using Table 5 in page 26/63 of the ACM0006 (Version 5). |
| Value(s) of monitored parameter: | 30.0 (Kg $CH_4$/TJ) or 0.00003 ($tCH_4$/GJ) for biomass from forest operations, with an associated conservativeness factor of 1.02. This results in an adjusted default emission factor of 30.6 (Kg $CH_4$/TJ) or 0.0000306 ($tCH_4$/GJ).<br><br>The reason for which the conservativeness factor 1.02 was chosen in this case can be found in section B.6, page 54 of the registered PDD. |

| | |
|---|---|
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | Not applicable. |
| Calculation method (if applicable): | Not applicable. |
| QA/QC procedures: | In this case, the project participant used the default factor provided by the ACM0006 (Version 05). |
| Purpose of data: | Project emissions calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$AVD_y$** |
|---|---|
| Unit: | (Km) |
| Description: | Average round-trip distance between biomass fuel supply sites and the project site. |
| Measured/ Calculated / Default: | Measured. |
| Source of data: | Calculations based on records provided by the Valdivia Pulp mill Procurement Department.<br><br>The information used to perform the corresponding calculations comes from Forestal Valdivia (an Arauco subsidiary) and the Valdivia pulp mill Procurement Department R-Maderas database. |
| Value(s) of monitored parameter: | <table><tr><td>Monitored parameter</td><td>2014</td></tr><tr><td>$AVD_y$</td><td>103.9 km</td></tr></table><br>The Project Participant would like to note that the value applied is a weighted average calculation for the round trip. For more details, please see the corresponding emission reduction calculation spread sheet. |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | The distance travelled by each truck transporting biomass from forestry operations residues was continuously recorded at the entrance of the Valdivia plant and registered in the R-Maderas database. |
| Calculation method (if applicable): | This parameter is determined for the monitored period by calculating a weighted average distance, which considers the transported biomass amounts and the corresponding distances of each supply center to the Valdivia biomass power plant. This weighted average is multiplied by two in order to determine the weighted average distance, round trip. |

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| QA/QC procedures: | Biomass residues from forest operations were brought from known suppliers which have known locations (e.g. road distances to the plant are also known). The QA/QC procedure in this case is carried out at the entrance of the Valdivia power plant and is applied in such a way that no truck with biomass residues from forestry operations is allowed if it does not come from a known and registered supplier (for which the road distance is also known). During the monitored period, no trucks from unspecified/unregistered sites were allowed, so no discrepancies were detected in this case. |
| Purpose of data: | Project emission calculations. |
| Additional comment: | -- |

| **Data / Parameter:** | $\mathbf{N_y}$ |
|---|---|
| Unit: | --- |
| Description: | Number of truck trips for the transportation of biomass. |
| Measured/ Calculated / Default: | Calculated. |
| Source of data: | The Superintendence of Fiber monitored and recorded each type of raw material (including biomass residues from forestry operations) dispatched to the mill. This information was stored in the mill's information system and the person in charge of reporting this information extracted the number of trucks that arrived at the mill with biomass residues (mix of sawdust and bark) and reported this information to the person in charge of calculating the emission reductions of the project activity in Arauco Bioenergía S.A. |
| Value(s) of monitored parameter: | 8,680 trips<br><br>Note: This is the original monitored value. However, because this value is calculated based on the amount of biomass from forest operations that feeds the power boiler and there was a delay in the calibration of the power boiler's weighmeter, the value used for emission reduction calculations is slightly higher. Please refer to section "Additional comment" under parameter $BF_{k,y}$. |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | All trucks that brought third party biomass residues were continuously recorded each day at the entrance of the plant in the R-Maderas database system. |
| Calculation method (if applicable): | This parameter is calculated as a ratio between the total wet biomass attributable to the project activity and transported to the Valdivia biomass power plant and the average truck load used for the transportation of the biomass to the power plant. |

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|---|---|
| QA/QC procedures: | The Project Participant verified the consistency of this variable with the quantity of biomass combusted (e.g. by the relation with previous years). Historical consumption records have been checked by the project participant, as shown in the table below:<br><br>Year (Jan to Dec) / Average N° of trips Per year:<br>2014: 8,680<br>2013: 4,702<br>2012: 3,212<br>2011: 2,593<br>2010: 2,904<br>2009: 4,008<br>2008: 3,444<br><br>As can be seen in the table above, the average number of trips during the monitored period (2014) is higher than in previous years. This is due to a higher consumption of biomass residues in the power boiler. Increased biomass consumption is related to the installation of the biomass dryer, which has allowed to reduce biomass moisture content. By doing so, part of the energy that was previously supplied by fossil fuel is now supplied by biomass residues. This is evidenced in the following table, in which the ratio of fossil fuel to biomass is shown. |

| Year (Jan to Dec) | Average N° of trips Per year |
|---|---|
| 2014 | 8,680 |
| 2013 | 4,702 |
| 2012 | 3,212 |
| 2011 | 2,593 |
| 2010 | 2,904 |
| 2009 | 4,008 |
| 2008 | 3,444 |

| | Total biomass (BDt) | 3rd Party biomass (BDt) | $N_y$ | Total fossil fuel used in the power boiler (t)** | Fossil fuel (t/BDt) |
|---|---|---|---|---|---|
| 2014* | 182,632 | 92,327 | 8,680 | 1,393 | 0.008 |
| 2013* | 163,327 | 62,395 | 4,702 | 6,033 | 0.037 |
| 2012 | 137,738 | 29,318 | 3,212 | 9,848 | 0.071 |
| 2011 | 123,651 | 19,553 | 2,593 | 8,812 | 0.071 |
| 2010 | 121,555 | 25,283 | 2,904 | 7,097 | 0.058 |

*The biomass dryer started full operation in March 2013, but it is not as efficient with eucalyptus residue. This affected its performance since 26% of 2013's production came from eucalyptus. In 2014, eucalyptus was processed only in January and February and represented only 10% of the year's production, thus improving the dryer's performance and the amount of biomass residues that could be combusted in the power boiler.

** Value taken from the power boiler's energy balance, not to be confused with $FF_{projectplant,y}$ (a calculated parameter).

| | |
|---|---|
| Purpose of data: | Project emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$TL_y$** |
|---|---|
| Unit: | (ton/truck) |
| Description: | Average truckload of the trucks used for the transportation of biomass from forest operations to the pulp mill. |
| Measured/ Calculated / Default: | Measured. |

| | |
|---|---|
| Source of data: | The Superintendence of Fiber monitored this parameter by measuring the truckloads at the project mill's weighbridges. The value was determined by calculating the average truckload in tons for the trucks that delivered biomass residues from forest operations to the power plant. |
| Value(s) of monitored parameter: | 24.7<br><br>The Project Participant would like to note that the applied value is an average considering truck load and the amount of biomass from third party suppliers.<br><br>Also, please note that the value reported here is the original one. Due to the delayed calibration of the power boiler's weighmeter, the value applied to emission reduction calculations is slightly different. See section "Additional comment" under parameter $BF_{k,y}$. |
| Monitoring equipment: | 330-WT-050<br>Type: Weighbridge #1 South METTLER TOLEDO JAGXTREME<br>Accuracy class: +/- 30 kg<br>Serial number: 5311768-5HD<br>Calibration frequency: 1 Year<br>Calibration dates: 24/11/2013, 28/05/2014<br>Date of last calibration: 21/11/2014<br>Validity: 20/11/2015<br><br>330-WT-051<br>Type: Weighbridge #2 Center METTLER TOLEDO JAGXTREME<br>Accuracy class: +/- 30 kg<br>Serial number: 5311767-5HD<br>Calibration frequency: 1 Year<br>Calibration dates: 24/11/2013, 28/05/2014<br>Date of last calibration: 21/11/2014<br>Validity: 20/11/2015<br><br>330-WT-052<br>Type: Weighbridge #3 North METTLER TOLEDO JAGXTREME<br>Accuracy class: +/- 30 kg<br>Serial number: 5311771-5HD<br>Calibration frequency: 1 Year<br>Calibration dates: 24/11/2013, 28/05/2014<br>Date of last calibration: 21/11/2014<br>Validity: 20/11/2015 |
| Measuring/<br>Reading/<br>Recording frequency: | All trucks that carried third party biomass residues to the Valdivia mill were continuously recorded at the entrance of the plant in the R-Maderas database system and truck loads were reported on a monthly basis for emission reduction calculation purposes. |
| Calculation method (if applicable): | Not applicable. |
| QA/QC procedures: | The weighbridges at the pulp mill received periodic maintenance and calibration according to proper industry standards. All data was found correct and consistent. Please refer to page 14 of this Monitoring Report, which presents a table with the corresponding calibration results. |
| Purpose of data: | Project emission calculations. |
| Additional comment: | Option 1 was used to estimate $CO_2$ emissions from transportation of biomass to the Valdivia power plant. |

| Data / Parameter: | $EF_{km,CO2,y}$ |
|---|---|
| Unit: | ($tCO_2$/km) |
| Description: | Average $CO_2$ emission factor for the trucks during year y. |
| Measured/ Calculated / Default: | Calculated. |
| Source of data: | The Project Participant used the following sources to determine this parameter:<br><br>Truck performance (Km/lt) from transportation subcontractors for each truck during the monitored period.<br>Fossil fuel density: Fossil fuel laboratory analysis.<br>Fossil fuel net calorific value: Fossil fuel laboratory analysis.<br>Fossil fuel carbon content: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1-4.<br>Fossil fuel fraction of carbon oxidized: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1-4. |
| Value(s) of monitored parameter: | 0.0012850 ($tCO_2$/km)<br><br>Note:<br>The above value is the original monitored value. However, the Project Participant carried out a conservative adjustment to the value informed due to the temporary deviation caused by delayed sampling for the analysis of fossil fuel net calorific values. The net calorific value of Diesel has an impact on the average $CO_2$ emission factor for trucks. For additional information refer to section B.2.1 of this Monitoring report and the emission reduction calculation spread sheet. |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | This parameter is calculated and recorded annually. Please note the following detail below:<br><br>Truck performance (Km/lt): Monitored and recorded monthly during the monitored period.<br>Fossil fuel density: Monitored twice a year (taking three samples each time) and recorded annually.<br>Fossil fuel net calorific value: Monitored twice a year (taking three samples each time) and recorded annually.<br>Fossil fuel carbon content: Default value from IPCC.<br>Fossil fuel fraction of carbon oxidized: Default value from IPCC. |
| Calculation method (if applicable): | The calculation method is as follows:<br><br>$EF_{km,FF}$ = [[1/(average fuel performance of trucks (km/l)] * Diesel fuel density (kg/l)/1,000] * [$EF_{CO2,FF,Diesel}$ ($tCO_2$/GJ) * $NCV_{Diesel}$ (GJ/ton)]<br><br>Where:<br><br>$EF_{CO2,FF}$ ($tCO_2$/GJ): Carbon content of diesel (tC/TJ) * Fraction of carbon oxidized* $CO_2$ / C conversion factor ($tCO_2$/tC) *(1TJ/1000GJ). |

| QA/QC procedures: | In this case, it was not possible to compare the monitored parameter $EF_{km,CO2,y}$ with the corresponding default factor for heavy truck transportation, since the corresponding $CO_2$ emission factor for heavy truck transportation is not available in the 2006 IPCC manual. |
|---|---|

However, the Project Participant compared this monitored parameter with the $CO_2$ emission factor of trucks observed in other biomass power plants by Arauco, also registered in the CDM.

| | $CO_2$ emission factor of trucks (kg $CO_2$/km). | | |
|---|---|---|---|
| Year | Valdivia Project Plant | Nueva Aldea Biomass Power Plant Phase 1, Ref:0258 | Trupan Biomass Power Plant, Ref:0259 |
| 2014 | 1.285 | --- | --- |
| 2013 | 1.258 | --- | --- |
| 2012 | 1.319 | --- | 1.044 |
| 2011 | 1.250 | 1.351 | 1.170 |
| 2010 | 1.271 | 1.347 | 1.130 |
| 2009 | 1.260 | 1.351 | 1.348 |
| 2008 | --- | 1.451 | 1.397 |

As can be seen in the table above, the monitored value is consistent with the truck emission factors observed in the other biomass power plants and therefore it was deemed acceptable in this case.

Additionally, the Project Participant compared the average truck fuel performance with the ones observed in other biomass power plants by Arauco. Result of this comparison was deemed acceptable, as shown in the table below.

| | Average truck´s fuel performance (km/l) | | |
|---|---|---|---|
| Year | Valdivia Project Plant | Nueva Aldea Biomass Power Plant Phase 1, Ref:0258 | Trupan Biomass Power Plant, Ref:0259 |
| 2014 | 2.08 | --- | --- |
| 2013 | 2.11 | --- | --- |
| 2012 | 2.13 | --- | 2.60 |
| 2011 | 2.13 | 1.98 | 2.34 |
| 2010 | 2.10 | 1.98 | 2.36 |
| 2009 | 2.10 | 1.95 | 1.98 |
| 2008 | --- | 1.84 | 1.91 |

Additionally, the Project Participant compared local $NCV_{Diesel}$ values used with the ones provided by the 2006 IPCC.

| | $NCV_{Diesel}$ (GJ/ton) | |
|---|---|---|
| Year | Valdivia Project Plant | 2006 IPCC Values |
| 2014 | 42.83 | |
| 2013 | 43.01 | 43.0 [Lower: 41.4 Upper: 43.3] |
| 2012 | 42.51 | |
| 2011 | 42.77 | |
| 2010 | 42.90 | |

According to the value above, the Project Participant deemed the monitored NCV within the acceptable range.

| | |
|---|---|
| Purpose of data: | Project emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$EF_{CO2,FF,i}$** |
|---|---|
| Unit: | ($tCO_2/GJ$) |
| Description: | $CO_2$ emission factor for fossil fuel type i. |
| Measured/ Calculated / Default: | Calculated. |
| Source of data: | The Project Participant used the following sources to determine this parameter:<br><br>Fossil fuel carbon content: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1-4.<br>Fossil fuel fraction of carbon oxidized: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1-4. |
| Value(s) of monitored parameter: | Diesel: 0.07407 ($tCO_2/GJ$)<br><br>Fuel oil: 0.07737 ($tCO_2/GJ$) |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | Annually |
| Calculation method (if applicable): | $EF_{CO2,FF,Diesel}$ ($tCO_2/GJ$): Carbon content of diesel (tC/TJ) * Fraction of carbon oxidized* $CO_2$ / C conversion factor ($tCO_2/tC$) * (1TJ/1000GJ)<br><br>where:<br><br>$EF_{CO2,FF,Diesel}$ ($tCO_2/GJ$) = 20.2 (tC/TJ) * 100% * 44/12 ($tCO_2/tC$) * (1GJ/1000TJ).<br><br>$EF_{CO2,FF,FO}$ ($tCO_2/GJ$): Carbon content of FO (tC/TJ) * Fraction of carbon oxidized* $CO_2$ / C conversion factor ($tCO_2/tC$) * (1TJ/1000GJ)<br><br>where:<br><br>$EF_{CO2,FF,FO}$ ($tCO_2/GJ$) = 21.1 (tC/TJ) * 100% * 44/12 ($tCO_2/tC$) * (1TJ/1000GJ). |
| QA/QC procedures: | The Project Participant used the most updated IPCC default factors to calculate the fossil fuel coefficients. In this case, values were obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 1-4. |
| Purpose of data: | Project emission calculations. |
| Additional comment: | --- |

<table>
<tr><td>Data / Parameter:</td><td>$FF_{project\ plant,i,y}$</td></tr>
<tr><td>Unit:</td><td>(ton/year)</td></tr>
<tr><td>Description:</td><td>Quantity of fossil fuel type i combusted in the biomass residue fired power plant during the year y.</td></tr>
<tr><td>Measured/ Calculated / Default:</td><td>Measured.</td></tr>
<tr><td>Source of data:</td><td>The Project Participant used the following information sources to determine this parameter:<br><br>– Specific consumption factor of 3.43 (kg of fuel oil/$m^3$st of forestry biomass residues): Corresponds to the historic fossil fuel consumption per unit of biomass from forestry operations used in the power boiler of the Valdivia biomass power plant. This variable is obtained from the revised PDD.<br><br>– Biomass residues from forestry operations related to the implementation of the CDM project activity: This biomass amount is calculated using the total biomass consumption in the power boiler and the equations derived from the approved methodology deviation of the ACM0006 (Version 5) presented in Annex 3 of the revised PDD.<br><br>– Fuel oil used in the power boiler attributable to the project activity: This corresponds to the amount of fossil fuel used in the power boiler to enhance the surplus power generation to the grid.<br><br>– Fuel oil used in the recovery boiler attributable to the project activity: This corresponds to the amount of fossil fuel used in the recovery boiler to enhance the surplus power generation to the grid. This fossil fuel amount is directly monitored by the power plant operators in the Valdivia biomass power plant.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>Fossil fuel consumption associated to additional biomass residues from forestry operations: 1,827.8 ton<br><br><u>Note</u>: The above value corresponds to the original calculation, before adjustments to net calorific value of biomass residues and total biomass combusted in the power boiler were made. For an explanation of these adjustments please refer to section B.2.1 and the “Additional comment” section under parameter $BF_{k,y}$ in this report.<br><br>Fossil fuel consumption in the power and recovery boilers related to additional surplus power generation to the grid:<br><br><table><tr><td>2013</td><td>Description</td></tr><tr><td>Measured value (ton/year)</td><td>Parameter</td></tr><tr><td>487.8</td><td>Additional Fuel Oil consumption in the power boiler for power generation.</td></tr><tr><td>1,040.5</td><td>Additional Fuel Oil consumption in the recovery boiler for power generation.</td></tr></table></td></tr>
</table>

| | |
|---|---|
| Monitoring equipment: | 352FT653<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3010822<br>Serial number sensor: 723360<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br><br>352FT657<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3010807<br>Serial number sensor: 728932<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br><br>352FT681<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3010892<br>Serial number sensor: 723912<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br><br>352FT685<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3012133<br>Serial number sensor. 729075<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br><br>352FT823<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3011047<br>Serial number sensor. 728916<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument..<br><br>363FT507<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3010656<br>Serial number sensor: 728840<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br><br>363FT510<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3010755<br>Serial number sensor. 728933<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br><br>363FT515<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ |

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|---|---|
| | Accuracy class: +/- 0.5%<br>Serial number transmitter: 3012292<br>Serial number sensor. 728929<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument.<br>363FT518<br>Mass Flow Transmitter MICROMOTION 2700R11EBASZAZ<br>Accuracy class: +/- 0.5%<br>Serial number transmitter: 3010764<br>Serial number sensor: 728954<br>Calibration frequency: According to manufacturer, calibration is not required for this instrument. |
| Measuring/<br>Reading/<br>Recording frequency: | Fossil fuel consumption amounts were continuously measured and recorded on-line by the pulp mill's DCS. The recorded data was aggregated monthly and yearly for emission reduction calculations. |
| Calculation method<br>(if applicable): | Fossil fuel consumption in the power and recovery boilers was measured using on-line Coriolis mass flow meters. Data obtained was registered on-line by the pulp mill's DCS and recorded in databases.<br><br>As defined in the revised PDD, the consideration of fossil fuel consumption for emission reduction calculations is limited only to the additional fossil fuel consumption associated to the implementation of the CDM project activity. As previously mentioned, this includes additional fossil fuel consumption due to additional biomass consumption in the power boiler and additional fuel oil consumption in the power and recovery boilers for surplus power generation to the grid:<br><br><u>Additional fossil fuel consumption used to burn additional biomass consumption related to the project activity:</u><br><br>According to the revised PDD, the Project Participant used the specific consumption factor (i.e. 3.43 kg fuel/$m^3$st)[3] which contemplates historic fossil fuel consumption per unit of biomass consumed in the Valdivia plant. Hence, the additional fossil fuel was determined by multiplying the specific consumption factor by the additional biomass residues from forestry operations associated to the implementation of the CDM project activity. The additional biomass residue amount was calculated using the equations of the approved ACM0006 (Version 5) deviation.<br><br><u>The additional fossil fuel consumption in the power and recovery boilers used to enhance surplus power generation to the grid:</u><br><br>The corresponding shift operator registered the accumulated Fuel Oil consumption given by the Delta V system at every hour (o'clock time) for the two boilers. In the case of the recovery boiler, the Fuel Oil consumption for the hour where extra fuel was used to enhance surplus power generation to the grid was determined by the difference of two consecutive records taken at o'clock time.<br><br>In the case of the power boiler, empirical curves were used to calculate the amount of Fuel Oil consumed for surplus power generation. |

[3] ($m^3$st) Volume unit commonly used in the Chilean forestry industry to express a cubic meter of biomass like sawdust, bark or chips that also contain a certain % of air and moisture that are not previously determined or quantified.

| | |
|---|---|
| QA/QC procedures: | The Project Participant performed consistency checks of the fossil fuel consumption amounts against the energy/mass balance in the recovery and power boilers. Additionally, the measured value was compared with fossil fuel stock variations and purchased amounts.<br><br><u>Energy/mass balance consistency check</u><br><br>The resulting average efficiency of the recovery boiler was 67.32% which is almost identical with the average efficiency value of 64.05 % specified for this boiler by the manufacturer. Therefore, the calculated efficiency is considered reasonable.<br><br>The efficiency obtained for the power boiler during the monitoring period was 69.85%, which is a reasonable value when compared with the manufacturer's range [61.99% - 87.31%]. In this way, consistency of fossil fuel measurements was confirmed.<br><br><u>Purchase and stock variations check</u><br><br>The total measurements of Fuel Oil in the plant were cross-checked with purchases and stock variations. A difference of 2% was obtained which is deemed a reasonable deviation. |
| Purpose of data: | Project emission calculations. |
| Additional comment: | According to the revised PDD, the Project Participant used the specific consumption factor (i.e. 3.43 kg fuel/$m^3$st) to calculate fossil fuel consumed in the power boiler attributable to additional biomass residues from forestry operations associated to the implementation of the CDM project activity. The amount of fossil fuel thus obtained is higher than the total amount of fossil fuel actually measured and consumed in the power boiler. This is due to the installation of the biomass dryer, which has, in practice, allowed to reduce the amount of fossil fuel consumed in the power boiler. However, calculating the amount of fossil fuel using the specific consumption factor given in the PDD is more conservative since it results in higher fossil fuel amounts and thus higher project emissions. |

| **Data / Parameter:** | $FF_{project\ site,i,y}$ |
|---|---|
| Unit: | (ton) |
| Description: | Quantity of fossil fuel type i combusted at the project site for other purposes that are attributable to the project activity during the year y. |
| Measured/ Calculated / Default: | Measured. |
| Source of data: | The Project Participant used the following information source to determine this parameter:<br><br>– Data supplied by front loader operators (biomass transportation subcontractors) of the Valdivia biomass power plant. |
| Value(s) of monitored parameter: | Diesel: 50.7 ton<br><br>(See additional comment below) |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ | This parameter is monitored daily. The subcontractors aggregate and record this parameter on a monthly basis. |

| | |
|---|---|
| Recording frequency: | |
| Calculation method (if applicable): | External subcontractors provide the service for the transportation of the biomass residues from forestry operations in the Valdivia biomass power plant site. Every month this entity provides the total amount of fossil fuel consumed as well as the operational hours of the front loader and/or bulldozers used to transport the biomass residues to the power boiler.<br><br>The Project Participant then uses this total amount of fossil fuel used for the transportation of biomass residues and scales it down to the transportation of the biomass residues attributable to the implementation of the CDM project activity. This adjustment is performed using the total amount of biomass residues from forestry operations and the fraction of this biomass amount that is attributable to the CDM project activity. This biomass amount is determined using the equations of the approved deviation of the ACM0006 (Version 5). The calculation is performed as follows:<br><br>Diesel used for on-site biomass transportation due to the CDM project activity = Total Diesel consumption for on-site biomass transportation * (Biomass residues from forestry operations associated to the implementation of the CDM project activity/Total biomass residues combusted in the power boiler). |
| QA/QC procedures: | The Project Participant carried out consistency checks based on monthly and annual operational indices (e.g. check whether front loader fossil fuel consumption divided by the operation hours resulted in a reasonable index, comparable to the ones observed in previous years).<br><br>The operational index obtained for 2014 was compared against historical operational indices which resulted in a reasonable value, as shown in table below:<br><br>Year (Jan-Dec) / Index (lt/hrs-year): 2014: 12.56; 2013: 13.44; 2012: 11.86; 2011: 12.07; 2010: 12.15; 2009: 12.24; 2008: 13.94; 2007: 13.94 |
| Purpose of data: | Project emission calculations. |
| Additional comment: | The value reported in this section is the original one. However, because the amount of biomass residues from forestry operations associated to the implementation on the CDM project activity is involved in its calculation, and this amount was adjusted due to delays in the measurement of biomass net calorific value and a calibration gap in the power boiler weighmeter, the value of parameter $FF_{project\ site,i,y}$ also was implicitly adjusted. Please refer to section B.2.1 of this Monitoring Report and the emission reduction spreadsheet. |

| Year (Jan-Dec) | Index (lt/hrs-year) |
|---|---|
| 2014 | 12.56 |
| 2013 | 13.44 |
| 2012 | 11.86 |
| 2011 | 12.07 |
| 2010 | 12.15 |
| 2009 | 12.24 |
| 2008 | 13.94 |
| 2007 | 13.94 |

| **Data / Parameter:** | **$EG_{project\ plant,y}$** |
|---|---|
| Unit: | (MWh/yr) |
| Description: | Net quantity of electricity generated in the project plant during the year y. |

| | |
|---|---|
| Measured/ Calculated / Default: | Measured and calculated. |
| Source of data: | The Project Participant used the following information source to determine this parameter:<br><br>– Valdivia power plant on-line direct measurements of the gross electric power generated in the Valdivia biomass power plant. Measurements are continuously stored in the DCS database system.<br>– Additional electric power consumption of the project mill: 4.59 % of the total electricity consumption of the project pulp mill. This value comes from the revised PDD and is used to calculate the net quantity of electricity generated in the project plant.<br>– Total power consumption of the project pulp mill: On-line direct measurements which are continuously stored in the DCS database system of the Valdivia biomass power plant. |
| Value(s) of monitored parameter: | 737,159 Mwh/yr |

| | |
|---|---|
| Monitoring equipment: | 368JI101<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0211A-633-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 27/11/2002<br>Date of last calibration: 24/04/2009<br>Validity: 23/04/2016<br><br>368JI102<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0211A-626-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 27/11/2002<br>Date of last calibration: 23/04/2009<br>Validity: 22/04/2016<br><br>368JI104<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0211A-632-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 28/11/2002<br>Date of last calibration: 21/04/2009<br>Validity: 20/04/2016<br><br>368JI105<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0212A-006-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 02/12/2002<br>Date of last calibration: 21/04/2009<br>Validity: 20/04/2016<br><br>368JI107<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0211A-611-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 27/11/2002<br>Date of last calibration: 22/04/2009<br>Validity: 21/04/2016<br><br>368JI201<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0212A-205-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 04/12/2002<br>Date of last calibration: 24/04/2009<br>Validity: 23/04/2016<br><br>368JI203<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0212A-044-11 |

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|---|---|
| | Calibration frequency: 7 Years<br>Date of penultimate calibration: 04/12/2002<br>Date of last calibration: 24/04/2009<br>Validity: 23/04/2016<br><br>368JI205<br>Type: Energy Meter POWER MEASUREMENT ION7300<br>Accuracy class: +/- 0.5%<br>Serial number: PA-0212A-045-11<br>Calibration frequency: 7 Years<br>Date of penultimate calibration: 04/12/2002<br>Date of last calibration: 23/04/2009<br>Validity: 22/04/2016 |
| Measuring/<br>Reading/<br>Recording frequency: | The electric power generation and total internal electricity consumption of the project pulp plant were continuously measured using dedicated energy meters. Measurements were recorded in the DCS database system every two minutes and aggregated and registered monthly for the emission reduction calculation of the monitored period. |
| Calculation method<br>(if applicable): | The net quantity of electricity generated in the project plant was determined using the following equation:<br><br>$EG_{project\ plant}$ (MWh) = Gross electric power generation (MWh) – [Total internal electricity consumption of the project plant * (4.59 %)] (MWh).<br><br>As defined in the revised PDD, and stated in the approved methodology deviation, the additional energy consumption (attributable to the project activity) was determined by multiplying the total internal electricity consumption measured by the Project Participant by a factor of 4.59 %. The resulting value (second term of the right side of the equation above) is subtracted from the gross electricity generation of the Valdivia biomass power plant, thus allowing to determine the net quantity of electricity generated in the project plant. |
| QA/QC procedures: | All electricity meters received maintenance and calibration according to the manufacturer's recommendation and/or proper industry standards.<br><br>According to methodology ACM0006 (Version 5), page 56/63 the consistency of metered net electricity generation shall be cross-checked with the quantity of fuel fired in the project plant. This means, check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years.<br><br>• Black liquor index: Electricity generation associated to black liquor/black liquor (dry basis) (MWh/tDS) = 0.55 (MWh/tDS). The result is deemed reasonable.<br><br>• Biomass residues from forest operations index: Electricity generation associated to forest biomass residues/Biomass residues from forestry operations (dry basis) (MWh/BDt) = 0.81 (MWh/BDt). The result is deemed reasonable.<br><br>According the revised PDD, the Project Participant must also perform the consistency check considering the total power generation and the monitored amount of steam passing through the turbines. This is shown below for each of the two turbines of the Valdivia power plant: |

| | |
|---|---|
| | TG1: The average annual index of 0.146 (MWh/t steam) is within the historical range of [0.13 - 0.15] (MWh/t steam). As a result, the observed index calculated during the monitoring period is deemed acceptable.<br><br>TG2: The average annual index of 0.253 (MWh/t steam) is within the historical range of [0.18 - 0.27] (MWh/t steam). As a result, the observed index calculated during the monitoring period is also deemed acceptable.<br><br>Finally, according to the revised PDD, the consistency of metered net electricity generation shall also be cross-checked with receipts from electricity sales of the Valdivia power plant.<br><br>The consistency of metered net electricity generation sold to the grid was cross-checked comparing the amount of electricity obtained from the energy bus balance with receipts from electricity sales and consumption. A deviation of 0.62 % was obtained, which resulted in an acceptable deviation. |
| Purpose of data: | Baseline emission calculations. |
| Additional comment: | It must be noted that the net electricity generation of the project plant calculated from the equation above is used to determine the net increased electricity generation of the Valdivia biomass power plant derived from implementing CDM initiatives N°1 and N°2 as described in the PDD. |

| **Data / Parameter:** | $\mathbf{Q_{project\ plant,y}}$ |
|---|---|
| Unit: | (GJ) |
| Description: | Net quantity of heat generated from firing biomass in the project mill. |
| Measured/ Calculated / Default: | Measured. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br><br>• High, medium and low pressure steam flows generated and used in the Valdivia biomass power plant: On-site measurements.<br><br>• Steam thermodynamic conditions: Predefined set points (established in the pulping process) of steam temperature and pressure as required (i.e. in the case of superheated steam). |
| Value(s) of monitored parameter: | 7,756,871 GJ<br><br>Note that the monitored value corresponds to heat generated in the power boiler and is the original value. Due to malfunction of the TG1 low pressure extraction flowmeter, conservative adjustments had to be made to the amount of low pressure steam generated and thus to the value of process heat generated in the cogeneration plant. See section “Additional Comment.” |

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|---|---|
| Monitoring equipment: | 365FT901<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 6408030356<br>Calibration frequency: 3 Years<br>Calibration dates: 10/11/2012<br>Date of last calibration: 27/11/2013<br>Validity: 26/11/2016<br><br>365FT902<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 5003010902<br>Calibration frequency: 3 Years<br>Calibration dates: 11/11/2012<br>Date of last calibration: 26/11/2013<br>Validity: 25/11/2016<br><br>365FT910<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 5003010903<br>Calibration frequency: 3 Years<br>Calibration dates: 11/11/2012<br>Date of last calibration: 27/11/2013<br>Validity:26/11/2016<br><br>365FT913<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 5003010904<br>Calibration frequency: 3 Years<br>Calibration dates: 11/11/2012<br>Date of last calibration: 27/11/2013<br>Validity: 26/11/2016<br><br>365FT914<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 6410003178<br>Calibration frequency: 3 Years<br>Calibration dates: 27/11/2013<br>Date of last calibration: 14/11/2014<br>Validity: 13/11/2017<br><br>*Replaced by on 24/11/2014 by:*<br>365FT914<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 6408013775<br>Calibration frequency: 3 Years<br>Calibration dates: 24/11/2014<br>Date of last calibration: 24/11/2014<br>Validity: 23/11/2017<br><br>365FT920<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075% |

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|---|---|
| | Serial number: 5003010906<br>Calibration dates: 11/11/2012<br>Date of last calibration: 28/11/2013<br>Validity: 27/11/2016<br><br>365FT923<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 5003010907<br>Calibration frequency: 3 Years<br>Calibration dates: 11/11/2012<br>Date of last calibration: 11/11/2012<br>Validity:10/11/2015<br><br>*Replaced 02/02/2013 by:*<br><br>365FT923<br>Type: Differential Pressure Flow Transmitter ABB 2600T<br>Accuracy class: +/- 0.075%<br>Serial number: 5003009136<br>Calibration frequency: 3 Years<br>Calibration dates: 05/02/2013, 05/04/2013<br>Date of last calibration: 28/11/2013<br>Validity: 27/11/2016<br><br>365FT924<br>Type: Differential Pressure Flow Transmitter ABB 264DSGSSB2A3<br>Accuracy class: +/- 0.075%<br>Serial number: 6410006727<br>Calibration frequency: 3 Years<br>Calibration dates: 10/11/2012<br>Date of last calibration: 28/11/2013<br>Validity: 27/11/2016<br><br>362PT980<br>Type: Pressure Transmitter ROSEMOUNT 3051S2TG4A2E11F1AA01B4<br>Accuracy class: +/- 0.025% of span<br>Serial number: 0075788<br>Calibration frequency: 5 Years<br>Calibration dates: 10/11/2012<br>Date of last calibration: 26/11/2013<br>Validity: 25/11/2018<br><br>362TT965<br>Type: Temperature Transmitter ROSEMOUNT 3244MV<br>Accuracy class: +/- 0.10 °C<br>Serial number: 430676<br>Calibration frequency: 1 Year<br>Date of penultimate calibration: 07/06/2012, 01/04/2013<br>Date of last calibration: 18/06/2014<br>Validity: 17/06/2015 |
| Measuring/<br>Reading/<br>Recording frequency: | The variables used to determine this parameter were monitored continuously using proper instruments. The data obtained was recorded in the power plant DCS and was aggregated monthly for emission reduction calculation purposes. |
| Calculation method | The algorithm used is shown in section E.1 Baseline emissions |

| | |
|---|---|
| (if applicable): | calculation of the Monitoring Report and in page 118 of the registered PDD.<br><br>This algorithm was part of the methodology deviation presented for the Valdivia CDM project activity, which was approved by the Executive Board on December 13, 2007. |
| QA/QC procedures: | All relevant steam flow meters received maintenance and calibration according to proper industry standards.<br><br>According to the revised PDD, the consistency of metered steam flows was compared with an ad-hoc energy/mass balance and/or operational indices of the mill (e.g. for each of the boilers --recovery and power boiler-- check whether the amount of steam produced divided by the amount of fuels fired results in reasonable values compared to the ones observed in previous years).<br><br>QA/QC 1: The Project Participant checked the consistency of metered steam flows against the annual energy balance of the power and recovery boilers.<br><br>The efficiency obtained for the power boiler during the monitored period was 69.85 %, which resulted in a reasonable value when compared with the manufacturer's acceptance range [61.99% - 87.31%].<br><br>The resulting average efficiency of the recovery boiler was 67.32% with minimal deviation from the 64.05% recommended by the manufacturer.<br><br>Considering the results presented above, the monitored variables used for the calculation of this parameter were deemed acceptable by the Project Participant.<br><br>QA/QC 2: The Project Participant checked consistency of metered heat flows against operational indices of the mill. Results are presented below:<br><br>Operational index of the recovery boiler: (ton of steam/ tDS)<br><br>The annual operational index was 3.19 (tons of steam/tDS) which is a reasonable value when compared with the historical acceptance range value of [3.5 +/- 0.5] (ton of steam/tDS)] for the recovery boiler.<br><br>Operational index of the power boiler: (ton of steam/ BDt)<br><br>The annual operational index was 4.67 (tons of steam/BDt), which resulted in a reasonable value compared with the historical acceptance range of [4.7 +/-0.5] (ton of steam/BDt) for the power boiler.<br><br>Considering the results obtained above, the monitored variables used for the calculation of this parameter were considered acceptable by the Project Participant.<br><br>QA/QC 3:<br><br>In accordance with the methodology, the Project Participant shall check the consistency of metered net heat generation with the quantity of fuels fired (e.g. check whether the net heat generation divided by the quantity of fuels fired results in a reasonable thermal efficiency that is comparable to previous years). |

| | |
|---|---|
| | <table><tr><td>Year<br>(Jan-Dec)</td><td>Index<br>(GJ/BDt)</td></tr><tr><td>2014</td><td>8.08</td></tr><tr><td>2013</td><td>9.29</td></tr><tr><td>2012</td><td>9.45</td></tr><tr><td>2011</td><td>9.03</td></tr><tr><td>2010</td><td>9.46</td></tr><tr><td>2009</td><td>9.22</td></tr></table><br>Due to the installation of the biomass dryer, which led to a higher consumption of biomass residues, this index had a lower value in 2014. |
| Purpose of data: | Baseline and Project emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$NCV_i$** |
|---|---|
| Unit: | (GJ/ton) |
| Description: | Net calorific value of the fossil fuel type i. |
| Measured/ Calculated / Default: | Measured. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br>• Net calorific value measurements carried out by reputed laboratories. |
| Value(s) of monitored parameter: | <u>First semester (Jan-June 2013) measurements:</u><br><table><tr><td>Date of Samples</td><td>Diesel<br>(Kcal/kg)</td><td>FO #6<br>(Kcal/kg)</td></tr><tr><td>Feb 10, 2014</td><td>10,237</td><td>9,647</td></tr><tr><td>Feb 10, 2014</td><td>10,229</td><td>9,661</td></tr><tr><td>Feb 10, 2014</td><td>10,227</td><td>9,657</td></tr><tr><td>Average (Kcal/kg)</td><td>10,231</td><td>9,655</td></tr><tr><td>Average (GJ/ton)</td><td>42.84</td><td>40.42</td></tr></table><br><u>Second semester (July-Dec 2013) measurements:</u><br><table><tr><td>Date of Samples</td><td>Diesel<br>(Kcal/kg)</td><td>FO #6<br>(Kcal/kg)</td></tr><tr><td>July 25, 2013</td><td>10,223</td><td>9,633</td></tr><tr><td>July 25, 2013</td><td>10,220</td><td>9,625</td></tr><tr><td>July 25, 2013</td><td>10,237</td><td>9,628</td></tr><tr><td>Average (Kcal/kg)</td><td>10,227</td><td>9,629</td></tr><tr><td>Average (GJ/ton)</td><td>42.82</td><td>40.31</td></tr></table> |

| | |
|---|---|
| Monitoring equipment: | Not applicable. |
| Measuring/<br>Reading/<br>Recording frequency: | Every six months, taking at least three samples for each measurement. |
| Calculation method<br>(if applicable): | Not applicable. |
| QA/QC procedures: | The measured net calorific values were found consistent with the corresponding IPCC default values. |
| Purpose of data: | Project emission calculations. |
| Additional comment: | The net calorific values informed in the above tables correspond to the original values obtained from sampling. However, the Project Participant informs that net calorific values used for emission reduction calculations differ from the original ones. Adjustments were carried out due to the temporary deviation caused by sampling delays. For detailed information refer to section B.2.1 of this Monitoring report and the emission reduction calculation spread sheet. |

| **Data / Parameter:** | **$NCV_k$** |
|---|---|
| Unit: | (GJ/ton) |
| Description: | Net calorific value of biomass residue type k. |
| Measured/<br>Calculated /<br>Default: | Measured. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br><br>• Net calorific value measurements carried out by reputed laboratories. |
| Value(s) of monitored parameter: | First semester (Jan-June 2013) measurements:<br><br>Black liquor: 11.87 (GJ/ton)<br>Sawdust & bark mix: 17.71 (GJ/ton)<br><br>Second semester (July-Dec 2013) measurements:<br><br>Black liquor: 12.41 (GJ/ton)<br>Sawdust & bark mix: 18.80 (GJ/ton) |
| Monitoring equipment: | Not applicable. |
| Measuring/<br>Reading/<br>Recording frequency: | Every six months, taking at least three samples for each measurement.<br>All NCVs were determined on dry basis of biomass. |
| Calculation method<br>(if applicable): | **Black liquor**<br><br>In accordance with the methodology, the required black liquor samples were collected with the purpose of measuring their Net Calorific Value in the laboratory. Results are presented below:<br><br>First period (Jan-June 2013): Black liquor Net Calorific Value |

| Date of Samples | NCV(pine) (GJ/ton) | Date of Samples | NCV(euca) (GJ/ton) |
|---|---|---|---|
| Feb 17, 2014 | 11.91 | Feb 10,2013 | 11.93 |
| Feb 17, 2014 | 11.77 | Feb 10,2013 | 12.00 |
| Feb 17, 2014 | 11.82 | Feb 10,2013 | 12.14 |
| Average | 11.83 | Average | 12.03 |

Second period (July-Dec 2013): Black liquor Net Calorific Value

| Date of Samples | NCV(pine) (GJ/ton) | Date of Samples | NCV(euca) (GJ/ton) |
|---|---|---|---|
| July 25, 2014 | 12.37 | No euca processed. Therefore, no sampling. | |
| July 25, 2014 | 12.37 | | |
| July 25, 2014 | 12.49 | | |
| Average | 12.41 | | |

A weighted average calculation is used considering percentage of pulp mill production (ADt) and the average net calorific value of pine and eucalyptus to determine the most representative net calorific value for black liquor. Results of these calculations are presented below:

| Parameter | First period (Jan-June 2013) | Second period (July-Dec 2013) |
|---|---|---|
| NCV (Black liquor) | 11.87 | 12.41 |

Note: Please, refer to section "Additional comments" below.

A description of the weighted average calculations performed to ensure the representativeness of the net calorific value of black liquor is presented here:

First period (Jan-June 2013):

NCV (Black liquor) 11.87 (GJ/tDS) = [81% * 11.83 (GJ/tDS) + 19% * 12.03(GJ/tDS)].

Second period (July-Dec 2013):

NCV (Black liquor) 12.41 (GJ/tDS)= [100% * 12.41 (GJ/tDS)]

**Biomass residues (mix of sawdust and bark) from forest operations.**

In accordance with the methodology, the required residual biomass samples were collected with the purpose of measuring their net calorific value in the laboratory. Results are presented below:

| | Date of samples | Biomass residues | NCV (kcal/kg) | (GJ/ton) |
|---|---|---|---|---|
| 1st Period | Feb 10, 2014 | mix of sawdust and bark. | 4,171 | 17.46 |
| 1st | Feb 10, 2014 | mix of sawdust | 4,229 | 17.71 |

| | | | | |
|---|---|---|---|---|
| Period | | and bark. | | |
| 1st Period | Feb 10, 2014 | mix of sawdust and bark. | 4,289 | 17.96 |
| Net calorific value (dry basis) | | | | 17.71 |

| | Date of samples | Biomass residues | NCV (kcal/kg) | (GJ/ton) |
|---|---|---|---|---|
| 2nd Period | July 25, 2014 | mix of sawdust and bark. | 4,456 | 18.66 |
| 2nd Period | July 25, 2014 | mix of sawdust and bark. | 4,493 | 18.81 |
| 2nd Period | July 25, 2014 | mix of sawdust and bark. | 4,525 | 18.95 |
| Net calorific value (dry basis) | | | | 18.80 |

Note: Please, refer to Section Additional comments below.

QA/QC procedures:

The Project Participant cross-checked the consistency of the measured values with the default values by the IPCC and other similar biomass power plants by Arauco located in the South part of the country. The values were found consistent.

Biomass type: Black liquor

| Source | NCV (GJ/Kg) |
|---|---|
| Values applied | 11.87(1st semester)<br>12.41(2nd semester)<br>Average: 12.14 |
| Default values IPCC 2006,Chapter 1, Volume 2 | Range [5.9 – 23.0] |
| Historical value 2013 of Valdivia Biomass Power Plant Ref: 1787 | 11.75(1st semester)<br>11.85(2nd semester) |
| Historical value 2012 of Valdivia Biomass Power Plant Ref: 1787 | 12.06 (1st semester)<br>13.25 (2nd semester) |
| Historical value 2011 of Valdivia Biomass Power Plant Ref: 1787 | 11.96(1st semester)<br>12.24(2nd semester) |
| Historical value 2010 of Valdivia Biomass Power Plant Ref: 1787 | 12.01(1st semester)<br>12.22(2nd semester) |
| Historical value 2012 (other registered CDM project Nueva Aldea Biomass Power plant Phase 2, Ref:0356) | 10.70 |
| Historical value 2011 (other registered CDM project Nueva Aldea Biomass Power plant Phase 2, Ref:0356) | 10.70 |
| Historical value 2010 (other registered CDM project Nueva Aldea Biomass Power plant Phase 2, Ref:0356) | 10.29 |
| Historical value 2009 (other registered CDM project Nueva Aldea Biomass Power plant Phase 2, Ref:0356) | 10.35 |

Biomass type: mix of sawdust and bark from forest operations

| Source | NCV (GJ/Kg) |
|---|---|
| Values applied | 17.71 (1st semester)<br>18.80 (2nd semester)<br>Average: 18.24 |
| Default values IPCC 2006, Chapter 1, Volume 2. | Range [7.9 – 31] |
| Historical value 2013 of Valdivia Biomass Power Plant. Ref: 1787 | 17.63 (1st semester)<br>18.02 (2nd semester) |
| Historical value 2012 of Valdivia Biomass Power Plant. Ref: 1787 | 18.65 (1st semester)<br>17.87 (2nd semester) |
| Historical value 2011 of Valdivia Biomass Power Plant. Ref: 1787 | 18.62 (1st semester)<br>16.93 (2nd semester) |
| Historical value 2010 of Valdivia Biomass Power Plant. Ref: 1787 | 16.53 (1st semester)<br>18.83 (2nd semester) |
| Historical value 2011 (other registered CDM project: Nueva Aldea Biomass Power Plant Phase 1, Ref: 0258) | 16.47 |
| Historical value 2010 (other registered CDM project: Nueva Aldea Biomass Power Plant Phase 1, Ref: 0258) | 16.95 |
| Historical value 2009 (other registered CDM project: Nueva Aldea Biomass Power Plant Phase 1, Ref: 0258) | 17.98 |
| Historical value 2008 (other registered CDM project Nueva Aldea Biomass Power Plant Phase 1, Ref.0258) | 17.97 |
| Historical value 2012 (other registered CDM project: Trupan Biomass Power Plant in Chile, Ref: 0259) | 18.32 |
| Historical value 2011 (other registered CDM project: Trupan Biomass Power Plant in Chile, Ref: 0259) | 17.68 |
| Historical value 2010 (other registered CDM project: Trupan Biomass Power Plant in Chile, Ref: 0259) | 17.86 |
| Historical value 2009 (other registered CDM project: Trupan Biomass Power Plant in Chile, Ref: 0259) | 17.93 |
| Historical value 2008 (other registered CDM project: Trupan Biomass Power Plant in Chile, Ref: 0259) | 18.59 |

According to the values above, the Project Participant deemed the monitored NCV values within the acceptable ranges.

| | |
|---|---|
| Purpose of data: | Baseline and Project emission calculations. |
| Additional comment: | The net calorific values informed in the above tables correspond to the original values obtained from sampling. However, the Project Participant informs that net calorific values used for emission reduction calculations differ from the original ones. Adjustments were carried out due to the temporary deviation caused by sampling delays. For detailed information refer to section B.2.1 of this monitoring report and the emission reduction calculation spread sheet. |

| Data / Parameter: | $EF_{burning,CH4,k,y}$ |
|---|---|
| Unit: | ($tCH_4$/GJ) |
| Description: | $CH_4$ emission factor for uncontrolled burning of the biomass residue type k during year y. |
| Measured/ Calculated / Default: | Measured once at the start of the project activity. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br>• Measurement report from U.S. Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana, USA: “Methane Emissions from Burning Sawmill Residues in South Central Chile”.<br><br>In this case, the Project Participant used a measured value for this parameter rather than the default methane emission factor provided by the baseline methodology. This was clearly stated in page 87 of the registered PDD. The Project Participant did not use the measured value in the registered PDD, since it was not available when the PDD of the Valdivia CDM project activity was written. |
| Value(s) of monitored parameter: | Biomass residues from forest operations (sawdust and bark mix from sawmills, pulp mills, etc.): 0.0008742 ($tCH_4$/GJ) or 874.2 (Kg $CH_4$/TJ). This value includes the adjustment of a conservativeness factor of 0.94. |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | Not applicable. |
| Calculation method (if applicable): | Not applicable. |

| | |
|---|---|
| QA/QC procedures: | The measured $CH_4$ emission factor for uncontrolled burning of biomass residues was compared with IPCC default values as presented in the table: |

| | | 2009 measured value.[1] | IPCC default value.[2] |
|---|---|---|---|
| $CH_4$ factor for biomass uncontrolled burning. | ($tCH_4$/BDt) | 0.0172 | 0.0027 |
| $CH_4$ factor for biomass uncontrolled burning. | ($tCH_4$/GJ) | 0.000930 | 0.000300 |

[1] Measurement report issued by ISDA Forest Service, Rocky Mountain Research.
[2] Default value according to the default values by the 2006 IPCC.

As can be seen, the measured value is considerably higher than the IPCC default value. However, as explained below, this comparison is not relevant in this case, since the default emission factor does not reflect the real methane emissions that occur in this case when the biomass residues are burned in the open air, under very low oxygen presence, in the south part of the country.

The Project Participant hired a highly reputed US institution to carry out two measurements for this emission factor: one in September of 2006 and another one in March, 2009. The 2009 measurement was carried out at the end of the dry season (summer), in which the piled biomass residues are drier. This facilitates the combustion of the biomass residues, which leads to a lower methane emission factor (there is less smouldering in the combustion of the biomass residues) than if the biomass residues were more humid (as it happened with the 2006 measurement). The following table shows the 2006 and 2009 measurements for the $CH_4$ emission factor:

| | | 2009 measured value | 2006 measured value. |
|---|---|---|---|
| $CH_4$ factor for biomass uncontrolled burning. | ($tCH_4$/BDt) | 0.0172 | 0.0137 |
| $CH_4$ factor for biomass uncontrolled burning. | ($tCH_4$/GJ) | 0.000930 | 0.0007405 |

Considering the results of the two measurements and the fact that the 2009 measurement (used in the Valdivia emission reduction calculation) was carried out under the most conservative conditions possible, the Project Participant deemed the 2009 measured value representative and appropriate in this case.

| | |
|---|---|
| Purpose of data: | Baseline emission calculations. |

| | |
|---|---|
| Additional comment: | The Project Participant informs that the adjustment factor for uncontrolled biomass burning of biomass residues from forest operations used for emission reduction calculations has changed as a result of the adjustments carried out in the net calorific value of biomass residues from forest operations due to the temporary deviation derived from sampling delays for net calorific value measurements. For detailed information refer to section B.2.1 of this monitoring report and the emission reduction calculation spread sheet. |

| **Data / Parameter:** | $e_{boiler}$ |
|---|---|
| Unit: | (%) |
| Description: | Average net energy efficiency of heat generation in the boiler that would generate heat in the absence of the project activity. |
| Measured/ Calculated / Default: | In this case, the Project Participant used the ASME PTC 4.1 standard for determining the boiler efficiency that would have been used in the baseline scenario. |
| Source of data: | The boiler efficiency was determined based on a similar and comparable plant owned by Arauco according to the ASME PTC 4.1 standard. |
| Value(s) of monitored parameter: | 85% |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | Once at the beginning of the project activity. |
| Calculation method (if applicable): | As per the ASME PTC 4.1 standard. |
| QA/QC procedures: | According to worldwide reputed consultants and equipment supplier in the Energy sector, the efficiency values for these types of boilers are:<br>• Andritz: Efficiency range for a biomass residues boiler (85% - 90%).<br>• Metso: Average efficiency for a biomass residue boiler: 88%.<br>The efficiency value used for the biomass boiler that would have been used in the baseline is similar to the efficiency values presented above. Furthermore and as indicated in the “Comment section below”, the 85% efficiency value used by the Project Participant in this emission reduction calculation is the most conservative efficiency value among the values suggested by the consulting companies above that can be used for the Valdivia project in this case. |
| Purpose of data: | Baseline emission calculations. |
| Additional comment: | It must be noted that the registered PDD used 100% efficiency of this boiler but only for the purpose of estimating the Valdivia CDM project emission reduction calculation ex-ante. However, the 100% default efficiency value is not conservative in this case (this project does not claim emission reductions due to heat displacement); therefore, the Project Participant decided to use a more realistic efficiency value, which in this particular case is based on a real (existing) saturated steam boiler for forestry biomass residues and is much more conservative than the original 100% value used in the PDD. |

| **Data / Parameter:** | -- |
|---|---|
| Unit: | ($m^3st$) |
| Description: | Quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region. |
| Measured/ Calculated / Default: | -- |
| Source of data: | This parameter was determined based on official data and statistics from:<br>• Various reports from INFOR "National Forestry Institute",<br>• Environmental Impact Assessment reports from the Environmental National Authority (CONAMA),<br>• The Instituto Nacional de Estadísticas INE (in English: National Institute of Statistics).<br>• Arauco internal information. |
| Value(s) of monitored parameter: | See table in the leakage section of this Monitoring Report. |
| Monitoring equipment: | Not applicable. |
| Measuring/ Reading/ Recording frequency: | Annually. |
| Calculation method (if applicable): | Not applicable. |
| QA/QC procedures: | --- |
| Purpose of data: | Leakage emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **---** |
|---|---|
| Unit: | ($m^3st$) |
| Description: | Quantity of available biomass residues of type k in the region. |
| Measured/ Calculated / Default: | --- |
| Source of data: | This parameter was determined based on official data and statistics from:<br>• Various reports from INFOR "National Forestry Institute",<br>• Environmental Impact Assessment reports from the Environmental National Authority (CONAMA),<br>• The Instituto Nacional de Estadísticas INE (in English: National Institute of Statistics).<br>• Arauco internal information. |
| Value(s) of monitored parameter: | See table in the leakage section of this Monitoring Report. |

| | |
|---|---|
| Monitoring equipment: | Not applicable |
| Measuring/<br>Reading/<br>Recording frequency: | Annually. |
| Calculation method<br>(if applicable): | Not applicable. |
| QA/QC procedures: | --- |
| Purpose of data: | Leakage emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$EC_{PJ,y}$** |
|---|---|
| Unit: | (MWh) |
| Description: | On-site electricity consumption attributable to the project activity during the year y. |
| Measured/<br>Calculated /<br>Default: | Measured. |
| Source of data: | There was no on-site electricity consumption attributable to the project activity during the monitored period. |
| Value(s) of monitored parameter: | 0 (MWh/yr) |
| Monitoring equipment: | Not applicable since there were no such type of electricity consumptions in this case. Please see clarification below in the “Additional comment” section. |
| Measuring/<br>Reading/<br>Recording frequency: | Continuously. |
| Calculation method<br>(if applicable): | Not applicable. |
| QA/QC procedures: | There was no on-site electricity consumption attributable to the project activity during the monitored period. |
| Purpose of data: | Project emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$EF_{grid,y}$** |
|---|---|
| Unit: | ($tCO_2$/MWh) |
| Description: | CO2 emission factor for grid electricity during the year y. |
| Measured/<br>Calculated /<br>Default: | Calculated. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br><br>• CDEC SIC dispatch centre reports.<br>• Ministry of Energy reports.<br>• 2006 IPCC lower values. |

| | |
|---|---|
| Value(s) of monitored parameter: | 0.676 $tCO_2$/Mwh |
| Monitoring equipment: | Not Applicable. |
| Measuring/ Reading/ Recording frequency: | Annually. |
| Calculation method (if applicable): | The grid emission factor corresponds to the Combined Margin of the SIC grid for the monitored period (full year data). The equation used for this calculation is equation N° 10 of the ACM0002 (Version 06).<br><br>Arauco Bioenergía S.A. is responsible for performing the calculations to determine the grid emission factor according to the last version of the ACM0002. Official and publicly available information is used for that purpose. |
| QA/QC procedures: | The data and results were found consistent with other official statistics and reports (i.e. Ministry of Energy, CDEC SIC dispatch reports). |
| Purpose of data: | Baseline emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | $\mathbf{EF_{OM,y}}$ |
|---|---|
| Unit: | ($tCO_2$/MWh) |
| Description: | $CO_2$ Operating Margin emission factor of the grid. |
| Measured/ Calculated / Default: | Calculated. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br><br>• CDEC SIC Dispatch Centre reports.<br>• Ministry of Energy reports.<br>• 2006 IPCC lower values. |
| Value(s) of monitored parameter: | 0.715 $tCO_2$/Mwh |
| Monitoring equipment: | Not Applicable. |
| Measuring/ Reading/ Recording frequency: | Annually. |
| Calculation method (if applicable): | In this case, the OM emission factor is calculated using the simple/adjusted method equation, N° 4 of the ACM0002 (Version 06). The justification for the chosen OM calculation method is presented in detail in page 48 of the registered PDD. |
| QA/QC procedures: | The data and results were found consistent with other official statistics and reports (i.e. Ministry of Energy, CDEC SIC Dispatch Centre reports). |
| Purpose of data: | Baseline emission calculations. |
| Additional comment: | --- |

| **Data / Parameter:** | **$EF_{BM,y}$** |
|---|---|
| Unit: | ($tCO_2$/MWh) |
| Description: | $CO_2$ Build Margin emission factor of the grid. |
| Measured/ Calculated / Default: | Calculated. |
| Source of data: | The Project Participant used the following information sources to determine this parameter:<br>• CDEC SIC Dispatch Centre reports.<br>• Ministry of Energy reports.<br>• 2006 IPCC lower values. |
| Value(s) of monitored parameter: | 0.637 $tCO_2$/Mwh |
| Monitoring equipment: | Not Applicable. |
| Measuring/ Reading/ Recording frequency: | Annually. |
| Calculation method (if applicable): | This variable is calculated according to equation N° 9 of the ACM0002 (Version 06). |
| QA/QC procedures: | The data and results were found consistent with other official statistics and reports (i.e. Ministry of Energy, CDEC SIC Dispatch Centre reports). |
| Purpose of data: | Baseline emission calculations. |
| Additional comment: | --- |

| **Data/Parameter** | **$F_{i,y}$** |
|---|---|
| Unit | Refer to the $CO_2$ grid emission factor calculation Excel sheet. |
| Description | Amount of each fossil fuel consumed by each power source/plant. |
| Measured/Calculated /Default | Measured. |
| Source of data | The Project Participant used the following information sources to determine this parameter:<br><br>CDEC SIC Dispatch Centre reports.<br>Ministry of Energy reports. |
| Value(s) of monitored parameter | Refer to the $CO_2$ grid emission factor calculation Excel sheet. |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Annually. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | Not applicable. This information comes from official sources. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| Data/Parameter | **$COEF_i$** |
|---|---|
| Unit | Units in ($tCO_2$/000ton) except Natural Gas ($tCO_2/MMm^3$). |
| Description | Emission factor coefficient of each fossil fuel type consumed by each power plant/source in the relevant grid. |
| Measured/Calculated /Default | Calculated. |
| Source of data | 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). |
| Value(s) of monitored parameter | Coal: 2,814 ($tCO_2$/000ton)<br>Petcoke: 2,857 ($tCO_2$/000ton)<br>Diesel: 3,378 ($tCO_2$/000ton)<br>Natural gas: 2,193 ($tCO_2/MMm^3$)<br>IFO 180: 3,401 ($tCO_2$/000ton) |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Annually. |
| Calculation method (if applicable) | $COEF_{CO2,i}$ ($tCO_2$/000ton)= $NCV_i$ (TJ/000ton) * Carbon content of fuel type i (tC/TJ)*Fraction of carbon oxidized * $CO_2$ / C conversion factor ($tCO_2$/tC)<br><br>Where:<br><br>– $COEF_{CO2,coal}$ ($tCO_2$/000ton) = 29.3 (TJ/000ton) * 26.2 * (44/12)<br>– $COEF_{CO2,Petcoke}$ ($tCO_2$/000ton) = 29.3 (TJ/000ton) * 26.6 * (44/12)<br>– $COEF_{CO2,Diesel}$ ($tCO_2$/000ton) = 45.6 (TJ/000ton) * 20.2 * (44/12)<br>– $COEF_{CO2,Nat\ Gas}$ ($tCO_2$/000ton) = 39.1 ($TJ/MMm^3$) * 15.3 * (44/12)<br>– $COEF_{CO2,IFO\ 180}$ ($tCO_2$/000ton) = 44.0 (TJ/000ton) * 21.1 * (44/12)<br><br>Note that local measurements of net calorific values presented in units of (TJ/000tons) because IPCC values are published in the units of (TJ/Gg), equivalent to (TJ/000 tons). This explains why parameter $COEF_{CO2,i}$ is presented in units of tons of $CO_2$ per thousand tons (tCO2/000ton). |
| QA/QC procedures | Local NCV values were duly compared with IPCC default and/or lower values. Local values were found consistent. Carbon content and % of carbon oxidized were taken from the IPCC. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| Data/Parameter | $GEN_{j/k/n,y}$ |
|---|---|
| Unit | (MWh) |
| Description | Electricity generation of each power source/plant j, k or n. |
| Measured/Calculated /Default | Measured. |
| Source of data | This information was directly obtained by the CDEC-SIC Dispatch Centre. |
| Value(s) of monitored parameter | Refer to the $CO_2$ grid emission factor calculation Excel sheet. |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Annually. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | The Project Participant used official data from the CDEC-SIC Dispatch Centre. The data was found to be consistent with official studies (e.g. CDEC-SIC Yearbook.). |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| Data/Parameter | -- |
|---|---|
| Unit | (Text) |
| Description | Identification of power source/plant for the OM. |
| Measured/Calculated /Default | Determined based on official data. |
| Source of data | This information was directly obtained by the CDEC-SIC Dispatch Centre. |
| Value(s) of monitored parameter | Refer to the $CO_2$ grid emission factor calculation excel sheet for the calculation of this emission factor. |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Annually. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | Not applicable. This information comes from official sources. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| **Data/Parameter** | **--** |
|---|---|
| Unit | Text. |
| Description | Identification of power source/plant for the BM. |
| Measured/Calculated /Default | Determined based on official data. |
| Source of data | This information was directly obtained by the CDEC-SIC Dispatch Centre. |
| Value(s) of monitored parameter | Refer to the $CO_2$ grid emission factor calculation excel sheet for the calculation of this emission factor. |
| Monitoring equipment | Not Applicable. |
| Measuring/Reading/ Recording frequency | Annually. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | Not applicable. This information comes from official sources. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| **Data/Parameter** | $\lambda_y$ |
|---|---|
| Unit | (Number) |
| Description | Fraction of time during which low-cost/must-run sources are on the margin. |
| Measured/Calculated /Default | Calculated. |
| Source of data | This factor was calculated from information directly obtained from the CDEC-SIC Dispatch Centre. |
| Value(s) of monitored parameter | 0 |
| Monitoring equipment | Not Applicable. |
| Measuring/Reading/ Recording frequency | Annually. |
| Calculation method (if applicable) | As per the corresponding methodology ACM0002 (Version 06) |
| QA/QC procedures | The data used for the calculation of this parameter comes from official sources. The calculation was double-checked in this case. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| Data/Parameter | $GEN_{j/k/l,y\ IMPORTS}$ |
|---|---|
| Unit | (KWh) |
| Description | Electricity imports to the project electricity system. |
| Measured/Calculated /Default | Not applicable. |
| Source of data | This information was directly obtained by the CDEC-SIC Dispatch Centre. |
| Value(s) of monitored parameter | 0 (KWh).<br><br>To date, the SIC system is not interconnected with any other transmission system, either of Chile or of any other country. |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Not applicable. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | To date, the SIC system is not interconnected with any other transmission system, either of Chile or of any other country. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| Data/Parameter | $COEF_{j/k/l,y\ IMPORTS}$ |
|---|---|
| Unit | ($tCO_2$/ton) or ($tCO_2/m^3$) |
| Description | $CO_2$ emission coefficient of fuels used in connected electricity systems (if imports occur). |
| Measured/Calculated /Default | Not applicable. |
| Source of data | This information was directly obtained by the CDEC-SIC Dispatch Centre. |
| Value(s) of monitored parameter | 0 ($tCO_2$/ton) or 0 ($tCO_2/m^3$). Since there are no imports in the SIC, this variable is currently not used in the emission reduction calculation. |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Not applicable. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | To date, the SIC system is not interconnected with any other transmission system, either of Chile or of any other country. |
| Purpose of data | Baseline emission calculations. |
| Additional comment | --- |

| Data/Parameter | $EF_{CO2,LE}$ |
|---|---|
| Unit | ($tCO_2$/GJ) |
| Description | $CO_2$ emission factor of the most carbon intensive fuel used in the country. |
| Measured/Calculated /Default | Default value. |
| Source of data | The most carbon intensive fuel type can be obtained from official national communication sources (e.g. CNE, CDEC-SIC). In case such information is not available, IPCC default values will be used instead. |
| Value(s) of monitored parameter | Since leakage was 0 during the monitored period, this parameter was not used in the corresponding emission reduction calculation. |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/ Recording frequency | Not applicable. |
| Calculation method (if applicable) | Not applicable. |
| QA/QC procedures | The Project Participant had no need to use this variable, since it was possible to show that the project activity did not cause leakage in the influence area of the power plant. |
| Purpose of data | Leakage emission calculations. |
| Additional comment | --- |

### D.3. Implementation of sampling plan

Not applicable

## SECTION E. Calculation of emission reductions or GHG removals by sinks

### E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Differences in baseline and project emission calculations included in tables below are due to the fact that all calculations are done directly in Excel spread sheets, which implies a decimal precision that is not carried over onto Word-formatted tables because decimals are truncated and rounded down. Exact resulting values can be viewed directly in the emission reduction calculation spread sheet.

<u>1. Baseline emissions due to electricity displacement</u>

In this case, the project participant used a modified version of equation N° 14 of the ACM0006 (Version 05), according to the PDD, page 120, to determine the net quantity of increased electricity as a result of the project activity. This modification was part of a request for deviation that pursued the simultaneous application of CDM project initiatives N° 1 and N° 2, which was approved by the Executive Board in December 13th, 2007.

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

Where:

$EG_y$ : Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during year y (MWh). In this case, the project plant would incorporate the net quantity of increased electric generation capacity derived from implementing CDM project initiatives N°1 and N°2, simultaneously.

$EG_{project\ plant}$: Net quantity of electricity generated in the project plant during year (MWh). In this case, the project plant would incorporate the net quantity of increased electric generation capacity derived from implementing CDM project initiatives N°1 and N°2, simultaneously. Refer to the parameter in section D.2. Data and parameters monitored of this monitoring report.

$\varepsilon_{el,\ other\ plant(s)}$ : Average net energy efficiency of electricity generation in (the) other power plant(s) that would use the biomass residues fired in the project plant in the absence of the project activity ($MWh_{el}/MWh_{biomass}$). In this case, the baseline power plant electric efficiency calculation considers a business-as-usual pulp mill (reference plant), in which the project initiatives N°1 and N°2 are not implemented. For more details please see pages 10 and 11 of the registered PDD.

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

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

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

<u>Data:</u>

| | | |
|---|---|---|
| (1) Gross electricity generated in the project plant | (MWh/y) | 756,904 |
| (2) Total internal electricity consumption | (MWh/y) | 430.185 |
| (3) Additional power consumption percentage due to the project activity | % | 4.59 |
| (4) Average net energy efficiency of electricity generation baseline plant | % | 11.971 |
| (5) Quantity of black liquor combusted in the project plant (dry basis) (adjusted) | (tDS/y) | 1,158,101 (a) |
| (6) Quantity of biomass from forest ops. combusted in the project plant (dry basis) (adjusted) | (BDt/y) | 183,140 (b) |
| (7) Net calorific value of black liquor (dry basis) (adjusted) | (GJ/ton) | 13.31 (c ) |
| (8) Net calorific value of biomass from forest operations (dry basis) (adjusted) | (GJ/ton) | 18.24 (d) |

<u>Notes</u>:

a) Due to the failure of the black liquor flow meter in the recovery boiler's back wall, the amount of black liquor combusted in the recovery boiler was adjusted as follows: the reading of the black liquor flow meter at the feed end of the collection ring was considered as the total black liquor flow to the recovery boiler. This is conservative since, net black liquor flow is cross-checked by the difference between the feed and return flows. In this case, the return flow is not considered. This adjustment was made only for the period of time when the back wall flow meter was out of service. A higher amount of black liquor leads to a lower net quantity of increased electricity generation as a result of the project activity, and therefore less emission reductions (equation 14 of ACM0006 (version 05)).

b) Due to the late calibration of the power boiler's biomass weighmeter, the amount of biomass from forest operations combusted in the power boiler was adjusted in a conservative manner: it was increased according to the meter's maximum permissible error (1%) during the period when the meter was out of calibration. A higher amount of biomass residues results in a lower net quantity of increased electricity generation as a result of the project activity, and therefore less emission reductions (equation 14 of ACM0006 (version 05)).

As part of the temporary deviations due to delays in sampling for fuel net calorific value analysis, the Project Participant carried out some adjustments to net calorific value measurements.

c) In equation 14 of ACM0006 (version 05) a higher net calorific value of black liquor results in a lower net quantity of increased electricity generation as a result of the project activity, and therefore less emission reductions. The Project Participant has adjusted the net calorific value using the upper IPCC value of 23.0 (GJ/tDS). (Refer to section B.2.1 of this monitoring report.)

d) In equation 14 of ACM0006 (version 05) a higher net calorific value of biomass residues from forestry operations results in a lower net quantity of increased electricity generation as a result of the project activity, and therefore less emission reductions. The Project Participant has adjusted the net calorific value using the upper IPCC value of 31.0 (GJ/tDS). (Refer to section B.2.1 of this monitoring report.)

<u>Calculations:</u>

| | Units | 2014 |
|---|---|---|

| | | | |
|---|---|---|---|
| (9) Net quantity of electricity generated in the project plant | (1)-(2)*(3) | (MWh/y) | 737,159 |
| (10) Electric power generated in the baseline mill (adjusted) | (4)*((5)*(7)+(6)*(8))*(1/3,600) | (MWh/y) | 631,884 |
| (11) Net quantity of increased electricity (adjusted) | (9)-(10) | (MWh/y) | 105,275 |

Using the values of the net quantity of increased electricity generation and the $CO_2$ emission factor of the grid, it is possible to calculate the emission reductions due to displacement of electricity for the monitored period using equation N° 9 of the ACM0006 (Version 05):

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

Where:

$EG_y$ : Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y (MWh).

$ER_{electricity,y}$ : Emission reductions due to displacement of electricity during the year y ($tCO_2$/yr).

$EF_{electricity,y}$ : $CO_2$ emission factor for the electricity displaced due to the project activity during the year y ($tCO_2$/MWh).

Data:

| | Units | 2014 |
|---|---|---|
| (1) Combined margin for the SIC grid | ($tCO_2$/MWh) | 0. 676 |
| (2) Electricity displaced by the project activity(adjusted) | (MWh/y) | 105,275 |

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| (3) Total grid emission savings (adjusted) | (1)*(2) | ($tCO_2$/y) | 71,161 |

Determination of the emission factor of the grid electricity generation:

The parameter EF should be determined as the combined margin $CO_2$ emission factor for the grid to which the project activity is connected in year y, calculated according to the ACM0002 (version 06). This calculation is presented below:

a) Operating Margin calculations:

In this case the OM emission factor is calculated using the simple/adjusted method --equation N°4 of the ACM0002 (Version 06). The Project Participant used ex-post data to calculate this parameter, that is, the coefficient was calculated in the year in which the project generation occurs, which is 2014 in this case.

The Project Participant used data from that year to determine the lambda factor which represents the percentage of time when low-cost/must-run sources were on the margin for 2014:

$$\lambda_y = \lambda_{2014} = 0.00000$$

The rest of the parameters used to calculate the $EF_{grid}$ for 2014 were obtained from the CDEC-SIC dispatch center (official and public information). The calculation is as follows:

- $CO_2$ emission of non-low cost/must-run power sources:

$$\sum_{i,j} F_{i,j,2014} \, . \, COEF_{i,j} = 17{,}121{,}276 \; (tCO_2/y)$$

- The total power generation in the SIC by non-low-cost/must-run power sources in 2014:

$$\sum_{j} GEN_{j,2014} = 23{,}957{,}647 \; (Mwh/y)$$

- The $CO_2$ emissions of low-cost/must run power sources in 2014. Note that since in Chile low-cost/must run power sources include mostly hydro energy, the total emissions for this part of the equation are low:

$$\sum_{i,k} F_{i,k} . COEF_{i,k} = 548{,}476 \; (tCO_2/y)$$

- Total power generation in the SIC by low-cost/must-run resources for 2014:

$$\sum_{k} GEN_{k,2014} = 28{,}328{,}214 \; (Mwh/y)$$

Replacing the above values in the equation used to calculate the EF for 2014, the operating margin results:

$$EF_{OM,2014} = (1 - 0.00000) . \frac{17{,}121{,}276}{23{,}957{,}647} (tCO_2/Mwh) + 0.00000 . \frac{548{,}476}{28{,}328{,}214} (tCO_2/Mwh)$$

$$EF_{OM,2014} = EF_{OM,simple\,adjusted,2014} = 0.715 \; (tCO_2/Mwh)$$

b) <u>Build Margin calculation</u>

According to 2014 SIC data, the group of plants that accounts for the largest generation that year are the ones responsible for the 20% of the total generation. These plants are considered to calculate the Build Margin for 2014:

$$EF_{BM,2014} = 0.637 (tCO_2/Mwh)$$

As in the previous case, the Build Margin calculation also considered official CDEC-SIC data and/or other official data publicly available.

Having obtained the Operating Margin $EF_{OM,y}$ and the Build Margin $EF_{BM,y}$, for 2014, and assuming the default value of 0.5 for the weights $W_{OM}$ and $W_{BM}$, it is possible to calculate $EF_{grid\,CM,y}$ for the year 2014:

$$EF_{2014} = 0.5 \times 0.715 + 0.5 \times 0.637 = 0.676(tCO_2/Mwh)$$

2. Baseline emissions due to uncontrolled 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° 30 of the ACM0006 (Version 05). As mentioned before, the proposed project activity only involves additional use of biomass from forest operations in the power boiler.

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

Where:

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

Since in the project mill, the power boiler and the recovery boiler generate high-pressure steam at the same thermodynamic conditions, the best way to determine the heat that is attributable to the power boiler, is to multiply the total amount of heat generated in the mill by the fraction of high-pressure steam generated by the power boiler with respect to the total high-pressure steam generated in the mill by both boilers. This algorithm was part of the request for deviation approved by the Executive Board for the Valdivia project activity.

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

Where:

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

Data:

| | Units | 2014 |
|---|---|---|
| (1) Total high-pressure steam generated by the recovery boiler | (ton/y) | 3,722,420 |
| (2) Total high-pressure steam generated by the power boiler | (ton/y) | 876,433 |
| (3) Total biomass residues from forest operations combusted in the power boiler (adjusted) | (BDt/y) | 182,123 (a) |
| (4) Net calorific value of biomass from forest operations (dry basis) (See notes). | (GJ/ton) | 17.25 (b) |
| (5) Quantity of process heat generated in the cogeneration project plant. | (GJ/y) | 7,760,516 (c ) |
| (6) Energy efficiency of the boiler used in the absence of the project activity. | | 85% |

Notes:
(a) Due to the late calibration of weighmeter 331-WT-005 (on the power boiler feed belt), the amount of biomass residues from forest operations combusted in the power boiler was adjusted by the instrument's permissible error (i.e. the original value was deducted

1%) to achieve lower methane emissions due to uncontrolled biomass burning. This is more conservative since it lowers baseline emissions.

(b) As part of the temporary deviations due to delays in sampling for net calorific value analysis, the Project Participant carried out some adjustments to net calorific value measurements. The adjustments are described in detail in section “B.2.1. Temporary deviations from registered monitoring plan” of this monitoring report. The purpose was also to achieve a more conservative value for baseline emissions.

(c) The low pressure steam flow meter of turbine 1 went out of service for four days in November. Low pressure steam flow was estimated for those four days considering the highest daily low pressure steam production in November. Thus, the quantity of process heat increased and biomass attributable to the project activity decreases. Therefore, baseline methane emissions due to uncontrolled biomass burning decrease.

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| (7) Process heat attributable to the power boiler | [(2)/(1)+(2)]*(5) | (GJ/y) | 1,478,971 |
| (8) Biomass used to generate heat | (7)/((4)*(6)) | (BDt/y) | 100,841 |
| **(9) Incremental biomass use (adjusted)** | **(3)-(8)** | (BDt/y) | 81,282 (d) |

Note:

(d) Incremental biomass use decreased from 87,270 (BDt/y) to 81,282 (BDt/y), which resulted in lower emission reductions due to uncontrolled biomass burning. This is the result of using a lower net calorific value of 17.25 (GJ/BDt), a lower amount of process heat, and a lower amount of biomass residues combusted in the power boiler in the emission reduction calculation. Details can be seen in the emission reduction calculation spread sheet.

With the above calculation, it is possible to calculate the baseline emissions due to uncontrolled burning of anthropogenic sources of biomass residues using equation N° 34 of the ACM0006 (Version 05):

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

Where

$BE_{biomass,y}$ : Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year y ($tCO_{2e}/y$).

$GWP_{CH4}$ : Global Warming Potential of methane valid for the commitment period ($tCO_{2e}/tCH_4$).

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

$NCV_k$ : Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter).

$EF_{burning,CH4,k,y}$ : $CH_4$ emission factor for uncontrolled burning of the biomass residue type k during the year y ($tCH_4/GJ$).

Data:

| | Units | 2014 |
|---|---|---|
| (1) Additional biomass from forest operations due to the project activity (adjusted) | (BDt/y) | 81,282 |
| (2) Adjusted $CH_4$ emission factor for uncontrolled burning of biomass from forest ops. | ($tCO_2eq/000ton$) | 377 (e) |

Notes:

(e) The Project Participant would like to note that an adjustment factor of 0.94 was chosen for the (original) measurement $CH_4$ emission factor following the indication of Table N° 6 of the ACM0006 (Version 05).

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| (3) Emissions | (1)*(2)* (ton/1000 kg) | ($tCO_2eq$) | 30,651 |

Total baseline emissions

| | 2014 |
|---|---|
| **Emission sources** | ($tCO_2eq$) |
| Carbon dioxide emissions due to electricity displacement | 71,161 |
| Methane emissions due to uncontrolled biomass burning avoidance | 30,651 |
| **Total emissions** | **101,813** |

## E.2. Calculation of project emissions or actual net GHG removals by sinks

Project emissions are calculated through the following equation:

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

Where:

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

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

PEEC,y : $CO_2$ emissions during the year y due to electricity consumption at the project site that is attributable to the project activity ($tCO_2$/y).

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

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

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

This emission source is calculated using equation N° 4 of the ACM0006 (Version 05).

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

Where:

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

$N_y$ : Number of truck trips during the year *y*

| | |
|---|---|
| $AVD_y$ : | Average round trip distance (from and to) between the biomass residue fuel supply sites and the site of the project plant during the year *y* (km) |
| $EF_{km,CO2,y}$ : | Average $CO_2$ emission factor for the trucks measured during the year *y* ($tCO_2$/km) |
| $BF_{k,y}$ : | Quantity of biomass residue type *k* combusted in the project plant during the year *y* (tons of dry matter or liter) |
| $TL_y$ : | Average truck load of the trucks used (tons or liter)during the year y. |

Data:

| | Units | 2014 |
|---|---|---|
| (1) Biomass bought from 3rd parties (dry) | (BDt/y) | 92,557 (a) |
| (2) Biomass average humidity (wet basis) | % | 59.2 |
| (3) Average load for 1 trip (adjusted) (see notes) | (ton/truck) | 24.7 (b) |
| (4) Average round trip distance between the biomass supply sites and the plant | (km) | 103.9 |
| (5) Emission factor for heavy truck transportation (see notes). | ($kgCO_2$/km) | 1.287 (c) |

Notes:

(a) This value takes into account the adjustment made to the amount of biomass combusted in the power boiler considering that the weighmeter had a calibration gap at the beginning of the monitoring period. In order to increase the amount of fuel used for the transportation of biomass residues to the power plant, the amount of biomass was increased by the weighmeter's maximum permissible error.

(b) For the same reason explained in note (a), the average truck load was decreased by considering the amount of biomass burnt in the power boiler with a 1% deduction due to the power boiler's weighmeter calibration gap. A lower average load leads to a higher number of truck trips. Therefore, Diesel consumption due to the transportation of third party biomass residues to the power plant increases and so do project emissions.

(c) As part of the temporary deviations due to delays in sampling for fuel net calorific value analysis, the Project Participant carried out conservative adjustments to net calorific value measurements. In equation 4 of the ACM0006 (Version 05) a higher net calorific value results in a higher $CO_2$ conversion factor and therefore, a higher emission factor for heavy truck transportation, increasing project emissions. The PP has conducted the most conservative adjustment to the amount of Diesel consumed, by using the upper IPCC value of 43.30 (GJ/ton) for this fossil fuel type. For further information refer to section "B.2.1. Temporary deviations from registered monitoring plan" of this monitoring report and to the emission reduction calculation spread sheet.

(d) The Project Participant would like to note that this parameter was calculated using the Diesel $CO_2$ emission factor and the monitored performance index of the trucks (2.08 Km/lt), provided by the transportation subcontractors.

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| (6) Biomass transported (wet) | (1)/[1 – (2)] | (wet ton) | 226,953 |
| (7) Number of trips needed for the Plant per year | (6) / (3) | (trips) | 9,207 |
| (8) Total distance travelled, considering round trip | (4)*(7) | (km) | 957,007 |
| (9) Total emissions | (5)*(8)*(1ton/1,000kg) | ($tCO_2$) | **1,231** |

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

This emission source is calculated using equation N° 6 of the ACM0006 (Version 05).

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

Where:

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

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

- Fossil fuel consumption in the recovery boiler: In this case, the Fuel Oil consumed associated to the project activity is related to additional electric power generation of the power plant.

Data:

| | Units | 2014 |
|---|---|---|
| (1) Fossil fuel used in the recovery boiler attributable to the project activity | (ton) | 1,040 (a) |
| (2) Fossil fuel net calorific value (average) (adjusted) | (GJ/ton) | 40.68 (b) |
| (3) Fossil fuel $CO_2$ emission factor | ($tCO_2$/GJ) | 0.07737 |

Notes:

(a) The PP would like to note that Fuel oil consumption is due to power generation reasons.

(b) As part of the temporary deviations due to sampling delays for fuel net calorific value analysis, the Project Participant carried out conservative adjustments to net calorific value measurements. Since a high NCV of fossil fuels results in a high $COEF_{i,y}$ which leads to higher project emissions due to on-site consumption of fossil fuels, the Project Participant has conducted the most conservative adjustment using the upper IPCC values of 41.70(GJ/ton) for Fuel Oil for the period of delay. For further information refer to section "B.2.1. Temporary deviations from registered monitoring plan" of this monitoring report and to the emission reduction calculations spread sheet.

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| **(4) Total emissions** | (1)*(2)*(3) | ($tCO_2$) | **3,275** |

- Fossil fuel consumption in the power boiler: In this case, there is fuel oil consumption associated to the project activity due to operational reasons and due to power generation reasons.

Data:

| | Units | 2014 |
|---|---|---|
| (5) Fuel oil used due to operational reasons (adjusted) (see notes) | (ton) | 1,990 (a) |
| (6) Fuel oil consumption due to power generation reasons (adjusted) (see notes) | (ton) | 488 (b) |
| (7) Fuel oil used in the power boiler attributable to the project activity [(5)+(6)] | (ton) | 2,478 |
| (8) Fossil fuel net calorific value (average) | (GJ/ton) | 40.68 (a) |
| (9) Fossil fuel $CO_2$ emission factor | ($tCO_2$/GJ) | 0.07737 |

Note:

(a) Fuel oil combusted in the power boiler for operational purposes is calculated based on a parameter fixed for the crediting period (3.43 kg fuel oil / $m^3$st biomass). Therefore, the higher the amount of biomass combusted in the power boiler that is attributable to the project activity, the higher the amount of fuel oil for operational purposes will be. Since there was a delay in the calibration of weighmeter 331-WT-005 (on the power boiler feed belt) (refer to section B.1 of this report) and a delay in sampling for biomass NCV analysis (refer to section B.2.1 of this report), the Project Participant conducted a conservative adjustment to the calculation of additional biomass from forest operations due to the project activity. Using a higher value for $BF_{k,y}$ and a lower value for $NCV_k$ in equation 30 of ACM0006 (version 05), results in a higher amount of additional biomass from forest operations due to the project activity and hence a higher amount of fuel oil used for operational purposes in the power boiler. This translates into higher project emissions.

(b) The Project Participant performed a conservative adjustment to the approach used to determine fuel oil consumed for power generation purposes. In this case, empirical curves were used to determine the amount of fuel oil for power generation purposes. As a result the fuel oil amount for power generation increased and therefore, so did project emissions.

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| **(10) Total emissions** | [(5)+(6)]*(8)*(9) | ($tCO_2$) | **7,798** |

- Fossil fuel consumption due to on-site biomass residues from forest operations transportation: This fossil fuel consumption is related to the transportation of the additional biomass from forest operations (mix of sawdust and bark) that is attributed to the project activity (e.g. generation of additional power).

Data:

| | Units | 2014 |
|---|---|---|
| (10) Diesel used for on-site biomass transportation due to the project activity (adjusted) (see notes) | (ton) | 55.0 (a) |
| (11) Fossil fuel net calorific value (average) | (TJ/000ton) or (GJ/ton) | 42.88 (b) |
| (12) Fossil fuel $CO_2$ emission factor. | ($tCO_2$/GJ) | 0.07407 |

Note:

(a) Since there was a delay in the calibration of weighmeter 331-WT-005 (on the power boiler feed belt) (section B.1 of this report) and a delay in sampling for biomass NCV analysis, the Project Participant conducted a conservative adjustment to the calculation of additional biomass from forest operations due to the project activity. Using a higher value for $BF_{k,y}$ and a lower value for $NCV_k$ in equation 30 of ACM0006 (version 05) results in a higher amount of additional biomass from forest operations due to the project. Therefore, a higher amount of Diesel used for on-site biomass transportation is obtained and thus higher project emissions.

(b) As part of the temporary deviations due to sampling delays for fuel net calorific value analysis, the Project Participant carried out conservative adjustments to net calorific value measurements. Since a high NCV of fossil fuels results in a high $COEF_{i,y}$ which leads to higher project emissions due to on-site consumption of fossil fuels, the Project Participant has conducted the most conservative adjustment using the upper 2006 IPCC value of 43.30(GJ/ton) for Diesel. For further information refer to section "B.2.1. Temporary deviations from registered monitoring plan" of this monitoring report and to the emission reduction calculation spread sheet.

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| **(13) Total emissions** | (10)*(11)*(12) | ($tCO_2$) | **174.8** |

- Fossil fuel consumption due to on-site biomass residues from forest operations preparation: Since there was no mechanical preparation of biomass residues (sawdust and bark) during the monitored period, this emission source was zero.

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

| | **2014** |
|---|---|
| **Carbon dioxide emissions from on-site consumption of fossil fuels** | **($tCO_2$)** |
| Fossil fuel consumption in the recovery boiler | 3,275 |
| Fossil fuel consumption in the power boiler | 7,798 |
| Fossil fuel consumption due to on-site biomass from forest operations transportation | 174.8 |
| Fossil fuel consumption due to on-site biomass from forest operations preparation | 0 |
| **Total emissions** | **11,248** |

3. Carbon dioxide emissions from electricity consumption

This emission source is calculated using equation N° 7 of the ACM0006 (Version 05). However, during the monitored period, there was no electricity consumption associated to the project activity, therefore the total emissions related to this source is zero.

$$PE_{EC,y} = 0$$

4. Methane emissions from combustion of biomass residues

This emission source is calculated using equation N° 8 of the ACM0006 (Version 05).

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

Where:

$BF_{k,y}$ : Quantity of biomass residue type k combusted in the project plant during the year y (tons of dry matter or liter).

$NCV_k$ : Net calorific value of the biomass residue type k (GJ/ton of dry matter or GJ/liter).

$EF_{CH4,BF}$ : $CH_4$ emission factor for the combustion of biomass residues in the project plant ($tCH_4$/GJ).

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 | 2014 |
|---|---|---|
| (1) Biomass related to the project activity burned in the power boiler (adjusted) (see notes). | (BDt) | 95,009 (a) |
| (2) Net calorific value of biomass from forest operations (dry basis) (adjusted) (see notes). | (GJ/ton) | 19.57 (b) |
| (3) Biomass methane emission factor under controlled burning conditions | ($KgCH_4$/TJ) | 30.0 |
| (4) Conservativeness factor | --- | 1.02 |
| (5) Global Warming Potential of $CH_4$ | --- | 25 |

Notes:

(a) Since there was a delay in the calibration of weighmeter 331-WT-005 (on the power boiler feed belt) (section B.1 of this report), a delay in sampling for biomass NCV analysis (section B.2.1), and a failure in one of the low pressure steam flow meters, the Project Participant conducted a conservative adjustment to the calculation of additional biomass from forest operations due to the project activity. Using a higher value for $BF_{k,y}$ , a higher value for $NCV_k$, and a lower amount of low pressure steam (thus lower amount of process heat) in equation 30 of ACM0006 (version 05), results in a higher amount of additional biomass from forest operations due to the project activity. Thus methane emissions due to biomass controlled combustion in the power boiler are higher.

(b) According to equation 8, a higher net calorific value of biomass residues results in a higher controlled biomass burning factor. For conservativeness reasons and due to delays in the samples taken, the Project Participant has adjusted net calorific value measurements using the upper 2006 IPCC value of 31(GJ/BDt) of biomass residues from forestry. This adjustment results in a higher controlled biomass burning factor and therefore, higher project emissions (section B.2.1).

The Project Participant would like to note that net calorific values of biomass must be monitored twice a year. For simplicity, an average was used here.

Calculations:

| | | Units | 2014 |
|---|---|---|---|
| **(6) Total emissions** | (1)*(2)*(1TJ/1,000GJ)*(3)*(4)*(5) *(1 ton/1,000kg) | ($tCO_2eq$) | **1,422** |

Total project emissions:

| | 2014 |
|---|---|
| **Emission sources** | **($tCO_2eq$)** |
| Carbon dioxide emissions from biomass residues transportation to the power plant | 1,230 |
| Carbon dioxide emissions from on-site consumption of fossil fuels. | 11,248 |
| Carbon dioxide emissions from electricity consumption | 0 |
| Methane emissions from combustion of biomass residues | 1,422 |
| **TOTAL PROJECT EMISSIONS** | **13,901** |

## E.3. Calculation of leakage

Since the project activity contemplates the utilization of additional biomass from forest operations (sawdust and bark), it is required to assess if the project displaced the current use of biomass as a fuel. If the project actually drove current users of biomass to resort to more carbon-intensive fuels, the emission related to that fuel must be deducted from the project's emission reductions.

There are two sources of biomass that can be used in the Valdivia biomass power plant:

1. Biomass from industrial operations, consisting basically of biomass generated by local sawmills. Currently, part of this biomass is used by the same sawmills for heat generation purposes, however, a considerable surplus still remains.

2. Biomass from forestry operations, consisting basically of harvesting, pruning and thinning operations in managed forestlands. Currently this biomass has very little use.

Arauco performed a biomass availability study for 2014, using official bulletins from INFOR[4] as well as other (whenever available) official sources to calculate the biomass supply and demand in the Valdivia power plant influence area[5]. This study is part of the monitoring plan of the Valdivia project activity and was carried out according to approach L2 of the baseline methodology. A detailed Excel spread sheet with the monitored data and the calculation of the forest biomass supply/demand situation 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 summarizes the results of this study:

[4] INFOR stands for "Instituto Nacional Forestal" or "National Forestry Institute" in English.
[5] The Valdivia project influence area is defined in page 129 of the registered PDD.

**Supply / Demand situation in Valdivia power plant influence area**

**(Estimation for year 2014)**

**Biomass residues generation**

| | | |
|---|---|---|
| Biomass from industrial operations | ($m^3$st/yr) | 4.387.570 |
| Biomass from forestry operations | ($m^3$st/yr) | 2.390.204 |

**Biomass residues demand**

| | | |
|---|---|---|
| Demand from industrial operations | **($m^3$st/yr)** | 2.586.078 |

**Sources:** Infor official bulletins and studies.

* Demand from forestry operations not available for year 2014

**Valdivia power plant surplus index**

**(estimation for year 2014)**

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

| | |
|---|---|
| **Industrial Biomass residues supply / Industrial Biomass residues consumption** | 1,6966 |
| **Biomass residues supply / Biomass residues consumption*** | 2,6209 |

* The Biomass residues supply considered the biomass residues from industrial and forestry operations

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. These results are consistent with the fact that in the last years the existing biomass power plants in the area/region continue to function without restriction and that new biomass based projects are being considered in the area[6].

From the above analysis, it is possible to conclude that the Valdivia biomass power plant 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 to the Valdivia project activity is considered to be zero.

$$L_y = 0$$

### E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

| Item | Baseline emissions or baseline net GHG removals by sinks (t $CO_2$e) | Project emissions or actual net GHG removals by sinks (t $CO_2$e) | Leakage (t $CO_2$e) | GHG emission reductions or net GHG removals by sinks (t $CO_2$e) achieved in the monitoring period | | |
|---|---|---|---|---|---|---|
| | | | | Up to 31/12/2012 | From 01/01/2013 | Total amount |
| **Total** | 101,813 | 13,901 | 0 | Not applicable | 87,911 | 87,911 |

### E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

| Item | Values estimated in ex-ante calculation of registered PDD | Actual values achieved during this monitoring period |
|---|---|---|
| Emission reductions or GHG removals by sinks (t $CO_2$e) | 135,548 | 87,911 |

[6] Including some prospective CDM biomass projects.

## E.6. Remarks on difference from estimated value in registered PDD

Not considering adjustments made due to temporary deviations from the registered monitoring plan and instrument failure, the net emission reductions would have been 130,698 $tCO_2eq$. This would have been 4% below the ex-ante estimated net emission reductions.

Such difference would have been mainly attributable to a higher grid emission factor estimated in the PDD (0.730 t $CO_2$/Mwh) as compared with the actual emission factor of 0.676 t $CO_2$/Mwh. This would have led to a 7% decrease in grid emission savings and therefore, lower baseline emissions.

After the corrections made to emission calculations, net emission reductions decreased to 87,911 $tCO_2eq$ (33% less than the original 130,698 $tCO_2eq$). Most of this difference is due to the temporary deviation from the monitoring plan regarding the delay in fuel sampling for NCV analysis.

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

| | |
|---|---|
| **Project participant and/or responsible person/ entity** | ☒ Project participant<br>☒ Responsible person/ entity for completing the CDM-MR-FORM |
| **Organization name** | Arauco Celulosa y Constitución S.A. |
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| **Contact person** | Christian Rodríguez |
| **Title** | Head of Climate Change |
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## Document information

| Version | Date | Description |
|---|---|---|
| 05.0 | 1 April 2015 | Revisions to:<br>• Include provisions related to delayed submission of a monitoring plan;<br>• Provisions related to the Host Party;<br>• Remove reference to programme of activities;<br>• Overall editorial improvement. |
| 04.0 | 25 June 2014 | Revisions to:<br>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));<br>• Include provisions related to standardized baselines;<br>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;<br>• Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*;<br>• Editorial improvement. |
| 03.2 | 5 November 2013 | Editorial revision to correct table in page 1. |
| 03.1 | 2 January 2013 | Editorial revision to correct table in section E.5. |
| 03.0 | 3 December 2012 | Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11). |
| 02.0 | 13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20). |
| 01 | 28 May 2010 | EB 54, Annex 34. Initial adoption. |

Decision Class: Regulatory
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