



**CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02**

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**SECTION A. General description of the small-scale project activity****A.1. Title of the small-scale project activity:**

- Russfin Biomass CHP Plant Project.
- Version number: Version 011
- Date: 10-04-2006

A.2. Description of the small-scale project activity:

The purpose of the proposed project activity is to use biomass for combined heat and electric power generation, that otherwise would be left to decay in open air. The project is presented by **Forestal Russfin Ltda.**¹, a leading *lenga*² lumber producing company in Chile.

Forestal Russfin Ltda. is a private company which main activity is the *lenga* management and production in Chile. They produce annually 9,300 MBF/y³ (22,000 m³/y) of *lenga* (*nothofagus pumilio*) lumber for export and domestic consumption. *Lenga*, which is also known as Fireland Cherry, is a tree which habitat is located in the Chilean's XI and XII regions, specifically in the Patagonia and in the Fireland territory. It has a sapwood of white to yellowish color and a heartwood of a pale to dark pink. It's a beautiful wood that offers excellent conditions for drying, being easily machined and stained.

The project involves the construction and operation of a new CHP plant of 1.2 MW net generating electric power capacity located inside the Forestal Russfin Sawmill facility. No Surplus electric power will be sold to third parties due no public electrical grid is available. The surplus heat after power generation will be delivered to the wood drying kilns and to the mill's central heating system .

The proposed project would also assist Chile's sustainable development by reducing greenhouse gases (GHG) emissions by switching Diesel for biomass to generate electricity and steam which will be used on site by **Forestal Russfin Ltda. Without the CERs additional income, they would continue using diesel fuel for electricity generation as they have done during the last 13 years.** In

¹ www.ignisterra.com

² The Lenga Beech or *lenga* (*Nothofagus pumilio*) is a deciduous tree or shrub native to the centre area of the Andes range, in the temperate forests of Chile and Argentina down to Tierra del Fuego. It grows to a height of up to 30 m, and a trunk diameter of 1.5 m. The leaves are 2-4 cm long, with irregularly lobed margin, and turn to yellow and reddish tones in autumn. The fruit is a small nut 4-7 mm long. It can be found in the Valdivian temperate rain forests, the Torres del Paine National Park, the Los Alerces National Park and the Nahuel Huapi National Park among other places. It belongs to the same genus as the coihue.

³ One board foot is the nominal quantity of lumber derived from a piece of rough green lumber 1 inch thick and 1 foot wide by 1 foot long the abbreviation M is used to represent 1,000. So, 6 MBF is 6,000 BF; 4 MMBF is 4 million BF- www.cwc.ca/design/tools/calcs/board_feet



addition, this project will accomplish an additional greenhouse effect reduction benefit derived from a biomass controlled disposal, which results into lower methane emissions.

The Forestal Russfin project activity participants believe that biomass power cogeneration constitute a sustainable source of power generation that brings advantages for mitigating global warming. Using the available natural resources in a more rational way, this project activity may help to enhance the development of renewable energy sources, in particular the use of biomass generated as a by-product of the forestry industry, which has a significant potential in Chile. The proposed project is a good example to demonstrate the viability of sustainable electricity generation to all forest-related industries. It is important to highlight that although this technological improvement is consistent with the internal policies of efficient energy usage and Forestal Russfin's environmental conscience, it must be recognized as an activity that goes far beyond the common practice of the Lumber industry in Chile, thus it will serve as example for other forest-related industries.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	Forestal Russfin Ltda..	NO

A.4. Technical description of the small-scale project activity:

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A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

Chile

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

Region XII, "Región de Magallanes y de la Antártica Chilena"

A.4.1.3. City/Town/Community etc:



“Tierra del Fuego”, Fireland Territory.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

The proposed project takes place in the Forestal Russfin Ltda. Mill, Timaukel county, (latitude 53° 45' 59" S; longitude 69° 11' 42" W; 218 m.a.s.l.), 380 km away from Punta Arenas City, located in Region XII, where Forestal Russfin's Lenga (*Nothofagus pumilio*) forests are. Region XII or “Región de Magallanes y de la Antártica Chilena” is located in the southern area of Chile. Its limits are, by the north, Region XI or “Región de Aysén” (48° 36'); by the south, the international waters of the Drake Sea (56° 30'); by the east, Argentina and by the west, the Pacific Ocean.

It is divided in four provinces, “Antártica Chilena” which capital city is “Puerto Williams”, “Tierra del Fuego” which capital city is “Porvenir”, “Última Esperanza” which capital city is “Puerto Natales” and “Magallanes” which capital city is “Punta Arenas”. These four provinces are divided in ten counties but, out of them, only three, “Punta Arenas”, “Natales” and “Porvenir” have urban characteristics. The rest are rural areas with very few inhabitants.

In 1999, the total population in this region was 150,000 inhabitants. 73% of the total population lives in Punta Arenas and 11% in Puerto Natales. The total surface of the region is 132,033 km². Thus, the population density is just 1.2 inhabitant per km².

One of the main characteristics of this region is its isolation from the rest of the country. There are no roads on land excepts from the Argentinean side. Another characteristic is the difference between the women (74,000) and men (83,000) population.





Figure 1. Map of South America showing Patagonia.

Figure 2. Map of “Región de Magallanes” showing the provinces cities.⁴

According to Donoso⁵, there are five forest types dominated by *Nothofagus* species, Roble - Hualo (*n. oblicua - n. glauca*), Roble - Raulí - Coigüe (*n. oblicua - n. alpina - n. donbeyi*), Coigüe - Raulí - Tepa (*n. donbeyi - n. alpina - laurelia philippiana*), Lenga (*n. pumilio*). Lenga is associated with roble (*n. oblicua*) and coigüe (*n. donbeyi*) in the extreme northern portion of the range, and with araucaria (*Araucaria araucana*) and coigüe de Magallanes (*n. betuloides*) in the southern portion and Coigüe de Magallanes (*n. betuloides*).

The Chilean government, through its National Forestry Corporation (CONAF⁶) approves and controls the harvest and management plans that assure the regeneration, permanence and improvement of the forest areas.

The national Forestry Corporation (CONAF) granted the following harvest permits to Forestal Rusffin Ltda.:

YEAR					
2.005		2.004		2.003	
hectares	authorization	hectares	authorization	hectares	authorization
562	24/37-120/04	1.517	1.203.134	1.760	1.203.104
139	20/37-120/04	182	1.203.146	486	1.203.103
958	21/37-120/04	958	1.203.130	230	1.203.105
56	23/37-120/04	105	1.203.132	40	1.203.125
230	22/37-120/04	230	1.203.133		

According to CONAF's 1997 land survey, *nothofagus* forests cover an area of approximately 7,397,000 hectares, accounting for 55% of all of Chile's native forests. Of this area, the native Lenga forests reach a surface of 3,400,000 hectares, out of which the Chilean legislation allows only 30% for commercialization, leaving the rest of the surfaces for national parks. This is carried out to protect the wildlife areas, to ensure the existence of the forest's ecosystems and to preserve the water courses and soils.

The Lenga forests are noted for their simple composition and structure. The most conspicuous features of these trees are the abundant boles of live mature and old trees, recent gaps filled with dense patches of seedlings, and abundant logs and other woody debris on the forest floor. A low ground layer dominated by herbs, grasses, and lenga seedlings is typically the only plant understory.

A.4.2. Type and category(ies) and technology of the small-scale project activity:

⁴ Modified from www.mapasdechile.com

⁵ Donoso, C. 1995. Temperate Rainforests of Chile and Argentina. Structural variation and dynamics. Editorial Universitaria. Santiago, Chile. 483 pp. Donoso, C., Lara, A. 1999. Silviculture of the Chile's native forests. Editorial Universitaria. Chapter 10. Evergreen forests. pp. 297- 339.



According to the categorization of Appendix B to the simplified M&P for small-scale CDM project activities this project conforms with the following two types and categories,

TYPE III. OTHER PROJECT ACTIVITIES

III.E. Avoidance of methane production from biomass decay through controlled combustion

TYPE I. RENEWABLE ENERGY PROJECTS

I.C Thermal energy for the user

The following project activity should obey the following characteristics,

- For type III, the project emissions per year over the crediting period will not go beyond the limits of 15 kilotonnes of CO₂e per year as it is shown in section A.4.3.1 of this document.
- For type I, category C, the Biomass Power Plant should not exceed a capacity of 15 MW. As said before, in the case of this project activity, the Biomass CHP Plant would have a net capacity of 1.2 MW.

The technology to be employed in this project activity is the Biomass fired Combined Heat and Power (CHP) Plant or cogeneration system. Cogeneration is the sequential generation of two different forms of useful energy, generally electrical and thermal, from a single primary energy source. Hence, cogeneration produces much lower emissions for each unit of energy produced. Combined Heat and Power (CHP) systems make efficient use of heat that would otherwise be wasted.

The predominant technology around 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 involved 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.

Thus, this project activity takes into account GHG emission mitigation due to the replacement of diesel to generate electricity and LPG to generate heat, for a much cleaner fuel, biomass, and due to non open-decaying of the biomass residues. It compares the emission of GHG between the current scenario (electricity generation with six old Diesel generation units, heat generated by biomass and LPG combustion and biomass decay in open air) and the project activity scenario (biomass fired combined heat and power plant, with a net capacity of 1.2 MW and no biomass decay in open air).

The combustion of fossil fuels gives rise to emissions, such as carbon dioxide, nitrous oxides, sulphur oxides, carbon monoxide, particulates, organic compounds, trace metals, etc. Aside from its local effects,

⁶ www.conaf.cl



the global issues are the greenhouse effect and the acid rain phenomenon. Biomass, on the other hand, acts as a sink for atmospheric carbon dioxide. If biomass is being regrown at the same rate as it is being harvested, the net flux of CO₂ to the atmosphere is zero. Biomass is a low sulphur fuel - contributing much less than fossil fuels to the acid rain phenomenon. The use of biomass wastes in modern boiler also reduces the environmental hazards associated with open-burning or open-dumping.

It makes sense to use biomass in place of conventional, nonrenewable fuels for several good reasons:

- **Biomass fuel is a local product.** In contrast to fossil fuels, biomass is grown and harvested on the same place it is needed. The fossil fuels that are needed to generate heat and electricity at the Forestal Russfin sawmill have to be taken from places far away from Fireland Territory. This does not only generate pollution from the transportation but also makes the fossil fuel more expensive.
- **Biomass energy is environmentally friendly.** Using biomass in place of fossil fuel, reduces the atmospheric buildup of greenhouse gases, which cause climate change. This can also reduce the levels of gases that cause acid rain. Biomass energy systems also help keep forests healthy by providing a market for low-grade "cull" wood, whose removal improves the well-being of the forest and the value of commercial trees.
- **Biomass is a renewable resource.** Biomass is a renewable fuel that can be sustainably produced. **Forestal Russfin Ltda.** takes care along with CONAF to ensure the sustainable management of the Lenga Forests in Chile. The use of biomass as a fuel also produces a less demand on the Earth's resources.

Forestal Russfin Ltda. does not need to build the biomass CHP plant since they could satisfy their power needs using diesel generators as it were theirs - *business as usual* - practice during last the 13 years.

National regulations and laws do not force them to use a renewable source of energy and/or to avoid the methane generation by the sawmill residues dumping in open air. As said before, a biomass combined heat and power plant is not a common practice in Chile.

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

The Project will reduce anthropogenic GHG emissions by replacing Diesel-based electricity and LPG-based heat with GHG-free biomass combined heat and power generation. Forestal Russfin actually satisfies some of their heat requirements by using biomass as a fuel, but an important part of the heat

⁷ Load Economic Dispatch Center Central Interconnected System (CDEC-SIC), Operation Statistics 1995-2004

⁸ According to the data taken from the Chilean National Energy Commission. CNE, "Comisión Nacional de Energía".
www.cne.cl



required is provided by the combustion of LPG⁹. In addition, the Project will assist Chile with greenhouse gas (GHG) reduction by curbing methane emissions from open-air decay of biomass derived from the sawmill.

There are three sources of GHG emissions in the absence of the project activity. The first is due to the generation of electricity with fossil fuel, specifically with Diesel engine generators. The second one is due to leaving the sawmill residues to decay in the open air. The third one is due to the combustion of biomass and LPG to generate heat.

The decomposition of the sawmill residues in the absence of oxygen (anaerobic digestion), as it is in the piles left to decay in open air, generate methane (CH₄), which is a powerful GHG. Thus, the second source of emissions are the amount of methane associated to the decay of the biomass.

In project scenario, no biomass is left to decay in the open air, thus no methane (CH₄) is liberated to the atmosphere. Then if the project goes ahead, the biomass is combusted instead of diesel to generate heat and power to satisfy the needs of the Sawmill facility. Thus, the GHG emissions due to the project are much smaller since the combustion of biomass is cleaner than the combustion of any fossil fuel.

Table 1.
GHG emissions sources

	Baseline scenario		Project scenario	
	GHG	Emissions due	GHG	Emissions due
Heat requirements	CO ₂	Biomass and LPG fuel use	CO ₂	Biomass fuel use
Power requirements	CO ₂	Diesel fuel use	CO ₂	Biomass fuel use
Biomass	CH ₄	Biomass anaerobic decomposition	-	-

The Project does not quantify any leakage effect related to biomass availability, because there is enough biomass available to satisfy all the requirements of the on site consumer in the influence area of the Forestal Russfin Biomass CHP Plant. As well, no leakage calculation is needed, as explained in the methodology, due to the Diesel generation units since these are to be removed and not use anymore.

An incentive to **Forestal Russfin Ltda.**, the investor, to pursue this energy sourcing development path is the higher status associated with CDM designation. The Project will publicly highlight its participant's environmental commitment, in a moment in which the Chilean authorities concern for the environment has become evident. Project participant, **Forestal Russfin Ltda.**, will also benefit from pioneering the learning experience for the CDM process, opening a new and very attractive option for future project developments, both in Chile and South America.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

⁹ LPG was used for the facility heating (not related or connected on anyway with the production line) and/or cooking, and because there is no more m² in the facility (footprint expansion) and the number of employees is quite stable, is logical to consider historical LPG consumption as a constant (fixed) figure or are least not - *expandable or scalable* - one. So due the LPG will be not longer in use and 100% replaced by biomass. For the last 13 years, an average of 59.574 kg of LPG (propane/butane) was yearly transported from Punta Arenas capital city to the site to be used in cooking stoves and propane heaters. Due the project activity, such LPG will be not in use anymore.



Years	Annual estimation of emission reductions (tonnes CO ₂ equ)
2006	37,405
2007	37,405
2008	37,405
2009	37,405
2010	37,405
2011	37,405
2012	37,405
Total estimated (tonnes of CO₂equ)	261,837
Total numbers of crediting years	7 y
Annual average over the crediting period (tonnes C O₂equ)	37,405

A.4.4. Public funding of the small-scale project activity:

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

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

Debundling is defined as the fragmentation of a large project activity into smaller parts. The proposed Project Activity is not a debundled component of any other larger project. At present time **Forestal Russfin Ltda.** only would like to submit this project activity, a biomass combined heat and electric power plant with the residues from their Fireland Territory's Sawmill Facility.

This project activity is submitted by **Forestal Russfin Ltda.** and no other project will be submitted by them at this location. Forestal Russfin will use the residues from their sawmill to generate power and heat for themselves.

SECTION B. Application of a baseline methodology:

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

TYPE III. OTHER PROJECT ACTIVITIES

III.E. Avoidance of methane production from biomass decay through controlled combustion

TYPE I. RENEWABLE ENERGY PROJECTS

I.C. Thermal energy for the user

B.2 Project category applicable to the small-scale project activity:

As seen in *B.1* there are two categories applicable for this project activity. The reason for this is that there are four relevant sources of GHG reduction.

The first one, avoidance of methane production from biomass decay through controlled combustion, comprises project activities that avoid the production of methane from biomass that would otherwise have been left to decay as a result of anthropogenic activity. Due to the project activity, decay is prevented through controlled combustion and less methane is produced and emitted to the atmosphere. This is the case of the Forestal Russfin Biomass CHP Plant. With the construction of this power plant all the biomass that usually was dumped and stored in stockpiles would now be used as a fuel, emitting no methane to the atmosphere.

The other, thermal energy for the user, comprises renewable energy generation unit that supply users with electricity and heat. The renewable energy generating unit, in this case, biomass fired heat and power plant, replace existing Diesel fired generation units and Biomass and LPG fueled heat generation units.

These project categories are applicable to the small-scale project activity since the project characteristics are,

- Renewable energy technology that supply the user with electricity and thermal energy.
- By using the biomass as a renewable energy technology to generate electricity and thermal energy the production of methane is avoided by not leaving biomass to decay in the open air.

In order to apply these methodologies in the context of the project activity several assumptions have to be made. Then, the first methodology, avoidance of methane production from biomass decay through controlled combustion, is developed as follows,

$$CH_4_IPCC_{decay} = (MCF * DOC * DOC_F * F * 16/12)$$

where,

$CH_4_IPCC_{decay}$	IPCC CH ₄ emission factor for decaying biomass in the region of the project activity (tonnes of CH ₄ /tonne of biomass)
MCF	Methane Correction Factor (fraction) (default is 0.4)
DOC	Degradable organic carbon (fraction, see equation below or default is 0.3)
DOC_F	Fraction DOC dissimilated to landfill gas (default is 0.77)
F	Fraction of CH ₄ in landfill gas (default is 0.5)

For DOC, the following equation may be used instead of the default:

$$DOC = 0.4 (A) + 0.17 (B) + 0.15 (C) + 0.30 (D)$$

where,



- A Per cent waste that is paper and textiles
- B Per cent waste that is garden waste, park waste or other non-food organic putrescibles
- C Per cent waste that is food waste
- D Per cent waste that is wood or straw

In the case of this project activity, considering that the only waste that is being dumped and left to decay is the sawmill residues, then the per cent waste that would only be accounted for the calculation of the DOC is D.

Thus, DOC would result as,

$$\text{DOC} = 0.30 \text{ (D)}$$

$$\text{Then: } \text{CH}_4_IPCC_{\text{decay}} = (0.4 * 0.30 * 0.77 * 0.5 * 16/12) = 0.0616$$

Finally the baseline emissions would be calculated as,

$$BE_{y1} = Q_{\text{biomass}} * \text{CH}_4_IPCC_{\text{decay}} * \text{GWP_CH}_4$$

where,

BE_{y1}	Baseline emissions from biomass decay (tonnes of CO ₂ equivalent)
Q_{biomass}	Quantity of biomass treated under the project activity (tonnes)
$\text{CH}_4_IPCC_{\text{decay}}$	IPCC CH ₄ emission factor for decaying biomass in the region of the project activity (tonnes of CH ₄ /tonne of biomass)
GWP_CH_4	Is the approved Global Warming Potential value for methane for the first commitment period, 21 (tonnes of CO ₂ equivalent / tonnes of CH ₄)

In the case of the second source of GHG emissions in the baseline scenario, the methodology, stands:

For renewable energy technologies that displace electricity the simplified baseline is the electricity consumption times the relevant emission factor calculated as described in category I.D, paragraphs 6 and 7.

The emissions baseline is the energy baseline calculated in accordance with the mentioned guidelines

For the electricity emissions will be the projected electricity consumption times the relevant CO₂ default emission factor. A conservative IPCC – I.D. paragraph 6 value of 0.9 kg CO₂equ/kWh, which is derived from diesel generation units¹⁰, might be used.

In the case of the 3rd source, biomass combustion for heat generation, the simplified baseline is the fuel consumption of the technologies, in this case biomass, times an emission coefficient for the fuel combusted. IPCC default values for emission coefficients may be used. The formulae used to calculate the baseline emissions for the combustion of biomass is explained above:

$$BE_{y3} = Q_{\text{biomass}} * E_{\text{biomass}} (\text{CH}_4_{\text{bio_comb}} * \text{CH}_4_GWP + \text{N}_2\text{O}_{\text{bio_comb}} * \text{N}_2\text{O_GWP}) / 10^6$$

¹⁰ >=135<200 kW , Mini-grid with 24 hour service



where,

BE_{y3}	Baseline emissions due to biomass combustion (tonnes of CO ₂ equivalent)
$Q_{biomass}$	Quantity of biomass treated under the project activity (tonnes/year) 1,700 t
$E_{biomass}$	Energy content of biomass (TJ/tonne) 0.015 TJ/t default value
$CH_4_{bio_comb}$	CH ₄ emission factor for biomass (kg of CH ₄ /TJ, default value is 300)
CH_4_{GWP}	Is the approved Global Warming Potential value for methane for the first commitment period, 21 (tonnes of CO ₂ equivalent / tonnes of CH ₄)
$N_2O_{bio_comb}$	N ₂ O emission factor for biomass combustion (kg/TJ, default value is 4)
N_2O_{GWP}	Is the Global Warming Potential for N ₂ O set as 310 tCO ₂ e/tN ₂ O for the 1st commitment period. (tonnes of CO ₂ equivalent / tonnes of N ₂ O)

In the case of the 4th source of GHG emissions, LPG combustion for heat generation, in the baseline scenario, the methodology, stands:

For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced. IPCC default values for emission coefficients may be used.

Therefore, for the combustion of LPG, the emission are calculated as it follows:

$$BE_{y4} = O * (CO_{2\text{ LPG_comb}} + CH_{4\text{ LPG_comb}} * CH4_GWP + N_2O_{\text{ LPG_comb}} * N_2O_GWP)$$

where,

BE_{y4}	Baseline emissions due to LPG combustion (tonnes of CO ₂ equivalent)
O	Annual energy output (TJ/year) 2.8 TJ/year (see figure below)
$CO_{2\text{ LPG_comb}}$	CO ₂ emission factor for LPG (tonnes of CO ₂ /TJ, default value 63.07)
$CH_{4\text{ LPG_comb}}$	CH ₄ emission factor for LPG (tonnes of CH ₄ /TJ, default value is 0.0011)
CH_4_{GWP}	Is the approved Global Warming Potential value for methane for the first commitment period, 21 (tonnes of CO ₂ equivalent / tonnes of CH ₄)
$N_2O_{bio_comb}$	N ₂ O emission factor for LPG combustion (tonnes of N ₂ O/TJ, default value is 0.004)
N_2O_{GWP}	Is the Global Warming Potential for N ₂ O set as 310 tCO ₂ e/tN ₂ O for the 1st commitment period. (tonnes of CO ₂ equivalent / tonnes of N ₂ O)

In the following table, the biomass plant installed parameters are shown.

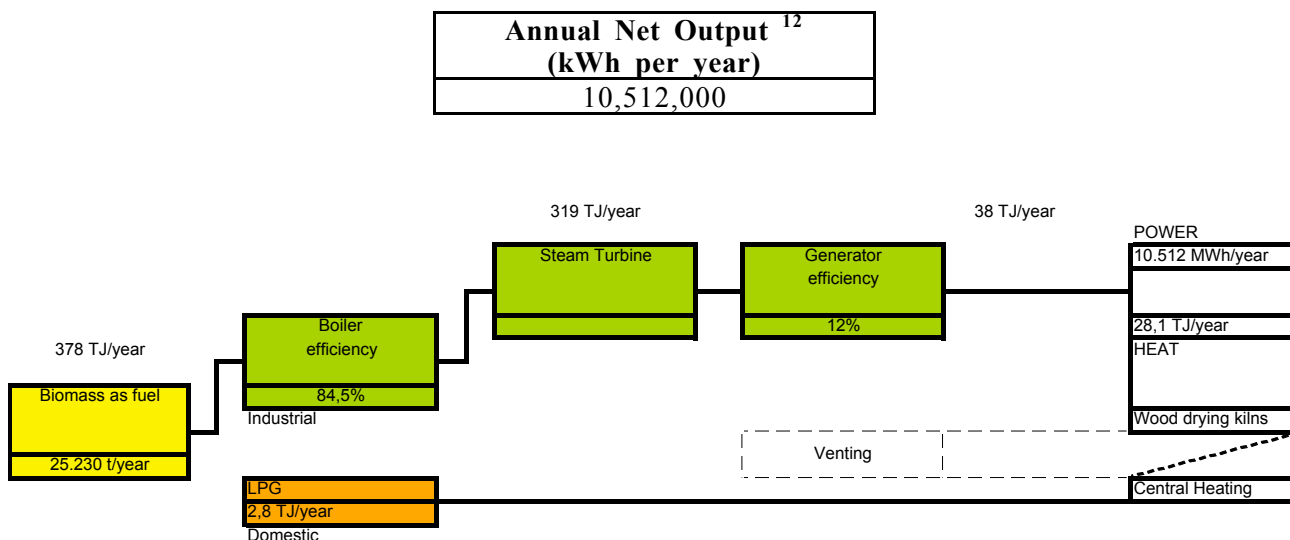
Table 2. Biomass Power Plant parameters.

Plant capacity (net)	1,200 kW
Working hours per year (net)	7,008 hours/year ¹¹

¹¹ (24 h/d x 365 d/y) x 0.8



Thus, the estimated annual output of the biomass plant installed in kWh per year is,



[MSOffice4]

Fuel Balance (energy input)

Fuel	TJ/y	
	Baseline	Project activity
Biomass	26 (1)	378 (2)
Diesel	189 (3)	-
LPG	3	-
Total	218	378

- (1) $1.700 \text{ t/y} \times 0,015 \text{ TJ/t} = 25,5 \text{ TJ/y}$
 (2) $25.229 \text{ t/y} \times 0,015 \text{ TJ/t} = 378,4 \text{ TJ/y}$
 (3) $5.256.000 \text{ L/y} \times 0,000036 \text{ TJ/L} = 189 \text{ TJ/y}$

Energy output balance

Fuel	Year	
	Baseline	Project activity
Biomass	6.110 MWh _{th} (4)	(6) 10.512 MWh _e + 7.780 MWh _{th}
Diesel	10.512 MWh _e	-
LPG	708 MWh _{th} (5)	-
Total	10.512 MWh_e + 6.818 MWh_{th}	10.512 MWh_e + 7.780 MWh_{th}

¹² Represent a reasonable estimate of the average yearly energy that would have been generated by Forestal Russfin's diesel generators during the last years.



- (4) $26 \text{ TJ/y} \times 0,85 = 22 \text{ TJ/y} \times 278 \text{ MWh/TJ} = 6.110 \text{ MWh}_{\text{th}}$ at 6-8 bar
- (5) $3 \text{ TJ/y} \times 0,85 = 2,5 \times 278 \text{ MWh/TJ} = 708 \text{ MWh}_{\text{th}}$
- (6) $37,8 \text{ TJ} \times 278 \text{ MWh/TJ} = 10.512 \text{ MWh}_e$
 $28,1 \text{ TJ} \times 278 \text{ MWh/TJ} = 7.780 \text{ MWh}_{\text{th}}$

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

According with Attachment A to Appendix B

1. Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

- (a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;
- (b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;
- (c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;
- (d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The Forestal Russfin Biomass CHP Plant clearly represents a technological breakthrough and therefore presents new risks not only from a financial perspective, but also from an operational point of view.

Technological barriers: Despite the technology is available and proven, it clearly implies facing a higher complexity at the construction level and at the operational level due the sawmill is located in a very remote area. It demands specialized and qualified labor to design, integrate and build the electric power generating unit inside Forestal Russfin and demands (additional) qualified personnel to operate the CHP plant to provide electric power and heat to the the sawmill.

It must be noted that much of the engineering used to build these type of plants is subcontracted abroad, usually from northern European countries, which are leaders in energy efficiency and clean energy generation technologies. That is clearly in line with the CDM postulates.

In addition, Forestal Russfin core business is the production of forestry-related products for exports and not the generation of electric and heat energy.

Being Chile one of the most important forestry-products producing countries in the world, few other companies apart from Forestal Russfin is currently generating electric power from biomass sources, but they have been doing it for not so long and using large and more efficient power units connected to the public grid.



The project scenario involves the use of a new imported high pressure boiler (there is no high pressure boilers manufacturers in Chilean country) plus steam turbines which are a totally different technology compared with a local manufactured low pressure boiler (6 bar - baseline), for other hand, produce electricity with a otto engine principle (diesel generator) similar to any common truck is totally different than cycle rankine principle. On top of that the operation, maintenance and monitoring of both systems are absolutely different. Then the technological barrier seems to us evident.

Barriers due to the prevailing practice: As previously stated above, the Forestal Russfin Biomass CHP Plant uses a proved technology to generate electric power, however the implementation of such technology within a lumber mill complex clearly departs from the conventional approach in the wood industry. For that reason, the project is one of the first of its kind in Chile, and one of the few of its kind at least in South America.

Finally, at a more macro level, despite regulatory authorities have taken some measures to promote the use of non-conventional renewable energy sources, these efforts have proved to be clearly insufficient:

- There is a lack of awareness of the multiple benefits of Decentralized Energy. The great potential to develop micro power plants in the south of the country remains to be exploited.
- Regulations for the electric sector are oriented around central generation.
- There are no clear national promotion for cogeneration or renewable energy promotion policies.

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

Since the proposed baseline scenario would use the conventional (*business as usual*) fossil fuel on site generators, there would be no risks either from a financial or operational perspective since this is the current scenario.

It can be easily shown that none of the above barriers would prevent the wide implementation of the proposed or any alternative baseline project scenario:

As said before, baseline scenario or alternative conventional power generation do not represent technological barriers. **Forestal Russfin Ltda.** has been satisfying their power needs with Diesel for a very long time (**last 13 years**). To continue to use Diesel or to replace the Diesel on site generators by any other fossil fuel on site generators do not represent a technological barrier for them.

The proposed baseline case scenario constitutes the prevailing practice in this case.

There are no barriers in the wood industry that would prevent the utilization of alternative fossil fuel power units for electric or thermal power generation other than the ones that could be found in any other industry.

Documented evidence to show the existence of the barriers and to support that the barriers could have stopped the implementation of the project:

a) A very recent public study performed on september 2005, by GTZ (Gesellschaft für technische Zusammenarbeit GmbH) in Chile called: NON CONVENTIONAL RENEWABLE ENERGIES. FINAL REPORT AVAILABILITY OF ORIGINATING LUMBER WASTE BIOMASS BETWEEN THE IX AND X REGION FOR POWER GENERATION. PN: 2001,2548,8 (copy available upon request) At the



introduction sentence explain the Chilean actual context for the use of waste biomass for power generation: - *At the moment 39 million of solid m3 of wood is harvested in Chile, destining 69% to supply the national lumber industry, whereas the remaining volume, near 12 million of m3, is used for firewood. From the total biomass that arrives at the lumber industry, important part was lost in the form of waste biomass, of which it does not exist at the present time information systematized with respect to his quantity and areas of generation, being able to be a this source important to contribute to the diversification of the national power matrix, and to as well reduce pressure on the forests, mainly native.-*

b) At present time, even the enormous quantity of waste biomass available at the Chilean country, only 10 biomass power plants are under operation in a range of 5,5 to 61 MW all of them dispatching energy to the central interconnected grid (see: www.cdec-sic.cl) . The proposed project will be the smallest one at the Chilean country and will not receive any additional income for sell electricity to the interconnected grid.

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

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



The project boundary for the project activity is where the treatment of biomass takes place. In concern with this project activity, the project boundary is the Forestal Russfin Sawmill facility. The characteristics of the site are explained in a deeper manner in the section A.4.1 of this document. It is important to quote that the zone around the sawmill is almost depopulated by houses or industries.

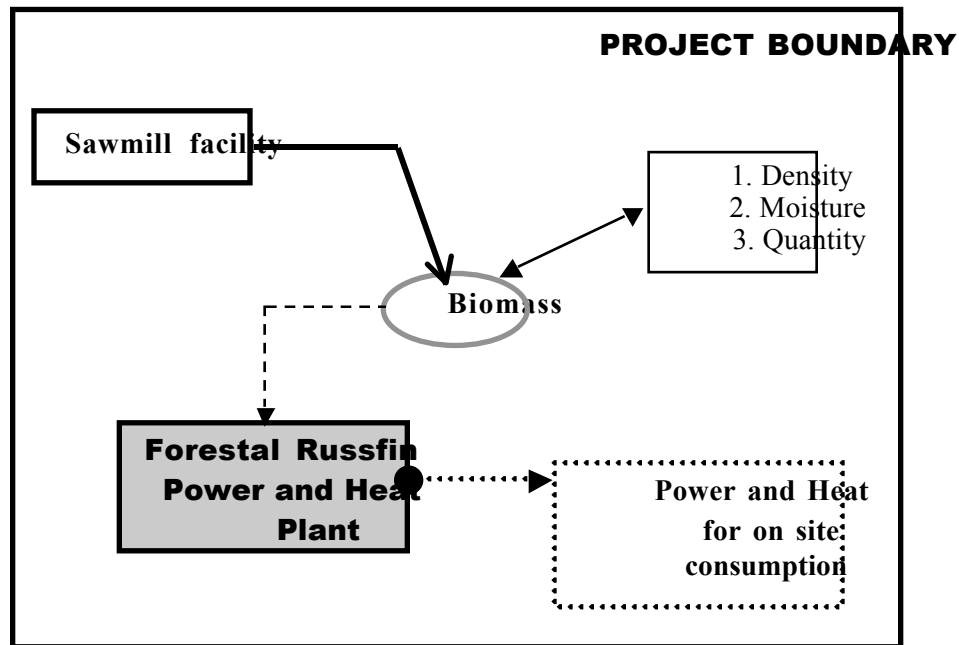


Figure 5. Project Boundary with the monitoring variables.



Table 5. GHG gases with their respective source accounted for each scenario, baseline and project activity.

	Source	Gas	Comment
Baseline Scenario	Biomass open air decay	CH ₄	The anaerobic conditions at the open air provide the properties for methane generation and its released to the atmosphere.
	Diesel and LPG combustion	CO ₂ equ.	GHG emissions due to the combustion of diesel to generate electricity.
	Biomass combustion	CO ₂	CO ₂ emissions due to the combustion of Biomass to generate heat
Project Scenario	Biomass combustion	CH ₄	CH ₄ emissions due to the combustion of biomass to generate power and heat.
	Biomass combustion	N ₂ O	N ₂ O emissions due to the combustion of biomass to generate power and heat.
	Biomass combustion	CO ₂	CO ₂ emissions due to biogenic sources are considered to be carbon- neutral.

B.5. Details of the baseline and its development:

The methodologies to use are the following,

AMS.-III.E, *Avoidance of methane production from biomass decay through controlled combustion,*
AMS.- I.C *Thermal Energy for the user*

As said before, the baseline scenario is the situation where, in the absence of the project activity, biomass is left to decay within the project boundary and methane is emitted to the atmosphere. In this scenario Diesel, LPG and Biomass are needed to generate electricity and thermal energy for the sawmill facility. Thus, the baseline emissions are the amount of methane from the decay of the biomass treated in the project activity and the emissions due to the combustion of Diesel, LPG and Biomass.

**SECTION C. Duration of the project activity / Crediting period:****C.1. Duration of the small-scale project activity:**

21 years

C.1.1. Starting date of the small-scale project activity:

01/01/2005

C.1.2. Expected operational lifetime of the small-scale project activity:

25 years

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

Renewable crediting period

C.2.1. Renewable crediting period:

Yes.

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

01/06/2006

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

Not applicable.

**C.2.2.1. Starting date:**

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Application of a monitoring methodology and plan:

There are two approved methodologies applied to this project activity.

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

These are the following,

AMS-I.C Thermal energy for the user

AMS-III.E. Avoidance of methane production from biomass decay through controlled combustion

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

Applicability of AMS-1.C:

- . This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels or non-renewable sources of biomass. Upgrading of existing equipment is not allowed. Examples include solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass for water heating, space heating, or drying, and other technologies that provide thermal energy that displaces fossil fuel. Biomass-based co-generating systems that produce heat and electricity for use on-site are included in this category. Forestal Russfin Biomass CHP Plant will use biomass for heat and power generation and will replace diesel generators.



- . *Where generation capacity is specified by the manufacturer, it shall be less than 15MW. Forestal Russfin Biomass CHP Plant will use a 1.2 MW Net generator.*

- . *For co-generation systems and/or co-fired systems to qualify under this category, the energy output shall not exceed 45 MW_{thermal}. E.g., for a biomass based co-generating system the capacity for all the boilers affected by the project activity combined shall not exceed 45 MW_{thermal}. In the case of the cofired system the installed capacity (specified for fossil fuel use) for each boiler affected by the project activity combined shall not exceed 45 MW_{thermal}. Forestal Russfin Biomass CHP Plant will use a 15 MW_{thermal} boiler.*

Applicability of AMS-III.E.:

- *This project category comprises measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay as a result of anthropogenic activity. Due to the project activity, decay is prevented through controlled combustion and less methane is produced and emitted to the atmosphere. The project activity does not recover or combust methane (unlike III D). Measures shall both reduce anthropogenic emissions by sources, and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually. Forestal Russfin Biomass CHP Plant will use biomass that would have otherwise been left to decay. The project activity directly emit 2.8 kilotonnes of carbon dioxide equivalent annually*

Monitoring has been chosen as it is suggested in the last proposal on “Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories”.

In the case of the avoidance of biomass decay’s methodology, the most important and unique value to be monitored is the amount of biomass combusted previous and after the project implementation. For this, it is necessary to monitor as well the moisture and density of the biomass combusted in the project activity or left to decay in the case of the baseline scenario. Thus, this parameter, Q_{biomass} , is used for baseline and project activity emission calculations.

In the case of thermal and electricity generation by the user the only parameters that need to be monitored are, the annual output of the renewable energy, calculated as the biomass fired CHP plant capacity times the other parameter to be monitored, the operation working hours of the biomass CHP plant. This is to calculate the project activity emissions in the case of thermal and electricity generation by the user methodologies.

Data collection is compatible with the baseline methodology described in Section E.

**D.3 Data to be monitored:**

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	For how long is archived data to be kept?	Comment
1.	Amount of biomass combusted in cubic meters.	$Q_{\text{biomass}} \text{m}^3$	m^3	m	Daily calculation [MSOffice5] and monthly recording	100%	Electronic	Two years after the end of the crediting period.	Q_{biomass} is the total biomass used for power generation due to the project activity. The quantity of biomass combusted should be collected separately for all types of biomass and dumped into a dimensioned (standard volume) container before to be burned. The daily measurement recorded will be equivalent to the total number of full containers burned per day.
2.	Amount of biomass combusted in tonnes.	Q_{biomass}	tonnes	c	Daily calculation and monthly recording	100%	Electronic	Two years after the end of the crediting period.	Q_{biomass} is calculated as, $Q_{\text{biomass}} = ((Q_{\text{biomass}} \text{m}^3 \times \rho_{\text{biomass}}) / 1000) \times (1 - M_{\text{biomass}})$
3.	Density of the biomass [MSOffice6].	ρ_{biomass}	kg/m^3	m	Weekly measurement	100%	Electronic	Two years after the end of the crediting period.	Measured to calculate ID number 1 and 2.
4.	Moisture of the biomass.	M_{biomass}	%	m	Weekly measurement [MSOffice7]t	100%	Electronic	Two years after the end of the crediting period.	Measured to calculate ID number 1 and 2.
5.	Power output	O_i	kWh	m	Daily measurement [MSOffice8] and monthly recording.	100%	Electronic	Two years after the end of the crediting period.	Measured as, the plant capacity times the working hours of it. Total yearly energy output will be compared against total yearly biomass combusted for the empiric



6.	Heat output	O_i	GJ	m	Daily measurement [MSOffice9] and monthly recording.	100%	Electronic	Two years after the end of the crediting period	<p>confirmation of TJ/tonne biomass figure. Due the boiler output steam will be deliver at constant pressure, flow and temperature, we have must use the specific enthalpy of superheated steam formula calculated as follow:</p> $h_s = h_g + c_p (t_s - t_f)$ <p>where h_s = enthalpy of superheated steam (kJ/kg) c_p = specific heat of steam at constant pressure = 1.860 (kJ/kg.oC) t_f = saturation temperature (oC) 212 degrees F (default) t_s = superheated steam temperature (oC) (measured on site) $c_p = 1.860$ (kJ/kg.oC) at standard atmosphere. Be aware that c_p varies with temperature and must be consulted at proper tables. Then,</p> $H = m h \text{ (kJ)}$ <p>where H = enthalpy (kJ) m = mass (kg) (taken from density by proper tables associated with temperature) h = specific enthalpy (kJ/kg) (taken from above) Finally, after to get the Power = Enthalpy (kJ), we can directly calculate the output energy (MWhth) accounting the total hours of boiler operation.</p>
7.	Working hours per	h	h	m	Monthly measurement	100%	Electronic	Two years after the end of the	Biomass and emergency diesel generation unit.



	year				and annually recording.			crediting period.	
8.	Kiln drying process expansion	O_i	GJ	e	yearly	100%	Electronic	Two years after the end of the crediting period.	<p>Forestral Russfin's kilns are designed at least on the following 10 years horizon capacity and 1,700(tonne/year) * 0.015(TJ/tonne) = 25.5 TJ/y represent the actual (and future) kiln's energy requirements at full capacity round year. 25.5 TJ/y will be the energy taken anyway from biomass if the kilns works 7,008 h/y (full capacity) so for be conservative and straightforward we prefer to use a fixed figure (worst case scenario) and just discount it from the total thermal energy produced, instead to link it with a variable thermal requirement associated with the number of hours of kiln operation. If, in the future, the sawmill expand the number of drying kiln's this (25.5 TJ/y) will be updated and adjusted according with a new full yearly thermal requirement. Therefore the lumber drying kiln expansion will be included at the monitoring program.</p>



D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

Forestal Rusffin is an ISO 9.000 certified company therefore the QA/QC will be undertaken according with such guidelines.

ID number	Data type	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1.	Amount of biomass combusted in cubic meters.	Medium	The inflow biomass receptacles will be standardized filled
2.	Amount of biomass combusted in tonnes.	Medium	Measured biomass flow = Burned biomass flow
3.	Density of the biomass[MSOffice10].	Medium	A representative statistical method will be used
4.	Moisture of the biomass.	Low	Meters will be subject to regular maintenance and testing regime to ensure accuracy. The consistency of metered net electricity and heat generation should be cross-checked with the quantity of biomass fired (e.g. check whether the electricity generation divided by the quantity of biomass fired results in a reasonable efficiency that is comparable to previous years).
5.	Power output	Low	
6.	Heat output	Low	
7.	Working hours per year	Low	
8.	Kiln drying process expansion	Low	

The measurement of a power plant's output is relatively simple. The electricity generated by a biomass-based energy project activity can be determined from measuring energy generation meter readings. This method is the preferred measurement method, and requires installing an electric output meter at the power plant that constantly measures the electricity production.

The meter must meet the calibration standards of the grid market (local, national or international). Meter readings records will be particularly important to auditors and must be readily available. This method may produce errors if the meter is not properly calibrated, therefore calibration should be checked periodically for accuracy. Calibration tests' records are useful and should be kept for the auditors.

All relevant data for monitoring comes from direct and verifiable sources (whenever available) and is crosschecked with commercial and / or other official data (whenever available) to assure the accuracy, comparability, completeness and validity of the data.

Quality control and quality assurance procedures

Regarding quality control and assurance procedures to be undertaken for the monitored data, the practices to be implemented in the context of this project are as follows:

Monitoring records:

Daily readings of all field meters will be registered in either electronic form or on paper worksheets. Data collected will be entered in electronic worksheets and stored. Periodic controls of the field



monitoring records will be carried out to check any deviation from the estimated CERs and according to the Operational Manual for correction or future references.

Recommendations on system and procedures improvements will be presented. Periodic reports to evaluate performance and assist with performance management will be elaborated.

Equipment calibration and maintenance:

All meters and other sensors will be subject to regular maintenance and testing regime according to the technical specifications from the manufacturers to ensure accuracy and good performance.

Calibration of equipment will be performed periodically according to technical specifications and in agreement with recommendations given by suppliers.

It is the independent QA/QC-department that will ensure the implementation of proper maintenance and calibration.

Corrective actions:

Actions to handle and correct deviations from the Monitoring Plan and Operational Manual procedures will be implemented as these deviations are observed either by the operator or during internal audits. If necessary, technical meetings between the operator, the developer and the sponsor of the project will be held in order to define the corrective actions to be undertaken.

Site audits:

The quality assurance team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the Monitoring Plan and the Operational Manual (MP&OM).

Training:

The operator personnel will be trained in equipment operation, data recording, reports writing, and operation, maintenance and emergency procedures in compliance with the Operational Manual.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

The project monitoring will be done by Ing. Rodolfo Tirado, General Manager of Forestal Russfin and other 2 professionals at Forestal Russfin's Sawmill facility.

D.6. Name of person/entity determining the monitoring methodology:

Ing. Rodolfo Tirado



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Camino Troncal 01348
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SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

Since there are three sources of GHG emission reductions and thus three methodologies from appendix B of the simplified modalities and procedures for small-scale CDM project activities used, then it seems necessary to describe the formulae for baseline and project activity emissions as shown in section E.1.2.

E.1.2 Description of formulae when not provided in appendix B:

The anthropogenic emissions by sources of GHGs due to the project activity within the project boundary are those due to,

1. The amount of biomass combusted

The formulae used to estimate them, according to the methodology for the type of projects *III. Other project activities, category, III.E, Avoidance of methane production from biomass decay through controlled combustion* are,

$$PE_y = Q_{\text{biomass}} * E_{\text{biomass}} (CH_4_{\text{bio_comb}} * CH_4_GWP + N_2O_{\text{bio_comb}} * N_2O_GWP) / 10^6$$

$$PE_y = 25,229(\text{tonne/year}) * 0.015(\text{TJ/tonne}) [MSOffice11]^{13} [(300(\text{kgCH}_4/\text{TJ}) * 21(\text{kgCO}_2/\text{kgCH}_4)) + (4(\text{kgNO}_2/\text{TJ}) * 310(\text{kgCO}_2/\text{kgN}_2O))] / 1000$$

$$PE_y = 2,853 \text{ tCO}_2/\text{year}$$

where,

PE_y	Project activity emissions (kilotonnes of CO ₂ equivalent)
Q_{biomass}	Quantity of biomass treated under the project activity (tonnes)
E_{biomass}	Energy content of biomass (TJ/tonne)
$CH_4_{\text{bio_comb}}$	CH ₄ emission factor for biomass (kg of CH ₄ /TJ, default value is 300)
CH_4_GWP	Is the approved Global Warming Potential value for methane for the first commitment period, 21 (tonnes of CO ₂ equivalent / tonnes of CH ₄)
$N_2O_{\text{bio_comb}}$	N ₂ O emission factor for biomass combustion (kg/TJ, default value is 4)

¹³ This IPCC default value will be corroborate annually against the total energy output vs real wood consumption.



N₂O GWP Is the Global Warming Potential for N₂O set as 310 tCO₂e/tN₂O for the 1st commitment period. (tonnes of CO₂ equivalent / tonnes of N₂O)

The value for the energy content of biomass was taken from the TABLE 1-13 ENERGY CONTENT OF BIOMASS FUELS: DEFAULT NET CALORIFIC VALUES of the “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual”, Page 1.45. According to this conservative and transparent source of information, the value for E_{biomass} is 15 MJ/kg (0.015 TJ/tonnes).

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

GHG emissions from biomass combustion in the Power Boiler

As we explained in point E.1.2 according to the IPCC Guidelines a methane emission from wood / wood waste combustion in energy industries is 300 kg CH₄/TJ & 4 kg N₂O/TJ¹⁴. On the basis of the IPCC default factor, the combustion at the Forestal Rusffin will result in the following emissions from controlled biomass burning in the power boiler:

$$PE_{BIOMASS,CH_4,y} = (300 \text{ (kg CH}_4\text{/TJ)/1000} * 378 \text{ TJ/year} * 21 \text{ (tCO}_2\text{/tCH}_4\text{)}) + (4 \text{ (kg N}_2\text{O/TJ)/1000} * 378 \text{ TJ/year} * 310 \text{ (tCO}_2\text{/tN}_2\text{O)})$$

$$PE_{BIOMASS,CH_4,y} = 2,853 \text{ (tCO}_2\text{e/year)}$$

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

No leakage calculation is required due the diesel generators to be replaced by this CDM project activity will be totally decommissioned. But, according with the Chilean law, at least one diesel generator must remain on the site as – *back up* – in case of the main biomass unit fail or requires maintenance. The emergency diesel equipment power is equivalent to 1/6 of the total energy demand by the sawmill complex and probably will work no more than 2-3 weeks per year, therefore the emissions associated to this emergency device in the worst case scenario will be negligible¹⁵. The exactly amount of working hours per year of it will be included at the monitoring program (see monitoring program D.3. point 7).

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

Since no leakage calculation is required then the project activity emissions are those calculated in E.1.2.1.

¹⁴ Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Table 1-7, pag 1.35.

¹⁵ 200 kW x 24 h/d x 21 d/y x 0,9 kg CO₂/kWh = 90 t CO₂/y = less than 0.5 % of total emission reductions.



E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

The anthropogenic emissions by sources of GHGs in the baseline within the project boundary are those due to,

1. Biomass left to decay in open air.

The first source of emissions are calculated using the methodology in the type of project *III. Other project activity, category, D, Avoidance of methane production from biomass decay through controlled combustion* as follows,

$$\begin{aligned} \text{CH}_4_IPCC_{\text{decay}} &= (\text{MCF} * \text{DOC} * \text{DOC}_F * F * 16/12) \\ \text{CH}_4_IPCC_{\text{decay}} &= (0.4 * 0.3 * 0.77 * 0.5 * 16/12) \\ \text{CH}_4_IPCC_{\text{decay}} &= 0.0616 \end{aligned}$$

where,

$\text{CH}_4_IPCC_{\text{decay}}$	IPCC CH ₄ emission factor for decaying biomass in the region of the project activity (tonnes of CH ₄ /tonne of biomass)
MCF	Methane Correction Factor (fraction) (default is 0.4)
DOC	Degradable organic carbon (fraction, see equation below or default is 0.3)
DOC_F	Fraction DOC dissimilated to landfill gas (default is 0.77)
F	Fraction of CH ₄ in landfill gas (default is 0.5)

As explained in section B.2 of this document the Degradable Organic Carbon, DOC, would be remains as DOC = 0.30 (D) since the biomass left to decay is only the rest of the sawmill operations.

Thus, the baseline emissions would be calculated as,

$$\begin{aligned} BE_{y1} &= Q_{\text{biomass}} * \text{CH}_4_IPCC_{\text{decay}} * \text{GWP}_{\text{CH}_4} \\ BE_{y1} &= 23,529 \text{ (tonne/year)} * 0.0616 \text{ (tonneCH}_4\text{/tonne biomass)} * 21 \text{ (tonneCO}_2\text{e/tonne CH}_4\text{)} \\ BE_{y1} &= 30,437 \text{ tonne (CO}_2\text{e/year)} \end{aligned}$$

where,

BE_{y1}	Baseline methane emissions from biomass decay (tonnes of CO ₂ equivalent)
Q_{biomass}	Quantity of biomass treated under the project activity less quantity of biomass used to generate heat in the baseline (tonnes)
$\text{CH}_4_IPCC_{\text{decay}}$	IPCC CH ₄ emission factor for decaying biomass in the region of the project activity (tonnes of CH ₄ /tonne of biomass)
GWP_{CH_4}	Is the approved Global Warming Potential value for methane for the first commitment period, 21 (tonnes of CO ₂ equivalent / tonnes of CH ₄)

2. Diesel generation units.

The second source of emissions are calculated using the methodology , as follows,



$$E_b = 10,512,000 \text{ (kWh/year)}$$

The emissions baseline is the energy baseline calculated times the CO₂ emission coefficient for the fuel displaced. A IPCC default value of 0.9 kg CO₂equ/kWh, which is derived from diesel generation units, is used. The baseline emissions per year due to the use of diesel are then calculated as,

$$BE_{y_2} = E_b * 0.0009$$

$$BE_{y_2} = 9,461 \text{ tonne CO}_2\text{e/year}$$

where,

BE_{y_2}	Baseline methane emissions from diesel fired electricity generation (tonnes of CO ₂ equivalent per year)
E_b	Annual energy baseline in kWh per year.
0.0009	CO ₂ emission coefficient for the fuel displaced in tonnes of CO ₂ equ per kWh.

3. Biomass heat generation units (kiln drying process)¹⁶.

$$BE_{y_3} = Q_{\text{biomass}} * E_{\text{biomass}} (CH_4_{\text{bio_comb}} * CH_4_GWP + N_2O_{\text{bio_comb}} * N_2O_GWP) / 10^6$$

$$BE_{y_3} = 1,700(\text{tonne/year}) * 0.015(\text{TJ/tonne}) [(300(\text{kgCH}_4/\text{TJ}) * 21(\text{kgCO}_2/\text{kgCH}_4)) + (4(\text{kgNO}_2/\text{TJ}) * 310(\text{kgCO}_2\text{e}/\text{kgNO}_2))] / 1000$$

$$PE_y = 192 \text{ tCO}_2\text{/year}$$

where,

BE_{y_3}	Baseline emissions due to biomass combustion (tonnes of CO ₂ equivalent)
Q_{biomass}	Quantity of biomass treated under the project activity (tonnes/year)
E_{biomass}	Energy content of biomass (TJ/tonne)
$CH_4_{\text{bio_comb}}$	CH ₄ emission factor for biomass (kg of CH ₄ /TJ, default value is 300)
$CH_4 \text{ GWP}$	Is the approved Global Warming Potential value for methane for the first commitment period, 21 (tonnes of CO ₂ equivalent / kg of CH ₄)
$N_2O_{\text{bio_comb}}$	N ₂ O emission factor for biomass combustion (kg/TJ, default value is 4)
$N_2O \text{ GWP}$	Is the Global Warming Potential for N ₂ O set as 310 tCO ₂ e/tN ₂ O for the 1st commitment period. (kg of CO ₂ equivalent / kg of N ₂ O)

4. LPG heat generation units¹⁷.

¹⁶ In order to increase the value of the lumber, is necessary a kiln drying process. Kilns provide a controlled process to reduce wood moisture up to target %, proper content for indoor projects like furniture, cabinets, and wood flooring.

Forestral Russfin's kilns are designed at least on the following 10 years horizon capacity and 1,700(tonne/year) * 0.015(TJ/tonne) = 25.5 TJ/y represent the actual (and future) kiln's energy requirements at full capacity round year. 25.5 TJ/y will be the energy taken anyway from biomass if the kilns works 7,008 h/y (full capacity) so for be conservative and straightforward we prefer to use a fixed figure (*worst case scenario*) and just discount it from the total thermal energy produced, instead to link it with a variable thermal requirement associated with the number of hours of kiln operation. If, in the future, the sawmill expand the number of drying kiln's this (25.5 TJ/y) will be up-dated and adjusted according with a new full yearly thermal requirement. Therefore the lumber drying kiln expansion will be included at the monitoring program.



$$BE_{y4} = O * (CO_{2\text{ LPG_comb}} + CH_{4\text{ LPG_comb}} * CH_4_GWP + N_2O_{\text{ LPG_comb}} * N_2O_GWP)$$

$$BE_{y4} = 2.8(\text{TJ/year}[\text{MSOffice12}]) * (63.07 (\text{tCO}_2/\text{TJ}) + (0.0011 (\text{tCH}_4/\text{TJ}) * 21 (\text{kgCO}_2\text{e}/\text{kgCH}_4)) + (0.004 (\text{tN}_2\text{O}/\text{TJ}) * 310 (\text{kgCO}_2\text{e}/\text{kgN}_2\text{O}))$$

$$BE_{y4} = 169 \text{ tonnes } [\text{MSOffice13}] \text{CO}_2\text{e}$$

From the sum of these three sources of baseline emissions result the total baseline emissions as follows,

$$BE_{y\text{ t}} = BE_{y\text{ 1}} + BE_{y\text{ 2}} + BE_{y\text{ 3}} + BE_{y\text{ 4}}$$

$$BE_{y\text{ t}} = 40,259 \text{ tonne CO}_2\text{e/year}$$

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

The emission reductions due to the project are those given by,

$$ER_y = BE_{y\text{ t}} - PE_y$$

$$ER_y = 37,405 \text{ tCO}_2\text{e}$$

¹⁷ LPG was used for the facility heating (not related or connected on anyway with the production line) and/or cooking, and because there is no more m² in the facility (footprint expansion) and the number of employees is quite stable, is logical to consider historical LPG consumption as a constant (fixed) figure or are least not - *expandable or scalable* - one. So due the LPG will be not longer in use and 100% replaced by biomass. For the last 13 years, an average of 59.574 kg of LPG (propane/butane) was yearly transported from Punta Arenas capital city to the site to be used in cooking stoves and propane heaters. Due the project activity, such LPG will be not in use anymore.

**E.2 Table providing values obtained when applying formulae above:**

Baseline		tCO ₂ e/year		
Fuel	Unit	Combustion	Left to Decay	Total
Diesel	1.2 MWh/year	9.461	0	9.461
LPG	0.06 kt/year	169	0	169
Biomass	25.229 kt/year	192	30.437	30.629
		Total		40.259

Project Activity		tCO ₂ e/year		
Fuel	Unit	Combustion	Left to Decay	Total
Diesel	1.2 MWh/year	0	0	0
LPG	0.06 kt/year	0	0	0
Biomass	25.229 kt/year	2.853	0	2.853
		Total		2.853

Net Emission Reductions	37.405
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Year	Baseline Emissions due to Biomass decay tCO ₂ equ	Baseline Emissions due to Diesel Electricity generation tCO ₂ equ	Baseline Emissions due to Biomass Heat Generation tCO ₂ equ	Baseline Emissions due to LPG Heat Generation tCO ₂ equ	Project activity emissions tCO ₂ equ	Emission reductions tCO ₂ equ
2006	30.437	9.461	192	169	2.853	37.405
2007	30.437	9.461	192	169	2.853	37.405
2008	30.437	9.461	192	169	2.853	37.405
2009	30.437	9.461	192	169	2.853	37.405
2010	30.437	9.461	192	169	2.853	37.405
2011	30.437	9.461	192	169	2.853	37.405
2012	30.437	9.461	192	169	2.853	37.405
2013	30.437	9.461	192	169	2.853	37.405
2014	30.437	9.461	192	169	2.853	37.405
2015	30.437	9.461	192	169	2.853	37.405
2016	30.437	9.461	192	169	2.853	37.405
2017	30.437	9.461	192	169	2.853	37.405
2018	30.437	9.461	192	169	2.853	37.405
2019	30.437	9.461	192	169	2.853	37.405
2020	30.437	9.461	192	169	2.853	37.405
2021	30.437	9.461	192	169	2.853	37.405
2022	30.437	9.461	192	169	2.853	37.405
2023	30.437	9.461	192	169	2.853	37.405
2024	30.437	9.461	192	169	2.853	37.405
2025	30.437	9.461	192	169	2.853	37.405
2026	30.437	9.461	192	169	2.853	37.405
					Total (tCO₂ 21 years)	785.510
					Total (tCO₂)	261.837



7 years)

SECTION F.: Environmental impacts:**F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:****Not Applicable**

According to the “Decreto 95” of the Ministry of the General Secretary of the Presidency¹⁸, of date August 21st, 2001, the Forestal Russfin Plant does not need to enter the environmental impact evaluation system. This is due to the article 3.c, which states that power plants with capacity lower than 3 MW do not cause a significant environmental impact to be evaluated by the designed environmental authorities.

SECTION G. Stakeholders’ comments:**G.1. Brief description of how comments by local stakeholders have been invited and compiled:**

Under the existing Chilean environmental legislation, the local DNA (CONAMA) calls for a Public Consultation Process (PCP) to identify concerns of the local stakeholders and response of the developer, as part of the EIA.

However, due to the technical & legal characteristics of the proposed CDM project activity (see section F.1) an open public consultation is not required by Law. In this case, what the common sense recommended, and it was done that way, was a focused public consultation, surveying the neighbors in the area of direct influence of the project and leaders or organized local groups in that same area.

Therefore the following independent PCP's activities was performed by the project developer:

- a) 02 public announcements were performed in a regional newspaper.
- b) Letters to all the public authorities and neighbors was sent explaining the project.

The PCP has been developed following crystal-clear procedures and tried to cover the interested parties and/or by those affected by the project.

¹⁸ <http://www.segpres.cl/inicio.asp>



Only the Chilean service of agriculture and stockbreeding (Servicio Agrícola y Ganadero, SAG) submit a concrete positive opinion about the project through letter number 11772 dated September 12th 2005, signed by the Regional Director of SAG in the “Region XII”, Mr. Carlos Rowland Ovando (letter's copy available upon request).

G.2. Summary of the comments received:

In general, the perception of the project is positive and related benefits regarding the use of clean mechanisms for electricity generation are well recognized by local stakeholders. Other concerns about the local permits and operation are seen as solvable and not as key within their general concerns about the mill itself.

G.3. Report on how due account was taken of any comments received:

The project developer will take the suggestions up and will inform the stakeholders regularly on the progress of the project at Forestal Russfin Ltda. Mill site.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding.
