CLEAN DEVELOPMENT MECHANISM

SMALL SCALE PROJECT DESIGN DOCUMENT (CDM-PDD)

IRANI BIOMASS ELECTRICITY GENERATION PROJECT

Version 4.0

Prepared by

EcoSecurities Ltd

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A. GENERAL DESCRIPTION OF PROJECT ACTIVITY

A.1 Title of the project activity:

Irani biomass electricity generation project

A.2. Description of the project activity:

The project activity is a renewable energy project, which consists of the construction and operation of an 9.43 MW biomass generation plant that will generate electricity required by Celulose Irani in the paper manufacturing process. The proposed project activity involves displacing more carbon-intensive electricity from the grid with electricity generated by a GHG-neutral option. The project activity also involves methane avoided from biomass not being landfilled.

Celulose Irani is a Brazilian pulp and paper manufacturing company, located in the 'Campina da Alegria' district (Santa Catarina State, Brazil), with years of experience in the manufacturing of a diversified range of paper products for both domestic and export markets. Currently, wood used in the paper manufacturing process comes from Irani's own 16,800 ha of plantation forests.

Currently, about 56% of the electricity consumed at the site is produced on-site from their existing two biomass units and two small-scale hydro plants. The two thermal units for electricity generation fuelled by biomass have an installed capacity of 4.8 MW; and the two small-scale hydro plants have installed capacity of 9.7 MW. It is worth mentioning that Celulose Irani also has a 1.05 MW diesel-based plant, which is only used as a back-up system in emergency cases. The remaining 44% of their electricity consumption is imported from Centrais Elétricas de Santa Catarina S.A. (CELESC), the local grid electricity authority.

From 2000 to 2003, Celulose Irani increased its production capacity from 83,000 tonnes of paper per year[1] to 147,000 tonnes of cellulose (paper) per year, resulting in a large increase in energy consumption, with no significant increase in the installed capacity of electricity generation. In the coming years, Celulose Irani plans to expand its production capacity even further, given that their

1 Celulose Irani, 2002 – Balance sheet related to 2002

plantations are reaching maturity. This means an estimated increase of energy consumption from 125,353 MWh per year in the period 2004-2007 to almost 145,000 MWh per year in the period 2008-2024. The new biomass plant will displace part of the energy imported from the South-SouthEast grid. However, Celulose Irani will continue to be connected to the grid, with an energy purchase contract of 22,075 MWh/year. This represents a reduction of electricity purchase from the grid of about 33,271 MWh per year in the period from 2004 to 2007 and over 52,035 MWh per year in the period from 2008 onwards, comparing to the baseline scenario.

Celulose Irani is proposing to build a captive biomass generation plant of 9.43 MW to supply the energy necessary to promote the production expansion, and to displace electricity generation from a more fossil-intensive grid, thus reducing GHG emissions in the process. This new biomass generation plant will use 348,000 tonnes of biomass per year. The new plant is also more efficient in terms of biomass use, as it will have a shredder that will enable the plant to use a wider range of granulometric sizes of the biomass.

Together with the new plant, the two other thermal plants will continue its activities. All the biomass used by the three plants will come from the same sources: wood chips (from, *Eucalyptus* sp. planted by Irani exclusively to produce wood for fuel), biomass residues, from Irani forests, with high granulometry (from Irani own *Pinus sp.* Plantations), biomass residues, also from Irani forests, with low granulometry and biomass residues purchased from third parties.

In the baseline scenario, the high granulometry biomass residues from Irani forests have been landfilled in the Irani's own landfill. It is not used as fuel due to technical problems. In the project scenario, with the installation of the new plant, there will be also a shredder, which will make possible the use of this biomass, avoiding it to be landfilled.

The project scenario also involves avoiding the landfilling of biomass that would not have been used if the cogeneration plant were not built. The amount that would have been landfilled is 120,000 tonnes of biomass per year. Landfilled Biomass generates methane. The avoidance of biomass landfilling will avoid methane generation, reducing the GHG emissions.

Table 1 below summarises the baseline and project scenarios. As indicated above, energy consumption is scheduled to increase due to production expansion. As the Table 1 indicates, it is estimated that existing on-site resources (i.e., two biomass units and three small-scale hydro plants) will provide 70,007 MWh/year of electricity in both the baseline and project scenario.

Table 1: Summary of Baseline and Project scenarios

			Phase 1 (2004-2007)	Phase 2 (From 2008)
Baseline Scenario	Total electricity consumption	MWh/year	125,353	144,116
	Existing on-site sources		70,007	70,007
	Electricity imported from the grid		55,346	74,110
	Biomass consumption	Tonnes/year	301,880	301,880
	Biomass landfilled		120,000	120,000
Project Scenario	Total electricity consumption	MWh/year	125,353	144,116
	Electricity generated by the new biomass generation plant		44,308	63,072
	Electricity used by the biomass generation plant		11,037	11,038
	Other existing on-site sources		70,007	70,007
	Electricity imported from the grid		22,075	22,075
	Energy displaced from the grid		33,271	52,035
	Biomass consumption	Tonnes/year	432,000	432,000
	Biomass landfilled		0	0

The electricity currently provided by the grid is relatively carbon intensive, with an operating margin emission factor of 0.957 tCO_2/MWh and a build margin emission factor of 0.421 tCO_2/MWh (see section B, baseline scenario). In 2000, the electricity generation in Brazil was mainly based on hydropower. However, the share of coal and natural gas has been increasing over the last years in order to address the security of electricity supply.

As mentioned above, about 44% of the energy currently used by Celulose Irani is provided by Centrais Elétricas de Santa Catarina S.A. (CELESC), the relevant grid electricity authority. CELESC is located in Santa Catarina state, South of Brazil, which is connected to the South –

Southeast Electricity System. It is important to note that the project approach is conservative, because most of coal mines and coal thermoelectric plants of the country are located in the south region of Brazil, near Celulose Irani region, and the project is not considering the displacement of a specific plant, but the average of the South-Southeast grid.

The grid energy displacement component of the project has the capacity to reduce the emission of 701,177 tonnes of CO_2e over a 21-year timeframe (from October 2004 to October 2025). The methane avoidance component of the project has the capacity to reduce the emission of 3,108,052 tonnes of CO_2e over the same timeframe. In total, the project has the potential to reduce the emission of 3,809,229 tonnes of CO_2e.

The project is helping Brazil fulfil its goals of promoting sustainable development. Specifically, the project:

- Increases employment opportunities in the area where the project is located;
- Acts as a clean technology demonstration project, encouraging development of modern and more efficient cogeneration of electricity and thermal energy using biomass fuel throughout Brazil;
- Optimises the use of natural resources, avoid new uncontrolled waste disposal places, using a large amount of wood residues from region;
- Diversifies the sources of electricity generation (a national target after the 2001 Brazilian energy crisis[2]);
- Helps Celulose Irani achieve its commitment to environmentally clean and environmentally friendly production;
- Uses clean and efficient technologies, and conserves natural resources, thus the project will be meeting the Agenda 21 and Sustainable Development Criteria of Brazil.

A.3. Project participants:

- **Carbon credit owner and project manager:** Celulose IRANI

Founded in 1941, Celulose Irani is a wholly integrated company, with lumber, pulp and paper, packing, resins and furniture divisions. The company maintains a total of 34,000 hectares of forests. Of this total, 16,800 hectares are reserved for the planting of Chilean pine, eucalyptus and three other species of pine. The remaining 17,200 hectares are native forests and legally

[2] Brazilian Federal Government, MME (Ministério de Minas e Energia), 2003

established reserves. The new captive generation plant will be placed in The Campina da Alegria plant, which is located in Santa Catarina state. The Campina da Alegria plant is a timber, pulp and paper facility, producing raw sawtimber, cellulose and lightweight Kraft paper. There are other divisions and units in: Rio Negrinho, SC (Furniture Unit), Santana de Parnaiba, SP (Packing Unit), Balneario Pinhal, RS (Resin Unit) and Celulose Irani headquarters in Porto Alegre, RS.

- **Project CO_2 Advisor and Annex 1 Party:** EcoSecurities UK Ltd.

- **Project Annex 1 Party:**
    - Shell Trading International Limited (“STIL”).
    - Showa Shell Sekiyu K.K.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1 Host country Party: Brazil

A.4.1.2 Region/State/Province etc.: South region, Santa Catarina state

A.4.1.3 City/Town/Community etc: Vargem Bonita city, Campina da Alegria district (see Figure 1 below)

A.4.1.4 Detailed description of the physical location: The project is located at Celulose Irani main industrial complex, in the Campina da Alegria integrated mill (see Figure 2), located in Campina da Alegria district, in the municipality of Vargem Bonita, Santa Catarina State (Rodovia BR 153, km 47 CEP: 89600-000). Celulose Irani also has other production units in other parts of Santa Catarina and São Paulo States that will not be part of this project. See below the map of Santa Catarina State.

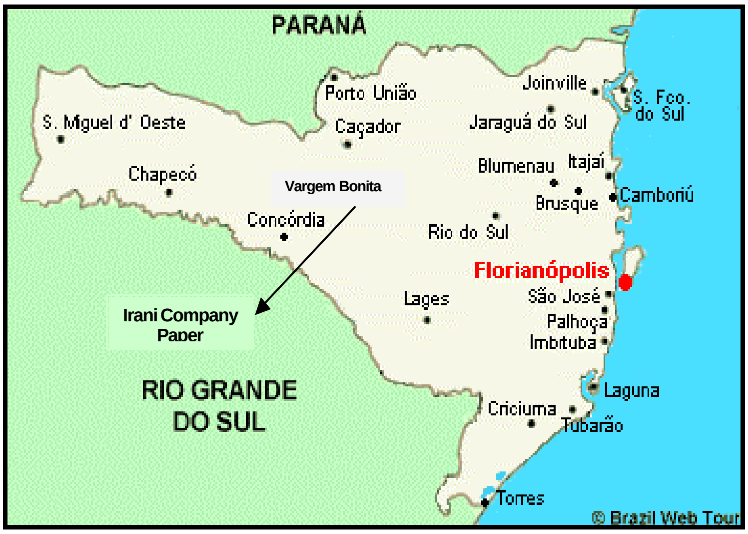

Figure 1: Geographic localization of Irani Paper Division, in the municipality of Vargem Bonita, SC (Source: http://www.brazilwebtour.com.br/imagens/sc.gif).

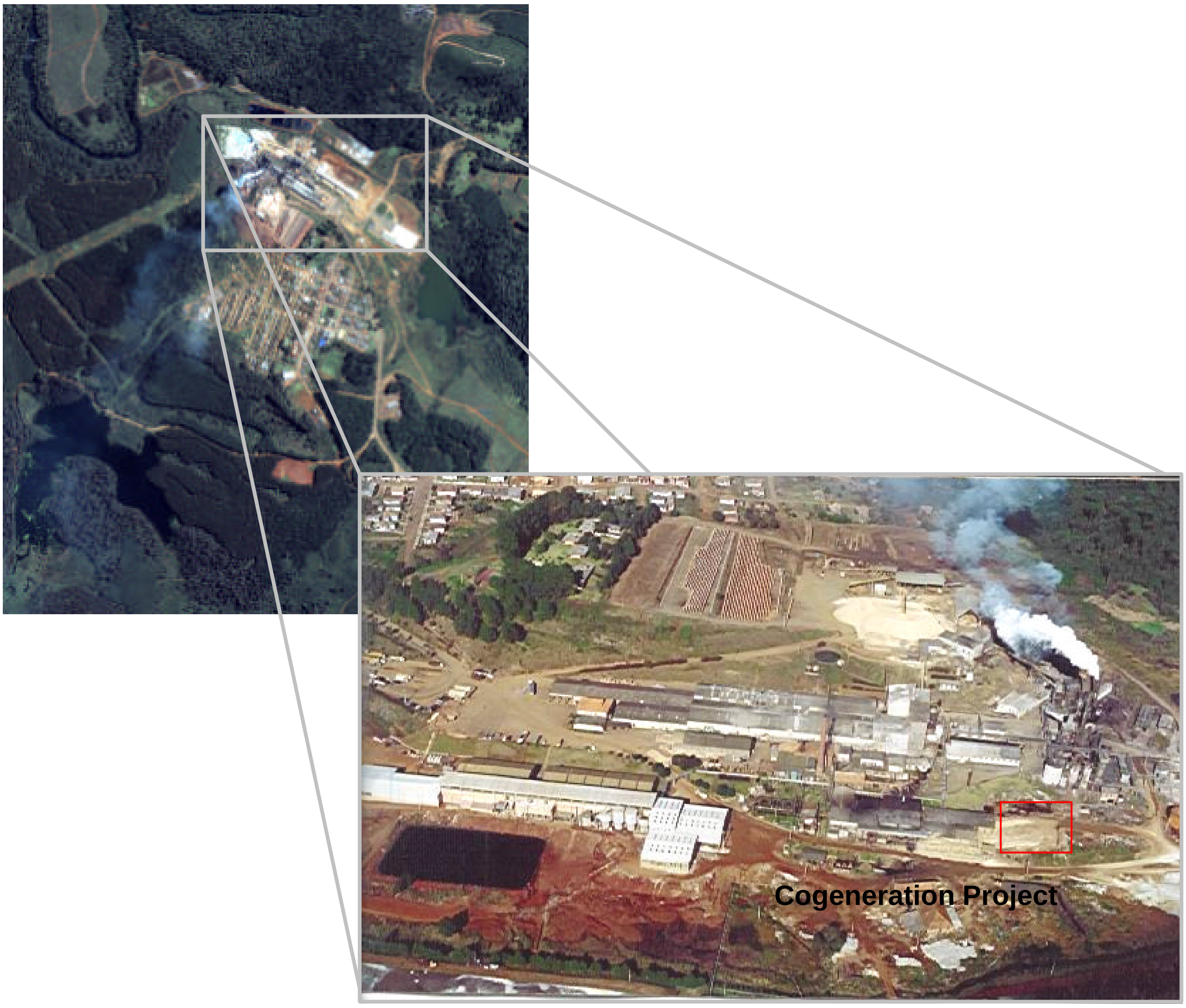

Figure 2: Aerial view of Celulose Irani S.A. Paper Plant. New thermoelectric plant will be located in the same area.

A.4.2. Type and category (ies) and technology of project activity

According to the simplified modalities and procedures for small-scale CDM project activities, the Celulose Irani Small Scale Renewable Energy Project falls under the Type/Category I.D (Renewable Energy Projects / Renewable electricity generation for a grid) in regard to the power generation component; and, under Type/Category III.E in regard to the methane avoidance component (Other project activities / Avoidance of methane production from biomass decay through controlled combustion).

As mentioned above in Section A.2 (description), the objective of the project is to supply the increased demand for energy due to production expansion with a clean alternative to the more fossil-fuel-intensive electricity grid, a new biomass power generation plant will be built, with an installed capacity of 9,43 MW.

The proposed project activity is eligible under Type 1.D of the simplified procedures because it is a biomass generation system with installed capacity under 15 MW that will be supplying "electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel". Technically, electricity generation will be produced by a more efficient energetic conversion equipment, which consists of a high pressure and temperature thermal cycle, a modern boiler with burn system and a high efficiency multiple stages turbine generator.

The methane avoidance component of the project is eligible under Type III.E of the simplified procedures because the project activity of methane avoidance directly emits less than 15,000 tCO_2e annually, and it reduces anthropogenic emissions by sources. In this case, it has been estimated that the project activity emits 7,230 tCO_2e per year, and it reduces anthropogenic emissions by sources in 148,002 tCO_2e.

The generator to be installed is manufactured by Weg Indústrias S.A.[3] It is a SPW 900 Model with an installed capacity of 11 MW (which corresponds to 12,500 kVA), a generator polarity control of 04 (1,800 rpm), and a nominal tension of 13.8 kV and nominal frequency of 60 Hz (National Grid nominal frequency). It presents a refrigeration system with air water switcher. The system also includes a transformer with capacity from 13.8 to 23 kV.

Celulose Irani will also install a "washing gases" system, which will reduce the amount of suspended particulate from effluents when compared with some old energy generators and boilers that will be displaced by the cogeneration plant. This system will work with a water closed circuit, and the residues obtained from the system will be used in their own forest plantations.

The technology and know-how being promoted by this project is environmentally safe and sound, and will further promote such activities in the future. It is worth mentioning that the technology to be used in the generator is 100 % Brazilian.

3 .(http://www.weg.com.br)

A.4.3. Brief statement on how anthropogenic emissions of greenhouse gases (GHGs) by sources are to be reduced by the proposed CDM project activity:

The Irani biomass plant will reduce GHG emissions by displacing fossil-fuel-based electricity generation with GHG-neutral biomass electricity generation. Additionally, the implementation of the biomass plant will involve avoiding 120,000 tonnes of biomass to degrade and generate methane emissions, as this biomass will be used as the fuel of the biomass plant.

In the Baseline Scenario, 44% of the electricity required by Irani comes from CELESC, the grid utility. The remaining 56% comes from electricity generated on-site by the two biomass thermal plants and the two small-scale hydro plants. Table 2 below shows installed capacity of energy generation units in Irani site and Irani's electricity consumption from on-site and off-site sources.

Table 2: Celulose Irani current (baseline) electric energy matrix

Sources	Installed Capacity (MW)	Electricity consumption (MWh)
On-site hydroelectric plants	9.70	52,380
On-site biomass plants	4.80	17,627
Concessionaire CELESC	N/a	55,346
TOTAL	14.50	125,353

Comments:

- During dry period, thermoelectric produces half of installed capacity, due to lack of steam.
- During dry period, Irani purchases 1.2 MW more from CELESC (60 Hz).

The Project Scenario is the construction of a new biomass generation plant, which will displace energy from a more carbon-intensive grid. The electricity production will displace about 33,270 MWh/year of electricity from the grid before production expansion in 2008, and 52,030 MWh/year after 2008. The estimate of total reductions from the electricity generation component is 701,177 tCO_2e over 21 years.

Another source of emission reduction of the project is avoidance of methane emissions from decomposition of wood and biomass in landfills. Brasil has a huge wood industry, with more than

1200 sawmills. Most of industries (87%) are located in south region. As an example, Parana and Santa Catarina states represent almost 80% of all Pinus spp. consumption (Sant'anna et.al [4]).

The Brazilian technologies in sawmills in general are very poor, and less than 50% of wood is transformed in products. The other 50% are wood residues. Given the large number of sawmills in south region the biomass residue generation is concentrated in south region, creating an excess of biomass residues that the market cannot absorb.

A study from Brand et.al.[5] reports the production and use of wood residues of 283 companies in the region. The study concludes that more than 20% of residues are not used or sold resulting in many large biomass piles that a left for decay, generating methane during this process. Nevertheless Brand et.al. study was limited to the region around the municipality of Lages, Santa Catarina state. It took in to account only part industries in the region and excluded the pulp and paper sector. Furthermore the selected region accounts for only 94,400 ha of Pinus plantation.

According to a study from ABIMCI[6] (Associação Brasileira da Indústria de Madeira Processada Mecanicamente), Santa Catarina State has 598 industries in the wood sector, and a total area of Pinus plantation of 317,000 ha.

Given that Pinus is, according to Brand et.al study, an important source of residue generation in the region, we conclude that the study covers 47% of the industry (in number of industrial plants) and 30% of the Pinus planted area.

Taking into account that the study concludes that the covered area generates around 960,000 t/year of unused residues it is reasonable to conclude that the state of Santa Catarina alone produces around 2.2 to 3.0 million t/yr of residues. This amount is more than enough to supply the 120,000 t/year that Irani, and other potential consumers, will need for the project.

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[4] Sant'Anna, Mário; Teddy A. Rayzel; Mário C. M Wanzuita, 2004. Indústria consumidora de Pinus no Brasil. Rev. da Madeira. nº 83 - ano 14 - Agosto de 2004.

[5] Brand, Martha A; Flávio J. Simioni; Débora N. H. Rotta; Luiz Gonzaga Padilha Arruda. Relatorio Final do Projeto " Caeacterizacao da producao e uso dos residuos madeiraveis gerados na industria de base florestal da regiao serrana catarinense, 2001.

[6] "Setor de processamento Mecanico da Madeira no Estado de Santa Catarina", Associação Brasileira da Indústria de Madeira Processada Mecanicamente, 18/02/2004, available at www.abimci.com.br, accessed in 10/12/04.

Note that the estimation above excludes the availability of residues from the nearby states of Rio Grande do Sul and Parana that are also big wood producers (Parana has a Pinus plantation area of 605,000 ha, and Rio Grande do Sul 137,000 ha, see footnote[7]). In any case, all three states also have substantial areas of plantations of other species.

As additional information about biomass availability in Brazil, a presentation form Waldir Ferreira Quirino Eng. Florestal, Ph.D., IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) points to an estimated production of wood and agricultural residues produced and not utilised in Brazil is of 200 million tonnes per year. His study estimates that 50 million tonnes are derived from the sustainable forestry sector (Revista Sul Ambiental, 9, Marçh 2004). This is intimately linked to the wood processing industry, as 75% of wood processed becomes residue (Revista da Madeira 85, Nov 2004). According to Revista da Madeira 80, April 2004), the potential for wood biomass generation in the South Region of Brasil is at least 200 MW.

Under the Project Scenario these residues would not be stockpiled but instead burned in the cogeneration plant. The estimate of total reductions from the methane component is 3,108,052 tCO_2e over 21 years.

Total emission reductions from the electricity and methane components are estimated as 3,809,229 tCO_2e over 21 years, which means an average annual emission reduction of 181,392 tCO_2e.

A.4.4. Public funding of the project activity:

Irani Celulose biomass plant will not receive any public funding from Parties included in Annex-I.

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

The sponsoring company, Celulose Irani, has no other CDM project associated with their activities. According to Appendix C of the simplified modalities and procedures for small-scale

[7] Data available at sbs.org.br, accessed in 10/12/04.

CDM project activities, the Celulose Irani small-scale renewable energy project is not part of a larger emission-reduction project.

B. BASELINE METHODOLOGY

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

The proposed project activity falls under Type/Category 1.D in regard to the electricity component; and, under Type/Category III.E in regard to the methane avoidance component.

B.2. Project category applicable to the project activity:

The calculations of the baseline emissions for the methane emissions avoidance component (Type III.E.) are conducted according to the paragraph 93 of Appendix B of the small-scale modalities and procedures for CDM small-scale project activities. According to the same guidelines, the following two options are offered for preparing the baseline for Type I.D. project activities: “(a) The average of the “approximate operating margin” and the “build margin”; and (b) The weighted average emissions (in kgCO_2/kWh) of the current generation mix. Option A is selected because the Irani project will displace mostly fossil-fuel generating sources since they are at the margin of the electricity generation system. According to the Brazilian Expansion Plan 2003-2012, prepared by the Ministry of Environment, the national plan for Brazil is to increase the share of fossil-fuel plants in the energy mix of the country with the intention to diversify Brazil’s energy supply sources.

Option (a) of paragraph 29 uses a combined margin approach (i.e., the average of the approximate operating margin and the build margin) to estimate the emission reductions from the proposed project activity. The data and assumptions used to apply the methodology are from a study published by IEA (Bosi *et al*.,2002).

B.3. Description of how the anthropogenic GHG emissions by sources are reduced below those that would have occurred in the absence of the proposed CDM project activity (*i.e. explanation of how and why this project is additional and therefore not identical with the baseline scenario*)

The Celulose Irani biomass plant project will result in GHG emissions reductions due to the fact that the project scenario is not the same as the baseline scenario. In the Celulose Irani project, the emission reductions are a consequence of the following:

- Reduce anthropogenic GHG emissions by displacing grid-connected fossil fuel-based electricity generation with GHG-neutral biomass electricity generation;
- Reduce anthropogenic GHG emissions by using biomass that would have been landfilled should the Irani plant were not built.

To determine the baseline scenario two analyses were conducted. First, two possible scenarios were developed. Second, each of those scenarios was evaluated according to the most important barriers facing such outcomes. According to Attachment A to Appendix B of the simplified modalities and procedures for CDM small-scale project activities evidence to why the proposed project is additional is offered under the following categories of barriers: (a) investment barrier, (b) technological barrier, and (c) prevailing practice. The result is a matrix that summarizes the analyses, providing an indication of the barriers faced by each scenario; the most plausible scenario will be the one with the fewest barriers.

As indicated above, two different scenarios were considered:

1. <u>The continuation of current activities</u> – This scenario represents the continuation of current practices, which is the purchase of electricity from the grid to maintain or expand the paper and cellulose production rate.
2. <u>The construction of a biomass plant</u> - This scenario is based on the construction of a new biomass generation plant of 9.43 MW, to reduce electricity purchases, and therefore dependence on the grid.

The barriers were as follows:

- <u>Financial/economical</u> – This barrier evaluates the viability, attractiveness and financial and economic risks associated with each scenario, considering the overall economics of the project and/or economical conditions in the country.
- <u>Technical/technological</u> – This barrier evaluates whether the technology is currently available, if there are indigenous skills to operate it, if the application of the technology is a

regional, national or global standard, and generally if there are technological risks associated with the particular project outcome being evaluated.

- Prevailing business practice – This barrier evaluates whether the project activity represents prevailing business practice in the industry. In other words, this barrier assesses whether in the absence of regulations it is a standard practice in the industry, if there is experience to apply the technology and if there tends to be high-level management priority for such activities.

With respect to **financial/economical** barriers, only the construction of an on-site power plant faces this obstacle. Specifically:

- The continuation of current practices (Scenario 1) does not pose any financial/economical barrier as the structure and practices necessary are already installed, requiring no further financing. Moreover, the company has always purchased electricity from the grid, and has been able to maintain high profits and increases in production.
- The construction of a biomass generation plant (Scenario 2) faces specific financial/economic barriers due to the fact that technical/technological innovations carry with them further risk premiums in terms of financing. The capital costs involved in the project pose a barrier, especially considering the high interest rates prevalent in Brazil. It is worth noting that there are no direct subsides or promotional support for the implementation of independent renewable energy plants. Although the PROINFA Brazilian Government Programme promotes renewables (e.g., biomass, wind, and small hydro units), it works by providing guaranteed prices that are higher than the market price for electricity for the next 20 years. However, this scenario does not intend to sell energy to the grid and thus does not fit into PROINFA's scope.

The financial/economical barrier to the project activity is demonstrated through a cash flow financial analysis. Comparing the project results with and without carbon, it is clearly demonstrated that the project would not occur without carbon revenues (see table 3 below). The investment analysis considers all savings and expenses associated to the project such as the revenues from costs reduction with electricity and fuel purchases and the costs associated to the installation and operation of new plant. Values used in the financial analysis are presented in the Annex 5. The carbon revenues increase the returns of the project to an acceptable level compared to other investments in Brasil.

Financial Results (10 years)

	with carbon	without carbon
Net Present Value (NPV)	**1,802,322**	**-323,539**
Internal Rate of Return (IRR)	**23.67%**	9.95%

Table 3: Financial Results for project scenario.

With respect to the **technical/technological** barrier, this element does not pose any difficulties to any of the scenarios. Specifically:

- In the case of Scenario 1 (continuation), there are no technical/technological issues as this simply represents a continuation of current practices and does not involve any new technology or innovation. Indeed, in this scenario there are no technical/technological implications as the scenario calls for continued purchases of electricity from the grid.
- In the case of Scenario 2, constructing a renewable energy generation plant, there are no significant technical/technological barriers. All the technologies involved in this scenario are available in the market, and have been used effectively around Brazil. As a result, this technology option faces few barriers to implementation.

With respect to the barrier related to the **prevailing business practice**, the construction of on-site plants face obstacles. Specifically:

- Continuing purchases of electricity from the grid (Scenario 1) presents no particular obstacles. This practice has been used effectively in the past with good results, and the continued operation of existing facilities and actual practices presents no real barriers. Moreover, in this scenario the company can focus on its core business, the production of paper.
- The construction of an on-site biomass plant (Scenario 2) represents a deviation from the company's core business. Even with large increases in demand, new plants are generally not planned as they imply significant changes and adaptations in the production process and in the employees' activities (e.g., safety measures). As a result, such changes require high management capacity and have high economic costs. Finally, the outsourcing of some activities (e.g., energy production) is a market trend because it tends to simplify operations at the facility. To conclude, the construction of an on-site generating facility is not consistent with prevailing business practice.

Table 3 below summarises the results of the analysis regarding the barriers faced by each of the plausible scenarios. As the table indicates, Scenario 1 faces no barriers, whereas Scenario 2 faces two important barriers – the financial/economic and the prevailing business practice barriers.

Table 3: Summary of Barriers Analysis

Barrier Evaluated		Scenario 1	Scenario 2
		Continuation of current activities	Construction of a biomass plant
1.	Financial / Economical	No	Yes
2.	Technical / Technological	No	No
3.	Prevailing Business Practice	No	Yes

To conclude, the barrier analysis above has clearly shown that the most plausible scenario is the continuation of current practices (continuation of purchases of electricity from the grid). Therefore, the project scenario is not the same as the baseline scenario, and each of these is defined as follows:

- The **Baseline Scenario** is represented by the continued purchasing of electricity from the grid to maintain paper production. In this Baseline Scenario Celulose Irani purchases approximately 55,346 MWh/year (until 2008) and 74,110 MWh/year (from 2008) from CELESC. All other biomass and hydro plants will continue working normally. Also, in the baseline scenario 120,000 tonnes of biomass would have been landfilled.

- The **Project Scenario** is represented by the construction of an on-site biomass plant with an installed capacity of 9.43 MW. All other biomass and hydro plants will operate as in the baseline. The new plant will displace electricity imported from a more carbon-intensive grid, and it will avoid methane emissions from degradation of biomass in a landfill, thus resulting in significant GHG emission reductions.

It is important to note that the project approach is conservative, because most of coal thermal plants of the country are located in the southern region of Brazil. Therefore it could be assumed that a biomass plant such as the one proposed would probably be displacing electricity from a coal-based generation plant, however, the project scenario considers the average fuel mix of the grid.

Considering these facts, non-emitting sources of electricity as the biomass renewable energy project activity as Celulose Irani, is not an electricity market trend. The Project Scenario is environmentally additional in comparison to the baseline scenario, and therefore eligible under the CDM to secure Certified Emissions Reductions (CERs).

With the construction of a biomass plant, supported by the CDM, 1,017,673 MWh of electricity will be displaced from the grid, therefore potentially reducing 700,159 tonnes of CO_2e emission over a 21-year timeframe. Additionally, 120,000 tonnes of biomass to be used as the fuel for the proposed plant will result in 3,108,052 tonnes of CO_2e emission reduction over 21 years. The total emission reductions are 3,809,229 tCO_2e over 21 years.

B.4. Description of the project boundary for the project activity:

For the purpose of this analysis, and according to paragraph 26 and 92 of the simplified modalities and procedures for small-scale projects (Appendix B) the project activity boundary encompasses the physical, geographical site of the renewable generation source (p.26) and where the treatment of biomass takes place (p.92). For the Irani project this includes emissions from activities that occur at the project location.

The boundary for the baseline of the electricity generation component, however, is defined as the grid level and for the project this only relates to the interconnected grid from which the plant currently draws its electricity. The project boundary for the baseline will include all the direct emissions related to the electricity produced by the power plants that will be displaced by this project.

Conforming to the guidelines and rules for the small-scale project activities, the emissions related to production, transport and distribution of the fuel used in the power plants in the baseline are not included in the project boundary, as these do not occur at the physical and geographical site of the project. For the same reason the emissions related to the transport and distribution of electricity are also excluded from the project boundary.

B.5. Details of baseline and its development:

B.5.1 Specify the baseline for the proposed project activity using a methodology specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities:

The baseline to be used in calculating the emission reductions from this project is that outlined in the relevant paragraphs of Appendix B (simplified modalities and procedures for small-scale CDM project activities). These are option (a) of paragraph 29 for the grid electricity component, and paragraph 93 for the methane emissions avoidance component.

B.5.2 Date of completing the final draft of this baseline section:

08/07/2004

B.5.3 Name of person/entity determining the baseline:

The entity determining the baseline and participating in the project as the CO_2 Advisor is EcoSecurities Ltd.. The individuals at EcoSecurities that prepared the baseline are Pablo Fernandez de Mello e Souza and Flávia Resende.

C. DURATION OF THE PROJECT ACTIVITY / CREDITING PERIOD

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity (DD/MM/YYYY):

01/01/2005

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

Over 30y-0m

C.2 Choice of the crediting period and related information: *(Please underline the selected option (C.2.1. or C.2.2.) and provide the necessary information for that option.)*

C.2.1. Renewable crediting period (at most seven 7 years per period)

C.2.1.1. Starting date of the first crediting period (DD/MM/YYYY):

01/01/2005

C.2.1.2. Length of the first crediting period:

7y – 0m

C.2.2. Fixed crediting period (at most ten (10) years)

C.2.2.1. Starting date (DD/MM/YYYY):

C.2.2.2. Length (max 10 years):

D. MONITORING METHODOLOGY AND PLAN

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

The Celulose Irani Small Scale Renewable Energy Project is being submitted as a small-scale project. As described in paragraph 31 of the Simplified Procedures for SSC projects for Type I.D. Projects, the monitoring will consist of metering the electricity generated by the renewable technology. The proposed project activity also has a methane emissions avoidance component, which falls under Type III.E of the abovementioned guidelines for SSC projects in its revision of June 12th, 2004. According to this document, the monitoring of Type III.E is specified in paragraphs 95 and 96, which states that the amount of biomass and/or other organic matter combusted by the project activity in a year; and, the total annual project activity related emissions will be monitored.

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

The methodologies were selected as suggested by the Simplified Monitoring Methodologies for small-scale CDM projects. For Type I.D. projects, measuring and recording the amount of electricity generated is the most accurate method of monitoring the project. For Type III.E. projects, monitoring the amount of biomass combusted by the project activity and the related direct emissions are the most accurate method.

D.3. Data to be monitored:

Table 4: Data to be collected in order to monitor emissions from the project activity, and how this data will be archived

ID n°	Data type	Data variable	Data unit	Measured (m), calculated (c) indicated (I)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
D.3.1	Electricity	Electricity imported from grid by Celulose Irani	MWh	M	Monthly	100%	Electronic and paper	During the whole crediting period + 2 years	This item will be monitored by meters and through the electricity bill by the distribution company
D.3.2		Gross electricity produced by new cogeneration plant							Monitored by meters and backup meters
D.3.3		Net electricity produced by new cogeneration Plant							Monitored by meters and backup meters
D.3.4	Fuel	Amount of Biomass generated by Irani	tonne/ month	M	Monthly	100%	Electronic and paper	During the whole crediting period + 2 years	
D.3.5		Amount of Biomass obtained from third parties	tonne/ month	M	Monthly				
D.3.6		Total annual project activity (methane component) related emissions	tCO_2e/yr	C	Yearly				

D.3.7		Identification of third party suppliers of biomass actually used	N/A	M	Monthly				

This monitoring plan contains simplified monitoring requirements to reduce monitoring costs as permitted by small-scale project procedures. Once implemented, the relevant data report will be submitted to a designated operational entity contracted to verify the emission reductions achieved during the crediting period. Any revisions requiring improved accuracy and/or completeness of information will be justified and will be submitted to a designated operational entity for validation. The plan is designed to collect and archive all data needed to:

- Estimate or measure anthropogenic emissions by sources of greenhouse gases occurring within the project boundary during the crediting period as specified in appendix B for the Type/Categories I.D. and III.E.;
- Determine the baseline of anthropogenic emissions by sources of greenhouse gases occurring within the project boundary during the crediting period, as specified in appendix B for the Type/Category I.D. and III.E.;
- Calculate the reductions of anthropogenic emissions by sources by the proposed small-scale CDM project activity, and for leakage effects, in accordance with provisions of appendix B for the Type/Category I.D. and III.E.

The plan does not include monitoring of any variable regarding leakage since no leakage is expected. Nevertheless, in the case of evidence of any leakage, this plan will be revised in order to include a suitable variable.

With regards to quality control, the Celulose Irani has been awarded a series of internationally recognized certifications, including ISO 9001-2000. Celulose Irani will use these systems to ensure that data collected for the project are subject to the most rigid quality control systems.

D.4. Name of person/entity determining the monitoring methodology:

This Project Design Document was prepared by Pablo Fernandez de Mello e Souza and Flávia Resende, EcoSecurities Ltd. EcoSecurities Ltd. is the entity determining the monitoring plan and participating in the project as the CO_2 Advisor.

E. CALCULATION OF GHG EMISSIONS BY SOURCES

E.1 Formulae used:

E.1.1 Selected formulae as provided in appendix B:

No formula is provided for the baseline for Project Category I.D., paragraph 29 a. According to the simplified methodology for type III.E small-scale emission reduction projects, the baseline emissions are calculated using the following formulae:

$$CH_4\_IPCC_{decay} = (MCF * DOC * DOCF * F * 16/12)$$

where,

$CH_4\_IPCC_{decay}$ = IPCC CH_4 emission factor for decaying biomass in the region of project activity (tonnes of CH_4/tonne of biomass or organic waste)
MCF = methane correction factor (fraction) (default is 0.4)
DOC = degradable organic carbon (fraction, see equation below or default is 0.3)
DOCF = 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

$$BE_y = Q_{biomass} * CH4\_IPCC_{deca}y * GWP\_CH_4$$

where,

BE_y = Baseline methane emissions from biomass decay (tonnes of CO_2 equivalent)
$Q_{biomass}$ = Quantity of biomass treated under the project activity (tonnes)
CH_4_GWP = GWP for CH_4 (tonnes of CO_2 equivalent/tonne of CH_4)

According to the same guidelines for type III.E small-scale emission reduction projects, the project emissions are calculated using the following formula:

$$PE_y = Q_{biomass} * E_{biomass} (CH_4bio\_comb * CH_4\_GWP + N_2Obio\_comb * N_2O\_GWP)/10^6$$

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_4bio_comb = CH_4 emission factor for biomass and waste (which includes dung and agricultural, municipal and industrial wastes) combustion (kg of CH_4/TJ, default value is 300)

CH_4_GWP = GWP for CH_4 (tonnes of CO_2 equivalent/tonne of CH_4)

N_2Obio_comb = N_2O emission factor for biomass and waste (which includes dung and agricultural, municipal and industrial wastes) combustion (kg/TJ, default value is 4)

N_2O_GWP = GWP for N_2O (tonnes of CO_2 equivalent/tonne of N_2O)

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

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: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

No formula is used to calculate the project emissions of the electricity generation component of the proposed project activity. In this case, emissions by sources are zero since biomass generation is a GHG-neutral source of energy.

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 *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

For the electricity component, calculation of leakage is not applicable as the renewable energy technology used is not equipment transferred from another activity. Therefore, as per the Simplified Procedures for SSC Project Activities no leakage calculation is required. Also, calculation of leakage for the methane component is not required, as per the abovementioned guidelines.

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

Zero emissions for the electricity generation component. As for the methane component, project emissions are calculated using the formula described in E.1.1. The project emissions for the methane avoided component results in 7,230 tCO_2e per year.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHG's 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: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

The methodology used for the calculation of baseline emissions from the use of grid electricity follows paragraph 29.a of the simplified modalities for small-scale projects, which uses the Combined Margin (CM) approach.

The formula used to measure the emissions reductions is:

$$ER_{net} = (E_b * C_b) - (E_p * C_p) - (E_t * C_t) \quad (1)$$

Where:

E_b: Energy *required* from grid in *baseline* activity case
C_b: Carbon intensity of energy from grid in *baseline* case
E_p: Energy *required* from grid in *project* activity case
C_p: Carbon intensity of energy from grid in *project* activity case
E_t: Energy *produced* in *project* activity case
C_t: Carbon intensity of energy in *project* activity case

Once the baseline case has been defined, accounting for the GHG reductions for the renewable fuel based electricity energy project activity is relatively simple. Net emission savings (ER_{net}) are calculated by the amount of energy displaced from the grid.

The amount of energy displaced from the grid is calculated as the difference between the energy required in the baseline activity case minus the energy required in the project case, considering that this difference was caused by the additional energy supplied by the project activity.

The formula used to define the baseline emissions is established by determining the annual kWh for the project and multiplying this by the combined margin rate of the grid:

$$Emissions_{b} = E_b * C_b \qquad (2)$$

Where:

$Emissions_b$: Baseline emissions

E_b: Energy required from grid in *baseline* activity case

C_b: Carbon intensity of energy from grid in *baseline* case

For estimating the baseline carbon intensity, the project developer decided to use the combined margin carbon intensity for sub-national Brazilian grid, as this data is available and is provided by a reliable and credible source for calculating the emission reductions (ER_{net}) achieved by the project.

The anthropogenic emissions by sources of GHGs of the project activity ($Emissions_p$) was estimated by multiplying the energy produced in the project case and the carbon intensity of energy in project case, as follow:

$$Emissions_p = (E_g * C_g) + (E_p * C_p) \qquad (3)$$

Where:

$Emissions_p$: GHGs Emissions from anthropogenic sources

E_g: Energy required from *grid* during project activity (MWh)

C_g: Carbon intensity of the *grid* energy (tCO_2 / MWh)

E_p: Project Energy production (MWh)

C_p: Carbon intensity of the *project* energy produced (tCO_2 / MWh)

The energy required from grid in the project scenario was estimated by the following formula:

$$E_p = (E_b + E_w) \qquad (4)$$

Where:

E_p: Energy required from grid in project activity case

E_b: Energy required from grid in baseline activity case

E_w: Energy required to maintain the generation plant

The energy required to maintain the thermoelectric (E_w) was estimated to be 1.4 MW. Thus, if the new renewable plant operates 90% of the time, which corresponds to 328 days/year, it would generate 11,037 MWh/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 for the electricity component of the proposed project is calculated using formula 1 above. The expected annual emission reduction from the grid-electricity displacement component is 22,924 tCO_2e prior production expansion in 2008 and 35,852 tCO_2e onwards.

The emission reductions for the methane avoidance component of the proposed project activity is estimated as 148,002 tCO_2e using the formulae described in section E.1.1.

E.2. Tables providing values obtained when applying formulae above:

Table 5. Values used to calculate the GHG emissions reductions from grid electricity displacement

			Formula	unit	October 2004 - October 2007	October 2007 - October 2014 Crediting Period I	October 2014 - October 2021 Crediting Period II and III
Data from Celulose Irani's Cogeneration Plant							
	D.	Days of operation per year**	=365*0,9	days/year	328,5	328,5	328,5
	E.	Hours of operation per year***	=D * 24	hours/year	7.884	7.884	7.884
	F.	Installed capacity**		MW	9,43	9,43	9,43
	G.	Expected maximum energy production**	=F * E	MWh/year	74.346	74.346	74.346
	H.	Energy necessary to maintain the thermoelectric plant **	=1.4 * G	MWh/year	11.038	11.038	11.038
	I.	Maximum Net amount of energy produced by Thermoelectric ***	=G - H	MWh/year	63.309	63.309	63.309
Data from South-South-eastern electricity grid							
	A.	Operating margin (OM) *		tCO2/MWh	0,957	0,957	0,957
	B.	Building margin (BM) *		tCO2/MWh	0,421	0,421	0,421
	C.	Combined margin (CM) *	=(A+B)/2	tCO2/MWh	0,689	0,689	0,689
Baseline Data							
	J.	Total energy consumption**		MWh/year	125.353	144.117	144.117
	K.	Amount of energy imported from grid **		MWh/year	55.346	74.110	74.110
Project Data							
	L.	Total energy consumption **		MWh/year	136.391	155.155	155.155
	M.	Amount of energy imported from grid **		MWh/year	22.075	22.075	22.075
	N.	Maximum energy produced by project **	=G	MWh/year	74.346	74.346	74.346
	O.	Energy displaced from grid ***	=K - M (max= I)	MWh/year	33.271	52.035	52.035
Total Emission							
	P.	Energy displaced from the grid ***	=O * n°of years	MWh/period	133.083	156.104	728.486
	Q.	Total expected GHG emission reduction ***	= O * (C)	tCO2/year	22,924	35,852	35,852
	R.	Total expected GHG emission reduction ***	= P * (C)	tCO2/period	91,394	107,556	501,928
						TOTAL	701,177

Sources:
* Bosi et al, 2002.
** Data from Irani team
*** Estimated data.
**** Project start date is September 1st, 2004. Emission reductions only account for 4 months in the year.

Table 6. Values used to calculate the GHG emissions from avoided methane production

Fuel Type	Type	Percentage	Mass (T)	CV (TJ/Tonne)	Energy Contribution
Sawdust with bark	Biomass	50,0%	60.000	7,0820E-03	4,2492E+02
Ships with bark					

Biomass	50,0%	60.000	8,8442E-03	5,3065E+02
	Total Biomass =	**120,000 tonnes**	**Total =**	**9,5557E+02**

SSC Avoided Methane

Baseline Emissions

CH_4 IPPC (decay)	=	MCF x DOC x DOCf x F x (16/12)	
	=	**0.0616**	
Where:			
MCF	=	0.4	default
DOC	=	0.3	default
	=	0.3	Project Specific (100% of waste is wood or straw)
DOC used	=	0.3	Actual
DOCf	=	0.77	default
F	=	0.5	default
GWP CH_4	=	21	
GWP N_20	=	310	
Percentage of CH_4 needing to be removed as a result of legislation	=	0.00%	
Baseline Emissions	=	Q biomass x CH_4 IPCC (decay) x GWP CH_4	
	=	**155,232**	Tonnes CO_2e
Project Emissions			
CH_4 bio comb	=	300	default (kg CH_4 TJ energy)
N_2O bio comb	=	4	default (kg N_2O TJ energy)
Project Emissions (T CO_2e)	=	Q biomass x E biomass x (CH_4 bio comb x CH_4 GWP) + (N_2O bio comb x N_2O GWP) / 1e+3	
	=	**7,230**	Tonnes CO_2e
Emission Reductions	=	**148,002**	Tonnes CO_2e/year

F. ENVIRONMENTAL IMPACTS

F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

In the Brazilian environmental license system, the proponent of a new achievement must present the project to the state or federal environmental agency, to provide a preliminary environmental license, known as LAP (Licença Ambiental Prévia). In this license the environmental agency may request, as a condition to provide the installation and operation environmental licenses, an environmental impact assessment for projects with the potential for significant environmental impacts.

The Celulose Irani Biomass generation plant's license requisition is being conducted by Fundação do Meio Ambiente do Estado de Santa Catarina (FATMA/SC), the environmental agency of Santa Catarina State. Through the licensing process, Celulose Irani obtained its Preliminary Environmental License Nº 0709/2003, referent to the activity thermoelectric/cogeneration of electric energy coded 34.11.00, dated on December 16, 2003. Among the Preliminary Environmental License conditions, only some additional technical information and compensatory/mitigation procedures were requested and no environmental impact assessment was required. It indicates that the potential impacts of Celulose Irani Biomass plant project are insignificant. Irani already has the Installation Environmental License (Licença Ambiental de Instalação). The Operation Environmental License (Licença Ambiental de Operação) can only be requested after construction is complete and before the project becomes operational.

The biomass electricity generation plant component of the project will not result in significant environmental problems. Instead, the project will improve the local environmental condition, due to the adequate treatment of effluents and other residues of the processes. Celulose Irani will install a "washing gases" system, which will reduce the amount of suspended particulate from effluents when compared with the old energy generators and boilers that will be displaced by the new plant. This system will work with a water closed circuit, and the residues obtained from the system will be used in the forest plantations as fertilizers and to produce activated coal. Moreover, the new system to be installed is more efficient than the old ones, so it uses fewer raw materials to produce the same amount of heat, steam and electricity.

The methane avoidance component of the project is not likely to result in any negative environmental impacts.

Regarding out-of-boundary impacts, the Celulose Irani project activity will not affect the expansion of forests and plantations to produce raw material, as all the raw materials are residues from cellulose and furniture production processes.

Furthermore, there is no need for agricultural area expansion or logging trees to construct a transmission line, or other grid connections related impacts, since the biomass plant will be constructed inside the Campina da Alegria integrated mill, and all the electricity is for own consumption.

G. STAKEHOLDERS COMMENTS

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

According to the Resolution #1 dated on December 2nd, 2003, from the Inter-Ministerial Commission of Climate Change (Comissão Interministerial de Mudança Global do Clima - CIMGC), decreed on July 7th, 1999[8], any CDM projects must send a letter with description of the project and an invitation for comments by local stakeholders. In this case, letters were sent to the following local stakeholders:

- City Hall of Vargem Bonita;
- Chamber of Alderman of Vargem Bonita;
- Environment agencies from the State and Local Authority;
- Brazilian Forum of NGOs;
- District Attorney (known in Portuguese as Ministério Público, i.e. the permanent institution essential for legal functions responsible for defending the legal order, democracy and social/individual interests) and;
- Local communities associations.

Local stakeholders were invited to raise their concerns and provide comments on the project activity for 30 days after they received the letter of invitation. EcoSecurities and Celulose Irani were prepared to answer any doubts about the project during this period. Letters were dispatched by fax or email to the institution mentioned above.

G.2. Summary of the comments received:

Three comments were received, and all of them were supportive of the project.

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

As all comments were supportive of the project, no modifications of the project design will need to be made related to the comments received.

8 Source: http://www.mct.gov.br/clima/comunic/pdf/Resolução01p.pdf

ANNEX 1: CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project sponsor:

Organization:	Celulose Irani S.A.
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Mobile:	
Direct FAX:	
Direct tel:	
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ANNEX 2: INFORMATION REGARDING PUBLIC FUNDING

Celulose Irani will not receive any ODA for the development of this project.

ANNEX 3: REFERENCES

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ANNEX 5. VALUES USED IN FINANCIAL ANALYSIS

Financial Parameters	
Tariff (Rs$/MWh)	136,0
Tariff (Us$/MWh)	45,33
Net price of carbon (U$/tCO2)	6,00
Rs$/US$	3,00
Additional Power Plant O&M - fixed costs (US$/year)	10.000
Power Plant O&M - variable costs (US$/MWh)	3,24
Additional Fuel Costs (US$/year)	(192.972)
9,43 MW Boiler + Engine (US$)*	7.506.835
Import Duties*	0%
PDD Elaboration	30.000
Validation Costs	20.000
Verification Costs	8.000
Discount rate	12%
Taxes on Carbon Sales	13,25%
Income Tax	34%

* National Technology

Table 4: Financial Parameters used in financial analysis