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

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Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

6.0 MW Biomass based cogeneration power plant of Rama Paper Mills Limited, Kiratpur, Uttar Pradesh.

Version 5.0, dated 10/10/2007

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

Rama Paper Mills Limited (RPML) are into paper manufacturing and at present the company has three (3) units involved in manufacturing of papers, like packaging, printing and writing grades and News print. Unit I and II are installed with production capacity of 10,500 TPA each and unit III is installed with a production capacity of 23,000 TPA, thereby totalling to 44,000 TPA. RPML proposes to install a 6 MW cogeneration facility to meet the thermal and electrical requirements of the company. The power generated is for captive use and is not being sold to the grid. Since this project activity utilizes a renewable energy source, it positively contributes towards the reduction in GHG emissions.

Existing Scenario

Power

Presently, the company is meeting its power demand from Uttar Pradesh State Electricity Board (UPSEB) supply at 33kV. Further, two DG sets each of 750kVA capacity are used as a standby source of power. A 320kVA DG set caters to lighting and boiler power requirement during the UPSEB outage.

Steam Generation

The total process steam requirement is being met by existing three nos. of low pressure boilers of 10 TPH, 6 TPH and 15 TPH, which are fed with rice husk and bagasse. Generally the 15 TPH boiler is used with Bagasse & Rice Husk for meeting the present requirement of all units. Other boilers are used only as & when required.

Project Scenario

The project activity, which is a 'carbon neutral fuel' based cogeneration plant, generates electricity in addition to steam to meet captive electricity requirement thereby displacing an equivalent amount of electricity the plant would have generated through fossil fuels. In case of failure of the power plant, power from the UPSEB grid would be used as a standby source of power. The existing diesel generator sets could also be used as per the requirement.

The total process steam requirement of all the three units is about 18 TPH at 4.5 ata. It is proposed to shut down the present low-pressure boilers and supply low-pressure steam from the proposed Co-generation plant to all the pressure 4.5 ata. Taking into account the future expansion/balancing plans of the company, the proposed turbine will have facilities to extract about 22.5 TPH steam at 5.0 ata. The extraction steam will cater the steam requirement of paper machines of Units I, II

& III, digesters and the steam requirement of the boiler de-aerator. The balance steam of about 14.4 TPH will be fed to the condenser for generating the required power & then the same will be recirculated to the boiler.

The total electrical load demand of the plant at present is about 4.5 MW. Taking into consideration the peak load and starting torque requirements, the maximum plant load demand is considered as 5 MW. The auxiliary power requirement of the co-generation plant will be about 0.6 MW. Power generated at 11kV is proposed to be stepped up to 33kV and hooked to existing 33kV distributions system at S/S.

Availability of biomass

It is intended to use Rice Husk & Bagasse as main fuels in the boiler, which are easily available in the surrounding area and also being presently used in the plant. In addition, wood chips are also envisaged as alternative fuel, especially when bagasse is not available.

RPML has carried out survey & initiated action to mobilize additional biomass fuels required to generate steam in the high capacity & high-pressure boiler to generate the rated power. Sufficient fuel stocking and handling space is available to maintain adequate stocks of fuels for uninterrupted operation of the power plant. The total requirement of biomass is estimated to be 85,000 MT/annum at 100% capacity utilisation for the project activity. The fuel consumption of Rice Husk at 100% firing is estimated to be about 10.5 TPH and similarly the consumption of Rice husk & wood chips at 70% & 30% firing respectively is estimated at 10.0 TPH.

Project activity's contribution to sustainable development

Government of India has stipulated social, economic, environmental and technological well-being as indicators for sustainable development in the interim approval guidelines[1] for CDM projects. RPML believes that the project activity has beneficial effect on agriculture, rural industries and employment in the region and has the potential to shape the economic, environmental and social life of the people in the region, specially unemployed educated/uneducated youth with meagre resources.

Social well being:

- Since, the biomass resources are to be collected and transported to the plant site from the fields, employment opportunities are being generated for uneducated people.
- Preference was given to employment of local people during operation of project site thereby creating opportunities in the area for skilled and unskilled labour.

Economical well being:

- The project activity helped to create business opportunity for local stakeholders such as suppliers, manufacturers, contractors *etc*.
- Crop residues are collected from the farmers and brought to the project site, which otherwise would have remained under-utilized or just burnt. In other words, the project activity is generating commercial value for crop residues enabling the farmers to get better price out of their produce augmenting their income substantially thereby creating a positive impact on purchasing capacity of the individuals.
- Project activity has helped to reduce the demand-supply gap in the power deficit state grid.

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[1] Ministry of Environment and Forest web site: http://envfor.nic.in: 80/divisions/ccd/cdm_iac.html

Environmental well being

- Since, the project activity uses only biomass (carbon neutral fuel) for electricity generation it would eliminate an equivalent carbon dioxide which would have been otherwise generated to produce electricity.
- This electricity generation from the project activity would substitute the power generation by thermal power plants, which supply electricity to the state grid. It would contribute towards the reduction in (demand) use of finite natural resource like coal, natural gas etc. minimizing depletion or else increasing availability to other important processes.

Technological well being

- The technology selected for the power plant is a modern and energy efficient one using a steam turbo generator with matching boiler capable of firing multiple fuels.

In view of the above arguments, RPML considers that the project activity contributes to the sustainable development.

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)
India (Host)	Rama Paper Mills Limited	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):

India

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

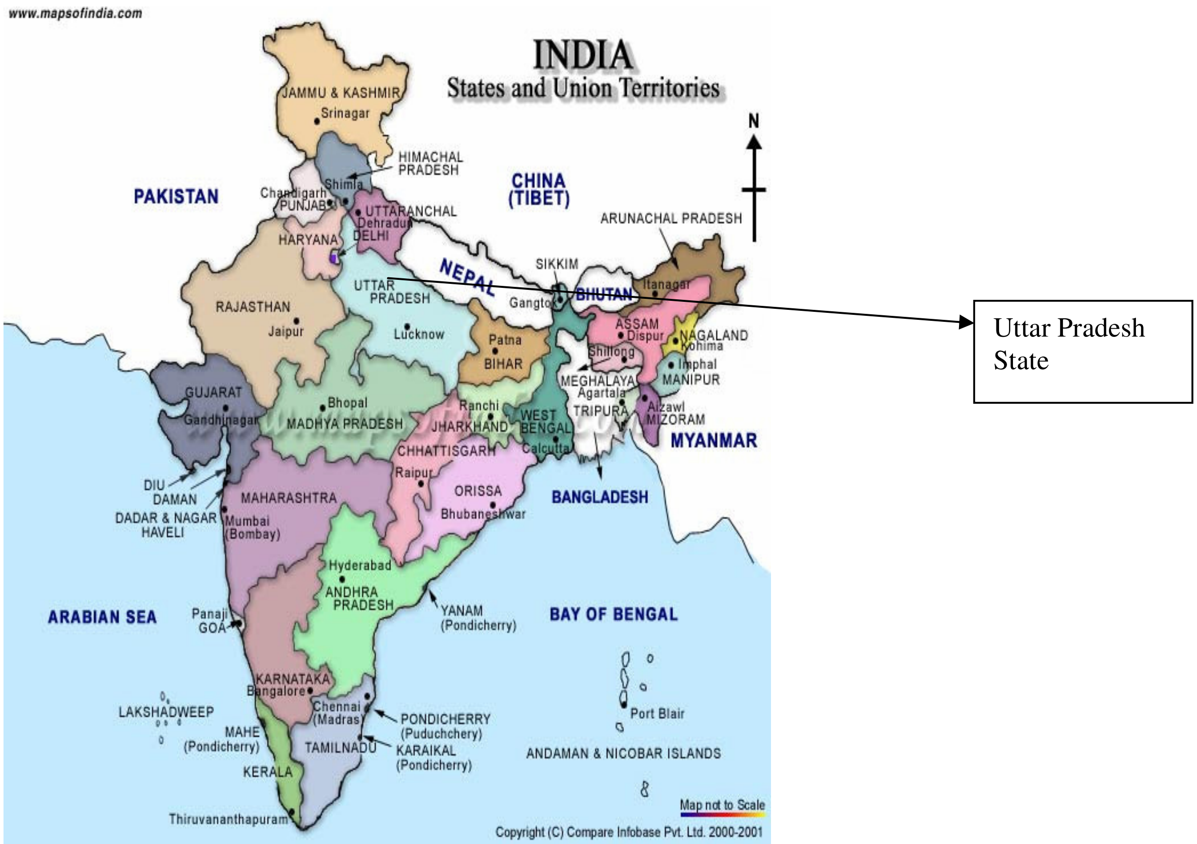
Uttar Pradesh

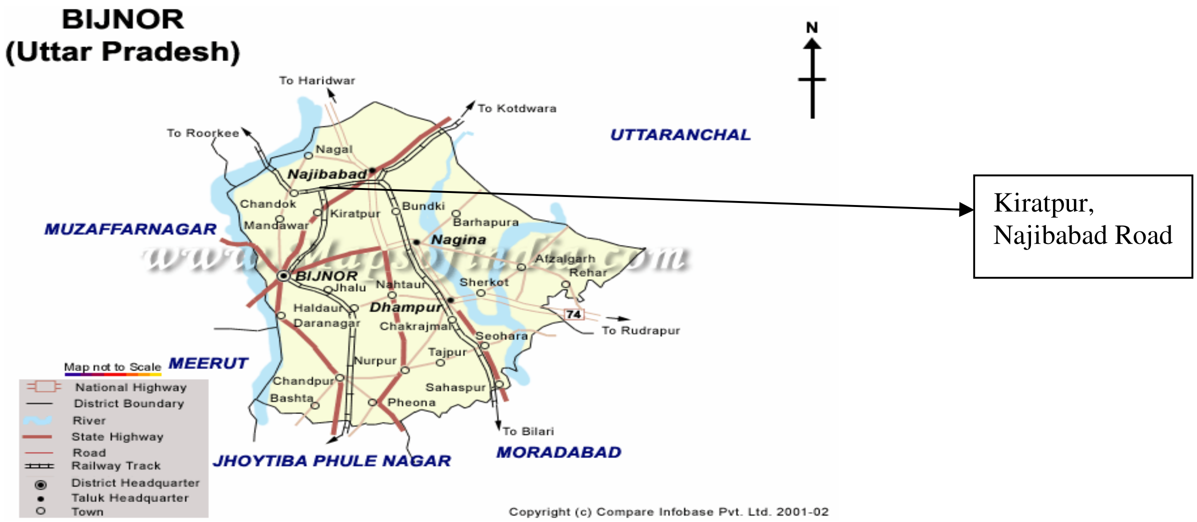
A.4.1.3. City/Town/Community etc:

Kiratpur, District Bijnor, Uttar Pradesh

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

The project activity is located in Khasra No. 4013, 4009, 1151, 1152, 1153 in Kiratpur of Najibabad Road, Kiratpur, District Bijnor, Uttar Pradesh. The geographical location of Fatehgarh Sahib is detailed in the maps below.





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

Type I: Renewable Energy Projects
Category-D: Grid Connected Renewable electricity generation

The project activity is a biomass-based cogeneration power plant. The installed/rated capacity of the turbine is 6 MW, which is less than the limit of 15 MW and the total heat rating capacity of the boiler is also less than 45 $MW_{thermal}$. Hence the renewable energy project activity qualifies under Type I project activities. The calculations for the same are given hereunder:

Boiler Capacity: 38 TPH=10.55 kg/s

Energy of Steam: 3300 kJ/kg (at 67 ata and 495 ^{0}C temperature)=3.3 MJ/kg

Energy of Water at 110^{0}C: 418 kJ/kg=0.418 MJ/kg

Boiler Rating: 10.55*(3.3-0.418) = 30.40 $MW_{thermal}$

As per the provisions of Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities, (Version 10, 23rd December 2006) Type ID "comprises renewable, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and biomass, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit".

Project activity comprises biomass-based cogeneration power plant displacing electricity from the Uttar Pradesh state grid. With above considerations, the Type I.D. is the most appropriate category for the project under discussion. The project activity does not comprise any electricity generation from non-renewable energy sources.

Technology of project activity

The project activity is a 6.0 MW (gross) capacity grid-connected biomass based cogeneration power plant with high-pressure steam turbine configuration.

The power plant has boiler sized to produce a maximum of 38 TPH of steam and 6.0 MW steam turbine, which is a condensing type machine. The steam conditions at the boiler heat outlet are a pressure of 67 ata. and temperature of 495 ± 5^0C. All the necessary auxiliary facilities for the power plant have been provided for the power plant. The plant and equipment facilities have been designed to comply with the applicable stipulations / guidelines of statutory authorities such as State Pollution Control Board etc.

Boiler Details

Type of Boiler	:	Fluidized Bed Combustion
Generation Capacity at MCR	:	38 TPH
Superheater Outlet Pressure	:	67 ata
Superheater Outlet Temperature :		495±5°C
Feed Water Temperature	:	120°C
No. of Feed pumps	:	2 (1 working + 1 stand by)
Type of Feed pumps	:	Multistage, Centrifugal

Turbine Details

Type	:	Extraction cum Condensing
Inlet Steam Flow	:	36.9 TPH
Inlet Steam Temperature :		64 ata
Extraction flow	:	22.5 TPH
Extraction pressure	:	5.0 ata
Exhaust flow	:	14.4TPH
Exhaust pressure	:	0.10 ata
Generator Rating 3Phase, 0.8 PF, 50Hz	:	6 MW, 11kV ±10%,

There is no transfer of technology to the host country since the technology is available in India from reputed manufacturers.

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 activity leads to GHG on-site emissions in the form CO_2 from combustion of biomass, which will be consumed by plant species, representing a cyclic process of carbon sequestration. Since, the biomass contains only negligible quantities of other elements like Nitrogen, Sulphur *etc*. release of other

GHGs are considered as negligible. Hence energy generation from project activity does not lead to any GHG emissions.

The project activity has replaced the grid connected electricity which is fossil fuel dominant, with carbon neutral fuel for power generation. energy supplied by project activity to the state grid would reduce anthropogenic GHG emissions as per the combined margin carbon intensity of the grid, which is mainly dominated by fossil fuel based power plants.

Project activity would save energy equivalent of approximately 238.7 million kWh from the grid in a period of 7 years thereby resulting in total CO_2 emission reduction of 172,480 tons. In the absence of the project activity equivalent electricity would have had to be supplied by the grid from a mix of power plants supplying power to grid and consequent CO_2 emissions would occur.

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

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**
2007-2008	24,640
2008-2009	24,640
2009-2010	24,640
2010-2011	24,640
2011-2012	24,640
2012-2013	24,640
2013-2014	24,640
Total CER's	172,480
Crediting Period	7 years
Annual average over the crediting period of estimated reductions ((tonnes of CO_2 e)	24,640

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

No public funding as part of project financing from parties included in Annex I of the convention is involved in the project activity.

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

The project activity is not a debundled component of a large project activity as the project proponents have not registered or applied to register any small scale project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline methodology:

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

Main Category: Type I - Renewable Energy Projects
Sub Category: I.D.-Grid Connected Renewable electricity generation

The reference has been taken from the list of the small-scale CDM project activity categories contained in 'Appendix B of the simplified M&P for small-scale CDM project activities- Version 10, 23rd December 2006

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

Appendix B of the simplified M&P for small-scale CDM project activities provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per this document the project activity falls under Category I.D.- Grid Connected Renewable electricity generation. (Version 10, 23rd December 2006)

The power requirement of the paper unit is being met by the supply from UPSEB. However, after the project activity, the power requirement of the plant would be met by supply from the cogeneration power plant. In case of exigencies like the failure of the power plant, power from the grid may be used.

Baseline for projects under Type I.D has been detailed in paragraph 10 of Type I.D. described in Annex B of the simplified modalities and procedures for small-scale CDM project activities. It states that the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in $kgCO_2/kWh$) calculated in a transparent and conservative manner as:

a) The average of the "approximate operating margin" and the "build margin", where:
   i. The "approximate operating margin" is the weighted average emissions (in $kgCO_2equ/kWh$) of all generating sources surviving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;
   ii. The "build margin" is the weighted average emissions (in $kgCO_2equ/kWh$) of recent capacity additions to the system, defined as the higher (in MWh) of most recent 20% of plants built or the 5 most recent plants;

   OR
b) The weighted average emissions (in $kgCO_2equ/kWh$) of current generation mix.

Considering the available guidelines and the present project scenario, Northern Grid has been chosen for baseline analysis by selecting "The average of the approximate operating margin and the build margin (combined margin)" for baseline calculations. Further details of the baseline are given in section B.5.

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:

The implementation of the biomass based cogeneration project activity is a voluntary step undertaken by RPML with no direct or indirect mandate by law. The main driving forces to this 'Climate change initiative' have been GHG reduction and subsequent carbon financing against sale consideration of carbon credits and Rural Development of the region by creating job opportunities for the local people.

However, the project proponent was aware of the various barriers associated to project implementation. But it was felt that the availability of carbon financing against a sale consideration of carbon credits generated due to project activity would help to overcome these barriers.

As per the attachment A to Appendix B of the simplified M&P for small-scale CDM project activities of the UNFCCC CDM website, to prove that the project is an additional, explanation regarding the project activity would not have occurred anyway due to at least one of the following barriers is required:

(a) Investment barrier
(b) Barrier due to prevailing practice
(c) Other barriers

The barriers faced by the project activity are discussed below:

a) Investment Barrier to project implementation

The performance of RPML was satisfactory upto 1995-96 but started deteriorating subsequently due to factors like overall economic recession, reduction in import duty on newsprint, delay in implementation of its expansion project for manufacture of newsprint, steep hike in power tariff, etc. This resulted into the company incurring losses ultimately leading to erosion of its networth as on March 31, 1999, consequent to which it made a reference to Board for Industrial & Financial Reconstruction (BIFR). The company's reference was registered and it was declared sick in December 2000, with Industrial Development Bank of India (IDBI) being appointed as Operating Agency.

The company first submitted a rehabilitation proposal in March 2001, based mainly on restructuring of liabilities. However, before the scheme could be sanctioned, the company entered into One Time Settlement (OTS) with all the lenders and started paying their dues mainly by way of infusion of fresh funds by the promoters as the earnings were insufficient to meet the OTS.

In order to set up a cogeneration facility in the plant, RPML initiated dialogues with the financial institutions in June 2004 to finance the cogeneration power plant. However, due to RPML's poor financial background, the financial institutions were apprehensive and reluctant to finance the project. RPML continued to approach various financial institutions and subsequently in the year November 2005 borrowed the debt from the financial institution at a higher rate of interest as against the normal rate offered. This has lead to financial burden on RPML who is in the process of recovering from its BIFR. Though RPML had an option of continuing with the grid power, with no additional investment, or setting a diesel based power plant with lesser investment and lesser financial burden, RPML went ahead with setting the project activity considering that the carbon benefits would offset the financial burden.

An investment analysis of the project activity was conducted with the Internal Rate of Return as the financial indicator. 'Internal Rate of Return' is one of the known financial indicators used by banks, financial institutions and project developers for making investment decisions.

The internal rate of return (IRR) of the project activity was calculated and compared it with the benchmark IRRof 16%[2] for an electric utility industry. The IRR on investment was based on the capital investment and the rate of return of each of the investors.

RPML have worked out the IRR of the project activity and the same has been estimated at 10.1% with an assumption of an average price of Biomass @ INR 1700/ton and a 5% escalation every year. The financial internal rate of return of the project activity is lower than the 16 % IRR which is the benchmark for Indian electric utility industry. The IRR is computed for the debt period of 10 years. ***The workings to calculate IRR are given to the DOE.***

CDM revenues at Euro 9 per CER would increase the IRR to 15.9% and make the operations sustainable in the long run to tide over the uncertainties.

A sensitivity analysis has been made considering the following possible scenarios. These are:

1) Increase in the price of biomass by 5%
2) Reduction in power generation by 10%

In respect of the project activity the proponents have not considered any other sensitivity assumption since project cost is firmed up and project proponents are not expecting any escalation in the capital investment. Therefore, sensitivity analysis for an increase in price of biomass is justified. Since the price of biomass is not expected to come down, effect of reduction of price of biomass has not been considered for sensitivity analysis.

The second sensitivity factor considered is reduction in power generation by 10%. This is also a plausible scenario since biomass power plant may face shutdowns due to raw material problem or other equipment problems. Therefore considering reduction in generation by 10% as a sensitivity factor is appropriate.

S. No.	Parameters	Variation	IRR	Comments
1.	Annual power generation	-10%	7.0 %	The IRR of the project activity is very less than the benchmark.
2.	Price of biomass	-5%	4.6%	The IRR of the project activity is very less than the benchmark.

The results of the sensitivity analysis conducted confirm that the financial internal rate of return of the project activity without CDM revenues is much lower than the benchmark for the project activity as required by the investors, under circumstances, which could bring about variations in the critical factors used for the IRR computations

The revenue from CDM is vital, as the same would significantly improve the sustainability of the project, as the project can be rendered financially unstable due to various factors indicated above. CDM would increase the IRR to 15.1% considering a price of 9 Euros per CER and thus mitigate some of the hard ships faced by the project proponent.

b) Prevailing practice barrier:

[2] Central Electricity Regulatory Commission, New Delhi, India order dated 21/01/2004

The prevailing and the common practice in the Indian power sector have been investments in the fossil fuel based power plants. This is mainly due to assured return on investments, economies of scale and easy availability of finances.

However, RPML decided to go ahead with the implementation of the project activity taking CDM funding into consideration. The practice of generating power from biomass has not penetrated in the region due to prohibitive barriers to project implementation discussed in this section.

At the time of implementation of the project activity, there were about 117[3] paper mills operating in the state of Uttar Pradesh of which, the mode of power supply for about 90[4]% of the paper mills is either by state grid or by fossil fuel operated plants which contribute to the increase in GHG emissions. RPML were amongst the first few to initiate the setting up of biomass based cogeneration facility, however, due to the delay in acquiring finances, have not been able to set up the cogeneration plant.

c) Other Barriers

Increased Fuel Prices

The CDM fund for the project was initially considered to cover the project risk related to the fuel (biomass) price increase in the future. The CDM fund is critical considering biomass availability and prices are seasonal, which depends on many external factors whereas the earnings for the power plant are long term fixed rate. Therefore, the revenue from CDM could prove to be vital, as they would significantly improve the sustainability of the project, as the project can be rendered financially unstable due to the increase in cost of fuel.

Average Raw material cost (per ton) in the year 2004-05 was INR 1472 per ton and in the year 2005-2006 was INR 1790, which has increased to INR 2049 in the year 2006-07. There has been an increase of approximately 15% increase in the cost and it is envisaged that there would a continuous increase in the price of biomass. Due to the increase in the raw material cost there would be a continuous increase in the cost per unit of generation.

Above barriers are strong enough to affect the decision of project implementation and in case if due to any of the above reason project implementation cancels, the project will get power from the project alternatives as discussed above. Since, these alternatives are more GHG emissive, project option only can reduce the GHG emissions. Although there is a good potential for biomass cogeneration power plants in India very few have adopted for the similar project activity due to above strong barriers. Therefore, the proposed renewable energy project is an additional activity as it over comes the above barriers by taking up additional risk of implementation.

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:

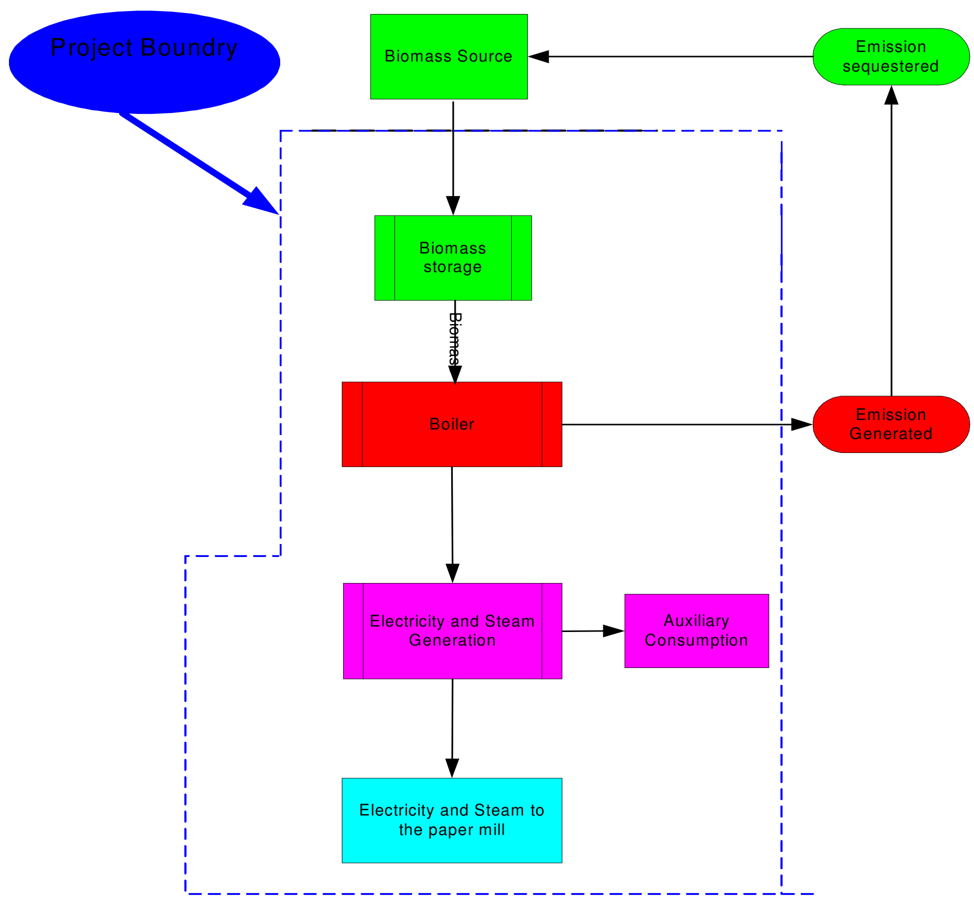
[3] Indian Agro & Recycled Paper Mills Association, New Delhi.

[4] Indian Agro & Recycled Paper Mills Association, New Delhi.

As mentioned under paragraph 6 of Type I.D. of '*Annex-B of the simplified modalities and procedures for small-scale CDM project activities'*, project boundary encompasses the physical, geographical site of the renewable generation source. For the project activity the project boundary is from the point of fuel storage to the point of electricity supply to the paper mill where the project proponent has full control.

Thus, project boundary covers fuel storage, boiler, steam turbine generator and all other accessory equipments.

Flow chart and project boundary is illustrated in the following diagram:



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

Using the methodology available in paragraph 9 of Type I.D. described in Annex B of the simplified modalities and procedures for small-scale CDM project activities, **the average of the approximate operating margin and the build margin** (in kgCO_{2e}qu/kWh) of current generation mix of Northern grid is used for the calculation of baseline.

Base line data

Carbon emission factor of grid

The Northern grid comprises of Delhi, Punjab, Haryana, Chandigarh, Rajasthan, Himachal Pradesh, Jammu & Kashmir, Uttaranchal and Uttar Pradesh. Northern Grids present generation mix, sector wise installed capacities, thermal efficiency, and emission co-efficient is used to arrive at the net carbon intensity/baseline factor of the chosen grid. As per the provisions of the methodology the emission coefficient for the electricity displaced would be calculated in accordance with provisions of paragraph 9 of Type I.D. mentioned in Appendix B of Draft Simplified Modalities and Procedures for Small Scale CDM Project Activities for grid systems.

The provisions require the emission coefficient (measured in kg CO_2equ/kWh) to be calculated in a transparent and conservative manner as:

(a) The average of the "approximate operating margin" and the "build margin" (or combined margin)

OR

(b) The weighted average emissions (in kg CO_2equ/kWh) of the current generation mix.

Complete analysis of the electricity generation has been carried out for the calculation of the emission coefficient as per paragraph 9 (a) given above.

Combined Margin

The baseline methodology suggests that the project activity will have an effect on both the operating margin (i.e. the present power generation sources of the grid, weighted according to the actual participation in the grid mix) and the build margin (i.e. weighted average emissions of recent capacity additions) of the selected grid and the baseline emission factor would therefore incorporate an average of both these elements.

Operating Margin

The "approximate operating margin" is defined as the weighted average emissions (in kg CO_2equ/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, and nuclear and solar generation;

The carbon emission factor as per the operating margin takes into consideration the power generation mix of 2004-2005 excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation of the selected grid, thermal efficiency and the default value of emission factors of the fuel used for power generation.

The formulae are presented in Section-E and the calculations are presented in an excel sheet as Enclosure

A. Carbon Emission Factor of grid as per OM is 0.913 kg CO_2/kWh electricity generation.

Build Margin

The "build margin" emission factor is the weighted average emissions (in kg CO_2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

The project activity will have some effect on the build margin of the Northern Grid. The baseline factor as per the build margin takes into consideration the delay effect on the future projects and assumes that the past trend will continue in the future. Capacity additions of 20% most recent plants is greater than (in MWh) most recent 5 plants hence, for our build margin calculation we would take into consideration 20% of most recent plants built in Northern grid given in Table-2. The key parameters for calculating build margin have been assumed same as that for calculating operating margin. Carbon Emission Factor of grid as per build margin is 0.553 kg CO_2/kWh electricity generation.

Net Carbon Emission Factor Grid for 2004-2005 as per combined margin = (OM + BM)/2 = 0.733 kg of CO_2 / kWh generation respectively. (Refer to Excel Sheet Enclosure 1).

Table-1: Generation and fuel consumption details (2004-2005)

				Generation (million kWh)[5]	**Coal Consumption (000' tones)**
	Name	**Type**	**Fuel**	**2004-2005**	
1	Badarpur TPS	Thermal	Coal	5462.78	3732
2	Singrauli STPS	Thermal	Coal	15803.34	10336
3	Rihand STPS	Thermal	Coal	7988.06	4768
4	Dadri NCTPS	Thermal	Coal	6842.52	4432
5	Unchahar-I TPS	Thermal	Coal	3342.83	4604
6	Unchahar-II TPS	Thermal	Coal	3438.28	-
7	Tanda TPS	Thermal	Coal	3254.67	2596
8	Anta GPS	Thermal	Gas	2595.77	-
9	Auriya GPS	Thermal	Gas	4119.47	-
10	Dadri GPS	Thermal	Gas	5527.71	-
11	Faridabad GPS	Thermal	Gas	3172.01	-
12	Bairasiul	Hydro	Hydel	689.67	-
13	Salal	Hydro	Hydel	3443.29	-
14	Tanakpur HPS	Hydro	Hydel	495.17	-
15	Chamera HPS	Hydro	Hydel	3452.25	-

[5] Annual reports of Northern region Electricity Board (NREB).

16	Uri HPS	Hydro	Hydel	2206.71	-
17	RAPS-A	Nuclear	Nuclear	1355.20	-
18	RAPS-B	Nuclear	Nuclear	2954.43	-
19	NAPS	Nuclear	Nuclear	2760.01	-
20	Bhakra Complex	Hydro	Hydel	4546.01	-
21	Dehar	Hydro	Hydel	3150.52	-
22	Pong	Hydro	Hydel	882.57	-
23	Delhi	Thermal	Coal	5203.80	1330
24	SJVNL	Hydro	Hydel	1617.45	-
25	Delhi	Thermal	Gas	4091.37	-
26	Haryana	Thermal	Coal	7192.41	5269
27	Haryana	Hydro	Hydel	251.73	-
28	H.P.	Hydro	Hydel	3666.39	-
29	J&K	Hydro	Hydel	851.03	-
30	J&K	Thermal	Gas	23.51	-
31	Punjab	Thermal	Coal	14390.42	9520
32	Punjab	Hydro	Hydel	4420.43	-
33	Rajasthan	Thermal	Coal	17330.79	11133
34	Rajasthan	Thermal	Gas	360.70	-
35	Rajasthan	Hydro	Hydel	494.07	-
36	U.P.	Thermal	Coal	19788.21	15559
37	U.P.	Hydro	Hydel	2063.04	-
38	Uttaranchal	Hydro	Hydel	3452.96	-
	TOTAL			**172681.58**	**73279.00**

TABLE-2 POWER PLANTS CONSIDERED FOR CALCULATING BUILD MARGIN

List of plants supplying power to Northern grid arranged in descending order of date of commissioning[6]

Total generation	**172681.58**
20 % of total generation	**34536.32**

	Plant	Date of commissioning	MW	Generation of the unit in 2004-2005 (MU)	Fuel Type
1	Chamera HPS-1	2003-2004	100		Hydro
2	Chamera HPS-2	2003-2004	100		Hydro
3	Chamera HPS-3	2002-2003	100	1344.07	Hydro
4	SJVPNL	2003-2004	1500	5108.77	Hydro
5	Baspa-II (Unit 3)	2003-2004	100	398.94	
6	Suratgarh TH-5	2003-2004	250	1698.37	Coal
7	Kota TH-6	2003-2004	195	1302.49	Coal
8	Baspa-II (Unit 1&2)	2002-2003	200	797.88	Hydro
9	Pragati gas turbine-2	2002-2003	104.6	790.21	Gas
10	Pragati gas turbine-3	2002-2003	121.2	915.61	Gas
11	Ramgarh CCGT Stage _II (GT-2)	2002-2003	37.5	114.19	Gas
12	Ramgarh CCGT Stage _II (GT-2)	2002-2003	37.8	115.11	Gas
13	Upper Sindh Extn (HPS)(1)	2002-2003	35	32.12	Hydro
14	Suratgarh stage-II (4)	2002-2003	250	1698.37	Coal
15	Suratgarh stage-II (3)	2001-2002	250	1698.37	Coal
16	Upper Sindh Stage II (2)	2001-2002	35	32.12	Hydro
17	Malana-2	2001-2002	43		Hydro
18	Malana-1	2001-2002	43	266.08	Hydro
19	Panipat TPS (6)	2000-2001	210	1269.31	Coal
20	Chenani Stage III (1,2,3)	2000-2001	7.5	19.10	Hydro
21	Ghanvi HPS (2)	2000-2001	11.25		Hydro
22	Ghanvi HPS (1)	2000-2001	11.25	74.06	Hydro
23	RAPS-B (2)	2000-2001	220	1309.70	Nuclear
24	Ranjit Sagar HPS (1,2,3&4)	2000-2001	600	1131.37	Hydro
25	Gumma HPS	2000-2001	3	4.35	Hydro
26	Faridabad GPS	2000-2001	144	1030.59	Gas
27	Suratgarh TPS #2	1999-2000	250	1698.37	Coal
28	RAPS-B (2)	1999-2000	220.00	1309.70	Nuclear
29	Uppersindh-2 HPS #1	1999-2000	35	32.12	Hydro
30	Faridabad GPS #1&2 (NTPC)	1999-2000	286	2046.86	Gas
31	Unchahar-II TPS #2	1999-2000	210	1559.75	Coal
32	Unchahar-II TPS #1	1998-1999	210	1559.75	Coal

[6] Reports of Northern region Electricity Board (NREB).

33	Suratgarh TPS #1	1998-1999	250	1698.37	Coal
34	GHGTPLM (Unit 2)	1998-1999	210	1453.23	Coal
35	GHGTPLM (Unit 1)	1997-1998	210	1453.23	Coal
36	Tanda TPS (Unit-4)	1997-1998	110	731.54	Coal
Total				**34694.10**	
20% of Ex-Bus Generation				**34536.32**	%age

B.5.2 Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

18/07/2006

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

Rama Paper Mills Limited has determined the baseline and they are project participant as listed in Annex 1 of this document.

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

>>

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

07/09/2005

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

25y-0m

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

Project activity would use Renewable 7 -year crediting period

C.2.1. Renewable crediting period:

>>

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

15/08/2007 /Date of Registration whichever is later

C.2.1.2. Length of the first crediting period:

07 years, 0 months

C.2.2. Fixed crediting period:

>>

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan:

>>

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

Title: Monitoring Methodology for the category I D –Grid Connected Renewable electricity generation

Reference: 'Paragraph 13' as provided in Type I.D. of 'Appendix B of the simplified M&P for small-scale CDM project activities-Version 10, 23rd December 2006.

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

As established in Section A.4.2, the project activity displaces grid connected power supply and hence falls under Category I.D and can use the monitoring methodology for type I.D project activities.

GHG SOURCES

Direct on-site emissions after implementation of the project arise from the combustion of biomass in the boiler. These emissions mainly include CO_2. However, CO_2 released is taken up by the biomass when it grows, therefore no net emissions occur.

Direct Off-Site Emissions

Direct off-site emissions in the project activity arise from the biomass transport. The emissions due to the transport of the biomass is considered.

Indirect On-Site Emissions

The indirect on site GHG source is the consumption of energy and the emission of GHGs involved in the construction of biomass based power plant.

Considering the life of the power plant and the emissions to be avoided in the life span, emissions from the above-mentioned source is too small and hence neglected.

No other indirect on-site emissions are anticipated from the project activity.

D.3 Data to be monitored:

a. Parameters affecting the emission reduction potential of the project activity

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	Energy	Energy generated	kWh	M	Hourly	Total	Paper	2 years after end of crediting period	This is monitored at generation end and is used for calculating the emission reductions
2	Energy	Auxiliary energy consumption	kWh	M	Hourly	Total	Paper	2 years after end of crediting period	This is monitored at the plant and is used for calculating the emission reductions
3	Energy	Energy supplied to the paper mill	kWh	M	Hourly	Total	Paper	2 years after end of crediting period	This is monitored at interconnection point and is used for calculating the emission reductions.

b. Fuel related parameters

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	Fuel	Biomass Quantity procurred	MT	M	Daily	100 %	Paper	2 years after end of crediting period	The total biomass quantity procured will be measured on the weigh bridge.
2	Fuel	Biomass– Calorific Value	kcal/Kg	M	Once a year for every new type of biomass	Actual sample tested	Paper	2 years after end of crediting period	Through sample testing
3	Fuel	Diesel Quantity	KL	M	Daily	100%	Paper	2 years after end of crediting period	
4	Fuel	Biomass availability	MT	E	Annually	100%	-	-	Information from the regional offices on the availability of the biomass in the region would be procured.

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

Data	Uncertainty level of data (High Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
D.3. (a)1	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)2	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)3	Low	Yes	This data will be used for calculation of emission reductions by project activity.

Key Project Parameters affecting Emission Reductions

Total Power generated by the project: The power generated and supplied to the paper mill would be monitored to the best accuracy and as per the table given in section D.3.

Auxiliary consumption: The power consumed by the plant auxiliaries would also be monitored to the best accuracy and as per the table given in section D.3. The total quantum of power consumed by the auxiliaries would affect the net power supplied to the paper mills and therefore the amount of GHG reductions. Therefore any increase in the consumption pattern of the auxiliary system would be attended to.

Net Power supplied to the Paper Mill: This would be calculated by deducting the auxiliary consumption from the total power generation.

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 Chief Engineer (Operation & Maintenance) is responsible for the operation and maintenance of the power plant. Adequate support staffs assist the chief engineer. The Chief Engineer would be a qualified diploma/degree engineer with 5-7 year experience in power industry. The Director would be overall responsible for the operation and maintenance of the power plant.

The Chief Engineer (Operation & Maintenance) is responsible for the hourly data recording of the power generation. The Daily and monthly reports stating the generation and net power supplied to the paper mill would be prepared by the Engineer and verified by the Chief Engineer (Operation & Maintenance), who would maintain the records. The Chief Engineer maintains records with regard to the operation and maintenance of the boiler and turbine.

The Director is responsible for identifying the training needs and schedule the yearly training. As and when required and identified, people are sent to short term training courses on operation and maintenance of the power plant. The chief engineer is responsible for identifying the training needs and maintaining the undergone training records.

Adequate fire fighting and safety equipment would be installed. The Chief engineer is responsible for the upkeep of the safety and fire fighting and maintains necessary records.

Calibration of the meters recording the power generated and supplied would be done by RPML every year and necessary records would be maintained by RPML. Similarly, calibration of the weigh bridge recording the quantity of fuel, would be done by department of weights and measures every year and the monitoring would be done every month. The Chief Engineer (Operation & Maintenance) department maintains records of the same.

In order to ensure that the project emissions are being regularly monitored and to ensure the function of the monitoring system, the Director would carry out an audit every six months and maintain necessary records of the same. Necessary corrective and preventive action based on the audit findings would be carried out.

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

Rama Paper Mills Limited has determined the monitoring methodology and they are project participant as listed in Annex 1 of this document.

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

>>

E.1.1 Selected formulae as provided in appendix B:

Since category I.D. does not indicate a specific formula to calculate the GHG emission reduction by sources, the formula is described below in E.1.2

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:

The project activity leads to GHG on-site emissions in the form of CO_2 emissions from combustion of biomass. The project activity uses an environmentally renewable resource as fuel for power generation. Hence there would be zero emissions from the project activity.

The plantations, representing a cyclic process of carbon sequestration, will consume the CO2 emissions from biomass combustion process. Since the biomass contains negligible quantities of other elements like Nitrogen, Sulphur etc. release of other GHG emissions are considered negligible. GHG emissions during on-site construction work are negligible compared to GHG reductions in the project lifetime and are not accounted for. Similarly emissions associated with transportation of construction materials are ignored.

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

As prescribed in Appendix B of the Simplified Modalities and Procedure for small-scale CDM project activities, for Category I.D leakage estimation is only required if renewable energy technology is equipment transferred from another activity. This does not apply to the project case. However, the only source of leakage activity identified, which contributes GHG emissions outside the project boundary is transportation of biomass from the areas within a 50 km radius to power plant.

Emissions due to transportation of biomass		
Total biomass required	Ton/year	85,000
Biomass transported by truck	Ton/year	85,000
Biomass load per tractor truck	ton	10
Total no. of trips		8500
Average distance between project site and collection centres	km	50
Consumption of diesel per trip (to and fro)(@5km/lit)	litres	20
Total diesel consumption	litres	170,000
Calorific value of diesel	TJ/lit	0.0000283
Emission factor for diesel	t CO_2/TJ	74.1
Emissions due to transportation of biomass	**t CO_2 /year**	**356**

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

The project emissions are estimated to be 356 T .

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 Northern Grid, which comprises of Uttar Pradesh State Electricity Board (UPSEB) grid to which project activity is displacing power, has been considered as the baseline. As per the provisions of the methodology the emission coefficient for the electricity displaced would be calculated in accordance with provisions of paragraph 9 (a) of Type I.D of '*Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities'*.

The emission coefficient has been calculated in a transparent and conservative manner as: **'The average of the approximate operating margin and the build margin'.**

The step-by-step calculation of base line emission is as follows:

Step 1	**:**	Thermal efficiency of coal based power plants	=	35.51 %
Step 2	**:**	Thermal efficiency of gas based power plants	=	50 %
Step 3	**:**	CO_2 emission factor for coal	=	96.10 kg CO_2 / GJ
Step 4	**:**	CO_2 emission factor for gas	=	56.10 kg CO_2 / GJ
Step 5	**:**	Actual emission factor for coal	=	CO_2 emission factor for coal/ Thermal efficiency of coal based power plants (kg CO_2/kWh)
Step 6	**:**	Actual emission factor for gas	=	CO_2 emission factor for gas/ Thermal efficiency of gas based power plants (kg CO_2/kWh)
Step 7	**:**	Net emission factor for coal	=	Actual emission factor for coal x % of generation by coal out of total generation excluding renewable, hydel and nuclear power generation. (kg CO_2/kWh)
Step 8	**:**	Net emission factor for gas	=	Actual emission factor for gas x % of generation by gas out of total generation excluding renewable, hydel and nuclear power generation. (kg CO_2/kWh)
Step 9	**:**	Net operating margin factor for grid	=	Net emission factor for coal + Net emission factor for gas (kg CO_2/kWh)
Step 10		Net build margin factor for grid	=	Weighted average emissions of 20% of most recent plants built in Northern grid (kg CO_2/kWh)
Step 11		Combined margin factor	=	(Net operating margin factor for grid + Net build margin factor for grid)/2 (kg CO_2/kWh)
Step 12	**:**	Units supplied to paper mill	=	Net energy supplied after auxiliary consumption
Step 13	**:**	Baseline emission	=	Combined margin factor x Units supplied to paper mill -Project Emissions

Detailed calculation has been shown in Enclosure 1.

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:

Following formula is used to determine Emission reduction

CO_2 emission reduction due to project activity	=	Baseline emission	–	Project Activity emission

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

Emission reductions by project activity for 7 -year crediting period have been calculated and tabulated below:

Table E.2.1: Emission Reductions

Sr. No.	Operating Years	Power Exported (kWh)	Net Baseline Emission Factor (kg of CO_2 / kWh)	Baseline Emissions (Tons of CO_2)	Project Emissions (Tons of CO_2)	Emission Reductions, (Tons of CO_2)
1.	2007-2008	34,101,000	0.733	24,996	356	24,640
2.	2008-2009	34,101,000	0.733	24,996	356	24,640
3.	2009-2010	34,101,000	0.733	24,996	356	24,640
4.	2010-2011	34,101,000	0.733	24,996	356	24,640
5.	2011-2012	34,101,000	0.733	24,996	356	24,640
6.	2012-2013	34,101,000	0.733	24,996	356	24,640
7.	2013-2014	34,101,000	0.733	24,996	356	24,640
			Total CERs	**174,972**	**2,492**	**172,480**

Therefore a conventional energy equivalent of 238.7 million kWh for a period of 7 years would be saved by displacing power from the grid, which in turn would reduce 172,480 tons of CO_2 emissions considering baseline calculations.

SECTION F.: Environmental impacts:

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

A detailed Environmental Impact Assessment report highlighting the impacts arising from the project has been prepared and submitted to the Uttar Pradesh Pollution Control Board (UPPCB). On reviewing the EIA report, the UPPCB has accorded the 'Consent to Operate'.

The design philosophy of this project activity is driven by the concept of providing the energy with no impact on the environment. The environmental aspects of the project activity are discussed below.

The pollutants generated from the power plant include:

- Dust and particulate matter in the flue gas
- Effluent from water treatment plant
- Sewage from the plant

Control methods for air pollution

Dust and particulate matters

The pollution control norms stipulate a maximum dust concentration of 150 mg//Nm^3. The power plant will have an Electrostatic Precipitator, which separates the dust from the flue gas and dust concentration is the flue gas leaving the ESP is kept below 150 mg/Nm^3.

The dust concentration level in the chimney will be periodically monitored. Corrective steps will be taken, if the concentration is not as per the acceptable limits.

Sulphur-di-oxide and Nitrogen-di-oxide

The main fuel in the power plant is biomass, which does not have significant amount of sulphur in it. Hence, the sulphur dioxide is not produced. However, the stack height is as per the local pollution control board stipulations.

The nitrogen-di-oxides are not produced in firing.

Control methods for water pollution

Effluents from Water Treatment Plant

Water drained from the water treatment plant is pumped to a neutralization pit so that the water let out is neutral. The neutralization pit has effluent resistant cement lining.

Sewage from the Power Plant Buildings

The sewage from the various power plant buildings is taken to a common septic tank through trenches. The sewage from the septic tank is disposed off manually.

Control methods for noise pollution

The major source of noise pollution in the power plant power plant is from the following:

- Rotating equipments like ID, FD and SA fans
- Feed pumps
- Boiler and super heater safety valves
- Start up vent
- Steam turbine

The start up vent, safety valve outlets and the DG sets are provided with silencers to reduce the noise level to the acceptable limits. The powerhouse building has been constructed suitably to keep the noise level within the acceptable limits.

SECTION G. Stakeholders' comments:

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

RPML organised stakeholder consultation meetings with individual village panchayat (elected body of representatives administering the local area) and the farmers in the area with the objective to inform the interested stakeholders on the environmental and social impacts of the project activity and discuss their concerns regarding the project activity. Invitation for stakeholder consultation meetings were sent out requesting the members of village panchayat to participate and communicate any suggestions/objections regarding the project activity in writing. On the day of meeting, RPML representatives presented the salient features of the company and the project activity to the participants and requested their suggestions/objections. The minutes of the meeting were prepared and are available for verification by DOE.

G.2. Summary of the comments received:

RPML officials briefed stakeholders in meeting about the project activity and invited their comments. There were no major comments received from stakeholders. List of participants attended the meeting and minutes of the meeting is available with RPML for verification by DOE.

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

In view of various direct and indirect benefits (social, economical, environmental), no concerns were raised during the consultation with stakeholders, hence it is not required to take due account of the comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Rama Paper Mills Limited
Street/P.O.Box:	Najibabad Road, Kiratpur,
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding as part of project financing from parties included in Annex I of the convention is involved in the project activity.

Annex 3
ABBREVIATIONS

BAU	Business As Usual
BM	Build Margin
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CO_2	Carbon dioxide
DPR	Detailed Project Report
EIA	Environment Impact Assessment
GHG	Greenhouse gas
Hz	Hertz
IPCC	Inter Governmental Panel On Climate Change
IPP	Independent Power Producer
IREDA	Indian Renewable Energy Development Agency
Kg	Kilogram
Km	Kilometer
kW	Kilo watt
kWh	Kilo watt hour
MW	Mega watt
NRSE	New and Renewable Sources of Energy
OM	Operating Margin
PDD	Project design document
RPML	Rama Paper Mills Limited
SHR	Station Heat Rate
TPH	Tons per hour
UNFCCC	United Nations Framework Convention on Climate Change
UPPCB	Uttar Pradesh Pollution Control Board
UPSEB	Uttar Pradesh State Electricity Board

ANNEX 4
LIST OF REFERENCES

Sl. No.	Particulars of the references
1.	United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int
2.	UNFCCC document: Clean Development Mechanism, Simplified Project Design Document For Small Scale Project Activities (SSC-PDD), Version 02
3.	UNFCCC document: Simplified modalities and procedures for small–scale clean development mechanism project activities
4.	UNFCCC document: Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories, Version 08
5.	UNFCCC document: Determining the occurrence of debundling
6.	Power sector profile for Northern region-Ministry of Power
7.	Ministry of Power (MoP), Govt. of India, www.powermin.nic.in
8.	Central Electricity Authority (CEA), Govt. of India, www.cea.nic.in
9.	Emission Baselines-Estimating the Unknown, International Energy Agency
10.	Ministry of Environment and Forest, http://envfor.nic.in/cdm/host_approval_criteria.htm
11.	Detailed Project Report for Rama Paper Mills Limited
12.	Northern Region Electricity Board (NREB)
13.	Indian Agro & recycled paper mills association, www.inpaper.com

Enclosure-1`
Baseline Calculations

CALCULATION OF BASELINE EMISSION FACTORS AND EMISSION REDUCTIONS

Year of offer	2002-03		2003-04		2004-05	
Generation Mix					BASE YEAR	
Sector	MU	%	MU	%	MU	%
NTPC - Coal	43571.83	28.19	44515.88	26.54	46132.48	26.72
Delhi - Coal	1455.83	0.94	1164.11	0.69	1617.45	0.94
Haryana - Coal	5867.03	3.80	6849.26	4.08	7192.41	4.17
Punjab - Coal	13576.98	8.79	14118.96	8.42	14390.42	8.33
Rajasthan - Coal	13826.40	8.95	15044.48	8.97	17330.79	10.04
UP - Coal	20426.15	13.22	20638.05	12.30	19788.21	11.46
NTPC - Gas	14939.98	9.67	14874.57	8.87	15414.96	8.93
Delhi - Gas	2035.15	1.32	5159.77	3.08	4091.37	2.37
Haryana - Gas	0.00	0.00	0.00	0.00	0.00	0.00
J&K - Gas	67.36	0.04	15.40	0.01	23.51	0.01
Rajasthan - Gas	218.92	0.14	201.37	0.12	360.70	0.21
NHPC - Hydro	11108.60	7.19	13841.64	8.25	14765.34	8.55
SJVNL - Hydro	5123.25	3.32	6032.81	3.60	6154.13	3.56
BBMB - Hydro	3253.10	2.10	3299.29	1.97	3150.52	1.82
Haryana - Hydro	245.75	0.16	251.73	0.15	251.73	0.15
HP - Hydro	1598.25	1.03	3666.69	2.19	3666.39	2.12
J&K - Hydro	407.09	0.26	851.00	0.51	851.03	0.49
Punjab - Hydro	3525.55	2.28	4420.43	2.64	4420.43	2.56
Rajasthan - Hydro	60.78	0.04	494.07	0.29	494.07	0.29
Uttaranchal - Hydro	3426.31	2.22	3452.96	2.06	3452.96	2.00

UP - Hydro	1391.30	0.90	2063.04	1.23	2063.04	1.19
NPC - Nuclear	8418.42	5.45	6797.49	4.05	7069.64	4.09
Other - Low Cost (Wind, Biomass)						
Total	154544.03	100.00	167753.00	100.00	172681.58	100.00
Total generation excluding Low-cost power generation	115985.63		122581.85		126342.30	
Generation by Coal out of Total Generation excluding Low-cost power generation	98724.22	85.12	102330.74	83.48	106451.76	84.26
Generation by Gas (Naphtha) out of Total Generation excluding Low-cost power generation	17261.41	14.88	20251.11	16.52	19890.54	15.74
Imports from others						
Imports from WREB	131.64	0.09	282.02	0.17	1495.77	0.87
Imports from EREB	1019.53	0.66	2334.76	1.39	3581.79	2.07
Estimation od Baseline Emission Factor (tCO_2/MU)						
Simple Operating Margin						
Fuel 1 : Coal						
Avg. Efficiency of power generation with coal as a fuel, %		34.518		35.103		35.103
Avg. Calorific Value of Coal used (kcal/kg)		4171		3820		3820
Estimated Coal consumption (tons/yr)		58971331		65628561		68271527
Emission Factor for Coal-IPCC standard value (tonne CO2/TJ)		96.1		96.1		96.1
Oxidation Factor of Coal-IPCC standard value		0.98		0.98		0.98
COEF of Coal (tonneCO2/ton of coal)		1.642		1.503		1.503
Fuel 2 : Gas						
Avg. Efficiency of power generation with gas as a fuel, %		45		45		45
Avg. Calorific Value of Gas used (kcal/kg)		10750		10750		10750
Estimated Gas consumption (tons/yr)		3068566		3600045		3535947
Emission Factor for Gas- IPCC standard value(tonne CO2/TJ)		73.3		73.3		73.3
Oxidation Factor of Gas-IPCC standard value		0.995		0.995		0.995
COEF of Gas(tonneCO2/ton of gas)		3.277		3.277		3.277
EF (OM Simple, excluding imports from other grids), tCO2/MU		921.33		901.15		904.11

EF (WREB), tCO2/MU		910.00		910.00		906.00
EF (EREB), tCO2/MU		1192.00		1186.00		1178.00
EF (OM Simple), tCO2/MU		**923.67**		**906.48**		**911.60**
Average EF (OM Simple), tCO2/MU			**913.92**			
Considering 20% of Gross Generation						
Sector	**MU**	**%**	**MU**	**%**	**MU**	**%**
Thermal Coal Based					17821.15	51.37
Thermal Gas Based					5012.57	14.45
Hydro					9240.98	26.64
Nuclear					2619.40	7.55
Wind					0.00	
Total					34694.10	100.00
Built Margin						
Fuel 1 : Coal						
Avg. efficiency of power generation with coal as a fuel, %						35.103
Avg. calorific value of coal used in Northern Grid, kcal/kg						3820
Estimated coal consumption, tons/yr						11429377
Emission factor for Coal (IPCC),tonne CO2/TJ						96.1
Oxidation factor of coal (IPCC standard value)						0.98
COEF of coal (tonneCO2/ton of coal)						1.503
Fuel 2 : Gas						
Avg. efficiency of power generation with gas as a fuel, %						50
Avg. calorific value of gas used, kcal/kg						10750
Estimated gas consumption, tons/yr						801978
Emission factor for Gas (as per standard IPCC value)						56.1
Oxidation factor of gas (IPCC standard value)						0.995
COEF of gas(tonneCO2/ton of gas)						2.508
EF (BM), tCO2/MU						**553.25**
Combined Margin Factor (Avg of OM & BM)						**733.58**
Baseline Emissions Factor (tCO2/MU)						**733.58**