

# Indian Paper Industry: Kyoto Protocol and Clean Development Mechanism

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Climate change represents the most widespread and pressing environmental concern of our time. Current climate models predict a global warming of about 1.4–5.8°C between 1990 and 2100 [5]. These projections are based on wide range of assumptions about the main forces driving future but do not assume any climate change policies for reducing emissions. The pulp and paper industry is a significant emitter of green house gases. Despite the proportion of industrial plantations devoted to pulp production, plantations do not appear to be offsetting emissions from energy use or landfills. Production, consumption and disposal of paper products are estimated to contribute a net addition of about 450 million tons in carbon dioxide equivalent units each year. The United Nations Framework Convention on Climate Change (UNFCCC) is the foundation of global efforts to combat global warming. Adopted in 1992, the UNFCCC sets out a framework for action aimed at stabilizing atmospheric concentrations for greenhouse gases to avoid dangerous anthropogenic interference with the climate system. India has signed Kyoto protocol in December 1997, ratified in August 2002 & established DNA in December 2003. The CDM is based on the emission reducing projects located in developing countries, selling carbon credits to buyers in industrialized countries. This Paper reviews the UNFCCC methodologies for CDM projects in pulp and paper industries and identifies specific opportunities pertaining to Indian pulp and paper industry. The paper also reviews the various implemented and ongoing CDM projects in Indian pulp and paper industry.

## INTRODUCTION

Climate change represents the most widespread and pressing environmental concern of our time. The detection of significant changes in the Earth's climate over the last 100 years and the attribution of these changes to anthropogenic emissions of greenhouse gases (GHGs) have now been accepted by the vast majority of the world's scientists, and the findings of the Intergovernmental Panel on climate Change (IPCC). The United Nations Framework Convention on Climate Change (UNFCCC) is the foundation of global efforts to combat global warming. Adopted in 1992, the UNFCCC had sets out a framework for action aimed at stabilizing atmospheric concentrations for greenhouse gases to avoid dangerous anthropogenic interference with the climate system. Kyoto Protocol was adopted in Kyoto in 1997. The objective of the Kyoto Protocol is aimed at bringing down the global GHG emission by 5.1% during the period 2008-2012. India has Signed Kyoto Protocol in December 1997 & ratified it in August 2002 & established DNA in December 2003. The CDM is based on the emissions reducing projects located in developing countries and selling carbon credits to buyers in industrialized countries [11].

The pulp and paper sector is one of the

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oldest industries in India. Today there are more than 600 pulp and paper mills in the country. Nearly 6.2 million tons of paper, paper board and news print is produced against an operating installed capacity of nearly 8.5 million tons [3]. The pulp and paper industry is a significant emitter of green house gases. While plantations maintained to supply fiber for pulp production store large amounts of carbon on land that previously was not forested. This carbon storage is insufficient to offset the even greater emissions from fossil fuel use in manufacture and from paper disposed in landfills. Despite the proportion of industrial plantations devoted to pulp production, plantations do not appear to be offsetting emissions from energy use or landfills.

This Paper reviews the UNFCCC methodologies for CDM projects in pulp and paper industries and identifies specific opportunities pertaining to Indian pulp and paper industry. The paper also reviews the various implemented and ongoing CDM projects in Indian pulp and paper industry.

## KYOTO PROTOCOL

The Protocol established three innovative 'mechanisms' known as 'Joint implementation (JI)', 'Clean Developing Mechanism' (CDM) and 'Emissions Trading' (ET). *Under joint implementation (JI)*, an Annex I Party

may implement a project that reduces emissions (e.g. an energy efficiency scheme) or increases removal by sinks (e.g. reforestation project) in the territory of another Annex I Party, and count the resulting Emission Reduction Units (ERUs) against its own targets. *Under the Clean Development Mechanism (CDM)*, Annex 1 Parties may implement projects in non Annex 1 Parties that reduce emissions and use the resulting Certified Emission Reductions (CERs) to help meet their own targets. The CDM also aims to help non Annex 1 Parties achieve sustainable development and contribute to the ultimate objective of the Convention. *Under Emission Trading (ET)*, Annex 1 Party may transfer some of the emission under its assigned amount, known as Assigned Amount Units (AAU5), to another Annex 1 Party that finds it relatively more difficult to meet its emissions target. It may also transfer CERS or ERUs that it has acquired through the CDM or JI activities in the same way. In view of the above, it is clear that India, as a non Annex I Party, can take part in only one of the three mechanisms, namely CDM, Precisely for this reasons, CDM is attracting a lot of government attention currently.

## Indian Policy on Kyoto Protocol: [4]

To enlarge the feedback mechanism,

the GoI has constituted the Advisory Group on Climate Change under the chairmanship of the Minister of Environment and Forests. Invitees to the advisory group include representatives of line ministries, research institutes, and civil society. The following are key elements of the Indian stand on the CDM.

- The use of flexible mechanisms to meet commitments should be supplemental to domestic effort and an upper limit to their use should be defined.
- Sinks should not be included in the CDM.
- Criteria for CDM projects
  - Host country to be sole judge of the national sustainable development criteria.
  - The project activity shall promote transfer of technology.
  - Capacity building should be incorporated in all CDM projects.
  - Baselines will be defined on a project-to-project basis.
  - Funding for project activity shall be additional to ODA (official development assistance), EF (global environment facility), and other financial commitments of developed country Parties.
- The 'share of proceeds from certified project activities' shall be a stipulated percentage of the differentials of the costs incurred by the developed country Party in reducing GHG through a project activity in a developing country and of the project costs that would have been incurred had the GHG reduction activity taken place in the developed country funding the project.
- The terms and conditions for sharing CERs (certified emissions reductions) and funding will be mutually agreed upon by the developed and developing country Parties.
- The operational entities to certify emission reductions shall be designated by the COP/MOP (conference of parties to the Convention serving as the meeting of parties to the Protocol).
- A national system of monitoring, verifying and reporting under the CDM shall be established.

### Greenhouse Gas Sources and Sinks Related to Paper Cycle

- Paper production is an energy intensive process requiring mechanical and thermal energy to transform raw materials into finished products. The sector is therefore a significant global user of fossil fuels and electricity. A significant amount of biomass wastes (in solid and sludge or liquid forms) is also produced and requires disposal. Consequently, the industry is a large emitter of Greenhouse gases (GHG) in many parts of the world. The emissions associated with pulp and paper materials differ based on a number of factors:

- The pulping process (mechanical or chemical)
- The type of paper produced
- The type of fuel used for onsite electricity generation.
- The energy efficiency of the mill.

Greenhouse gas emissions for the pulp and paper industry can be readily assessed by the fuel consumption and is already published for most countries in the International energy compendia [9]. Greenhouse gases emission related various activities of paper cycle and their sinks are given in Table 1. Carbon dioxide from fossil fuel combustion used in the production of pulp and paper proves to be the greatest source of greenhouse gas emission in the paper cycle

**Table.1: Annual Emissions of Greenhouse Gases from the Paper cycle:**

Sources	Annual gas Emissions (MT)	CO <sub>2</sub> Equivalents (MT)	CO <sub>2</sub> – C Equivalents (MT)	Certainty
Energy Use (CO <sub>2</sub> )	290	290	79	High
Energy Extraction(CH <sub>4</sub> )	1	32	9	Medium
Energy Use Recycling (CO <sub>2</sub> )	4	4	1	Medium - Low
Transport (CO <sub>2</sub> )	29	29	8	Medium - Low
Landfills (CH <sub>4</sub> )	12	278	76	Medium
Natural Forest Conversion (CO <sub>2</sub> )	74	74	20	Medium - Low
Natural Forest Management (CO <sub>2</sub> )	0	0	0	Low
<b>Total Sources</b>		<b>707</b>	<b>193</b>	
<b>Sinks</b>				
Waste Energy Recovery (CO <sub>2</sub> )	-4	-4	-1	Medium
Plantation – Stable Harvest (CO <sub>2</sub> )	-249	-249	-68	Medium–High
Plantations- New Establishment (CO <sub>2</sub> )	-21	-21	-6	Medium - Low
<b>Total Sinks</b>	<b>-274</b>	<b>-274</b>	<b>-75</b>	
<b>Net Emission Flux</b>		<b>433</b>	<b>118</b>	

**Table 2. Large Scale Methodologies Capacity>15MW [20]**

S.N.	Methodology Number	Name	Explanation
1.	ACM 002	Renewable electricity from captive power	This methodology is applicable only to plants that purchase electricity from grid or intends to export to grid, which is generated from renewable sources
2.	ACM 006	Electricity generation from biomass residues	This methodology is applicable to grid connected and biomass residue fired electricity generation project activities, including cogeneration plants
3.	AM 0008	Fuel switch from coke or petroleum fuel to activity,	This methodology is applicable to a project which is to switch the industrial Natural Gas fuel currently used in some element processing of a facility to natural gas from coal and/or petroleum fuels that would otherwise continue to be used during the crediting period
4.	AMOO18	Steam optimization system	

**Table 3. Large Scale Methodologies Capacity<15MW (UNFCCC - Review of Methodologies) [20]**

S.N.	Methodology Number	Name	Explanation
1.	AMS I.A	Electricity for the user like a fuel Switch)	This category comprises renewable energy generation units that supply individual households or users with a small amount of electricity. Upgrading of existing equipment is not allowed. These units include technologies such as solar power. Hydropower, wind power, and other technologies that produce electricity all of which is used on-site by the user, such as solar home systems, and wind battery chargers. The renewable generating units may be new or replace existing fossil fuel fired generation. The capacity of these renewable energy generators shall not exceed 15MW.
2.	AMS I.B	Mechanical energy	This category comprises renewable energy generation units that supply individual households or users with a small amount of mechanical energy.
3.	AMS I.C	Thermal energy	This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Biomass-based co-generating systems that produce heat and electricity for use on-site are included in this category.
4.	AMS I.D	Renewable electricity generation	This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.
5.	AMS III. B	Fossil fuel switch	
6.	AMS III D	Methane recovery	This project category comprises methane recovery from coalmines, agro-industries, landfills, Wastewater treatment facilities and other sources. Measures shall both reduce anthropogenic emissions by sources and directly emit less than 15 kilo tonnes of carbon dioxide equivalent annually. CO <sub>2</sub> emissions from combustion of non-biogenic methane shall be accounted for in the project activity.
7.	AMSIII.E	Methane avoidance	This project category comprises measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay because of anthropogenic activity. Due to the project activity, decay is prevented through controlled combustion and less methane is produced and emitted to the atmosphere.
8.	AMS II. D	Energy Efficiency and fuel switching measures for industrialized facilities	This category covers project activities aimed primarily at energy efficiency; a project activity that involves primarily fuel switching falls into category III.B.11 Examples include energy efficiency measures (such as efficient motors), fuel switching measures (such as switching from steam or compressed air to electricity) and efficiency measures for specific industrial processes (such as steel furnaces, paper drying, tobacco curing, etc.
9.	ACM 0013,	Avoidance or methane	This project category comprises measures that avoid the production of methane or capture and destroy the methane- from biomass or other organic matter that would have otherwise been treated in an anaerobic process.
10.	ACM 0022	Production through biomass decay through controlled production	

[1],[2],[6],[8],[10],[12],[13],[14],[15],[16],[18],[19],[21]. Production, consumption and disposal of paper products are estimated to contribute a net addition of about 450 million tons in

carbon dioxide equivalent units each year. This sum represents the net emissions of carbon dioxide and methane by equivalent global warming potential integrated over a 100 year

time horizon. This level is somewhat more than the carbon dioxide released each year from fossil fuel combustion in Canada, which is the ninth largest carbon dioxide emitter from energy use. On a carbon equivalent basis (CO<sub>2</sub>-C), i.e. considering only the carbon mass in carbon dioxide, net emissions are calculated to be 118 MT. On average, the production of 1 Adt (Air dry tone) of paper results in 0.67 TCO<sub>2</sub>, [17].

### Clean Development Mechanism: Methodology for Pulp & Paper Industry

The paper industry is possibly the only large-scale industrial sector that is capable of realizing a low carbon energy self-sustaining trajectory. Such a path could be realized whilst avoiding major changes to its primary production process. The adoption of a more effective organization of its existing biomass supply, improved energy efficiency and more sustainable waste management practices in the industry could result in huge savings annually to the industry through carbon trading mechanisms.

For a project to be eligible for carbon credits, it must fall into the limits of certain “methodologies” approved by the UNFCCC. To implement CDM project in pulp and paper Industry, methodologies given in table 2 and 3 need to be followed.

For example efficient chemical recovery units burn organics recovered through washing of pulp agents derivatives. The burning of these organics leads to enough high pressure steam production which can be used to produce power through double extraction turbines. This on one side helps to produce power for running the plant and on the other side produces enough steam to process section. This chemical recovery process comes under AMS I.D section.

### CDM Projects in Indian Pulp and Paper Industries.

Sector specific studies conducted for India indicate a significant potential for CDM projects in the power sector and in enhancing energy efficiency in industries (to the tune of about US\$1.05 billion each) over the next decade. Several CDM projects are being implemented at policy and ground level on Indian pulp and paper Industry.

**Table 4. CDM Projects in Indian pulp and Paper Industries [7]**

S.N.	Project Name:	Industry	Project Scope	Brief Description
1.	Methane Extraction and fuel Conservation Project,	TNPL, Kagitapura, Tamil Nadu	Methane Capture	Up flow Anaerobic Sludge Blanket (UASB) reactor is employed for treating the bagasse wash water effluent generated in the paper industry. Estimate of GHG abatement in tCO <sub>2</sub> eq. is 444984.
2.	Improvement in recovery of black liquor solids through Oxygen Delignification and Free Flow Falling Film Evaporator and its use for steam generation in Soda Recovery Boiler	ITC, Bhadrachalam, Andhra Pradesh	Industrial process	The project is proposed to install a two-stage Oxygen delignification process, an efficient free flow falling film evaporator and soda recovery boilers which will increase the biomass based energy in the plant and reduce the organic loading at the effluent treatment plant. Estimate of GHG abatement in t CO <sub>2</sub> eq. is 498440.
3.	Energy Efficiency Measures at Paper production Plant	APPM, Andhra Pradesh	Energy efficiency	The main thrust areas under this project were identified as use of airflow control, use of equipment that is more efficient and technology up-gradation. Estimate of GHG abatement in tCO <sub>2</sub> eq. is 44,225
4.	Validation of Demand-Side Energy Efficiency Programmes for Specific Technologies	ITC, Bhadrachalam	Energy efficiency	
5.	Validation of an Optimisation of Steam Consumption by Retrofit Measures in Blow Heat Recovery System CDM Project	ITC, Bhadrachalam	New lower GHG emitting technologies	The project intends to manufacture biodiesel from edible / non-edible oils derived from tree borne oil bearing seeds, fatty acids, animal fats etc. for substituting petrodiesel or using as a blend in petro-diesel

Indian paper industry has huge potential for growth, so that industry also has an opportunity to utilize new energy efficient process. It has great scope in the several areas like to install continuous digester, Methane capturing, two-stage Oxygen delignification process, to install biomass gasification plant, to introduce IGCC power plant, reforestation and energy management. Reforestation has wide scope especially in paper Industry; it can provide a sink for GHGs as well as insure sustainable fiber supply.

*Few projects currently being implemented in Indian pulp and paper industry and registered under CDM are briefly discussed in table 4. Table also indicates the target reduction GHG emission.*

**CONCLUSION**

To overcome to all global environmental problems while ensuring sustainable development,

CDM is the best approach for any developing country. This on one side provides environmental sound approach and on the other side encourages technology and money transfer towards developing world. Paper and pulp production sector has huge development potential. The Industry is a priority sector for foreign collaboration and foreign equity participation up to 100% receives automatic approval from Reserve Bank of India. Several fiscal incentives have also been provided to the paper industry, particularly to those mills, which are based on non-conventional raw material. Efficient chemical recovery units with lime mud reburning kilns, proper contribution of high pressure. Recovery boilers, suitable double extraction turbine system, efficient pulping and washing system are the areas which can come under CDM in paper industry. Despite near-term uncertainty about the size of the CDM market and the price of CERs, it is very likely that India will be a major player. This is also true in the long run

where India along with other developing countries may take on some commitments and where emissions trading may be an important component of the GHG abatement architecture. However, it is important that we understand and address the problems in using a broad market-based approach to environmental management in India, particularly with respect to monitoring and enforcement.

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