

# Clean Development Mechanism: Opportunities In Pulp And Paper Business In India

Marimuthu. P.

## ABSTRACT

Paper industry requires large amount of energy in the form of heat. The energy requirement is met with captive and National grid power. Substantial portion of the energy requirement is met through the generation from the fossil fuels such as oil and coal. The industry is also offering tremendous potential to save energy and such savings are CDM opportunities. Industry also emits Greenhouse gases (GHG) like CO<sub>2</sub>, methane are being discharged to the environment since the development of industrialization. Capturing and reusing them offer tremendous potentials. Hence the leading nations evinced enormous interest to save the environment and developed a scheme of Carbon trading. They assist the countries who participate in this programme and reward them with credits towards their emission targets. As the carbon reduction potential is plenty in the pulp and paper industry, we must commit to support this CDM so as to be mutually beneficial.

## Introduction

Life on earth is made possible by energy from the sun, which arrives mainly in the form of visible light. About 30 per

cent of sunlight is scattered back into space by the outer atmosphere and the rest reaches the earth's surface, which reflects it in the form of a calmer, more

slow-moving type of energy called infrared radiation. This is like heat thrown off by an electric grill before the bars begin to glow red. Infrared radiation is carried slowly aloft by air currents, and its eventual escape into space. This is delayed by greenhouse gases (GHG) such as, carbon dioxide, ozone, methane, nitrous oxide, Chlorofluoro Carbon, Perfluoro Carbon and Sulfur hexafluoride (Table-1).

GHG trap the heat emitted from the planet's surface before it can escape to space, called greenhouse effect (Fig-1). The Climate change caused by excess warming of our atmosphere due to the build-up of above GHGs, presents humanity with an unprecedented challenge. The composition of the atmosphere is undergoing a radical change as we consume more and more energy, demand new products from industry and intensify agriculture to feed an ever-increasing population.

GHG Name	Chemical Formula	Pre-industrial Concentration	Present Concentration	GWP
Carbon -di- Oxide	CO <sub>2</sub>	278 ppmv	380 ppmv	1
Methane	CH <sub>4</sub>	700 ppbv	1721 ppbv	21
Nitrous Oxide	N <sub>2</sub> O	275 ppbv	311 ppbv	310
Per-fluro ethane	C <sub>2</sub> F <sub>6</sub> , C <sub>3</sub> F <sub>12</sub> , C <sub>6</sub> F <sub>14</sub>	0	0.503 ppbv	7400-9200
HCFC	CHF <sub>3</sub> , C <sub>3</sub> H <sub>2</sub> F <sub>6</sub> , C <sub>2</sub> H <sub>3</sub> F <sub>3</sub> , C <sub>2</sub> H <sub>2</sub> F <sub>4</sub>	0	0.105 ppbv	1000-11700
Sulphurhexa-flouride	SF <sub>6</sub>	0	0.032 ppbv	23900

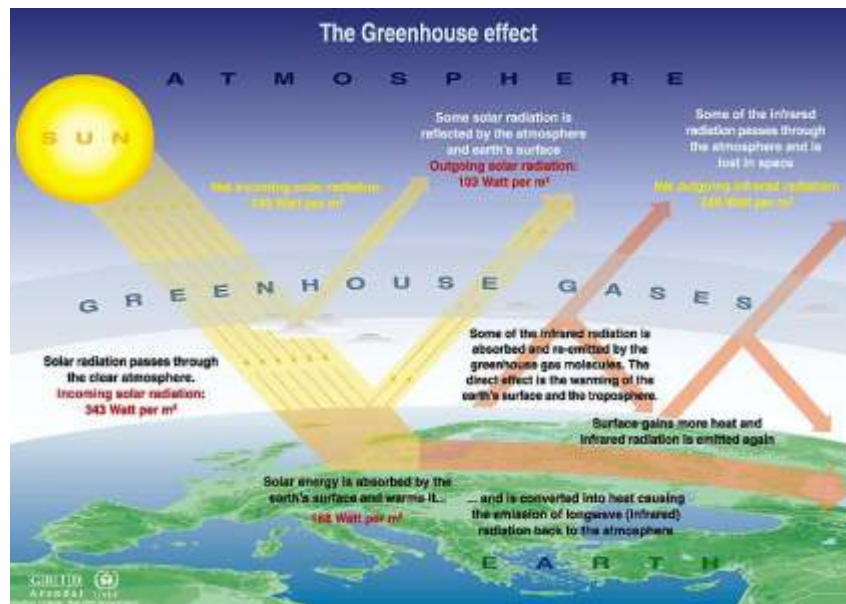


Fig.1

Seshasayee Paper and Boards Ltd,  
Erode-7, Tamilnadu. India.

## OUR CLIMATE AND GHG EFFECT

A planet's climate is decided by its mass, its distance from the sun and the composition of its atmosphere. Venus has almost same mass as Earth but a thicker atmosphere, composed of 96% carbon dioxide. The surface temperature on Venus is +460°C. However, Earth's atmosphere is 78% nitrogen, 21% oxygen, and 1% other gases like Carbon-di-oxide accounts for just 0.03 - 0.04% and water vapour etc, As stated earlier, Carbon dioxide and other GHGs present in the atmosphere absorb some of the thermal radiation

leaving the earth surface and emit radiation from much higher levels out to space. They act as a partial blanket for the thermal radiation from the surface and enable it to be substantially warmer than it would otherwise be, analogous to the effect of a greenhouse. This blanketing is known as the natural greenhouse effect. Without the GHGs, Earth's average temperature would be roughly -20°C.

Global Warming Potential (GWP) is an index defined as the cumulative radioactive forcing between the present and some chosen time horizon caused by a unit mass of gas, expressed relative to a reference gas such as CO<sub>2</sub>. GWP is an attempt to provide a simple measure of the relative radioactive effects of different GHGs. The future global warming potential of a greenhouse gas can be calculated over a chosen time horizon (such as 100 years) by multiplying the appropriate GWP by the amount of gas emitted. Over the last 400,000 years the Earth's climate has been unstable, with very significant temperature changes, going from a warm climate to an ice age as rapidly as few decades. These rapid changes suggest that climate may be quite sensitive to internal or external climate forcing and feedbacks.

Atmospheric CO<sub>2</sub> has increased from a pre-industrial concentration of about 280 ppmv to about 380 ppmv at present (ppmv= parts per million by volume). It is evident that the rapid increase in CO<sub>2</sub> concentrations has been occurring since the onset of industrialization. The increase has closely followed the increase in CO<sub>2</sub> emissions from fossil fuels (Fig-2). Emissions of carbon dioxide due to changes in land use mainly come from the cutting down of forests and using the forest land for

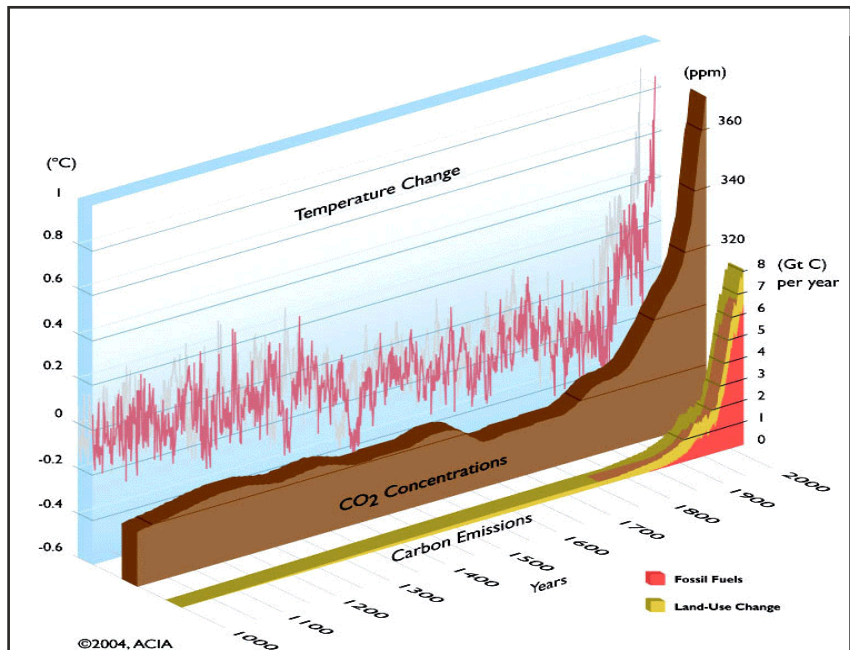


Fig 2

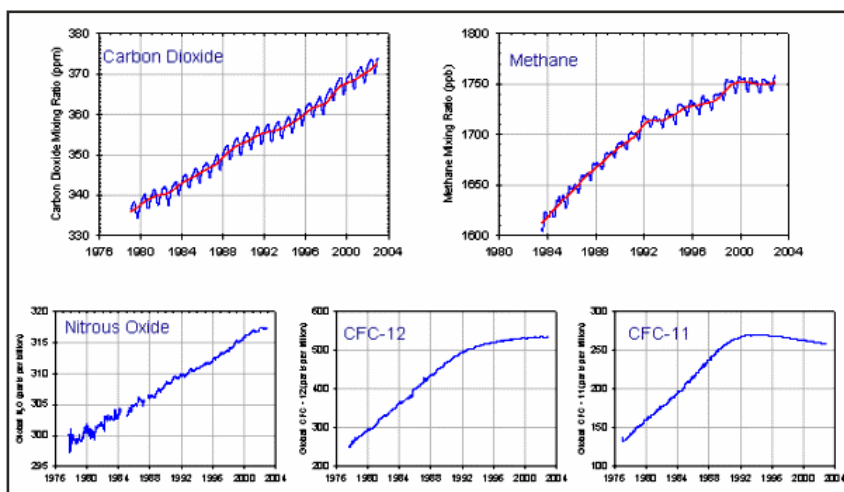
other purposes like agriculture, industry, infrastructure development, urbanization etc. When large areas of rain forests are cut down, the land often turns into less productive grasslands with considerably less capacity of storing CO<sub>2</sub> due to low biological productivity.

### Impact Of Greenhouse effect

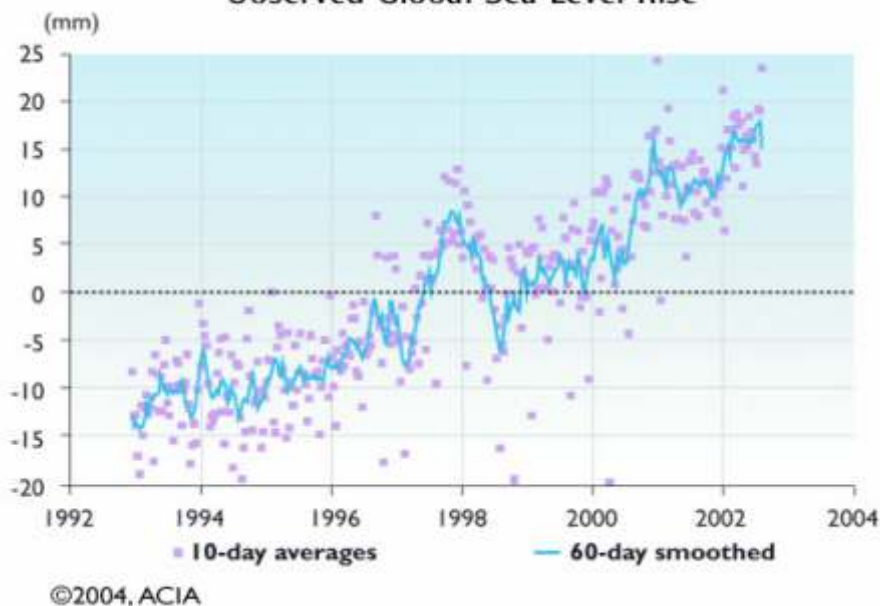
Due to greenhouse effect, the average temperature of the earth's surface has risen by 0.6 °C, since the industrial revolution. It is expected that it would increase by another 1.4 to 5.8 °C by the year 2100, a rapid and profound change. Even if the minimum predicted increase takes place, it will be larger than any century-long trend in the last 10,000 years. It appears that 1990 is the warmest decade of the last Millennium, and 1998 the warmest year. The current

warming trend is expected to cause extinctions of numerous plant and animal species, already weakened by pollution and loss of habitat and are not expected to survive the next 100 years. Most of the world's endangered species, 25 per cent of mammals and 12 per cent of birds, may become extinct over the next few decades as warmer conditions alter the forests, wetlands, and rangelands they depend on, and human development blocks them from migrating elsewhere. Human beings, while not threatened in this way, are likely to face mounting difficulties from extreme weather events, such as, severe storms, floods, droughts and wild fires.

Higher temperatures are expected to expand the range of some dangerous "vector-borne" diseases, such as malaria, which already kills 1 million people annually. All these effects lead to enormous economic loss to world community. The sea level rose on an average by 10 to 20 cm during the 20<sup>th</sup> century (FIG .3), and an additional increase of 9 to 88 cm is expected by the year 2100. Higher temperatures cause ocean volume to expand, and melting glaciers and ice caps add more water. Saltwater intrusion from rising sea levels will reduce the quality and quantity of freshwater supplies. This is a major concern, since billions of people already lack access to freshwater. Higher ocean levels are already contaminating underground water sources in Israel and Thailand, in various small island states in the Pacific



## Observed Global Sea Level Rise



and Indian Oceans, the Caribbean Sea, and in some of the world's most productive deltas, such as China's Yangtze Delta and Vietnam's Mekong Delta.

Therefore, global warming is considered as serious and complicated problem involving the entire world, tangled up with difficult issues such as poverty, economic development and population growth.

### Reasons for GHG Effect

Scientists have tested hypotheses of natural vs. anthropogenic (human-caused) forces to explain how climate has changed over the past century or more, using computer based models and found that there is a perfect correlation between enhanced greenhouse effect and anthropogenic activity. The industrialized countries of North America and Western Europe, along with a few other states, are responsible for the vast bulk of past and current GHG emissions. These emissions are a debt unwittingly incurred for the high standards of living enjoyed by a minority of the world's population. The rich countries of the world historically have emitted most of the anthropogenic GHGs since the start of the industrial revolution. The Developed countries still produce the significant emissions. Non-industrialized countries strive to increase their population and standard of living, thereby increasing their emissions of GHGs, since economic

development is closely associated with energy production. The volume of GHG thus will probably increase despite the efforts to reduce emissions in industrialized countries.

Those to suffer most from climate change will be in the developing world. They have fewer resources for coping with storms, with floods, with droughts, with disease outbreaks, and with disruptions to food and water supplies. They are eager for economic development themselves, but may find that this already difficult process has become more difficult because of climate change. The poorer nations of the world have done almost nothing to cause global warming yet are most exposed to its effects.

### Can WE manage our GHG EMISSION?

#### a. CO<sub>2</sub> friendly:

Getting more electricity, transport, and industrial output for less coal, oil, or gasoline is a no lose situation, more profit, less pollution, less global warming although initial outlays for better equipment and technology can be expensive. Most of the immediate progress that can be made to reduce GHG emissions involves using fossil fuels more efficiently. The savings realized this way will buy time for the global climate system while alternative energy technologies can be developed and made cost effective. It is hoped that emissions free sources ultimately will

replace fossil fuels as the main category of energy supply. Fuel cells and other advanced automotive technologies can cut carbon-dioxide emissions from transport roughly by half like hybrid (gas/electricity) vehicles and some of which are already in the market. Natural gas releases less carbon dioxide per unit of energy than coal or oil. Hence, switching to natural gas is a quick way to cut emissions.

#### b. Improved Energy Efficiency:

Industry, which accounts for over 40 per cent of global carbon-dioxide emissions, can benefit from combined heat and power co-generation, other uses of waste heat, improved energy management, and more efficient manufacturing processes. Installing more efficient lighting and appliances in buildings can significantly cut electricity use. Improving building insulation can greatly reduce the amount of fuel needed for heating or air conditioning.

#### c. Promoting Renewable Energy Technologies:

Solar and wind energy at current levels of efficiency and cost can replace some fossil-fuel use, and are increasingly being used. Greater employment of such technologies can increase their efficiencies of scale and lower their costs. The current contribution of such energy producing methods to world supplies is less than 2%. Expansion of hydro-electric power, where appropriate, could make a major contribution to lowering GHG emissions, but the use of hydropower is necessarily limited by its impacts on human settlements and river systems. Biomass sources of energy, such as, fuel wood, alcohol fermented from sugar, combustible oils extracted from soybeans and methane gas emitted by waste dumps can help cut greenhouse gas emissions. But only, if vegetation used for the purpose is replaced by equal amounts of replanted vegetation, so that the carbon dioxide released by biomass combustion is recaptured through photosynthesis.





#### d. The role of "sinks":

The unglamorous term "sinks" is the term used by climatologists for vast cover of trees and other green vegetation which "drain away" the most dominant greenhouse gas. Trees and other green plants, using only sunlight for energy, take carbon dioxide out of the atmosphere, releasing oxygen and storing carbon in a safe and useful way. Forests, which provide all kinds of undervalued benefits for mankind, can be major allies in the battle against climate change and global warming if only humans start planting them and stop cutting them down. Deforestation, which is occurring all over the world, has a doubly damaging effect. It reduces the number of trees that can recover the carbon dioxide produced by human activities and it releases into the atmosphere the carbon contained in the trees that are cut down. The value of trees as timber and as firewood and the value of the land they occupy for housing or farming, tend to be short-term. The value of forests for preventing global warming and preserving the earth's biodiversity, by contrast, are long-term and their rewards apply to everyone. Therefore, a way has to be found to increase forests cover to be cost-effective and benefit the local populations who depend on it.

#### Kyoto protocol

The United Nations Framework Convention on Climate Change (UNFCCC) is the foundation of global efforts to combat global warming and climate change. Opened for signature in 1992 at the Rio Earth Summit, its ultimate objective is the "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic human-induced interference with the climate system. Over a decade ago, most countries joined an international treaty, including India to consider what can be done to reduce global warming. After intense negotiations, a legally binding treaty namely Kyoto Protocol was agreed in 1997 by the majority of the governments called Conference of Parties. United Nations Environment Programme and World Meteorological Organization jointly established the Intergovernmental Panel on Climate Change (IPCC). The purpose of the IPCC was to assess the state of knowledge on the various aspects of climate change including science, environmental and socio-economic impacts and response strategies. The

IPCC is recognized as the most authoritative scientific and technical voice on climate change, and its assessments had a profound influence on the negotiators of the UNFCCC and its Kyoto Protocol. Legally, the Protocol entered into force on February 16, 2005 after ratification by the countries who contribute more than 55% of GHG emission/55% of the signatories including India.

#### Clean Development Mechanism (CDM)

Clean Development Mechanism (CDM) is a mechanism that is based on the provision of Article 12 of the Kyoto Protocol. It is a scheme for GHG emission reduction through cooperation between developed countries which are committed to certain GHG emission reduction targets under the Kyoto Protocol, and other developing countries, which do not have any commitment to reduce GHG emissions. The purpose of CDM is to assist to accomplish the GHG reduction targets of countries under the Kyoto Protocol. Under the CDM, countries under Kyoto Protocol, implement projects (e.g. biomethanation projects with biogas (methane) recovery and power generation or fossil saving resulting in reduction of greenhouse gas emissions within parts of projects. Developing countries will benefit by getting capital and technology through the CDM projects. CDM otherwise is an investment proposition by which developed countries would invest in a GHG mitigation project in a developing country and in turn get credits towards their emission reduction targets, while the firm in the developing country would receive capital flows and clean technology. GHG Emission Reduction

generated through the CDM projects are called Certified Emission Reduction (CER). 1 CER is equal to one 1 t CO<sub>2</sub> emission reduction or its equivalent (for example one tonne of methane emission reduction is equal to 21 t of CO<sub>2</sub> or 21 CERs).

#### CDM Project Scopes

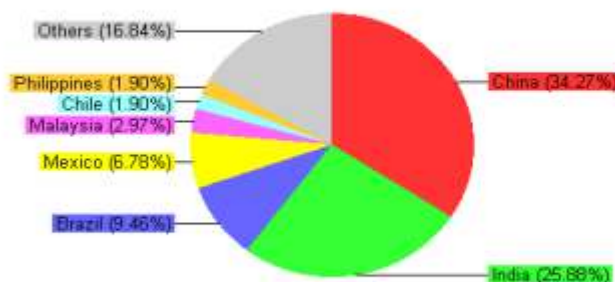
The following 15 scopes for CDM project activities were defined by the EB, based on the list of sectors and sources contained in Annex A of the Kyoto Protocol. The scopes are relevant in the validation and verification process. DOE must have a valid accreditation for each sector it wants to operate in. Also the baseline and monitoring methodologies are organized according to these scopes:

1. Energy industries (renewable - / non-renewable sources)
2. Energy distribution
3. Energy demand
4. Manufacturing Industry
5. Chemical Industry
6. Construction
7. Transport
8. Mining and Mineral Production
9. Metal Production
10. Fugitive emissions from fuels (solid, oil, gas)
11. Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride
12. Solvent used
13. Waste handling and disposal
14. Afforestation and Reforestation
15. Agriculture

#### CDM Scenario in India

India plays a leading role in the CDM by having maximum number of registered projects for its credit. As of

Registered project activities by host party. Total: 1,681



<http://cdm.unfccc.int> (c) 22.06.2009 14:53

January 2009 India has 435 registered CDM projects out of total 1691 registered projects accounting for 35292217 CERs per annum out of total 305107750 CERs. Ministry of Environment and Forest is the Designated National Authority which oversees all the CDM project activities in India.

### **CDM opportunities in pulp and industries**

Press upgrade to reduce steam in dryers  
Wet end Management in Paper Machines  
Energy friendly Refiners  
Steam and condensate upgrade  
Hood upgrade say in paper machine  
Stock refining optimization to save electrical energy  
High Pressure Cogeneration with high cogeneration efficiency  
Switch over to high pressure boilers  
Optimise compressors  
Make Pressure reducing system (PRDS) zero  
Bio mass in place of fossil fuel & paper culm as auxiliary fuel  
High Energy Recovery Boiler with associated energy efficient Steam turbo-generator  
Fuel switch ( HFO to Producer gas derived from coal/biomass) in Rotary Lime Kiln  
Bio methanation project ( methane capture and firing in lime kiln)  
LMCD moisture reduction in recausticizing section to relate to lowered specific fuel consumption in Lime Kiln  
MP to LP steam switch wherever practicable in process & utilities  
Heat exchangers wherever possible to recover and reuse heat  
Energy efficient chippers  
Blow heat recovery in Fiberline  
ODL with high Lignin recovery  
Increase concentration of black liquor from pulp mill  
State of the art Multieffect Evaporator with highest steam economy practicable  
Energy Conservation in Chlorine dioxide plant  
Energy Efficient Rotating Machinery viz., Pumps, fans etc.  
Energy Efficient Motors to suit  
Advanced Automation & Controls encompassing Fuzzy Logic

Plantation  
Solar projects  
Wind mills

## **EMISSION REDUCTION PROJECTS IN SPB**

### **Fuel switch in Lime Kiln**

Presently Furnace Oil is used as Fuel in Rotary Lime Kiln for lime sludge reburning. It is proposed to go in for a Biogas substitute for partial replacement of furnace oil. Biogas Generation is planned from bagasse and Coconut shell. This project not only contributes to reduction in GHG but also helps in conserving fossil fuel.

### **Methane Extraction for Fuel Conservation Project**

In paper making, bagasse is the agro based raw material and a good substitute for the pulp wood. The bagasse received from the sugar mill is having 3-4% residual sugar which yield the required Chemical Oxygen demand (COD) on storage. While preparing the fibre for paper making, bagasse is washed and the washed water is stored in an anaerobic lagoon. This open lagoon generates methane on an uncontrolled reaction. Research studies have shown that a controlled reaction in a Biomethanation reactor captures the GHG and converts it into a bio-fuel. Such biofuel not only substitutes the fossil fuel usage in the paper industry but substantially cuts down the organic pollution load in the effluent, saving consumption of chemical consumables.

Biogas captured contains mostly methane and the same shall be fired in the Lime kiln, thereby partly substituting furnace oil. Methane has been established to have 21 times more Global warming potential than CO<sub>2</sub>.

### **Multi-effect Falling Film Evaporator**

The objective of the project activity is to reduce specific steam consumption in the evaporator. by replacing the existing long tube rising film evaporators with multi effect free flow falling film evaporator. In the pulp and paper industry, the black liquor evaporation process consumes large quantities of thermal energy. The water content of black liquor is evaporated in the evaporation process and the solids concentration is raised to the level that facilitates its efficient combustion and higher thermal efficiency of the boiler.

Under the modernization programme SPB has opted for multi-effect energy efficient free flow falling film evaporator with improvised Low pressure steam economy of 6.3 as against 4 to 4.5 in the earlier design of long tube vertical type rising film evaporator. Therefore the project is likely to reduce GHG emissions in the boiler fired with coal for steam generation.

### **New High Pressure Recovery Island**

The objective of the project is to generate incremental power from the biomass used at the site for co-generation. SPB has replaced the existing low pressure (29 bar) biomass based cogeneration plant with high pressure (65 bar) biomass based cogeneration plant. Hence the project essentially replaces grid electricity and thus it reduces Greenhouse gas (GHG) emissions from sources that are supplying electricity to the common Southern Regional Grid.

### **Heat Recovery Projects bundle**

- Heat Recovery from Hot Effluent Discharge from EOP of Fiberline for Hot Water Generation. Special type Wide-Gap PHE planned as Heat Recovery Unit.
- Blow Heat recovery in RDH
- Heat Recovery from low grade warm water from evaporator condenser presently being cooled in Cooling tower
- Steam consumption optimization in ClO<sub>2</sub> plant

The steam consumption is reduced by recovering the excess heat and hence the project aids in lesser steam generation thereby helping reduction in GHG.

### **Conclusions:**

Paper industry is energy intensive. Substantial portion of the energy requirement is met through the generation from the fossil fuels such as oil and coal. The industry is also offering tremendous potential to save energy and such savings are CDM opportunities. To qualify for CDM, Additionally factor should be strong. Industry also emits Greenhouse gases (GHG) like CO<sub>2</sub>, methane and capturing and reusing them offer tremendous potentials in Emission Reduction.

### **Acknowledgement**

The author thanks M/s SPB Ltd management for the consent to publish this paper in the IPPTA zonal seminar 2009.