

# Positioning Of Indian Paper Industry To Face The Ecological Challenges Of Tomorrow

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## ABSTRACT

Indian Paper Industry is growing at 10% on an average across segment and expects to touch 28 million MT per annum by 2025 from the current level of 10 million MT, which will be about 200% growth in just 15 years. The main challenges before the Indian Paper Industry still remains the shortage of fibrous raw material and the energy and its cost. There is an urgent need to bridge the projected supply and demand gap. If this issue is not addressed without linking with ecology will derail all projections and growth figures and have adverse impact on every one associated with paper industry. Industrial ecology (IE) is a biological concept applied to industrial structures. The basic concepts of IE include regional, intra-firm and product-based waste recycling systems as well as the principle of upward and downward cascading. In best current examples of regional systems, several parties are in an industrial waste re-use symbiosis. Paper industry has learned to arrange the recovery and re-use of its products. For the paper industry, earth systems engineering offers several development routes. One of them is the further recognition of and research on the fact that the products of the industry are returned back to the carbon cycle of the natural environment. Opportunities for modifying current earth systems may also be available for the industry, e.g. genetically modified plants for raw materials or organisms for making good quality pulp out of current raw materials. It is to be recognized that existing Ecosystem may become a very controversial area, and that very diverse political pressures may determine its future usefulness to the Indian paper industry.

## Introduction

Paper has been innovating for nearly two thousand years to meet mankind's ever-changing needs and today it is an integral part of our daily life: as a print medium to communicate information and knowledge, as a packaging material, for daily hygiene, or as a special material for a variety of applications, from banknotes to medical filters. Throughout the day, each and every one of us is in permanent contact with this natural, renewable and recyclable material.

As with all production activities, papermaking uses resources. Unlike other materials, however, paper is made from wood, a renewable resource, and is a prime example of successful recycling. Indian Paper Industry is growing at 10% on an average across segment and expects to touch 28 million MT per annum by 2025 from the current level of 10 million MT, which will be about 200% growth in just 15 years (1). The main challenges before the Indian Paper Industry still

remain the shortage of fibrous raw material and the energy and its cost. There is an urgent need to bridge the projected supply and demand gap. If this issue is not addressed without linking with ecology, it will derail all projections and growth figures and have adverse impact on every one associated with paper industry.

## Connection Between Ecology And Industry

Ecology is science that studies the interaction between organisms and environment they live in and industry is manufacture of some merchandise or service in order to make profits. The final goal of industry is to create big profits while final goal of ecology is to find an ideal coexistence of all living and non-living organisms in some environment. Making money on one side and making harmony in nature on the other side are two completely different point of views, so it's really no surprise that ecology and industry are very rarely on the same wavelength. In most cases industry is the one that makes the rules and dominates the world because industry is all about money, and money is the only real driving force behind our civilization.

## The Ecological Footprint: A Global Context

The Ecological Footprint measures human demand on the biosphere in terms of the land and sea area required to provide the resources we use and to absorb the waste we generate. In 2003 the global Ecological Footprint was 14.1 billion global hectares, or 2.2 global hectares per person. (a global hectare is a hectare with world average ability to produce resources and absorb wastes). Total bio capacity was 11.2 global hectares, or 1.8 global hectares per person. With demand exceeding supply by about 25 per cent in 2003, it took the Earth approximately a year and three months to regenerate the ecological resources humanity used that year. Consumption differs considerably by country. India's Ecological Footprint in 2003 was on average 0.8 global hectares per person, ranking it 125th of 152 nations measured. Most people in India consumed less than this average, while others consumed far more. Despite this low average consumption per person, because of its large population, India has the third largest total Footprint, exceeded only by the United States and

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China (2).

### Industrial Ecology

During the last ten years, concepts such as sustainable development, industrial ecology and environmental management have been more frequently used by industry, the world of academia, the media, public administration and the NGOs. The rapidly-growing new field of *industrial ecology* (IE) offers methods that can assist corporations and organizations in sustainable operations and serving as agents of change. Industrial ecologists have even referred to their field as "**the science of sustainability**". In brief, industrial ecology might be defined as the study of interactions between industries and their environment. IE studies technological and managerial approaches for reconfiguring industrial activities to conserve natural resources and reduce pollution (3).

many interconnections new behaviors, new material and energy flows and new feedback among those components. Simple physical descriptions of the associated material and energy flows provide only one relevant piece of information to understand those changes.(4).

### Principles Of Industrial Ecology

Industrial ecology is the means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, giving continued economic, cultural, and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them (5).The Principles include the following:

#### i.) Connect individual firms into

#### individual ecosystem.

- a). Close loops through reuse and recycle.
- b).Maximise efficiency of materials and energy use.
- c).Minimise waste generation.
- d). Define all wastes as potential products and seek market for them.

#### ii.) Balance inputs and out puts to natural ecosystem capacities.

- a) Reduce the environment burden created by release of energy and material into the natural receiving environment.
- b) Avoid or minimise creating and transporting hazardous material.

#### iii.) Re-engineer industrial use of energy and materials.

- a) Redesign process to reduce energy usage.
- b) Substitute technologies and product design to reduce use of materials that disperses them beyond possibility of recapture.
- c) Do more with less ( dematerialisation )

#### iv.) Align policy with long- term perspective of individual system evolution.

The policy to be adopted for sustained ecosystem is shown in Fig.2. with self explanation.

### Industrial Ecology Systems And Types

The emerging discipline of industrial ecology is an attempt to re-establish an intricate mesh of exchanges of goods and services in order to minimise environmental impact of economic activities. To achieve these goals, industrial ecology must concentrate not

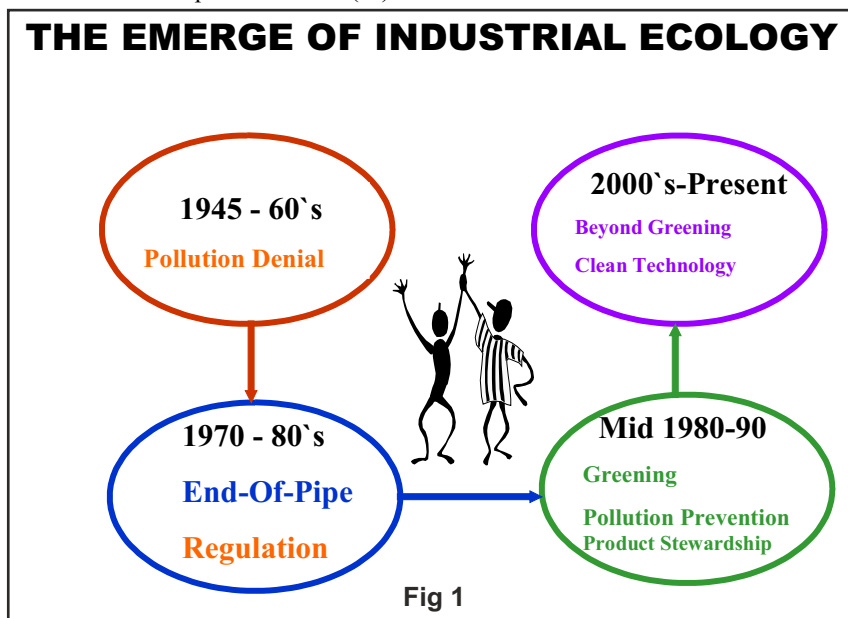


Fig 1

The periodic emerge of Industrial Ecology is shown in Fig-1.

### The Structure Of Industrial Ecosystem

The complexity of dynamic industrial ecosystems results from the many possible interactions at the physical and technological levels, the many pathways through which their ramifications permeate environmental, economic and social systems, and the many, diverse perceptions and actions of the individuals making up to those systems. A simple change anywhere in an industrial system may be buffered and never exert large-scale system impact- or it may ripple though the

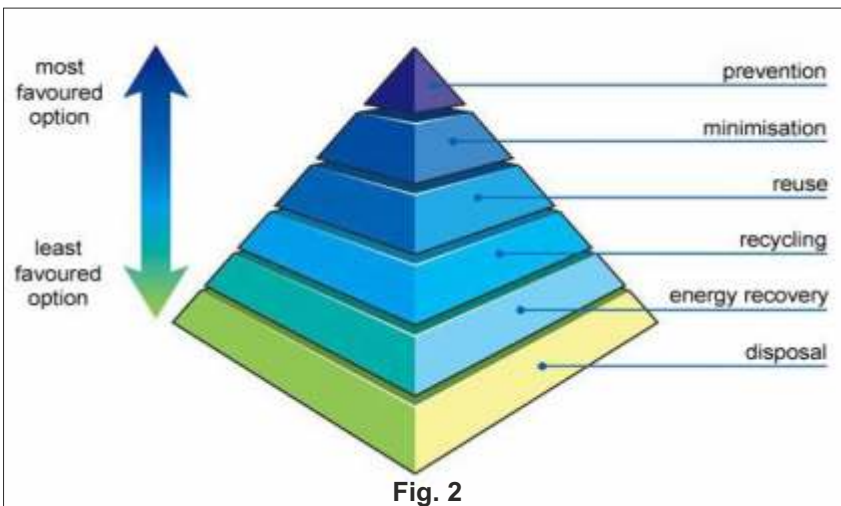
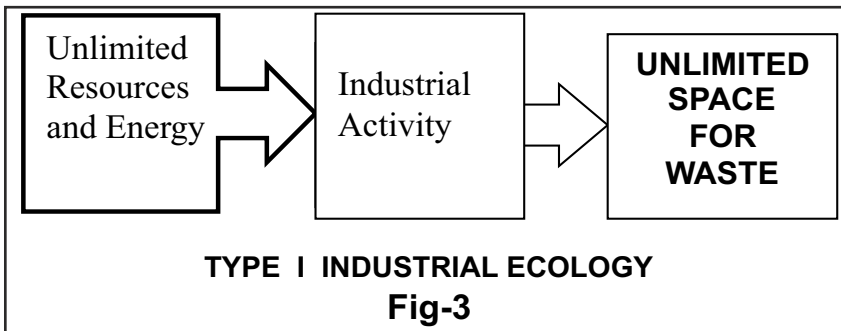


Fig. 2

only on the role of products, technology, and industry, but also on the combined socioeconomic and environmental system (6). There are three types of industrial ecologies.

**Type - I Ecology**

By mid-twentieth century Industry in the developed world, paid little attention to scarcity issues on either the source or sink side ; resources are cheap, essentially infinite and there is plenty of room for, and few restrictions on waste disposal. During that time the scenario of Indian Paper Industry was also similar to that of developing countries ; The paper Industry consumes various cellulosic materials, namely, bamboo, eucalyptus, sabai grass, salai wood, coniferous wood, waste paper, agricultural waste and imported pulp. This model is shown in Fig. 3. The process of making pulp and paper requires large amount of fibrous raw material, water and energy. In India, the activities arising out of raw

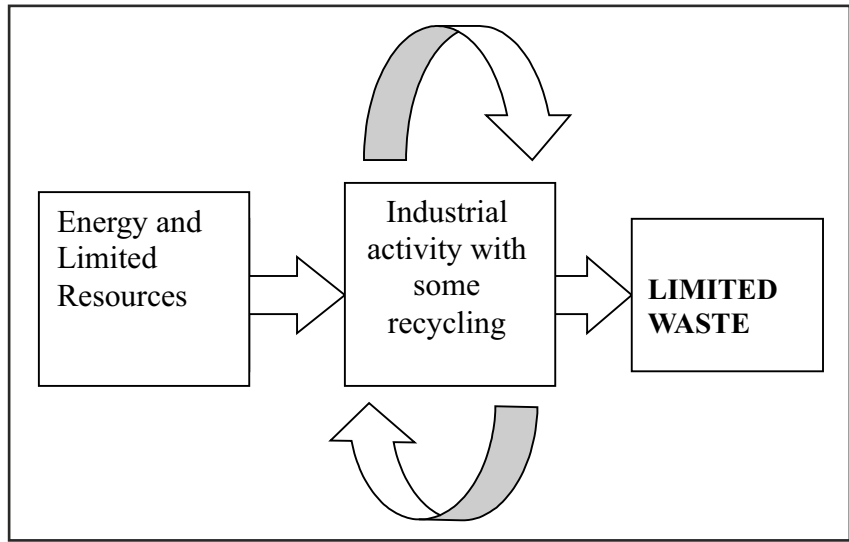


material utilisation and manufacturing process brings rise to ecological and environmental problems, which can be classified under three aspects.

- i) Depletion of renewable wood resources contributing to deforestation.
- ii) Increased resort to monoculture eucalyptus plantations with consequent ecological imbalance of tropical ever green forest.
- iii) Pollution of environment, waste waters and solid waste leading to water and land pollution, air and odour emissions leading to air pollution.

**Type-II Ecology**

The developed world is slowly moving towards second type ecology. It is a natural progression from a type one ecology that exists in a finite from an extended period of time. In this industrial ecology, economic pressures from scarcity and regulations put limitations on resources and sinks for



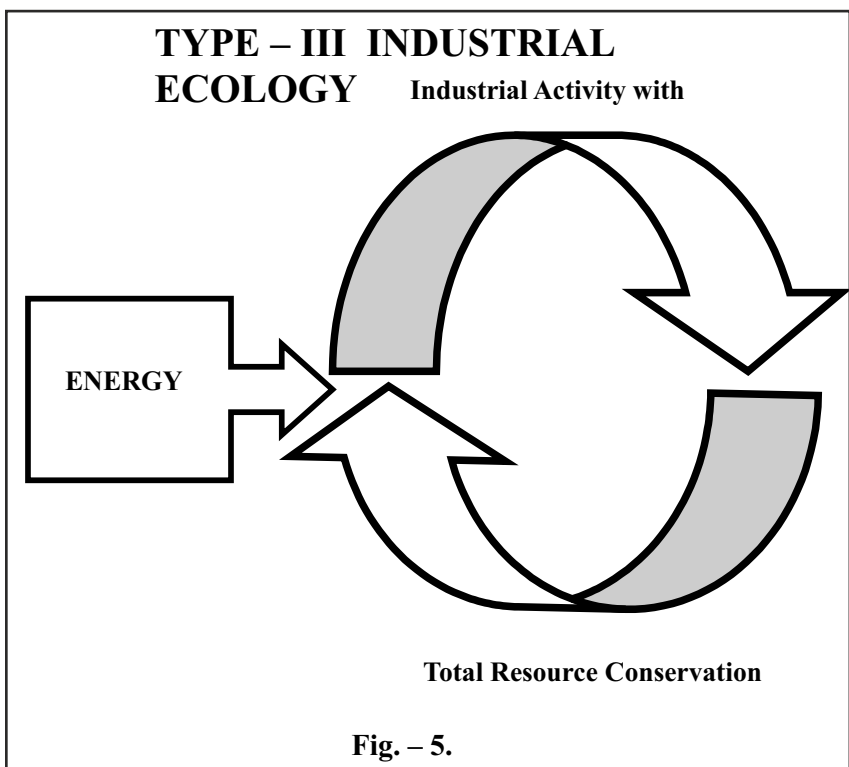
**Fig - 4**

resources, promoting modest loops in industry. However, a type II ecology is not an equilibrium state, only economic and regulatory pressures

prevent its reversion to type I. This type of model is shown in Fig 4.

**Type-III Industrial Ecology**

In this system, material and energy recycling endeavors are at thermodynamic maximal, and only minimal resource and solar energy inputs are necessary to sustain system vitality. Unfortunately, the transition to such an industrial structure is as much a socioeconomic issue as it is a technological one. This type of model is shown in Fig. 5



## Status Of Indian Paper Industry In Industrial Ecology And The Regulations.

At present the Indian Paper Industry is in the Type II industrial ecology system. Where, partial recycling / recovery exists and also making an effort to produce renewable raw materials, recovery of recycled fiber and adoption of cleaner pulping and bleaching technologies to produce more paper and paperboards.

### Actions Initiated by ITC - PSPD, Unit: Bhadrachalam For Ecological Balance.

- Developing & Planting of high yielding short maturity pulpable wood species.
- Improved Recovery & Utilisation of Recyclable Waste Paper.
- Adoption of Cleaner production Technologies.
- Total Productive Maintenance (TPM).
- Waste Minimisation & Reuse.
- Customer Care With Proper Supply Chain System.
- Commitment To Social Responsibility.

### Few Of The Above Are Described Below: Over Coming the scarcity of raw material and beyond.

Wood is the major raw material for the pulp and paper industry. Earlier, natural forests provided a ready available source, but with increasing anthropogenic pressures resulting in shrinkage and deforestation, this resource has drastically dwindled over the years. Acting proactively, ITC, has launched a major plantation programme. Its objective is two folds - to achieve self-sufficiency and improve productivity, on the one hand, and to provide agricultural farmers a viable alternative land use option. Moving forward in this endeavor, a Biotechnology based tree improvement programme is initiated by promoting clonal plantations. (7). The focus is on the genetic enrichment of pulpwood tree species and improvement of plantation package of practices. R&D efforts have resulted in high yielding, site specific, disease resistant eucalyptus and subabul clones and also extensive knowledge of plantation management practices.

Apart from the obvious benefits of increasing the green cover, this

initiative also directly contributes to in-situ moisture conservation, ground water recharge and significant reduction in top soil losses due to wind and water erosion. As result of leaf litter from the multi species plantations and promotion of leguminous inter crops, depleted soils are constantly enriched. ITC's social and farm forestry initiatives at the year 2009-10, stands at 103466 hectares. This initiative has not only provided a sustainable source of rawmaterial for the industry, but has also helped sequester 4785 KT of CO<sub>2</sub>, provided over 46 million person - days of employment and also consolidated ITC's status as a Carbon Positive Company for the fifth year in a row.

### Improved recovery and utilisation of recyclable waste paper

The share of recycled fiber in paper making in India is over 40%. Waste paper recovery rate is, however, not yet on the global average. The major

reasons for India lagging behind in the aspect of source segregation and recycling is our habits are deep rooted and we lack discipline. With every new born child, garbage levels also increase by 0.5 Kgs. per day. With Indian population growing at two crores per annum, the garbage level goes up by 3.65 million MT per annum. By 2015 India's population will be 1.3 billion and the annual garbage generated will be 600 million. The only alternative solution is to recover waste paper from it, which decrease the dependability on the imported recycle fiber.

### Steps For Effective Recovery Of Recycled Fiber

- # Make Commitment To Recycling
- # Appoint A Recycling Co Ordinator
- # Decide What Type Of Paper To Collect
- # Establish An Efficient Collection System.
- # Educate your Employees
- # Kick Off Your recycling

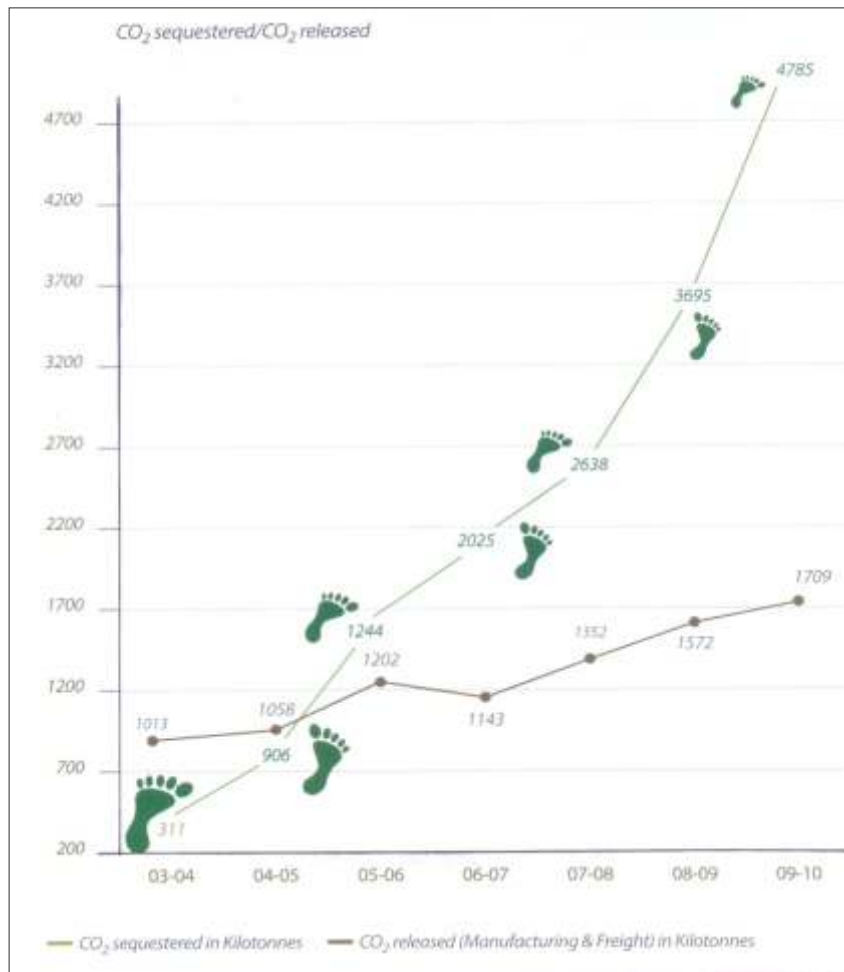


Fig. 6., shows the year wise CO<sub>2</sub> sequestered / CO<sub>2</sub> released by its operations.

### Programme

- # Carry out Waste Paper Audit
- # Research Market For Your Recycling Paper
- # Maintain your Recycling Programme.

ITC has taken an initiative, such as Creating Wealth Out Of Waste. (WOW). It not only creates awareness among the public about the advantages of the "Reduce-Reuse-Recycle" process, protect environment, improving civic amenities, public health and hygiene but also generates cost effective rawmaterial for the paper industry. To emphasise the importance of source segregation, ITC provides special bags to accumulate waste paper, arranges periodic collection through outsource agencies. What started in a small way with house holds have now spread to schools, Government offices, Corporate and other Institutions. In 2007, the WOW initiative spread itself across South India . WOW focus is shown in Fig-7. This activity will further boost the waste paper collection which can be recycled to produce more paper.(8).

### National Recycling

National Recycling day ie:1<sup>st</sup> July 2010,was organised at Hyderabad, with the association of NGO's and schools. More than five hundred School children attended and took a pledge on recycling. The pledge taken is as follows:

### Pledge to:

- Reduce, Reuse and Recycle.
- Take up segregation of waste into dry and wet waste.
- Use eco-friendly products made up of recyclable materials.
- Avoid Wastage.
- Conserve natural resources.
- Avoid stand by mode and switch off appliances.
- Use energy efficient appliances.
- Switch to renewable energy.
- Spread the message of recycling.

### Adoption Of Cleaner Pulp Bleaching System To Minimise Water Pollution And Resource Conservation.

Elemental Chlorine-Free (ECF) bleaching for the pulp and paper industry, dioxide, offers a number of fundamental benefits over traditional methods. Time and again, in both laboratory and industrial experience, chlorine dioxide has proven itself to be a pollution prevention process for the pulp and paper industry. Perhaps most important is that use of chlorine dioxide in the first stage of chemical pulp bleaching virtually eliminates the formation of dioxin and other persistent, bio-accumulative substances. Initially, chlorine dioxide was used to improve upon the pulp brightness. Today , Indian Pulp and paper industry realises the importance

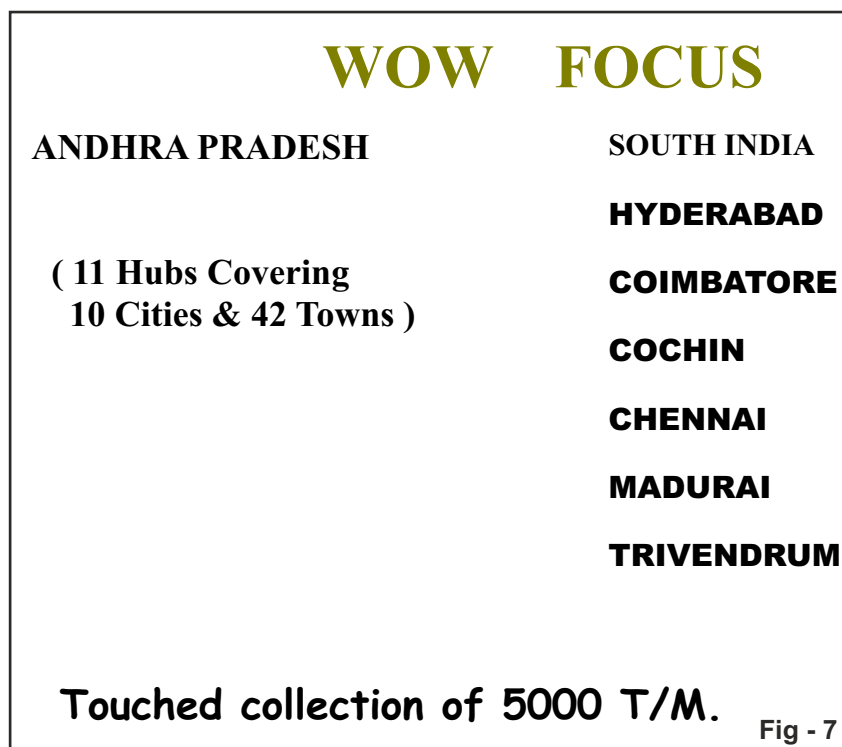
of use of ECF bleaching along with Oxygen De-lignification. This enables in bleaching of low strength pulps, reduction in usage of costly bleaching chemicals and finally minimum discharge of pollutants. Thus helping the industry for its sustainable growth and development. ITC, has gone further step in this direction by introduction of ozone bleaching, which further the improves the quality of pulp and waste water discharge.

### Improved Supply Chain System

The pulp and paper industry is stepping into a new phase of business evolution driven by consolidation of industry, globalisation and ever-increasing competition. These market drivers are forcing the pulp and paper industry to put a greater focus on cost efficiency. These focuses are creating totally new challenges for the organisation, specifically in the IT area. Thus, the present supply chain management involves all the activities associated with moving goods from raw materials stage through to the end user or customer, it coordinates and integrates all the activities into a seamless process. It links all of the partners in the chain of paper industry, i.e.: planning process, plantation activities, finance, materials procurement, production, sales/ marketing, HR activities, converters, vendors, transporters and major customers to work together for sustainable production and profitability.

### New Regulatory Pressures on Indian Paper Industry

Indian Paper Industry is already under severe pollution regulations added to this CREP has come into effect. The Ministry of Environment & Forest (MOEF) has launched the Charter on "Corporate Responsibility for Environmental Protection (CREP)" in march 2003 with the purpose to go beyond the compliance of regulatory norms for prevention & control of pollution through various measures including waste minimization, in-plant process control & adoption of clean technologies. The Charter has set targets concerning conservation of water, energy, recovery of chemicals, reduction in pollution, elimination of toxic pollutants, process & management of residues that are required to be disposed off in an environmentally sound manner. On the use of energy, regulations are on the anvil. It is due to considerable



differences in power consumption by European and Indian mills. Table-2 shows the utility consumption pattern.

### Future Of Paper Industry

The pulp and paper industry may change radically. Lumber and paper may become secondary by-products while synthetic gases become the primary products. One school of thought suggests that a pulp mill is really a large bio-refinery with synthetic gases--mostly hydrogen--as the primary product from biomass and black liquor gasification. Fig.-8 shows the future Bio-refinery mill. The hydrogen will have use directly in fuel cells or converted to more conventional motor fuels. Motor fuels could be methanol, dimethyl ether, or diesel fuel--substitute fuel via the Fischer-Tropsch process. In this scenario, cellulose fibers for papermaking are a by-product, and lower yields are preferable to maximize hydrogen production. If future mills are large chemical refineries, then the skill sets and process technology for making pulp and paper will be secondary. Engineering projects will be similar to those of petrochemical refineries.(9).

### Conclusion

The future of Indian Paper Industry is very clear, signs point towards the increasing importance of Industrial Ecology concepts and tools, it is also possible that the role of Industrial Ecologist will become so crucial to

continued survival of the human race that other disciplines will simply adopt the principles of Industrial Ecology into their own mainstream principles. Never the less, as environmental issues become major driving forces, particularly with respect to Global warming.

Table - 1

WHATS IN OUR GARBAGE ?	
	%
<b>PAPER</b>	<b>29.4</b>
<b>Food waste</b>	<b>15.6</b>
<b>Misc. in Org.</b>	<b>9.7</b>
<b>Yard debris</b>	<b>8.2</b>
<b>Wood</b>	<b>7.9</b>
<b>Plastics</b>	<b>5.2</b>
<b>Misc.Org.</b>	<b>6.7</b>
<b>Metals</b>	<b>8.2</b>
<b>Glass</b>	<b>2.8</b>

TABLE -- 2  
CONSUMPTION PATTERNS OF PAPER MILLS IN INDIA & EUROPE\*

Input / tonne of paper	Mills In India	Mills In Europe
Heat G J / t	15 -- 30	4 -- 8
Electricity(excl.Pulp Mill)	800 - 1500	400 -- 800
Water m3 / t	25 -- 150	5 -- 40
Chemical Recovery %	88 -- 94	95 -- 98
Productivity tpa/person	25 -- 100	800 -- 3500

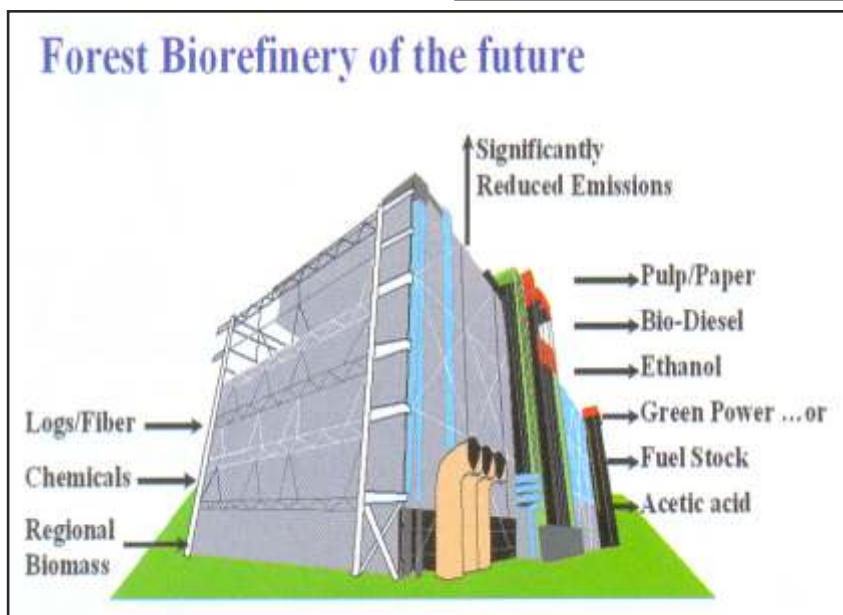


Fig - 8

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### References

1. WOW," Wealth Out of Waste", Paper Mart.,Vol.11.,No.02.,June-July 2010.,Page.17.
  2. Extracts from Wikipedia., Encyclopedia on "Ecology."
  3. Larry Chalfan, "Industrial Ecology A Path To Sustainability", White Paper On Sustainable Development And Industrial Ecology, Institute Of Electrical And Electronic Engineers Inc.,Oct.,1999.
  4. Davidsdottir,," A4.Technological Changes, Industrial Ecology and Sustainable Resource Use. "United Nations University (UNU/ZEF) Publications.ZEF-EN-1999-2.Page.5.
  5. Ed Cohen-Rosenthal, " Work and
- \* ( Source: JAAKKO POYRY )  
Environment Initiatives". 2006. Cornell University., Ithaca., New York., USA.
6. Editorial,"Best of Both Worlds", Futures., Vol.15.,Spring,2007
  7. Extracts, " For All Our Tomorrow", Sustainability Report, 2009. ITC. India.
  8. Extracts, "Best Practices Manual Of Pulp And Paper Industry", CII GBC., 2010.,INDIA.
  9. Peter Axegard, STFI Packforsk., " The Future Pulp Mill A Bio Refinery". Presentation at 1<sup>st</sup>. International Bio Refinery Work Shop . , J u l y 2 0 21.,2005.,Washington.,DC.,USA.