

Clean Use of Energy by India's Pulp And Paper Mills:- Environmentally And Economically Wise

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ABSTRACT

Global interest in environmental protection has led industry to rethink its practices in terms of environmental impacts and adherence to the principles of sustainable development (as promoted by UNCED (1992). The pulp and paper industry is no exception. Of its widespread environmental concerns, one of the most significant stems from its heavy reliance on energy consumption to power the pulp-and paper-making processes. In india, this is of particular concern, since mills are typically energy ineffecient, and burn large amounts of fossil fuels (namely coal) and biomass to satisfy their elevated energy demands. Burning coal and biomass leads to serious environmental atmospheric problems, including urban air pollution, acid rain, and climate change via the greenhouse effect. The especially daunting environmental and socio-economic repercussions of human-induced climate change spurred the global community to establish an international legal framework to protect the atmosphere. The framework Convention on climate change (1992) and the ensuing Kyoto Protocol (1997).

If India is to respect its international commitment to atmospheric protection and sustainable development, the pulp and paper industry must be proactive. In the face of rapidly increasing demand for paper products, India faces a considerable challenge. It must reduce emissions and minimise environmental impact while at the same time increase its product output. The United Nations Environment programme's Network for Industrial Environmental management promotes an approach to enviromental management, called Cleaner production, to help mills achieve this goal. Through Cleaner Production, mills can increase their energy efficiency and reduce atmospheric emissions. In so doing, they not only protect the environment, they realise the economic benefits of energy-saving practices, and produce a more environmentally friendly product. Thus, in the wake of global competition and increasing consumer awareness of environmental issues, mills can only benefit from a move toward sustainable and environmentally sound use of energy.

INTRODUCTION :

Linking environment, sustainable development, global competition and energy

Environmental issues are no longer treated as a cursory afterthought by industry, but are integral in the development of future pathways for technological and industrial advancement. The very presence of the United Nations Environment

Programme at a meeting such as this, and the incorporation of environmental concerns into the general annual meeting of the Indian Pulp and Paper

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Technological Society is a testament to the weight now carried by environmental issues in shaping our industrial activities and practices. This piqued interest in environment by industry, and the links which bind these two realms, may be epitomized by the concept of sustainable development; a concept which was popularized 11 years ago by the World Commission on Environment and Development (1987).

This commission, otherwise known as the Brundtland Commission, convened in an effort to reconcile the dual concerns of environment and development, and in so doing promoted sustainable development-defined as development that meets the need of the present without compromising the ability of future generations to meet their own needs- as a guiding philosophy for all development sectors (World Commission on Environment and Development 1987). However, because the Brundtland definition of sustainable development fails to explicitly specify concern for ecological systems, the IUCN, UNEP and WWF, in "Caring for the Earth" (1991), offer an alternative definition of sustainable development as that which improves the quality of human life while living within the carrying capacity of supporting ecosystems. From these two definitions, we may deduce that sustainable development embodies at least three crucial concepts (UNEP 1997) :

- Intragenerational and intergenerational equity: that is, "equitable" access to environmental resources both within the present generation as well as for future generations;
- Application to the precautionary principle or approach; and
- The maintenance of biological diversity and biological integrity : both of which are vitally important for the continued existence of healthy ecosystems.

To address and insitutionalize these concepts contained within the overarching goal of sustainable development, the United Nations held a now world-renowned Conference on Environment and Development in Rio de Janeiro, 1992- commonly referred to as the "Earth Summit" or "Rio Conference" (UNCED 1992). The high-profile nature of this conference, which was attended by over 100 heads of state and government, reflected the rise of environmental issues to the forefront of global development interests ; and gave political legitimacy to the emerging concept of sustainability. The outcome

of UNCED, (in response to its stated objective of formulating appropriate mechanisms to address the practical crisis facing humanity in protecting the environment while still guaranteeing a minimum level of development (UNCED 1992 from UNEP 1997), was the establishment of two international legal instruments : the Rio Declaration on Environment and Development, and Agenda 21. These declarations provide, respectively, 27 guiding principles to outline activities in accordance with a sustainable lifestyle, and the mechanism by which to implement these principles. More specifically, Agenda 21 outlines a framework for the cooperative generation of strategies for sustainable development and environmental management at a global level by way of policies, plans, programmes and guidelines for national governments (UNEP 1997).

As one may say that laws reflect and shape a society's norms, and influence attitudes towards particular aspects of life and behaviour, they may be interpreted as codes of conduct appropriate to the values of the community drafting and enforcing them (UNEP 1997). Thus, we may rightly perceive the recent prevalence of international environmental conventions, such as the Rio Declaration and Agenda 21 (among others to be discussed here with), as confirmation that the global community is no longer willing too blindly accept or endorse environmentally damaging practices. It is this global awareness of the unacceptability of unsustainable practices that links environmental issues to the interests of all industrialists. In particular, the increasing international attention to industrial practices and their environmental impacts, and the ensuing legal, political and economic measures to promote sustainability, is now a key determinant of the degree to which a company is globally competitive. And as market incentives begin to catch up with societal attitudes that value environmental protection and sustainable development, the economic and environmental considerations of industry will become more and more congruous.

An example of the merging of environmental and economic incentives in the pulp and paper industry in India is the promise of mills which use agricultural residues (agro-residuesas) their fibre raw material. While demand for paper products in India continues to rise, so does public concern regarding the environmental devastation linked to unsustainable timber harvesting (Jain and Mukundan 1996). Thus, a projected gap in national paper supply exists simultaneously with an increased demand for non-

wood-based "eco-friendly" paper products. India, being the world's largest producer of sugar, is thus in an optimal position to capitalize on the availability of bagasse, a by-product of the sugar industry, for use as a valuable fibre raw material for pulp and paper making. Bagasse-based mills alleviate pressure on precious forest resources, make valuable use of what has conventionally been treated as a "waste product" of the sugar industry, and in so-doing gain an edge in the competition among international companies to satisfy paper demands (Jain and Mukundan 1996, Jain 1997, Gopalratnam 1997).

Establishing itself as globally competitive is one of the biggest challenges facing the Indian pulp and paper industry today (Birla 1997). While the use of "eco-friendly" and economical fibre raw material is indeed a step in the right direction as Indian mills strive to compete globally, it is certainly not enough. A particularly relevant focus with universal application in the "greening" and "economizing" of mills is that of energy use, given the intense energy demands of this industry, and the pressing environmental issue associated with energy production and consumption. Energy use is shrouded in environmental concerns, many of which are now the basis of international conventions. Thus, as mills concertededly endeavour to maximize their productivity while respecting international environmental agreements, a pertinent focus is the efficient and sustainable use of energy.

ENVIRONMENTAL IMPACTS OF ENERGY PRODUCTION AND CONSUMPTION (IN RELATION TO INDIA'S PULP AND PAPER INDUSTRY)

Energy use has an extremely wide range of impacts on environment, stemming from environmentally damaging effects associated with each step of the energy life cycle—from exploration, to production, transportation, conversion, and end-use—and which vary for different energy sources (e.g. coal, oil and natural gas, nuclear power, hydropower, biomass, and other renewable sources) (Chapter 11, ESCAP and ADB 1995). Of the most immediate concern to the Indian Pulp and Paper Industry are the environmental effects of burning fossil fuels (particularly coal) and biomass, since the bulk of all commercial energy used in India comes from coal, followed by oil (Chapter 11, ESCAP and ADB 1995), and since pulp and paper mills use on-site waste and self-generated fuel (i.e. biomass) for approximately 35% of their required energy (Bajpai and Bajpai 1997).

Burning fossil fuels and biomass to generate energy has serious environmental implications because gaseous and particulate by-products of combustion pollute the air and degrade atmospheric quality. The atmosphere, the mixture of gases surrounding the Earth, is composed of a delicate balance of water vapour, carbon dioxide, sulfur dioxide, nitrogen, and other trace gases, and provides the Earth with a moderate and stable climate, a shield from the sun's harmful UV rays, and the chemical environment in which our life-sustaining biogeochemical cycles flow (Chapter 6, UNESCAP and ADB 1995). The spewing of particulates, sulfur oxides, nitrogen oxides, organic chemicals, carbon dioxide, carbon monoxide, trace elements, water vapour, and/or ash into the air as a result of fossil fuel and biomass combustion disrupts this balance—and can lead to significant environmental impacts at local, regional and global levels. For example, sulphur and nitrogen-oxide emissions contribute to urban air quality problems now plaguing all major Asian cities, and also lead to acid rain, which degrades natural ecosystems and man-made structures. This problem is being felt in India, whose high SO₂ emissions (on the scale of 3 to 4 million tonnes per year) are corroding the historic Taj Mahal in Agra, and are acidifying soils, lakes and water bodies hundreds of miles away (Chapter 6, UNESCO and ADB 1995).

Even broader in scope are the potential environmental effects of carbon dioxide emissions resulting from fossil fuel and biomass combustion. Carbon dioxide is recognized as the single most important anthropogenic source of greenhouse gas leading to human-induced climate change—and the energy sector is by far the worst culprit contributing to this phenomenon. "Greenhouse gases" (GHGs), notably carbon dioxide, water vapour, ozone, and methane, are so-called because of their potential to temporarily trap heat within the Earth's atmosphere via the "greenhouse effect." The greenhouse effect describes the process by which longwave radiation emitted from the Earth's surface (which was originally absorbed by the Earth as incoming shortwave solar radiation) spends a prolonged period of time in the lower atmosphere on account of GHGs before finally making its way out to space. GHGs absorb long wavelengths of solar radiation and then re-emit them in all directions within the atmosphere, which slows their eventual progression to space. Thus, when concentrations of GHGs are increased, longwave radiation spends a greater amount of time near the Earth's surface, leading to build-up of heat in the lower atmosphere, and the potential to spur a global

rise in average temperature (WHO/WMO/UNEP 1996).

Although predictions vary considerably as to the degree to which global warming, or human-induced climate change, will occur, and the subsequent environmental impacts that will result, there is unanimous consent among researchers that it is a worthy and undeniable concern. Even if we pay heed only to the most conservative of predictions regarding the scale and impacts of human-induced climate change, we are faced with disconcerting projected scenarios of far-reaching environmental and socio-economic impacts. For instance, a rise in annual average temperature of even one or two degrees has potential to impact (ESCAP and ADB 1995):

- ❑ the amount, timing, and pattern of precipitation (e.g. monsoons in Asia & the Pacific may be stronger or weaker, longer or shorter);
- ❑ plant growth rates, directly impacting agriculture and forestry;
- ❑ biodiversity, through impacts on the distribution and survival of species, and the structure, function and composition of ecosystems;
- ❑ ocean temperature, disrupting aquatic ecosystems and affecting fisheries;
- ❑ sea level, which leads to a whole slew of potential impacts resulting from the flooding of coastal areas and the ensuing loss of land (e.g. see table 6.5 the economic costs of sea level rise, one metre scenario, for India; Table 6.6 Cost of housing replacement and population resettlement; table 6.7 Cost estimates of infrastructural losses, and Table 6.8 The final picture; from ESCAP and ADB 1995, page 147-148).

The severity of the potential impacts of global warming, and the immediate effects of atmospheric pollution clearly being felt in terms of poor air quality and acid rain, have resulted in a number of global legal conventions to curb atmospheric pollution. At present, two major international environmental treaties, and their subsequent amendments, on atmosphere are now in effect: the Vienna Convention for the Protection of the Ozone Layer and the amending Montreal Protocol on Substances that Deplete the Ozone Layer, and the United Nations Framework Convention on Climate Change and the Kyoto Protocol. Furthermore, a Convention to limit the use of Persistent Organic Pollutants (POPs) is

currently in the development stages. Of these major Conventions, the Framework Convention on Climate Change and the Kyoto Protocol are particularly relevant to the pulp and paper industry given the nature of this industry's energy practices and resultant emissions, and thus merit further discussion.

THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE AND THE KYOTO PROTOCOL

The United Nations Framework Convention of Climate Change (UNFCCC) was adopted at the acclaimed Earth Summit in 1992 with the following stated ultimate objective:stabilization of atmospheric concentrations of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner (Article 2, United Nations Framework Convention on Climate Change 1992).

The Framework sets out guiding principles, based on "common but differentiated responsibilities" of member states, to (Article 4, UNFCCC 1992):

- ❑ develop and report "national communications" of inventories of greenhouse-gas emissions by sources, and greenhouse-gas removals by "sinks";
- ❑ adopt national programmes for mitigating climate change and develop strategies for adapting to its impacts;
- ❑ promote technology transfer and the sustainable management, conservation, and enhancement of greenhouse gas sinks and reservoirs (such as forest and oceans)
- ❑ take climate change into account in relevant social, economic, and environmental policies;
- ❑ cooperate in scientific, technical, and educational matters, and
- ❑ promote education, public awareness, and the exchange of information related to climate change.

While the aforementioned commitments apply to all Parties, the Framework recognizes special needs

of developing countries, and differentiates responsibility in combating climate change by developed and developing countries. Since the UNFCCC is a framework convention, the Kyoto Protocol was established in 1997 to substantiate the differing levels of commitment, and provide the UNFCCC with specific emissions targets to be met by Member States throughout a given time period. It imparts strength to the UNFCCC not only by quantifying national emission limitation and reduction commitments, but also by encouraging all Parties to improve energy efficiency, reform energy and transportation sectors, protect forest and other carbon sinks, promote renewable forms of energy, phase out inappropriate fiscal measures and market imperfections, and limit methane emissions from waste management and energy systems (Article 2, Kyoto Protocol to the UNFCCC 1997).

Perhaps the most portent aspect of the Kyoto Protocol is the legally binding nature of its emissions targets for developed countries. According to the Protocol, Members from developed countries must collectively reduce emissions of the six key greenhouse gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) by at least 5% by the period 2008-2012 (percent reductions will be calculated as an average over the 5 years); and "demonstrable progress" must be made by 2005. Since emissions levels would continue to increase without such a Protocol (many industrialized countries have not met their earlier non-binding aim of returning emissions to 1990 levels by the year 2000), actual emissions reductions effectively translate to much more than 5%. For instance, compared to emissions levels that would be expected by 2010 without binding control measures, the Protocol target represents a 30% cut (UNFCCC Secretariat 1998).

Another interesting quality of the Kyoto Protocol is flexibility it offers countries in terms of making and measuring their emissions reductions. An international "emissions trading" regime is being established to enable industrialised countries to buy and sell emissions credits amongst themselves; and also to acquire "emission reduction units" by financing certain kinds of projects in other developed countries. Of particular bearing to developing countries such as India, is a "clean development mechanism" that is currently being elaborated. This scheme will enable industrialised countries to finance emissions-reduction projects in developing countries and to receive credit for doing so (UNFCCC Secretariat 1998). In this way,

industries in developing countries can take advantage of the environmental and the almost certain economical benefits that accompany cleaner use of energy, while receiving the funding to do so from developed countries.

The promise of such a "clean development mechanism" for the Indian pulp and paper industry becomes evident when one examines the current and projected situation in terms of energy use and resultant emissions by most of the country's mills. By cleaning up its energy-related practices, the pulp and paper industry of India can contribute to its country's success (and possibly to that of a funding developed country as well) in fulfilling its commitments as a promoting sustainable development, it will be securing its position as a deserving international competitor.

THE ENERGY SITUATION IN INDIAN PULP AND PAPER MILLS

Pulp and paper mills, no matter where they are in the world, are energy-intensive, and must pay heed to the environmental impacts associated with their bounteous use of energy. India is no exception, and in fact may be in a particularly precarious situation as it tries to meet environmental regulations/responsibilities in the face of its current industrial practices and means, and projected trends in its future demand for pulp and paper.

In India, the pulp and paper industry is the sixth largest industrial consumer of energy (Bajpai and Bajpai 1997); demanding more energy than either the steel or cement industries (Government of India 1994, from Khanna 1998). Unfortunately, use of this energy is highly inefficient (which is generally the case for industries in developing countries), and when compared to energy efficiency of pulp and paper mills in developed countries shows startling room for improvement. For example, in India, the average mills uses almost 50% more energy to produce an equivalent amount of pulp and paper relative to a mill in Sweden or the United Kingdom (Government of India 1994, from Khanna 1998). Furthermore, the source of this energy in India comes largely from coal which provides significant cause for concern due to the serious environmental implications of burning this non-renewable resource (as discussed previously), and the high ratio of pollution released per unit of energy produced. Since production of one tonne of paper requires about an equal amount of coal to be burned (UNEP Industry and environment (IE) 1996), and India alone produced 3.2 million tonnes of paper in 1996 (Bijur 1997), it is easy to envision alarming

amounts of pollutants (including CO₂) being emitted into the atmosphere by mills.

The future outlook in terms of energy use by India's pulp and paper industry is not encouraging for environmental conditions, given that the industry is planning to add 2.6 million tonnes to its current paper production capacity by the year 2000 to meet massive forecasted national increases in paper demand (Jain and Mukundan 1996). However, while the rapidly accelerating rate of paper demand in India puts significant pressure on the country's pulp and paper industry to boost production, global competition and international environmental conventions apply pressure for it to do so in a sustainable manner. The United Nations Environmental Programme via its Network for Industrial Environmental Management, is helping the pulp and paper industry to meet this challenge by demonstrating the benefits, both economical and environmental, of improving energy efficiency, reducing emissions, and practicing sustainable activities through "Cleaner Production."

PROMOTING SUSTAINABLE ENERGY PRACTICES IN PULP AND PAPER MILLS THROUGH CLEANER PRODUCTION

Cleaner Production (CP) is an approach to environmental management that is promoted and defined by UNEP as the continuous application of an integrated preventive environmental strategy to processes, products, and services to improve eco-efficiency and reduce risks to humans and environment (UNEP/Regional Office for Asia and the Pacific (ROAP) 1997). It is applicable to all industrial sectors worldwide, but particular attention is paid to Cleaner Production in the pulp and paper industry through UNEP's Swedish-funded "Network for Industrial Environmental Management" (NIEM). Established in 1987, this network consists of research institutions, government agencies, industry associations, and 36 individual mills spanning 7 countries in the Asia and Pacific Region (China, India, Indonesia, Malaysia, The Philippines, Thailand, and Vietnam) (UNEP/ROAP 1997). Having set up mechanisms for cooperation within the network, NIEM promotes Cleaner Production via four inter-linked blocks of activity (UNEP/ROAP 1997).

- initializing and supporting CP assessments in the 36 core mills, thereby demonstrating the feasibility and advantages of adopting cleaner production in mills operating under typical conditions for the region;

- disseminating information and arranging CP training in each country to build capacity in concerned organizations and institutions;
- producing training materials and guidance manuals related to environmental management and cleaner production in pulp and paper mills (e.g. UNEP IE 1996; UNEP/ROAP and National Productivity Council of India 1996; UNEP 1998);
- assisting government regulators in their efforts to promote environmental management by adopting suitable regulations.

The essence of all NIEM training, guidance, and informational material disseminated to mills on Cleaner Production is the practical methodology of the approach, commonly referred to as the "Cleaner Production Assessment". This straightforward methodology enjoins mills to identify: where wastes and emissions are generated; why the wastes and emissions are generated; and possible options for how the wastes and emissions can be minimized; by offering a logical step-by-step process of assessment (UNEP IE 1996).

Cleaner Production Assessments are applicable to all aspects of mills operation, from production materials, processes and output, to management, maintenance, marketing, and others. As mills start out on their quest to achieve Cleaner Production, NIEM recommends that they begin with a clearly defined, relatively simple focus, so as not to be overwhelmed by taking on too much at once. The beauty of the Cleaner Production approach is that as a result of the CP assessment, many of the options identified by the mill's CP team to effectively minimize wastes and emissions are surprisingly simple, quick, and inexpensive. For example, of NIEM's 36 core mills, the vast majority of CP options identified and implemented to reduce wastes and emissions involved changes in housekeeping habits, process control, recycling of materials and modification of equipment. Only 15% of the implemented CP options to reduce emissions incorporated any kind of technology change.

Energy use is unquestionably a relevant focus of all mills as they progress with CP Assessments. In many cases, it may be realized that relatively simple, inexpensive changes in material and/or operational processes can lead to much more efficient energy use, cutting down on energy consumption per unit product output. Clearly this has economical as well as environmental benefits, given that energy contributes between 20-40% of total pulp and paper

manufacturing costs (Bajpai and Bajpai 1997; Gohel and Raheja 1997). Although it is certainly not within the scope of this paper to detail changes that may be made for specific mills to become more energy efficient, a sample of possible measures to reduce power consumption in pulp and paper mills include (from UNEP IE 1996):

- a mill lay-out designed to minimize transport distance;
- avoiding of over-sizing pumps and fans;
- selecting equipment (e.g. pumps, fans, compressors, motors) with high energy efficiency;
- using variable speed drives for pumps, fans, etc.;
- not using a lower pulp consistency than necessary when pumping;
- using belt transport instead of blowing;
- using low friction suction boxes;
- being careful with compressed air;
- having well-planned and efficient lighting; and
- powering-off equipment that is not in use.

It is reasonable to assume that more involved, relatively long-term changes, such as reducing or eliminating the need for external (and non-renewable) fuel sources such as coal and oil by making a mill self-sufficient in terms of energy use, are also options that will come out of a CP assessment. Options such as these can be taken on more gradually by mills in their move towards CP, and perhaps can even be funded by a developed country via the Kyoto Protocol's "clean development mechanism." Despite the nature of the solutions resulting from a CP Assessment, the critical point is that NIEM prompts mills to recognise their target areas of waste, inefficiency and/or pollution, and spurs them to devise and implement a broad range of Cleaner Production solutions. From the experience of the 36 core mills involved in NIEM's Cleaner Production Programme, the environmental and economic benefits of their efforts were quickly realised. For example, in one year alone, the 36 core mills collectively saved US\$ 10 million, of which US\$ 300 000 was directly attributed to savings from reduced energy use.

CONCLUSIONS

It is crucial that developing countries such as India do not follow in the footsteps of the developed world by building up industrial strength via polluting, environmentally degrading and unsustainable patterns of energy use. There is no question that developed countries have contributed far more than their share of environmental damage as a result of energy production and consumption thus far. However, as we are increasingly aware of the local and global repercussions of such unsustainable and careless practices, including urban air pollution, acid rain, and climate change, it is entirely unacceptable to forge ahead in such a manner. Steps must be taken by all countries to curb dependence on unsustainable, polluting forms of energy use, and to transfer to environmentally sustainable energy practices as global demand for energy continues to rise. Global environmental conventions, such as the United Nations Framework Convention on climate Change, can help guide countries in their efforts to meet this challenge; and as in the Kyoto Protocol, can set clear goals for which to strive.

The pulp and paper industry, being highly energy-intensive, has key role to play as industries progress toward sustainable development in lieu of international commitments to protect the environment. In India, this is abundantly clear, given the current and predicted practices and trends in the country's pulp and paper industry. The majority of India's pulp and paper mills are highly energy inefficient, employ unsustainable energy practices, and contribute large amounts of atmospheric pollutants, including greenhouse gases, into the atmosphere. Furthermore, demand for paper in India is increasing at an accelerating rate, pressuring mills to boost production output, and thus translating into further demand for energy. At the same time, the heightened global awareness of the importance of environmental protection, and ensuing global environmental conventions, are pressuring the industry to satisfy this demand through sustainable, environmentally-sound practices.

The United Nations Environment Programme, through NIEM's Cleaner Production Programme, provides a framework by which the pulp paper industry can simultaneously achieve environmental and economical goals, by identifying and implementing Cleaner Production solutions. Tantamount to this approach is the sustainable and efficient use of energy, which, if achieved by India's pulp and paper mills will

not only benefit environment, it will sharpen their edge in the wake of global competition.

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