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DECARBONIZATION IN THE INDIAN PULP & PAPER INDUSTRY

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Abstract:

Pulp & Paper industry is among the top five most energy-intensive industries globally. The CO_2 emission from the Indian Pulp & Paper sector was around 30.5 million Tonnes in 2019 contributing to 1.09% in total net GHG emissions[1]. The average emission intensity for the Indian Pulp and Paper industry is 1.58 $MTCO_2e$/MT paper. As paper production is projected to increase, significant efforts must be made to reduce the emission intensity of production. Paper is one of the sectors, which has huge potential in becoming carbon neutral in the near future. The pulp & paper sector is having an added advantage i.e. raw material (wood) for the final product can be sustainably grown by the producer. The paper highlights the potential in the Indian Pulp & Paper industry to decarbonize the sector considering the Business as Usual (BAU) and Deep Decarbonisation scenario. Energy efficiency in paper production will play a major role in decarbonizing the sector followed by fuel mix change, breakthrough technology, and the use of renewable energy.

Keywords: Industrial decarbonization, Carbon neutral, Energy efficiency, Renewable, Circularity & Material efficiency, Pulp & Paper sector

Introduction:

The total primary energy consumption in India has doubled since 2000 (from 440 million TOE (tonne of oil equivalent) in the year 2000 to 880 million TOE in the year 2020)[2] and is expected to again double in the next 20 years to around 1900 million TOE. The fossil fuel share in total primary energy consumption was around 90%. Coal has played a significant role in India's economic development while contributing to air pollution and growing GHG emissions. Among end-use sectors, India's industrial sector has been the main source of energy demand growing since 2000, around half of which was met by coal. India's GHG emission in 2016 was 2.8 billion $MTCO_2e$. CO_2 emission accounted for 78.6% of total GHG emissions. The emission from industries was around 1.20 billion MT. In order to decarbonize the industrial sector, significant efforts and measures need to be adopted. India's net zero emission pathways will be challenging as the rate of decrease of emissions required to achieve the net zero by 2050 onwards will have to be exponentially high compared to historic trends.

Indian Paper industry

The pulp & Paper industry is among the top five most energy-intensive industries globally. The Indian paper industry is highly fragmented, with varying sizes ranging from 10 TPD to 1500 TPD. 75-80% of paper production is from medium and small category mills. The CO_2 emission from the Indian Pulp & Paper sector was around 30.5 million MT in 2019 contributing to 1.09% of total net CO_2 emissions. The average emission intensity for the Indian Pulp and Paper industry is 1.58 $MTCO_2e$/MT paper. The per capita consumption of paper in India (15.75 kg) is significantly low compared to global per capita paper consumption (57 kg). As paper production is projected to increase, significant efforts must be made to reduce the emission intensity of production. Paper is one of the sectors which has huge potential in terms of becoming carbon neutral in the near future as the paper sector is having an

1. *CII-GBC study, 2021*
2. *India Energy Outlook 2021 – IEA report*
3. *Third Biennial Update Report to the UNFCC, 2021*

added advantage i.e. raw material (wood) the for final product can be sustainably grown by the producer and sequester the carbon. Few major Indian paper companies are already carbon positive. There is a need to focus on small and medium size mills for energy efficiency improvement.

The long-term demand outlook for the Indian paper industry remains favourable, driven by increasing literacy levels, growth in print media, higher government spending on the education sector, changing urban lifestyles as well as economic growth. Given that these factors are likely to be sustained, the paper industry is likely to continue growing at a rate of 6-8% per annum in the medium to long term. Assuming 5 to 6% CAGR, the per capita paper consumption in India will be 55% & 63% of the world average by 2035 & 2040.

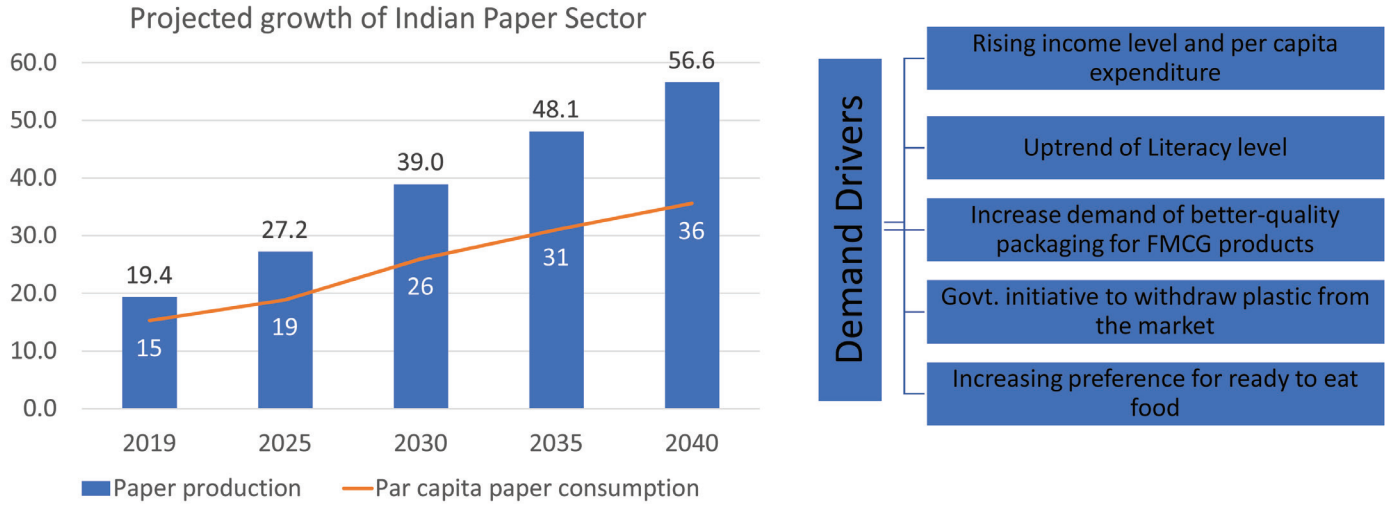

Fig.1 Projected growth of Indian Paper industry and demand drivers

Decarbonization in Paper industry

The share of energy cost in paper production is 16 to 25% of the total manufacturing cost. There is a need to decarbonize and increase efficiency whilst remaining competitive. Many of the major Indian paper companies have taken several measures and have planned various initiatives for decarbonization. There are certain challenges currently faced by the Indian Paper industry.

- Raw material availability & quality issue: The biggest challenge faced by the Indian paper industry is the uncertainty regarding the availability of uniform raw materials.
- High production cost due to high cost of raw materials: High cost of raw materials including wood, non-wood, and wastepaper increased the production cost & reduced profit margin.
- Technological obsolesce and cost of implementing new technologies: The medium & small agro and recycled wastepaper-based mills are yet to adopt some of the existing or emerging advanced technologies to achieve the desired efficiency.
- Highly fragmented industry: The Indian paper industry is highly fragmented with capacities ranging from less than 10 TPD to 1500 TPD.
- Transition to digital media and paperless communication: Increasing competition from electronic media and digital communication alternatives, resulting in reduced demand for writing & printing paper and graphics paper.
- Wastepaper collection/recovery mechanism: Wastepaper collection /recovery mechanism is not very strong. Poor collection of used paper results in a low recovery rate and undue dependence on imports to meet domestic needs.

On the other hand, there are huge opportunities for the Indian paper industry to decarbonize.

- Support climate goals of the nation and the world: The paper sector can play a vital role in achieving climate goals.
- Reduce production cost and fossil fuel dependency: Improving energy efficiency will result in a reduction in fossil fuel consumption and energy cost.
- Circular economy and resource efficiency: Waste material usage promotes industrial symbiosis and reduces dependence on virgin materials. Continuous improvements in technology can further reduce environmental impacts and optimize the use of resources.
- Breakthrough technologies and innovations: Breakthrough technologies, for example, those reducing the use of heat in

paper production through reduced water consumption, are needed to obtain the objectives for a low-carbon economy.

- Improvement in brand image and social acceptance: Brand image & social acceptance of the sector will improve.
- Enabling partnership among stakeholders: bring together R&D, industry, government, experts, innovators, and technology providers toward common agenda.

Decarbonization scenario

The following scenario was considered during the study – BAU and Deep Decarbonisation. BAU considered moderate efforts and deep decarbonization considered the high/ambitious efforts by the industry. The potential levers considered for decarbonization of the paper sector are – Energy efficiency, Circularity, and material efficiency, Electrification and use of clean energy, Biomass and zero-carbon fuels, and Breakthrough technologies.

As per the study, the GHG emissions in the BAU scenario will increase to around 70 million MT by 2040 whereas, in the Deep decarbonization scenario, the emissions can be restricted to 35 million MT by 2040 (Fig. 2). The total emission will increase by 129% by 2040 in BAU scenario and in Deep decarbonization scenario the emission increase will be only 15%. The emission intensity in the BAU scenario will be 1.26 $MTCO_2$/MT of paper, a reduction of 22% whereas in the Deep decarbonization scenario, the emission intensity will be 0.62 $MTCO_2$ /MT of paper, a reduction of 61%.

As per the projections, energy efficiency will play an important role in the paper sector's decarbonization. Energy efficiency can contribute to around 62% reduction in the BAU scenario and around 36% reduction in the Deep decarbonization scenario (Fig. 3). Paper industry, especially medium & small paper mills, needs to adopt the latest available technologies for improving energy efficiency. Following technology or measures offer significant potential for energy saving.

• Vacuum blowers in place of vacuum pumps • Centralized refining • Shoe press in paper machines • Advanced process control systems • Micro-turbine in place of PRDS • Oxy-fuel Burning in Lime Kilns and Black Liquor Boilers • Blow down steam recovery. • Condensate recovery improvements • Steam trap monitoring and improvements • Waste heat recovery

To further reduce the emission intensity, the use of biomass or zero-carbon fuels needs to be accelerated. The sector has a huge potential of using clean fuels like biomass and that will contribute to around 17% reduction in BAU scenarios and 21% in Deep decarbonization scenarios. Although many major paper companies are already using biomass or other alternate fuels, the use of alternate fuels must be increased in small and medium paper mills. Paper mills should focus on increasing the black liquor solid concentration. Increased solids content means less water must be evaporated in the recovery boiler, which can increase the efficiency of steam generation substantially.

It is projected that breakthrough technologies (like direct electric heating, solar thermal, gas-fired dryers, carbon capture, etc.) need to be introduced by 2030 to further reduce emissions. Futuristic technologies require significant policy push from the government to reduce the cost of technology adoption, also the industry leaders and best performers need to come forward and demonstrate their commitments towards the adoption of the latest technologies and set an example for others to follow.

Recycled paper has lower specific energy consumption when compared to wood-based or agro-based paper production (almost 3 times lower in wood-based and around 2.5 times lower in agro-based). Increasing production and utilization of recycled paper can hence play an important role in the overall decarbonization journey. Hence, circularity and material efficiency will contribute a 15% reduction in BAU and a 17% reduction in Deep Decarbonisation Scenario. Increased recycling and better sorting in mills where production is based on recovered paper could reduce emissions if sorting technologies and the use of collected fibers were improved. Improving the

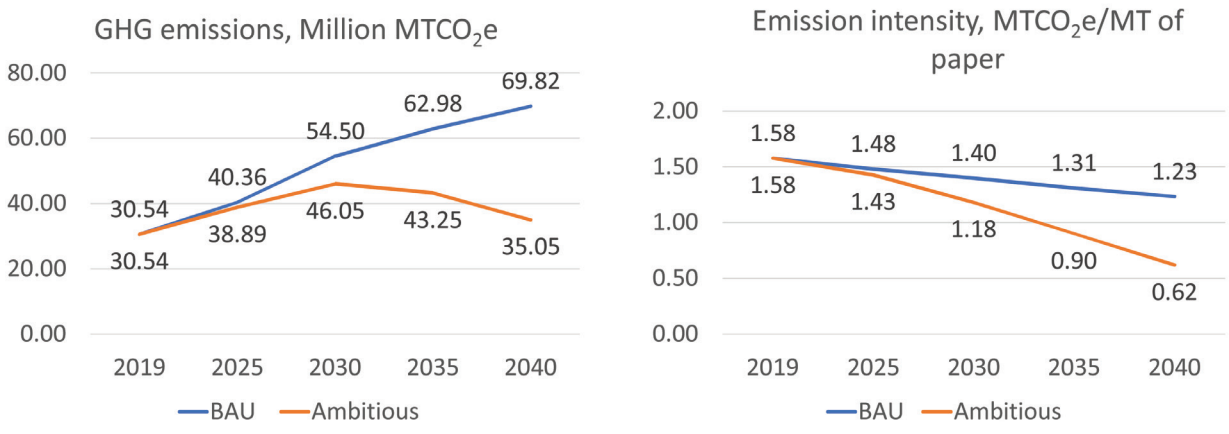

Fig.2 CO_2 emission and emission intensity

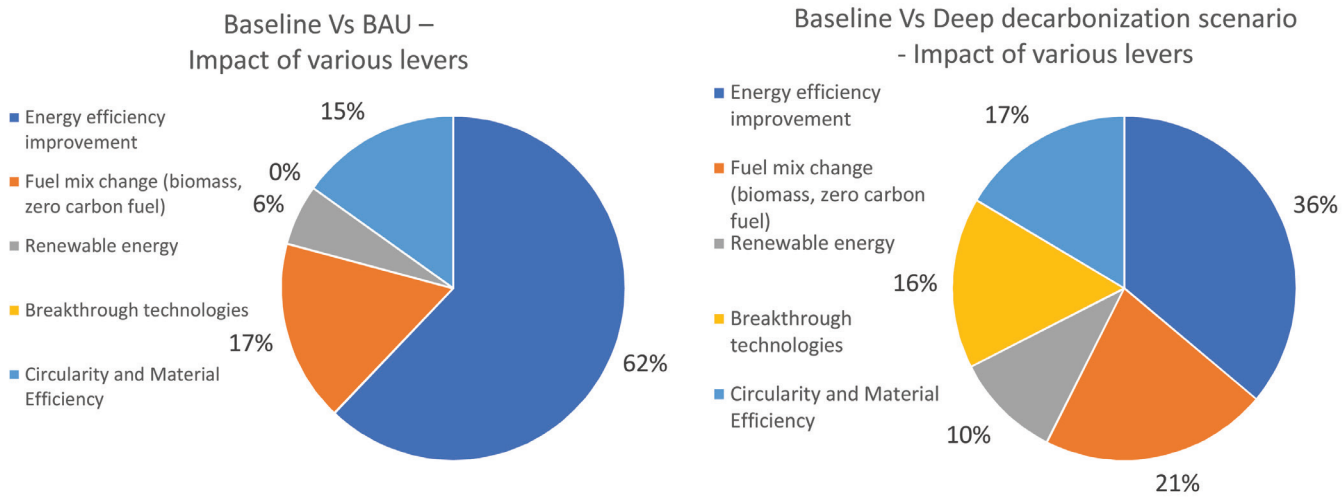

Fig.3 Impact of various levers in emission reduction

screening and filtering in the recycling pulping process can save energy from 5 to 30%. Increasing the share of production from recovered fibers could considerably reduce energy use.

Many paper companies are already moving towards renewable energy and this will contribute to around a 6% reduction in BAU and a 10% reduction in the Deep Decarbonisation scenario.

Conclusions

As paper production is projected to increase, significant efforts must be made to reduce the emissions intensity of production. This can be accomplished primarily by moving away from fossil fuels as an energy source and encouraging innovation in technologies that reduce the amount of heat needed for pulp and paper drying. The pulp and paper sector will need to be highly energy efficient and innovative in a future that is shaped by ambitious climate and energy policies. As per the projections and potential, a 60% to 70% reduction in emission intensity is possible in the deep decarbonisation scenario. Carbon neutrality cannot be achieved by a single measure alone but can be achieved through the combination of one or more measures that have the potential for emission reduction.

Therefore, the following points appear to be essential and should be considered in the future.

- Selecting a combination of technologies, particularly with the electrification of the steam supply, along with the use of carbon-free electricity generated by renewable energy.
- Close cooperation with stakeholders to select the most promising decarbonization options.
- Consideration of industry sectors coupling to explore the possibility of using waste heat and biofuel generated in nearby industries.
- Favorable policies
- R&D for making technology viable commercially.
- Carbon tax introduction.
- Schemes like PAT, CDM etc.

Futuristic technologies require significant policy push from the government to reduce the cost of technology adoption, also the industry leaders and best performers need to come forward and demonstrate their commitments to the adoption of the latest technologies and set an example for others to follow.