Energy Demand in Paper and Pulp Industry

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Objective:

Addressing energy demand in the paper manufacturing industry in the United States (US) by suggesting improvements in various stages to improve energy efficiency. This project evaluates energy consumption in the paper manufacturing industry using a two-fold approach:

1. **Comparing energy consumption** of current paper manufacturing industry against energy consumed using the most energy efficient technologies, equipment or processes.
2. Evaluating energy required to manufacture **virgin paper and recycled paper**.

Background:

The paper industry was among the top 3 energy intensive industry sectors in the US in 2018, consuming **11% of the total energy** consumed by the manufacturing sector.[1]

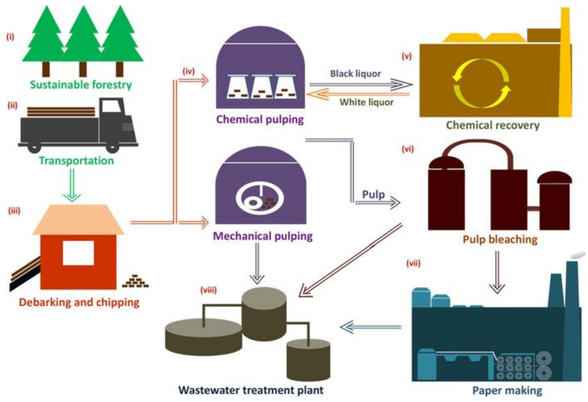

Figure 1: Paper manufacturing process

Recycling paper reduces the energy demand as well as the impact on the environment. The production of recycled paper has increased over the years.

Paper Industry landcape of the US	2010	2019
Market Worth (bn $)	38.5	56.4
Production (MMT)	82	78
Energy Consumed (tn Btu)	2110	1529

Figure 2 : Landscape of the paper industry[2,3,4,5]

Quantitative Analysis:

State of the Art (SOA) energy consumption is the minimum amount of energy that is used in a specific process using existing technologies and practices.

Assumptions:

- Most energy efficient technologies implemented around the world can be replicated in the US and are financially viable.
- Proportion of energy consumed by various processes in the paper industry is same during 2010 and 2019.
- Energy consumed to produce virgin paper = **33 MMBTU/tonne** and to produce recycled paper = **22 MMBTU/tonne**[6]

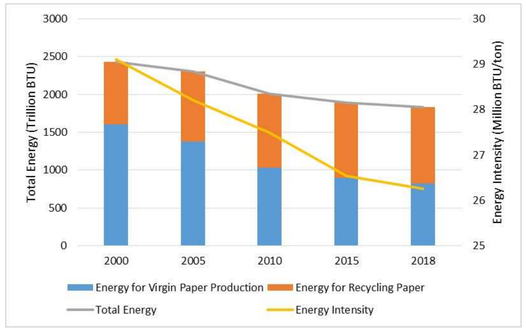

Figure 3 : Energy consumption pattern[7]

Growth in energy consumption by recycled paper is due to an increase in its proportion over the years. Decrease in energy intensity of paper production is due to **increasing amount of recycled paper** and implementation of energy saving equipment and technologies.

Figure 4 summarizes the most energy intensive stages of paper manufacturing in 2010 and 2019. Powerhouse losses and paper drying account for more than **50% of the energy consumption**. The powerhouse is the area of where electricity and steam is generated onsite.

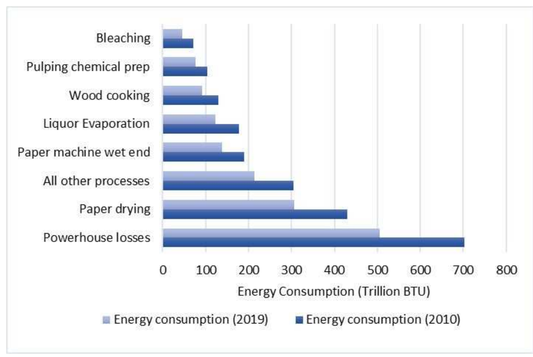

Figure 4 : Energy consumption by process (2019)[2]

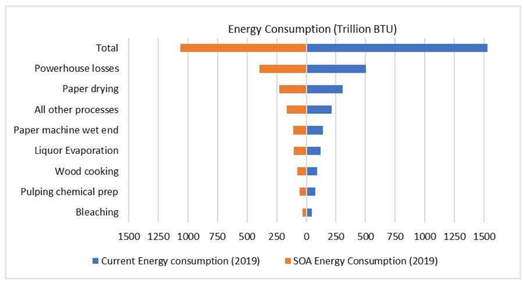

Figure 5 : Comparison of energy consumption between current and SOA (2019)[2]

Figure 5 shows the comparison of energy consumption in a hypothetical scenario of **shifting from current processes to SOA technologies** for the most energy intensive stages in the paper manufacturing industry.

Results:

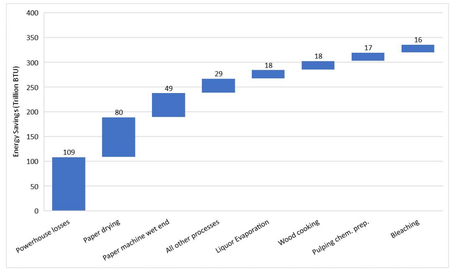

Figure 6 : Energy savings potential by using SOA processes (2019)[2]

The two most energy intensive processes are the ones which have highest energy saving potential of **189 Trillion BTU**.

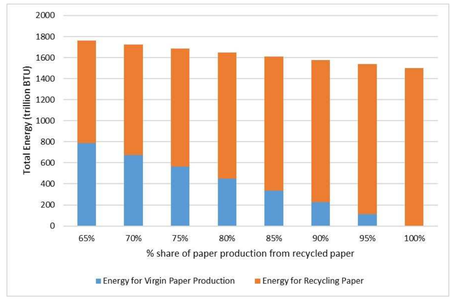

Figure 7: Sensitivity to portion of recycled paper as raw material[7,8]

For the same amount of paper produced, replacing wood with used paper as raw material entirely has the potential to **reduce total energy demand by 15%** as compared to the existing scenario (**65% used paper**).

Recommendations:

- Focusing on energy savings by investing in top two categories has **potential to save more than 50% of total possible energy savings**:

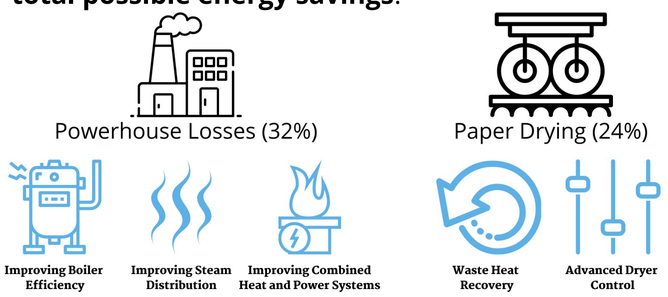

Figure 8: Improving efficiency of processes with highest energy saving potential

- Increase production of recycled paper through improved strategies in waste paper collection and transportation.

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