

Forest Products Industry Combined Heat and Power

Overview

Combined heat and power (CHP) is an energy efficient mode of simultaneous steam and electricity generation. In 2018, the US forest products industry produced 32% of all the CHP power generated by US manufacturing industries. Over 40 billion kWh of electricity were cogenerated by the US forest products industry in 2018, representing 95% of all on-site electricity generated by the sector. Based purely upon the energy efficiency benefits of CHP, the US pulp and paper sector avoids over 12 million metric tons of CO₂e annually by using CHP compared to the separate generation of steam and electricity. Pulp and paper and wood product facilities utilize predominantly biomass-based CHP to generate steam and electricity with very low greenhouse gas (GHG) emissions. Life cycle GHG emission intensities (emissions per kWh of electricity produced) from forest products industry generated electricity are highly negative when avoided GHG emissions are considered. The US forest products sector sold 6,449 million kWh in 2018, which helps contribute to greening of the US electrical grid. Given that electricity is being generated at the point of use, forest product CHP systems also contribute to overall electrical grid resiliency, i.e., electricity can still be generated and utilized at a mill even during grid power disruptions or outages.

Introduction

The forest products industry is a leader in the use of CHP, also known as cogeneration, which is an energy efficient mode of steam and electricity generation from the same fuel source. Several documents recognize the energy efficiency, GHG savings, and resiliency benefits of industrial (including forest products) CHP (US EPA 2017; NREL 2017; DGA and Institute of Industrial Productivity 2015). The broad advantages of CHP include:

- The simultaneous production of useful thermal and electrical energy, which is a more energy efficient generation mode than the separate generation of steam and electricity.
- Installation of CHP units at the point of energy use to avoid transmission and distribution losses that would occur with purchased power.
- Reduced dependency on the grid, particularly during power disruptions or outages.

The US forest products industry produced 32% of all the CHP power generated by US manufacturing industries in 2018, and biomass residuals are the primary energy source for industry energy generation. Biomass derived electricity represented 8.7% of total generation from renewable sources in the United States. The US forest products sector represented over half of the electricity generated nationally from biomass energy sources and generated 32 billion kWh in 2018.

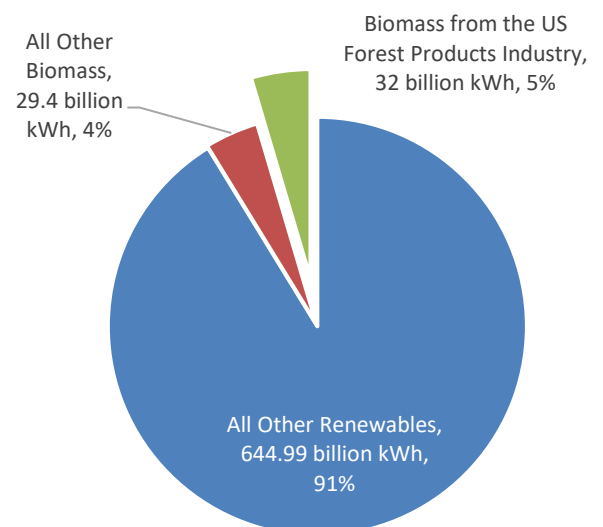


Figure 1. Electricity derived from renewable energy sources in the United States in 2018

US Forest Products Industry Combined Heat and Power

The US forest products industry currently has 12.7 GW of installed CHP capacity.

Table 1. US forest products industry installed CHP capacity

Sector	Installed CHP Capacity (GW)
Pulp & Paper	11.8
Wood Products	0.9
Forest Products (total)	12.7

Over 40 billion kWh of electricity was cogenerated by the US forest products industry in 2018, representing 95% of all on-site electricity generated by the sector.

Table 2. The US forest products industry cogenerated electricity profile

Sector	Cogenerated Electricity (million kWh)	Percentage of cogenerated on-site electricity
Pulp & Paper	38,663	95%
Wood Products	1,735	94%
Forest Products (total)	40,398	95%

The forest products sector sold 6,449 million kWh in 2018, which helps contribute to greening of the US electrical grid because of the low GHG emission properties of industry generated electricity.

Energy Efficiency and Air Emission Benefits of Industry CHP Use

CHP installations produce more useful energy with less primary energy input compared to the separate generation of steam and electricity. The combined electric and thermal energy efficiency of CHP ranges between 65–80 percent, which is more efficient than the separate generation of steam and electricity (US EPA 2017). Since CHP installations generate usable electricity at the point of use, transmission and distribution losses are avoided, further increasing the energy efficiency of CHP compared to the separate generation of steam and electricity.

Based purely upon the energy efficiency benefits of CHP, the US pulp and paper sector avoids over 12 million metric tons of CO₂e annually by using CHP compared to the separate generation of steam and electricity (NCASI 2024). Due to the energy efficiency benefits of combined heat and power, the use of CHP can reduce combustion-related emissions of criteria air pollutants such as carbon monoxide, nitrogen oxides, and sulfur dioxide.

Greenhouse Gas Benefits of Industry CHP Use

The US Department of Energy (DOE) has published an industrial decarbonization roadmap outlining decarbonization approaches for industrial sectors (DOE 2022). Within the DOE document, the following pillars of decarbonization were highlighted:

- Energy efficiency including CHP utilization
- Manufacturing of low-carbon fuels, feedstocks, and energy sources
- Carbon capture, utilization, and storage
- Electrification of heat

Pulp and paper and wood product facilities utilize predominantly biomass-based, i.e., low-carbon, fuel source-driven CHP to generate steam and electricity with very low GHG emissions. Since the US forest products industry uses predominantly biomass residuals for energy use, life cycle GHG emission intensities (emissions per kWh of electricity produced) from forest products industry generated electricity are highly negative when avoided GHG emissions are considered (NCASI 2024).

Grid Resiliency Benefits of Industry CHP Use

The Environmental Protection Agency’s (EPA) emission and generation resource integrated database (eGRID) is a comprehensive source of data on electricity generation in the United States. eGRID classifies electricity generation from hydro, biomass, wind, solar, and geothermal energy sources as renewable electricity generation. Baseload generation is the minimum amount of electricity that is required from the grid at any given time. Baseload generation is supplied from power plants operating at high-capacity factors, i.e., 24/7 operation, to provide reliable and resilient electricity generation. Biomass, hydro, and geothermal energy sources are currently the only renewable energy sources that can be classified as baseload generation (wind and solar electricity are classified as intermittent generation) (Matek and Gawell 2015).

Given that electricity is being generated at the point of use, forest product CHP systems also contribute to overall electrical grid resiliency, i.e., electricity can still be generated and utilized at a mill even during grid power disruptions or outages.

Conclusions

The US forest products industry is a leader in the utilization of CHP. Industry CHP is energy efficient and provides significant GHG emission benefits, especially from biomass-based CHP.

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