Finding a Path Forward for Decarbonizing Thermal Energy in the US Industrial Sector

RENEWABLE THERMAL COLLABORATIVE

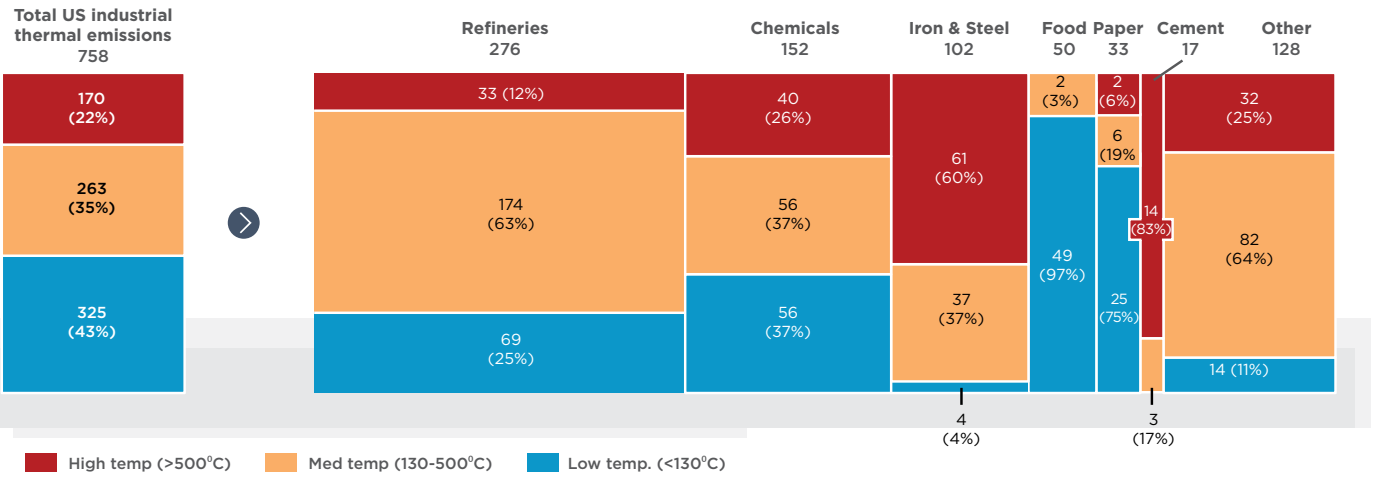
CRITICAL DECARBONIZATION PATHWAYS

- Electrify industry processes
- Green the grid
- Deploy renewable fuels
- Deploy renewable technologies
- Capture and store carbon

The Industrial Decarbonization Challenge

The industrial sector produces 24% of the greenhouse gas emissions in the United States. Industry's use of thermal energy to create many of the products we use in our everyday lives and the food we eat creates more than half of those emissions—generating approximately 13% of the total US emissions. Manufacturers often need to apply heat throughout the production process—for washing, drying, for creating steam, sterilizing, and more. That heat is typically generated from fossil fuels, particularly natural gas.

Estimated share of 2018 thermal emissions by temperature range (million tonnes of CO_2e)



Notes: Energy usage by temperature range was used as a proxy for thermal emissions by temperature range, most of industrial heat is fueled by natural gas across low, medium, and high temperature processes; certain sector emissions (e.g. Iron & Steel, Cement) may skew more towards the higher temperature range as these sectors combust fuels with higher carbon intensity for high temperature processes (e.g. coal in steel making)

Source: NREL Manufacturing Thermal Energy Use in 2014 (provides thermal energy use by temperature); EIA Outlook 2019 (provides 2018 energy consumption by fuel); EPA emissions intensity by fuel.

A RENEWABLE THERMAL VISION

Low and medium heat processes (<500°C) dominate industrial thermal emissions and prioritizing their conversion to renewable energy can reduce thermal emissions by nearly 80%.

This report focuses industry's use of thermal energy, providing actionable new insights and recommending potential pathways to net zero that could result in emissions reductions up to 758 million tons of CO_2e annually by mid-century.The Report examines six priority industrial sectors in the US—analyzing their thermal energy use by process, temperature (high, medium, and low), and geography. Incorporating post-Inflation Reduction Act cost projections and overlaying estimates of technology availability, the report identifies five parallel pathways to decarbonize industry by 2050. In addition, the report features six sector and eight technology deep-dives that will help corporate energy buyers and policymakers set priorities and make smarter and more timely investment decisions to meet near- medium- and long-term decarbonization goals. The analysis behind the study was conducted by Boston Consulting Group (BCG) in partnership with WWF, a convenor of RTC.

Five Parallel Pathways

1 Electrify industry processes

Electrify low- and medium-temperature processes with cost competitive technologies such as heat pumps and electric steam boilers and deploy other electric resistance technologies in medium-high temperature processes.

2 Green the grid

Use virtual power purchase agreements and other high impact renewable power procurement methods to accelerate the transition to a carbon free electric grid to meet industrial green electricity needs.

3 Deploy renewable fuels

Deploy sustainable and waste-derived Renewable Natural Gas and biomass as supply constraints allow; and develop and scale green hydrogen use for high-heat industrial process.

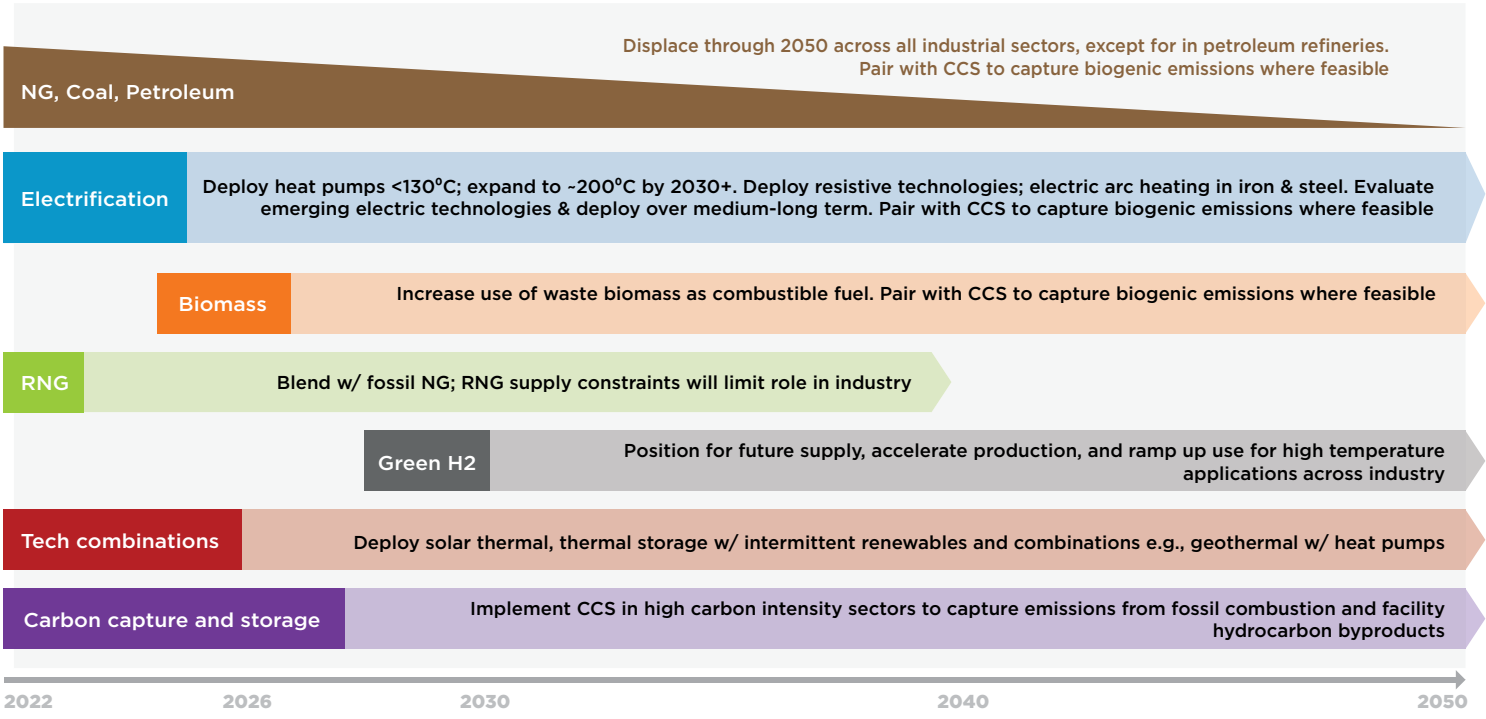
4 Deploy renewable technologies

Scale solar thermal, thermal storage paired with low-cost intermittent renewables, and clean technology combinations such as heat pumps with geothermal and solar thermal.

5 Capture and store carbon

Deploy carbon capture and storage (CCS) and direct air capture as a short- and medium-term lever in specific sectors. Phase down CCS as industry transitions to clean processes. Develop and deploy BECCS (bio-energy with CCS) for new and existing biomass combustion.

Thermal energy & technology actions across industry



The report also offers analyses of six key industrial sectors and eight renewable and clean thermal energy technologies.

For more information contact Daniel Riley at daniel.riley@wwfus,org, and visit the website for all the analysis docs www.renewablethermal.org/vision