Solar energy technologies could meet industrial process heating demands

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Solar energy technologies could meet process heating demands, reduce carbon emissions, and improve heating efficiency in the U.S. industrial sector—providing up to 15–50% energy savings.

However, due to the complexity of the industrial sector and lack of industrial energy data, there are many economic and technical questions that have prevented large-scale deployment.

Scientists at the National Renewable Energy Laboratory (NREL) have completed the first detailed review of the state of solar industrial processing heat (SIPH) technologies and potential applications at a national level, whereas research thus far has focused on broad future potential at a global level.

NREL researchers Colin McMillan, Parthiv Kurup, Sertac Akar, and Robert Margolis, along with research partners from Northwestern University, Carrie Schoeneberger and Eric Masanet, published the findings in the article, "Solar for Industrial Process Heat: A Review of Technologies, Analysis Approaches, and Potential Applications in the United States," which appears in the journal *Energy*.

"In thinking about the potential future role of solar energy technologies in the energy system, industry is the least studied sector," Margolis said. "This paper summarizes the literature on solar for industrial process heat and thus provides a solid foundation for thinking about how solar can play a larger role in this key sector."

Industrial process heating is a fundamental step in manufacturing to treat or transform raw materials, making up about 70% of U.S. manufacturing energy use. For decades, it has been produced primarily by fossil fuel combustion, accounting for 90% of reported manufacturing process heat energy in 2014 compared to 92% in 1992. About half of process heat demand takes place within low to medium temperature ranges.

Currently, the food, beverages, metals, and textiles industries, which have lower heat requirements, have the highest number of installed SIPH systems, particularly in solar-rich areas of the United States.

However, the study revealed that SIPH technologies available today, particularly solar thermal and PV electric heating, could meet a wide range of required temperatures for heat applications. There are opportunities to integrate these technologies into cleaning, cooking, and pasteurization operations.

"Much of the energy use for industrial process heat may be well suited for solar technologies. This study provides a foundation for understanding the current landscape of matching solar technologies to process heat demands," McMillan said. "It also identifies important research questions for analyzing the technical and economic potential in the United States for large-scale adoption of these technologies."

Integrating solar energy technologies into the industrial sector could also improve process heating efficiency, saving heating production costs. Solar energy could recover waste heat losses from equipment and products. The average payback period for a waste heat recovery system like this is typically less than two years. Still, many plants have chosen not to pursue these technologies, according to the study.

The analysts found that the most common barriers to SIPH adoption include limited budgets for capital energy investments, budget cycle constraints, and lack of dedicated engineering staff for energy efficiency projects.

To continue to understand technical and economic questions, the analysts recommend future research on integrating energy efficiency measures in SIPH models and developing load profiles to match process requirements with solar resources. The next priority will be studying production costs and SIPH potential in the U.S. industrial sector, which impacts facility-level decision making.

More information: Carrie A. Schoeneberger et al. Solar for industrial

process heat: A review of technologies, analysis approaches, and potential applications in the United States, *Energy* (2020). DOI: 10.1016/j.energy.2020.118083

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