RENEWABLE THERMAL COLLABORATIVE

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Renewable Thermal Collaborative
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About the Renewable Thermal Collaborative (RTC)

The Renewable Thermal Collaborative (RTC) serves as the leading coalition for organizations that are committed to scaling up renewable heating and cooling at their facilities and dramatically cutting carbon emissions.[1] RTC members are industrial and commercial thermal energy buyers with ambitious emissions reductions targets who recognize the urgent need to meet the growing demand for renewable heating and cooling in a manner that delivers sustainable, cost-competitive options at scale.[2]

We agree that technology development, demonstration, and deployment that enable industrial emissions reductions is critical to achieving net zero emissions by 2050 in the United States and that it is imperative to start now to maximize the emissions reductions as quickly as possible. A wide range of renewable technologies will be needed to address the various thermal needs of industrial energy users, including biomass, biogas (including landfill gas), renewable natural gas (RNG or biomethane), geothermal, beneficial electrification, green hydrogen, and solar thermal.

[1] The Renewable Thermal Collaborative was founded in 2017 and is facilitated by the Center for Climate and Energy Solutions, David Gardiner and Associates, and World Wildlife Fund.
[2] See page 8 for a list of the RTC's members and sponsors.

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C6.1 What emerging decarbonization technologies could have the most impact in the industrial sector over the next 5-10 years, and 10-20 years?

While some renewable thermal technologies are commercially available, others are still in early stages of development. Technologies including beneficial electrification, biomass, biogas, RNG, and geothermal are already being deployed and could have an impact in the near term, but require additional support to realize deeper deployment across additional sectors. While there are some solar thermal deployments, thermal energy buyers need more information to make informed investment and process change decisions, expanding the time horizon to achieve emissions reductions. Green hydrogen piques the interest of many industrial energy users, but futher developing green hydrogen and reducing deployment costs will be critical to realize widespread utilization. While green hydrogen has the potential to be highly impactful, it seems likely that this will occur further into the future.

Some beneficial electrification technologies are already being deployed or could be applied in various industrial subsectors. A 2021 report made to the RTC, *Electrifying U.S. Industry: A Technology- and Process-Based Approach to Decarbonization*, analyzes the current state of industrial electrification needs, the technologies available, and the electrification potential for thirteen industrial subsectors.[3] The report's technical analysis offers examples of electrified technologies that can replace conventional process heating technologies in each subsector.

Geothermal, biomass, biogas, and RNG technologies are also already successfully reducing emissions. The RTC previously completed six case studies on the industrial application of biomass, biogas, renewable natural gas, waste-to-energy, and geothermal.[4] These case studies examined the ability of these technologies to reduce emissions across a range of sectors—from food and consumer goods to automotive and manufacturing. In each case study, renewable thermal innovations generated significant cost and emissions savings. Combined, these six projects reduced more than 185,000 metric tons of CO2e annually, providing early proof points for the technical and financial viability of renewable thermal energy solutions. At the same time, they revealed some of the market and policy barriers that no single company can address. These ambitious first movers provide lessons learned, but there

[3] Ali Hasanbeigi, et al., "Electrifying U.S. Industry: A Technology- and Process-Based Approach to Decarbonization," January 2021, https://www.renewablethermal.org/electrifying-us-industry/.
[4] Jessica Leung, et al., "Sustainable Options for Reducing Emissions from Thermal Energy: Showcasing Successful Outcomes from Six Case Studies," October 2018, https://www.c2es.org/document/case-studies-of-renewable-thermal-energy/.

is still much work to be done to advance early stage technologies as well as new applications for existing technologies.

The RTC prepared a *Solar Thermal Technology Assessment*, that considers solar thermal's technical potential to meet industrial needs as well as the market, technical, and policy barriers that impact deployment.[5] This Technology Assessment confirmed that solar thermal technologies and systems can meet a significant percentage of industrial heat requirements, making solar thermal an important decarbonization solution. However, the Technology Assessment made clear that buyers need a way to assess their solar thermal opportunities efficiently in order to consider solar thermal as a strategic resource across their complex and often multinational portfolios.

Green hydrogen is a promising industrial decarbonization solution but faces numerous barriers that need to be resolved as quickly as possible. Cost and complex technological issues such as how much hydrogen existing systems can use or what replacement equipment may be needed are top barriers. RTC members are also greatly interested in how hydrogen will be delivered. DOE's support of green hydrogen research and development can help to solve these and other challenges thermal energy buyers currently face. A focused effort on green hydrogen development can help to overcome technical barriers, reduce costs for deployment, and achieve significant emissions reductions from the industrial sector. The RTC is in the process of developing a green hydrogen technology assessment that will analyze the potential of green hydrogen in the short-term (by 2030) and the long-term (2050), identify major technical, market, and policy barriers, risks and unintended consequences on climate, sustainable forest and land management, freshwater, and biodiversity, as well as implications for local communities, related workforce, and people with disabilities, and provide recommendations for large corporate and institutional buyers.

[5] The Renewable Thermal Collaborative, "Solar Thermal Technology Assessment," May 2021, https://www.renewablethermal.org/solar-thermal-technology-assessment/.

C6.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

As described above in C6.1, while some renewable thermal technologies are commercially available, others are in earlier stages of their development trajectory. All of the renewable thermal technologies could be deployed in the U.S. Moreover, a variety of technologies will be needed to meet industrial energy users' varied energy needs. Different technologies may be appropriate or ideal for different processes. As such, moving multiple renewable technologies forward in parallel can help to achieve industrial emissions reductions more quickly.

C6.4 What limiting factors or challenges do these crosscutting technology areas face regarding broad deployment in the United States?

Renewable thermal energy solutions face many technology, market, and policy barriers that hinder their development and deployment at scale. Some technology and market challenges are similar to those the renewable electricity sector faced in its early development 15 years ago. For example, some renewable thermal technologies are still in their early research phase. Others are technologically proven but not yet commercially available or too costly compared with fossil alternatives like natural gas. Large energy buyers face market barriers as well, including a lack of information; an immature marketplace for renewable thermal technologies; no functional equivalent to Renewable Energy Certificates (RECs) in the power sector that would allow for credible, traceable, and tradable thermal environmental attributes; and inadequate financing tools to underwrite technology deployment.

While there is a growing demand from large energy users for renewable thermal energy solutions, policy development has not kept pace. The policy incentives that were essential for accelerating the development of renewable electricity—such as subsidies and tax incentives for renewable electricity investments, RDD&D investments, and renewable portfolio standards—are not established for renewable thermal energy solutions. The market urgently needs these types of policy incentives to reduce technology costs, accelerate renewable thermal technology RDD&D, and unlock renewable thermal investment.

Thermal energy also faces several unique challenges when compared with renewable electricity. Thermal needs vary tremendously from one industrial process to another and are

often site- or sector-specific. Processes also require heat at widely different temperatures, and solutions for high-temperature processes differ greatly from low-temperature processes. Fuel availability is often limited by geography or scale.

C6.5 What DOE resources would be most beneficial to accelerate decarbonization?

RDD&D

DOE could more fully explore public-private partnerships that can enhance technology transfer and leverage private capital to accelerate commercially available renewable thermal technologies, including renewable fuels such as green hydrogen, RNG, and biofuels. The federal government could provide flexibility in cost-sharing models with the aim of helping technology developers commercialize critical technologies. DOE could continue to support progress in smart and sustainable manufacturing, particularly for energy-intensive, trade-exposed industries including steel, iron, aluminum, cement, glass, pulp, and paper.

DOE could coordinate related RDD&D efforts across the department. The Advanced Manufacturing Office's (AMO's) research focus could expand to include more renewable thermal and innovative industrial processes with much smaller GHG footprints. The office could also prioritize demonstration projects for viable renewable thermal technologies such as green hydrogen. Increases in funding could also focus on growing renewable thermal research at the Advanced Research Projects Agency-Energy (ARPA-E), as well as multi-stakeholder and multi-disciplinary programs such as energy innovation hubs, Manufacturing USA, and Energy Frontier Research Centers.

Three provisions in the Infrastructure Investment and Jobs Act—the Regional Clean Hydrogen Hubs, Clean Hydrogen Manufacturing and Recycling Program, and Clean Hydrogen Electrolysis Program—offer significant support for green hydrogen development. In addition, the Secretary's Energy Earthshot Initiative and the Hydrogen Shot will work to reduce the cost of green hydrogen on an accelerated timeline. Green hydrogen is a promising technology and the RTC applauds these efforts.

In addition to this focus on hydrogen, DOE could also establish an energy innovation hub that is dedicated more broadly to developing multiple renewable thermal technologies with industrial applications.

Finally, DOE could ensure data collection and develop methodologies for coherent monitoring and ex-post analysis of policy measures.

Technical Assistance

DOE can help increase technical assistance to various industrial sector stakeholders by exploring renewable thermal opportunities. In particular, DOE could offer the industrial sector improved access to federal laboratories to better collaborate on demonstration and pilot projects that are critical to deploying thermal solutions at scale. Such projects could include electrification and green hydrogen—all potentially viable technologies for high temperature heat users.

DOE could replicate the highly successful Gateway for Accelerated Innovation in Nuclear (GAIN) program for renewable thermal technologies. A GAIN analogue would provide the industrial community with a single point of access for technical, regulatory, and financial resources necessary to catalyze innovative renewable thermal solutions toward commercialization.

Technical assistance is also needed in establishing clear sustainability criteria for bioenergy that ensure that it delivers genuine climate benefits over fossil alternatives. DOE could design policies that incorporate clear and strict sustainability criteria for bioenergy that take into account the climate impact of the entire life cycle of bioenergy consumption to ensure delivery of genuine climate benefits over fossil alternatives. Forest Stewardship Council (FSC) certification, Roundtable on Sustainable Biomaterials (RSB) certification, or FSC controlled wood standards could be applied to any biomass sourcing to make sure that the lands from which the biomass is derived are managed well. Bioenergy could be treated as a transition solution as policy incentives support a broader set of more sustainable renewable thermal solutions including concentrated solar, beneficial electrification, and green hydrogen.

Financial Resources

Policymakers could establish a National Climate Bank, whose objectives could include providing grants and low-cost loans for renewable thermal technologies in the industrial sector. While the bank could fund a variety of different projects, renewable thermal projects could include infrastructure for green hydrogen and multi-user industrial parks that aggregate and centralize demand for renewable thermal resources.

DOE's Loan Programs Office (LPO) could expand eligibility for its loan guarantee programs to include RNG and beneficial electrification, as well as the infrastructure needed to facilitate these solutions. LPO could also work to reduce administrative costs and barriers to program participation.

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