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Combined Heat and Power Alliance
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This information is provided in response to the Request for Information #DE-FOA-0002529 from the U.S. Department of Energy's (DOE) Hydrogen Program as Additional Information for DOE to consider as it defines the scope and priorities of its hydrogen initiatives.

The Combined Heat and Power Alliance (CHP Alliance)[i] is a coalition of businesses, labor, contractors, non-profit organizations, and educational institutions with the common purpose to educate all Americans about combined heat and power (CHP) and waste heat to power (WHP) and how CHP and WHP can make America's manufacturers and other businesses more competitive, reduce energy costs, enhance grid reliability, and reduce emissions.

The CHP Alliance applauds the Secretary's Energy Earthshot Initiative and the Hydrogen Shot, as clean hydrogen development and cost reductions for deployment will be critical to solving climate change and ensuring that the U.S. is a global leader in developing clean energy technologies and that U.S. companies secure any competitive advantages from being early adopters of such technologies. The CHP Alliance and its members see clean hydrogen used in highly efficient CHP systems as a significant opportunity to reduce emissions from the industrial and buildings sectors. The CHP Alliance welcomes the opportunity to engage with DOE on clean hydrogen development and deployment by participating in working groups, connecting DOE with CHP members where appropriate, or providing additional information.

CHP systems are highly efficient, they typically operate with an overall efficiency of 65 to 85 percent, with some systems approaching 90 percent.[ii] This is compared to an average efficiency of 39 percent for fossil-fueled power plants in the U.S., and an efficiency of 50 percent when electricity generation is combined with an on-site boiler for thermal energy needs.[iii] CHP systems achieve these high efficiencies by recovering the waste heat by-product of electricity generation as useful thermal energy for heating and cooling.[iv] Because they

operate efficiently, CHP systems combust less fuel to provide the same energy services. This efficient generation of energy reduces all types of emissions, including greenhouse gases such as carbon, criteria pollutants, and hazardous air pollutants.

Historically, CHP units have run on traditional fuels, and many today use natural gas. This use of CHP can be thought of as "CHP 1.0," the first wave of CHP technologies that relied on fossil fuels. However, CHP units can be fueled by renewable and lower-carbon fuels, including hydrogen, known as "CHP 2.0." Use of hydrogen fuel can allow CHP systems to reduce emissions even further than they do under CHP 1.0. Hydrogen fuel can serve as the primary fuel source for CHP systems and further reduce emissions across the industrial, commercial, and municipal sectors. Moreover, CHP systems use hydrogen fuel efficiently, requiring less fuel inputs for the same energy outputs compared to other generation units. Given the high cost of hydrogen, using hydrogen fuel efficiently in CHP systems will help to keep costs low and enable greenhouse gas (GHG) reductions. Efficient use of hydrogen fuel should be central to any hydrogen and climate strategy, and CHP helps to meet this goal.

In the future, more CHP systems could run on fuels with higher percentage concentrations of hydrogen. Work is being done to increase the volume of hydrogen fuel that can be used in CHP systems and some CHP systems are already capable of running entirely on hydrogen. Gas turbine manufacturers are looking to provide equipment that can accommodate higher percentages of hydrogen fuel: various companies in the U.S. and abroad are deploying or working on hydrogen-ready technology, and in 2019, a number of European companies committed to provide gas turbines that can handle 20% hydrogen content in fuel by 2020, and 100% by 2030.[v] While hydrogen fuel has the potential to see more extensive use in CHP systems in the future and achieve deeper emissions reductions, it is critical that DOE keep in mind the following considerations when developing hydrogen initiatives to ensure that this potential becomes a reality:

- **Transportation**: The existing gas pipeline system may provide a cost-effective way to transport clean hydrogen, but additional research is required to determine what quantities of hydrogen can safely be transported or what retrofits may be required.
- **Distributed Generation**: Distributed generation technologies such as CHP can be deployed at the point of clean hydrogen production, allowing the use of hydrogen fuel in CHP systems and the realization of corresponding emissions benefits while the development of hydrogen-ready pipelines is still underway.

- **Use**: While research and development of hydrogen-ready CHP technologies is ongoing, technology manufacturers and end users will need support evaluating what amount of hydrogen current equipment can use, identifying the retrofits and upgrades needed to ensure the adjustment of existing equipment for hydrogen use is easy and affordable, and the development and deployment of new equipment as required.

As noted above, the CHP Alliance welcomes the opportunity to provide additional insights to DOE regarding industrial and commercial use of hydrogen through working groups, discussions, or other forums. Please do not hesitate to reach out to us for further information.

[i] Combined Heat and Power Alliance. "Who We Are." June 2021. https://chpalliance.org/about/
[ii] U.S. Department of Energy. "Combined Heat and Power (CHP) Technical Potential in the United States." March 2016, p. 3. https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf; U.S. Environmental Protection Agency. Combined Heat and Power Partnership. "CHP Benefits." https://www.epa.gov/chp/chp-benefits.
[iii] Combined Heat and Power Alliance. "Combined Heat and Power and a Changing Climate: Reducing Emissions and Improving Resilience." January 2021, p. 10. https://chpalliance.org/resources/chp-and-a-changing-climate-reducing-emissions-and-improving-resilience/.
[iv] U.S. Environmental Protection Agency. Combined Heat and Power Partnership. "Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems." February 2015, p. 3. https://www.epa.gov/sites/production/files/2015-07/documents/fuel_and_carbon_dioxide_emissions_savings_calculation_methodology_for_combined_heat_and_power_systems.pdf
[v] POWER. "High-Volume Hydrogen Gas Turbines Take Shape." May 1, 2019. https://www.powermag.com/high-volume-hydrogen-gas-turbines-take-shape/