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This information is provided in response to the Request for Information from the U.S. Department of Energy's (DOE) Hydrogen Program on the regional clean hydrogen hubs implementation strategy (DE-FOA-0002664.0001).

The Combined Heat and Power Alliance (CHP Alliance) appreciates the opportunity to submit feedback to the Hydrogen Program on the regional clean hydrogen hubs. Combined heat and power (CHP) technologies, especially those utilizing renewable and lower-carbon fuels such as clean hydrogen, can enable significant emissions reductions across the industrial and buildings sectors that will be critical to achieving the nation's goal of net zero emissions by 2050.

About the CHP Alliance

The CHP Alliance is a diverse coalition with more than 70 members including equipment manufacturers and distributors, engineers, utilities, labor, contractors, non-profit organizations, and educational institutions.¹ Our members come together with the common purpose to educate all Americans about 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.

¹ The Combined Heat and Power Alliance, "Who We Are," accessed February 28, 2022, <https://chpalliance.org/about/>.



33. What role/actions can DOE take to support reliable supply and demand for potential hydrogen producers and customers?

As described further below, well-applied CHP units are the most efficient way to generate power with traditional fuels today, requiring less fuel inputs for the same energy outputs. CHP units are already deployed across the industrial and buildings sectors and clean hydrogen can serve as the primary fuel source for CHP systems and further reduce emissions across these sectors. Some CHP systems can operate on 100% clean hydrogen fuel today,² and all manufacturers are working to ensure their units that can operate on 100% clean hydrogen fuel.

Engaging with industrial and commercial customers that have CHP systems can help DOE to better understand current hurdles to clean hydrogen adoption and develop plans to lower these hurdles. Ensuring that the hydrogen hubs' work considers these customers' needs and the needs of their systems that currently use natural gas can help to support potential customers when clean hydrogen becomes more readily available.

40. Please provide any additional information or input not specifically requested in the questions above that you believe would be valuable to help DOE develop a Regional Clean Hydrogen Hub FOA, including any specific criteria that DOE may take into consideration in implementing the Hub program.

CHP and Clean Hydrogen

CHP is a proven and highly efficient technology that can reduce emissions using traditional fuel, and has the opportunity to reduce emissions even further using clean hydrogen fuel. CHP units are already deployed throughout the industrial and buildings sectors and could transition to clean fuels in the near-term as these fuels become more accessible. Renewable and lower-carbon fuel technologies such as clean hydrogen can serve as the primary fuel source for CHP systems and further reduce emissions across the industrial and buildings sectors.

² "The UKs First 100% Hydrogen CHP." 2EA, February 19, 2021, <https://www.2ea.co.uk/The-UKs-first-100Percent-hydrogen-CHP.html>



CHP 2.0

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 clean hydrogen, known as “CHP 2.0.” Using clean 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 and buildings sectors. CHP systems can operate on 100% clean hydrogen fuel today, and all manufacturers are working to ensure their units that can operate on 100% clean hydrogen fuel within the decade. For example, gas turbine manufacturers are looking to provide equipment that can accommodate higher percentages of lower-carbon fuels: 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 100% hydrogen content in fuel by 2030.³

CHP’s Efficiency

Properly designed CHP systems typically operate with an overall efficiency of 65-85%, with some approaching 90%.⁴ CHP achieves these high efficiencies by recovering the waste heat byproduct of electricity generation as useful thermal energy for heating and cooling, a process that is particularly beneficial for energy-intensive industrial sectors. Because they operate efficiently, CHP systems combust less fuel to provide the same energy services, reducing all types of emissions including greenhouse gasses such as carbon, criteria pollutants, and hazardous air pollutants.

³ Sonal Patel, “High-Volume Hydrogen Gas Turbines Take Share,” *POWER*, May 1, 2019, <https://www.powermag.com/high-volume-hydrogen-gas-turbines-take-shape/>.

⁴ “Combined Heat and Power (CHP) Technical Potential in the United States,” U.S. Department of Energy, March 2016, p. 3, www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf ; “CHP Benefits,” U.S. Environmental Protection Agency Combined Heat and Power Partnership, last accessed February 2022, <https://www.epa.gov/chp/chpbenefits>.



CHP systems will also use clean fuels efficiently, requiring less fuel inputs for the same energy outputs compared to other generation units. Given the potentially higher costs of less abundant or newly-developed cleaner fuels such as clean hydrogen, using these fuels efficiently in CHP systems can help to lower costs while enabling emissions reductions.

CHP Deployment

Today, there is nearly 66 gigawatts (GW) of installed CHP at more than 1,200 industrial facilities across the country, which equates to 13% of U.S. industrial electric generating capacity.⁵ Using cleaner fuels such as clean hydrogen in these generation units can help industrial facilities reduce their emissions. Existing CHP systems, including ones installed today, can convert to 100% clean hydrogen at reasonable cost and with minimal downtime because these conversions can occur during scheduled overhauls.⁶

⁵ The Combined Heat and Power Alliance, “Factsheet: CHP and American Manufacturing,” October 2020, <https://chpalliance.org/resources/combined-heat-and-power-chp-and-american-manufacturing/>.

⁶ A CHP system overhaul typically occur every 8-10 years for a unit that runs continuously.