GE Gas Power Awarded $4.2 Million in Funding from ARPA-E to Develop Breakthrough Decarbonization Technologies

- *Funding is part of Advanced Research Projects Agency-Energy (ARPA-E) OPEN 2021 Program to strengthen novel approaches for the advancement of transformational technologies supporting a more decarbonized energy future*
- *GE Gas Power has been selected to advance breakthrough technologies in more sustainable energy production*

Atlanta, Georgia, July 28, 2022 - GE Gas Power (NYSE:GE) announced today it has secured $4.2 million in federal funding from the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E). The funding is part of the ARPA-E OPEN 2021 program, which prioritizes the advancement of transformational technologies supporting a more decarbonized energy system. GE Gas Power's funding is focused on two projects entitled "Lifted-flame combustion for high-hydrogen reheat gas turbines" and "Manufacturing high-yield investment castings with minimal energy." Both initiatives will be led by GE Gas Power and conducted at GE's Global Technology Center in Greenville, South Carolina.

As part of these projects, GE will conduct cutting-edge research for gas turbine decarbonization in close collaboration with industrial companies and educational institutions.

"As one of the world's leaders in combustion technology, GE Gas Power is leading technology and manufacturing advancements in the power generation industry to enable low or zero-carbon power generation, all of which fundamentally relies on conducting advanced research both at GE and with collaborators," said John Intile, Vice President, Engineering at GE Power. "GE is pleased that ARPA-E has recognized the value of developing alternative methods to boost the efficiency of gas turbines powered by fuel blends with high percentage of hydrogen, and the potential to completely disrupt current cycle time, producibility limits and energy requirements for investment castings of turbine components. We look forward to developing these breakthrough technologies with prestigious collaborators,

including Georgia Institute of Technology (Georgia Tech), our GE Global Research Center, and DDM Systems, a pioneering company in the investment casting industry."

Lifted-Flame Combustion for High-Hydrogen Reheat Gas Turbines

With this project, GE Gas Power will investigate a novel lifted-flame combustion approach for advanced gas turbine engines powered by mixtures of natural gas and hydrogen; hydrogen does not produce carbon emissions when burned in a gas turbine. Gas turbine combined cycle (GTCC) combustion technology is very mature in its present form, and further gains in efficiency are likely to be incremental without game-changing technical and operating cycle advances. This new technology and research aim to break the current, materials-limited upper bound efficiency barrier for new gas turbines and installed base retrofits and create a new GTCC growth trajectory—targeting net plant efficiencies of 67% or greater on a wide range of fuel compositions, all while meeting strict emissions standards.

"Our goal of increasing gas turbine combined cycle plant efficiency by 5 or more percentage points in the next decade will position GE's technology to help lead the energy transition," said Jeffrey Goldmeer, Emergent Technologies Director for Decarbonization at GE Gas Power. "The proposed technology offers transformative value for both high-hydrogen and post-combustion carbon capture applications, ensuring dispatchable power with significantly reduced carbon emissions via highly efficient gas turbine-driven power generation."

This project will be executed at GE's Gas Turbine Technology Center in Greenville, South Carolina, home to the world's largest gas turbine manufacturing facility and full-scale combustion test facility. The foundational testing of the technology will be conducted at the Atlanta-based Georgia Institute for Technology, a leading research university in the field of engineering and gas turbine combustion.

"As home to the largest university-based hydrogen research and development effort in the country, we are delighted to be collaborating with ARPA-E and GE Gas Power on this effort," said Tim Lieuwen, Regents' Professor and Executive Director of the Strategic Energy Institute at Georgia Tech. "We will be deploying state-of-

the-art diagnostics and modeling tools to predict key hydrogen flame parameters and relating those to macro-engine performance.”

Manufacturing High-Yield Investment Castings with Minimal Energy
This project will develop and combine key elements of casting technology including an innovative furnace development, as well as 3D printed additive ceramic mold technologies that will fundamentally change the production of high-value metal components for gas turbines. The new system could produce cast parts using up to 90% less energy than traditional methods, as well as provide improved quality, consistency, and yield, all at lower cost.

“The highly diverse energy mix of the future will demand that we are more flexible and responsive than ever before to fulfilling our customer needs for gas turbine components. The proposed system of technologies, combining digital tooling, cutting edge additive ceramic mold printing, and lean flow casting technology, will enable us to respond rapidly while reducing our energy usage and carbon footprint,” said Tom Amond, Emerging Technology Incubator at GE Gas Power.

GE Gas Power will develop this advanced solution in collaboration with DDM Systems, a company known for the precision investment castings of complex engineered components, with technical support from the GE Global Research Center in Niskayuna, New York.

“DDM Systems is honored and excited to be selected for this ARPA-E award. DDM has a decade of collaboration with GE to advance the investment casting of gas turbine components using 3D printed ceramic shells. DDM's vision of the Digital Foundry aims to dramatically modernize investment casting to produce castings ten times faster at half the cost without any tooling, wax patterns, and molded cores. The enabler is DDM's LAMP – one of the most sophisticated production-capable ceramic 3D printing technology in the world. The ARPA-E award provides funding for multidisciplinary science-based R&D, and to transition it to a commercially viable lean digital casting technology," said Dr. Suman Das, Founder and CEO of DDM Systems

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