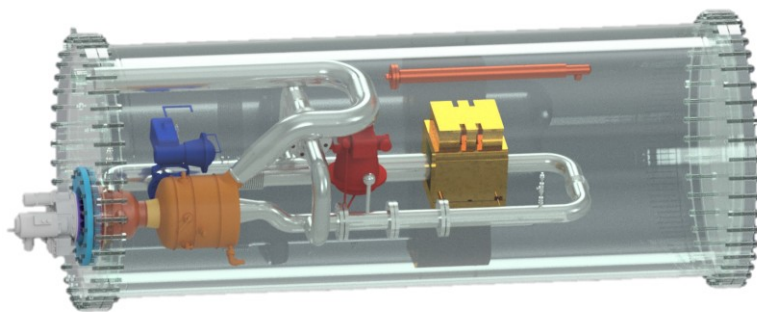


TECHBRIEF

NETL Ref. No: 25N-17

Hybrid Solid Oxide Fuel Cell-Gas Turbine for Efficient and Flexible Power Generation



A compact (truck scale) design of a scalable SOFC-GT integrated reformer system.

Opportunity

The U.S. Department of Energy's National Energy Technology Laboratory (NETL) has developed a recuperated gas turbine (GT) cycle, augmented with a solid oxide fuel cell (SOFC) capable of operating at ultralow fuel utilization (10%-30%). This is achieved through specific thermal and chemical management strategies, including a hot air bypass around the SOFC to the combustor for rapid load transitions and temperature control, and a cold air bypass around the recuperator directly to the turbine inlet for surge margin and temperature control. Chemically, anode exhaust is recycled to a reformer, which is thermally coupled to the exhaust stream, improving fuel use and mitigating carbon deposition. The SOFC itself incorporates larger flow passages to accommodate high air flow rates, contributing to high overall efficiency, especially at part-load, and extended SOFC operational life. This invention is available for licensing and/or further collaborative research from NETL.

Problems Addressed

- Traditional GTs suffer from significant efficiency losses and increased emissions during part-load operation and dynamic load changes.
- SOFCs offer high efficiency but are limited in their operational flexibility and lifespan.
- Existing hybrid systems combining fuel cells with GTs often operate with high fuel utilization, which increases fuel cell degradation risk.

Potential Commercial Applications

- Flexible and efficient distributed power generation: supporting modern grids with variable demand
- Resilient power for remote and critical applications: acting as a potential off-grid power solution
- High-efficiency combined heat and power (CHP) systems: producing electricity and useful heat with superior load following for industrial and commercial facilities

Competitive Advantages

- Offers high efficiency during part-load operations, addressing the efficiency drop observed in traditional GTs
- Mitigates degradation issues common in conventional SOFC-GT hybrids
- Is well-suited for distributed energy applications and to linkage to variable renewable generators, providing an advantage over larger, centralized power systems

Intellectual Property Status

A provisional patent application has been filed.

Publications

B. Zhang, et al. (2022) Rapid load transition for integrated solid oxide fuel cell-gas turbine (SOFC-GT) energy systems: A demonstration of the potential for grid response. *Energy Convers and Management*. <https://doi.org/10.1016/j.enconman.2022.115544>.

Licensing

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