High Efficiency Advanced Lightweight Fuel Cell (HEAL-FC), Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Infinity's High Efficiency Advanced Lightweight Fuel Cell (HEAL FC) is an improved version of its current fuel cell technology developed for space applications. The fundamental operation of this Proton Exchange Membrane (PEM) fuel cell is improved over comparable fuel cell technologies, providing simplified system design and longer duration missions. The Non Flow Through (NFT) nature of reactant consumption within the fuel cell stack produces a much higher utilization of reactants. The Advanced Product Water Removal (APWR) embodied within each repeat element of the fuel cell stack allows for the elimination of the water separation devices usually residing in the balance of system. This drives system simplification while increasing overall reliability and reducing system cost. The HEAL FC can be operated as a hydrogen-oxygen fuel cell for long endurance missions and also as a hydrogen-air fuel cell. This transition from pure oxygen to air can be accomplished dynamically in flight, allowing for reduced mass of the oxygen storage subsystem. This is a critical advantage for UAS flying to and from dense air environments consuming air as the fuel cell oxidant and switching over to pure oxygen when in the dense air region of concern. The fuel cell stack improvements to be made as part of this topic are planned to make the fuel cell stack more amenable to Unmanned Aerial Systems (UAS) by reducing mass and volume. The current configuration of the fuel cell stack was driven by performance only. Now that the NFT and APWR technologies have been proven, the stack hardware itself must be minimized to fit the UAS markets. Costs for this advanced fuel cell system will inherently be reduced through the implementation of mass production design methodology to transform a well-functioning power system for space applications to lower altitude uses.

ANTICIPATED BENEFITS

To NASA funded missions:

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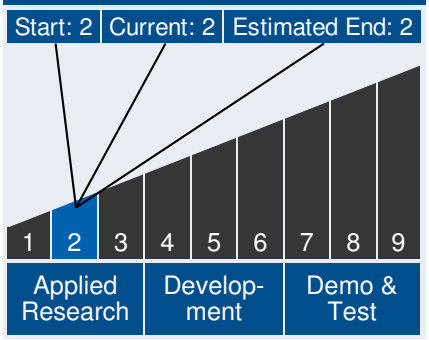
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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Potential NASA Commercial Applications: A High Efficiency Advanced Lightweight Fuel Cell (HEAL FC) provides a power architecture for a broad range of unmanned aerial vehicle (UAV) platforms. This modular system can be configured to power High Altitude Long Endurance (HALE) aircraft as well as much smaller UAVs gathering data within volcanic plumes. When combined with novel hydrogen and oxygen reactant storage systems, the HEAL FC can provide flight times well in excess of the two days the Predator B can fly for NASA's Ikhana program. Much smaller UAVs used for lower altitude data gathering, similar to Aerovironment's Dragon Eye, can benefit from utilizing a HEAL FC for extended mission duration, as well as flight within dense air environments. The Infinity HEAL FC can continue to be utilized within space applications being pursued by NASA, from Space Launch Systems (SLS) to future manned mission programs. Although Infinity's fuel cell has been developed for these space applications to date, the mass and volume of power infrastructure for such missions is always a major concern. The development of a much lighter fuel cell stack would provide a modular power system applicable to a broad array vehicles.

To the commercial space industry:

Potential Non-NASA Commercial Applications: From airborne activities to underwater operations, all commercial entities are eager for longer endurance above or below the water. Many activities within the oil and gas markets, for example, require battery powered autonomous underwater vehicles to re-surface frequently for battery replacement or recharging, resulting in far more costly pipeline inspections. The scientific community's underwater mapping capabilities and cost-effectiveness could also improve dramatically. The upcoming lower altitude package delivery services, such as Amazon, FedEx, and others, also demand longer duration in the air, effectively increasing delivery radius from warehouses and the mobile delivery platforms currently being developed. Commercial space companies, such as SpaceX, Blue Origins, and others could benefit from the mass and volume reduced HEAL FC. From launch vehicles to orbiting

Management Team *(cont.)*

Principal Investigator:

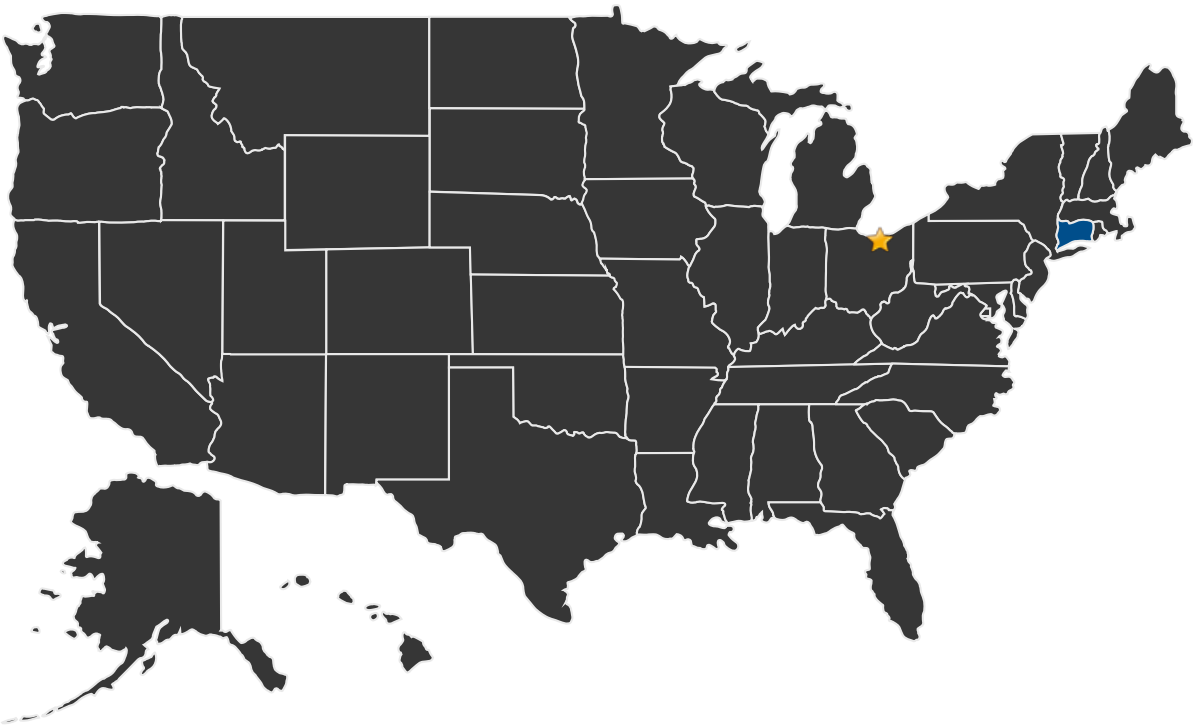
- William Smith

Technology Areas

Primary Technology Area:
Space Power and Energy Storage (TA 3)
└ Power Generation (TA 3.1)
  └ Chemical (TA 3.1.2)

platforms, the HEAL FC could form the heart of a power and energy infrastructure capable of scaling to meet the needs of each application.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

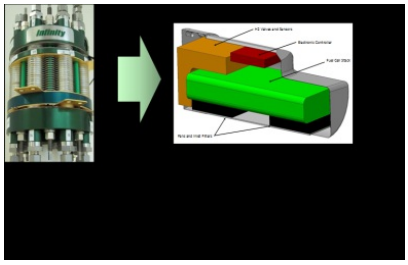
- Infinity Fuel Cell and Hydrogen, Inc. (Windsor, CT)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23161)

IMAGE GALLERY



High Efficiency Advanced Lightweight Fuel Cell (HEAL-FC), Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

A High Efficiency Advanced Lightweight Fuel Cell (HEAL FC) provides a power architecture for a broad range of unmanned aerial vehicle (UAV) platforms. This modular system can be configured to power High Altitude Long Endurance (HALE) aircraft as well as much smaller UAVs gathering data within volcanic plumes. When combined with novel hydrogen and oxygen reactant storage systems, the HEAL FC can provide flight times well in excess of the two days the Predator B can fly for NASA's Ikhana program. Much smaller UAVs used for lower altitude data gathering, similar to Aerovironment's Dragon Eye, can benefit from utilizing a HEAL FC for extended mission duration, as well as flight within dense air environments. The Infinity HEAL FC can continue to be utilized within space applications being pursued by NASA, from Space Launch Systems (SLS) to future manned mission programs. Although Infinity's fuel cell has been developed for these space applications to date, the mass and volume of power infrastructure for such missions is always a major concern. The development of a much lighter fuel cell stack would provide a modular power system applicable to a broad array vehicles.