

TEST Hub

The Transportation, Energy and Space
Technology Hub
at

NASA's John F. Kennedy Space Center

A Unique Energy Technology Partnership

ENERGY
FLORIDA

July 31, 2017
Florida Polytechnic University

 Florida Energy
Systems Consortium

Tim Franta

Director of Special Projects



Energy Florida

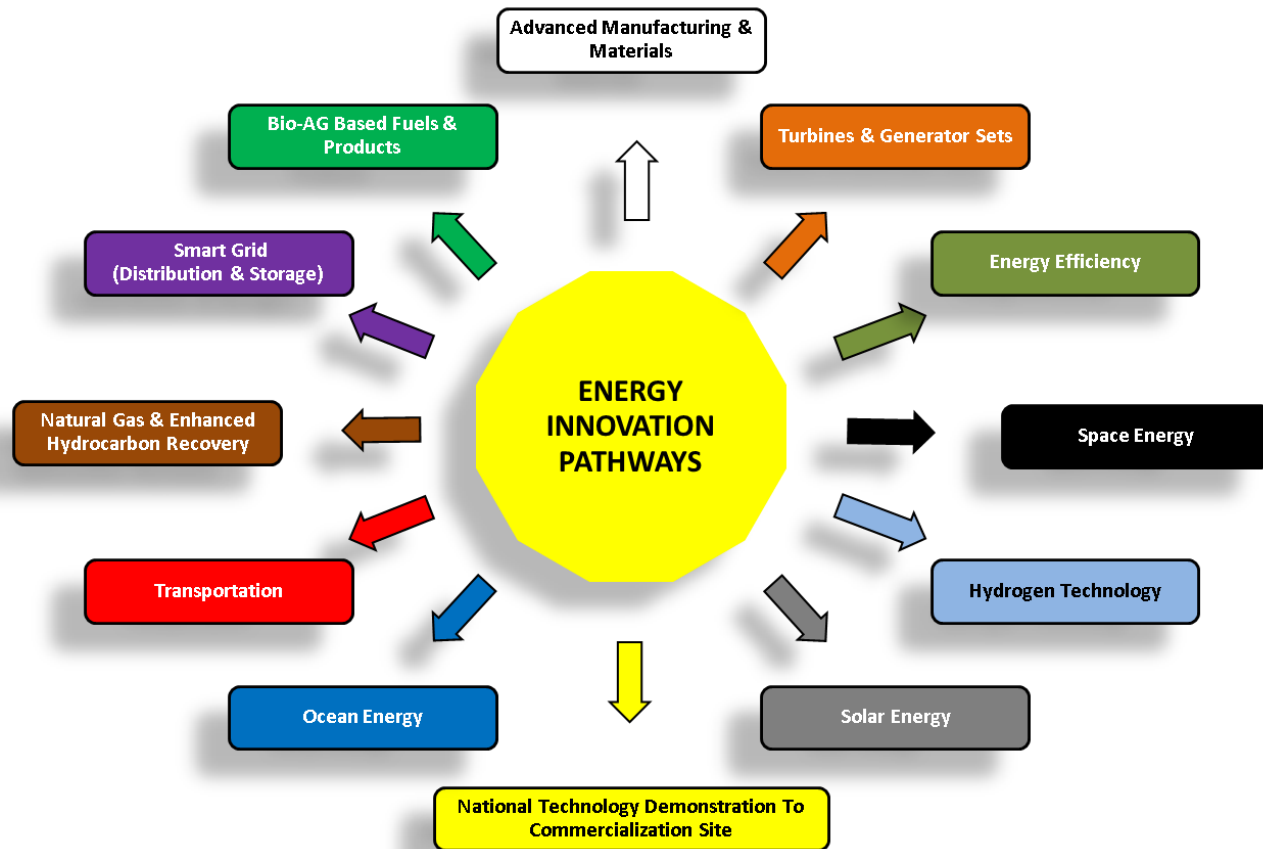
Energy Florida is the industry-led nonprofit association developing partnerships and marshalling resources to grow the energy sector and related industries across Florida, the Southeastern US, and Latin America and the Caribbean



We are Building America's Energy Economy



Technology Focus Areas



There Is Not One US Department of Energy National Laboratory or User Facility in Florida

Office of Science Laboratories

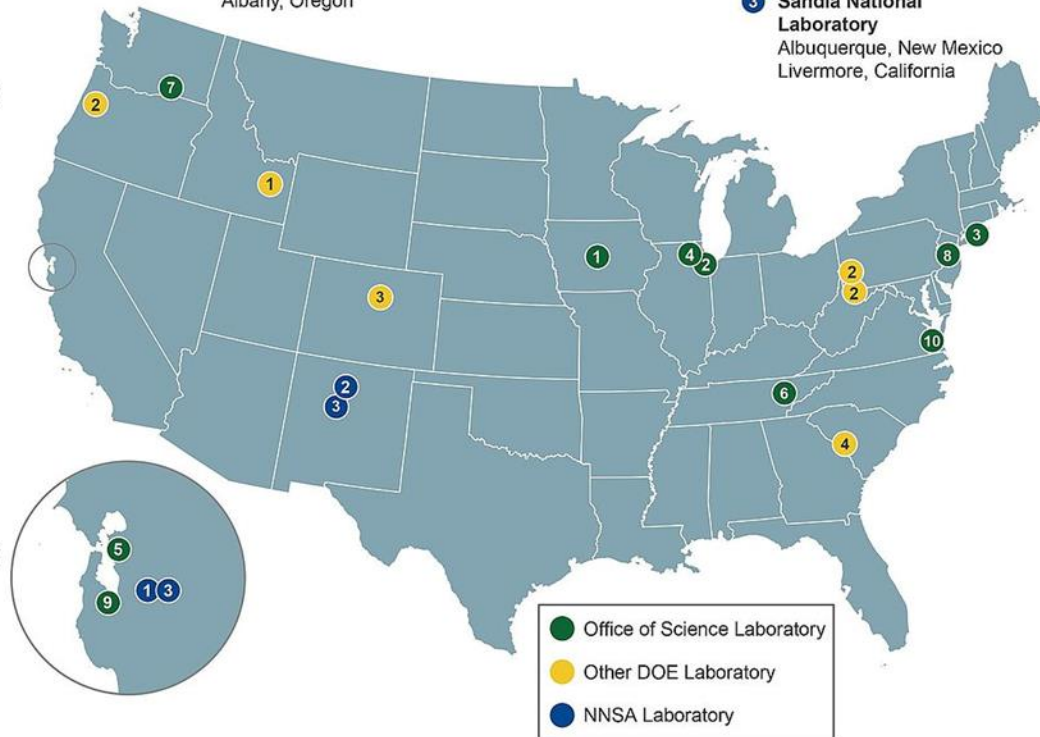
- 1 Ames Laboratory
Ames, Iowa
- 2 Argonne National Laboratory
Argonne, Illinois
- 3 Brookhaven National Laboratory
Upton, New York
- 4 Fermi National Accelerator Laboratory
Batavia, Illinois
- 5 Lawrence Berkeley National Laboratory
Berkeley, California
- 6 Oak Ridge National Laboratory
Oak Ridge, Tennessee
- 7 Pacific Northwest National Laboratory
Richland, Washington
- 8 Princeton Plasma Physics Laboratory
Princeton, New Jersey
- 9 SLAC National Accelerator Laboratory
Menlo Park, California
- 10 Thomas Jefferson National Accelerator Facility
Newport News, Virginia

Other DOE Laboratories

- 1 Idaho National Laboratory
Idaho Falls, Idaho
- 2 National Energy Technology Laboratory
Morgantown, West Virginia
Pittsburgh, Pennsylvania
Albany, Oregon
- 3 National Renewable Energy Laboratory
Golden, Colorado
- 4 Savannah River National Laboratory
Aiken, South Carolina

NNSA Laboratories

- 1 Lawrence Livermore National Laboratory
Livermore, California
- 2 Los Alamos National Laboratory
Los Alamos, New Mexico
- 3 Sandia National Laboratory
Albuquerque, New Mexico
Livermore, California



The State Does Have the NASA John F. Kennedy Space Center



What Is The TEST Hub?

The Transportation ,Energy and Space Technology Hub (TEST Hub) project uses the Kennedy Space Center facilities, workforce and that installation as a place to conduct energy technology development, demonstration , test and evaluation.

Energy Florida has been working for several years to open up the resources of KSC and its more than 50 laboratories and workshops to commercial and non-NASA governmental users and academia.



Relationship Between Energy & Space

- Propulsion
 - Rocket engines, turbo pumps, combustion chambers, fuel tanks
 - Ion propulsion
- Power
 - Solar electric
 - Solar thermal
 - Fuel cells
 - Auxiliary power units
 - Radioisotope power systems
 - Thermal-electric generators
 - Batteries/Storage
- Radiation Shielding
- Thermal Control
 - Insulation
 - Efficient radiators
- Power Transmission
 - Microwave
 - Laser
 - Micro-grids
- Power Management
 - Passive by design
 - Active
 - Software
- Biological
 - Food (personal energy)
 - Biofuels

Laboratories and Workshops with the Right Stuff

Chemistry and Physics Laboratories

- Applied Chemistry
- Applied Physics
- Chemical Analysis and Sampling
- Physical Test and Analysis

Electrical, Electronics & Power

- Advanced Electronics and Technology Development
- Controls
- Electronic Development and Test
- Electrical and Electronics Failure Analysis
- Instrumentation Systems Development
- Power Systems
- Battery Workshop
- Radio Frequency and Avionics

Meteorology

- Applied Meteorology Unit
- Electromagnetic Technology, Test and Qualification Services

Materials and Processes / Failure Analysis

- Metrology
- Nondestructive Inspection and Evaluation
- Standards and Calibration
- Materials Failure Analysis
- Corrosion Technology
- Contamination Control
- Certification Support
- Test, Teardown and Evaluation Unit
- Inspection and Process Control Support
- Sensors, Telemetry and Monitoring Support

Fluids, Mechanisms and Structures

- Corrosion Technology
- Cryogenics Test
- Prototype Development
- Launch Equipment Test Facility
- Commodity, Handling and Services

Fabrication and Manufacturing

- Displays and Controls
- Prototype Design and Fabrication
- Original Equipment Manufacturer (OEM) Replacement Unit
- Reverse Engineering Unit
- Life Cycle Modeling and Simulation

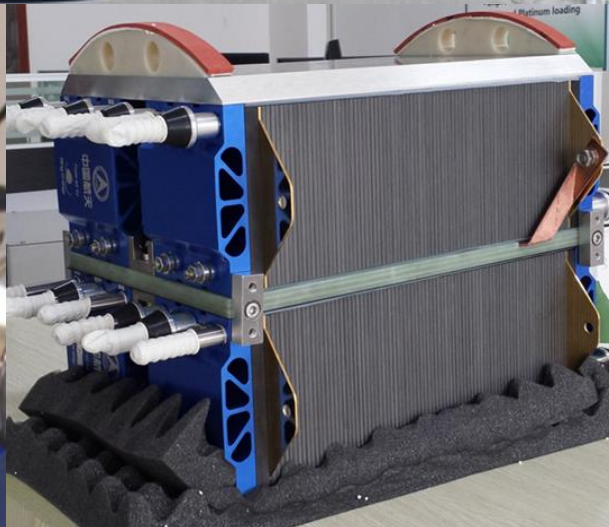
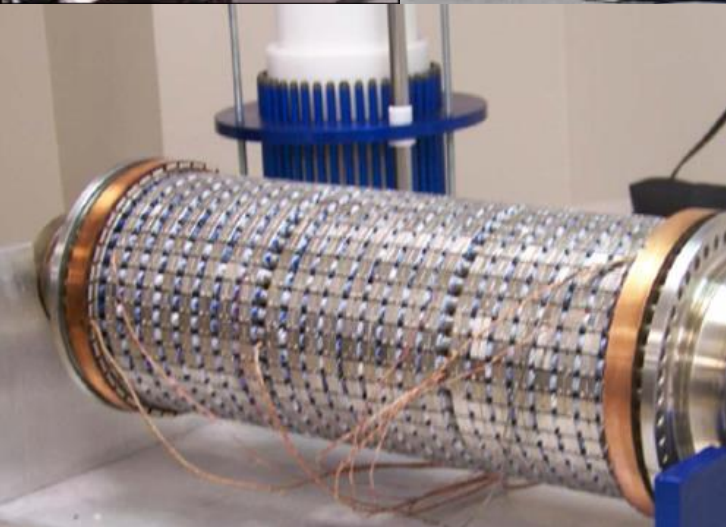
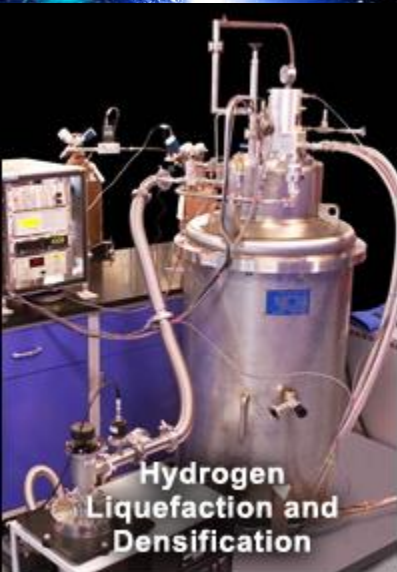
Information Technology and Communication

- Advanced Network Development
- Design Visualization
- Experimental Imaging
- Fiber Optics and Communication
- Telescience and Internet Systems

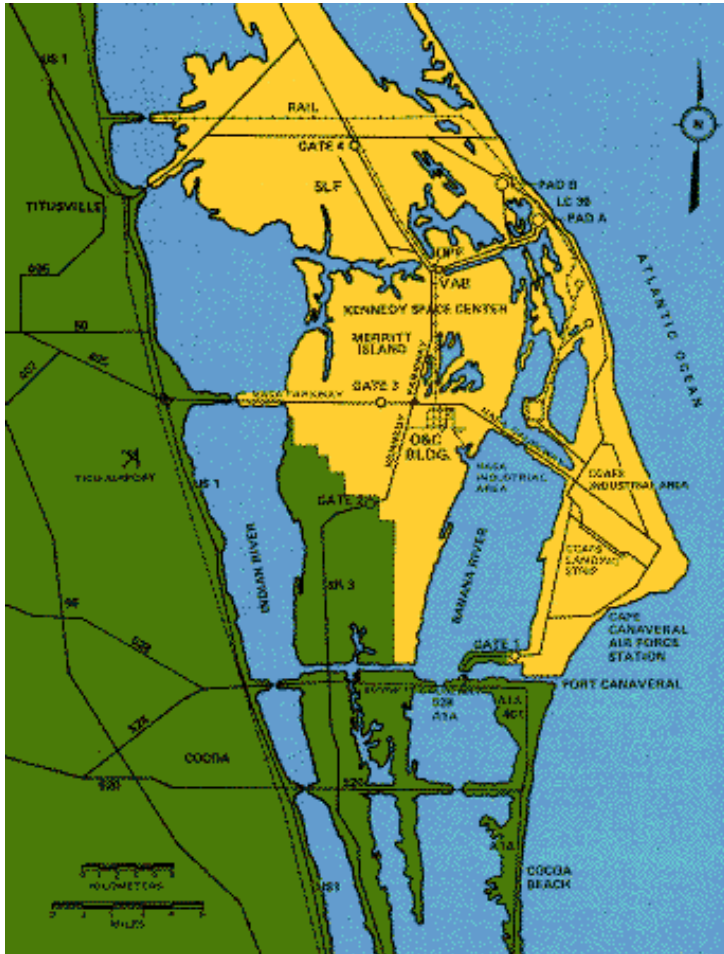
Life Sciences

- Space Life Sciences
- Analytical Chemistry Core
- Applied Genetic Technology
- Controlled Environmental
- Earth Systems Modeling

More Than 50 Laboratories & Workshops



Controlled Demonstration Site



The Space Center is:

- Larger than 17 countries
- A day population larger than half of the cities in the United States
- Has roads, bridges, runways, agriculture, power substations, sewage plants, a port, and large industrial facilities and hundreds of buildings
- A city with a controlled and secured environment
- Ideal to test :
 - Autonomous vehicles
 - Grid & Micro-grid technology
- Not scared of new technology

Benefits of Using the TEST Hub

- Provides third-party validation with a stellar reputation
- Everything used in human spaceflight must be certified – this discipline is applicable to energy technology
- NASA is used to working in extreme and hazardous environments
- Makes both the federal government and investors comfortable with results
- NASA is used to solving problems
- More than 50 year history of evaluating technology
- The Space Center is set up for test and evaluation

Pay by the drink, don't buy the bar.

Energy Florida acts as a guide or concierge

- Agreements
- Payments
- Access to facilities
 - Foreign nationals
 - Students
- Access to talent:
 - NASA
 - Contractors
- With NASA and/or contractor's approval these facilities and talent can be included in grant applications

Florida does have unique access to one national laboratory



The 2005 NASA Authorization Act designated the U.S segment of the ISS as a national laboratory.

In 2011, NASA chose the Center for the Advancement of Science in Space (CASIS) to be the sole manager of the International Space Station U.S. National Laboratory.

Thank You

Special Thanks to:

FDACS Office of Energy

Florida A&M University

Florida Institute of Technology

Florida Solar Energy Center – University of Central Florida

NASA Kennedy Space Center

Space Florida

US Department of Commerce – EDA & NIST

US Department of Defense

US Department of Energy – Energy Efficiency and Renewable Energy

US Department of Transportation – Federal Transit Administration

Delaware North, ITB, Proterra, Vencore, and many other commercial partners

Contact

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Additional Background

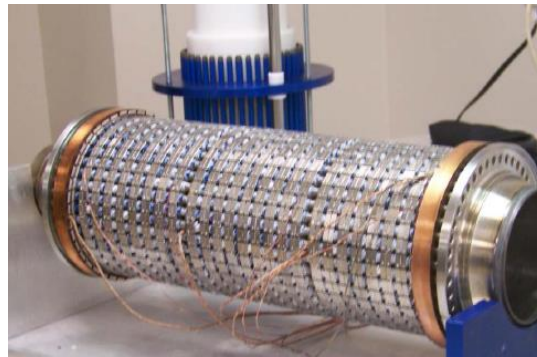
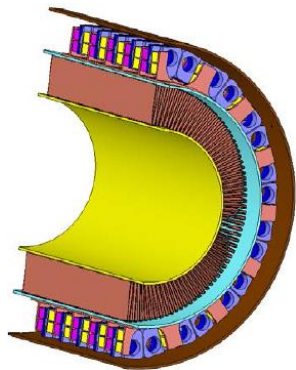
Additional Background on Existing TEST Hub Projects and Capabilities

Energy Florida and US DOT Federal Transit Administration Thermo-Electric Generation Transit Bus Demonstration

- Develop, install and test a prototype Thermal Waste Heat Recovery (TWHR) system on a diesel transit bus donated by LYNX (Greater Orlando transit authority), and monitor system performance in regular transit operations over 6 months
- **First application in transit environment** – TWHR originally developed for spacecraft, adapted for military vehicle (tank/Humvee) and diesel truck applications through research funded by US DoD, Dept of Energy and National Science Foundation



Thermal Waste Heat Recovery is the 1st energy technology to leave our solar system (Voyager 1 & 2 space probes)

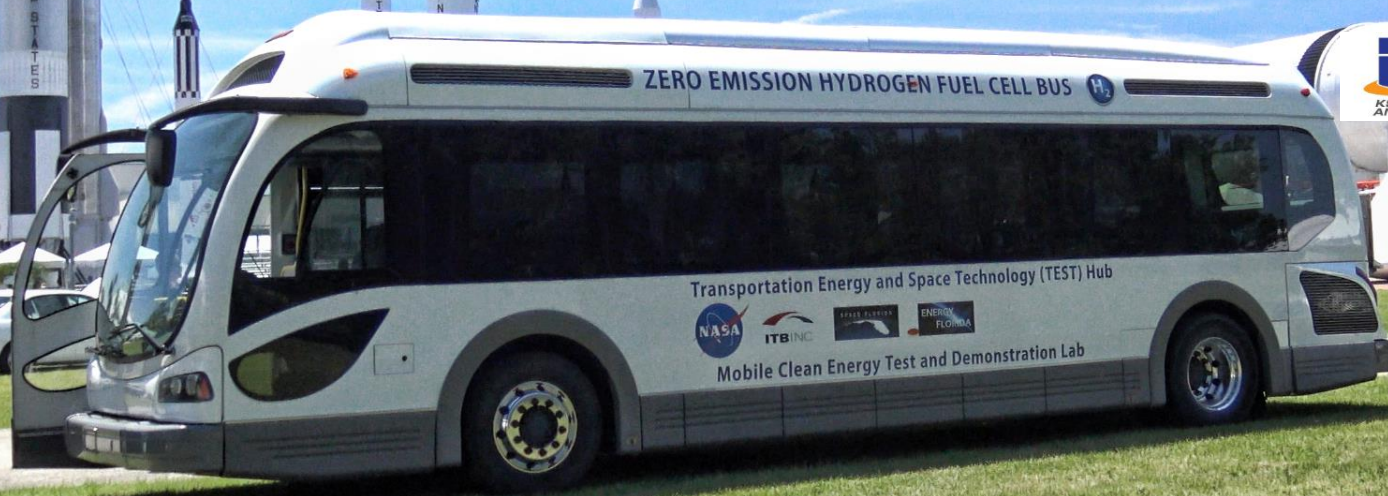
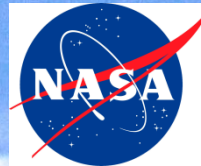
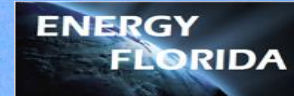


Proterra Gen2 Fuel Cell Electric Bus at KSC

- Mobile educational and testing platform for Hydrogen or Transit-based technology

PROPOSED TECHNOLOGY TESTING AND USE

- Energy Generation and H₂ Storage (fuel cells)
- Vehicle to Vehicle Communication
- Inductive Charging and Storage (batteries)
- Transit Safety Technologies



Building Transportation Supply Chains

Fleet Operations

Central Florida Natural Gas Fleet Implementations

- **Frito Lay Orlando**
 - Centralized delivery fleet operations
- **Waste Management**
 - CNG Sanitation Vehicle Fleet
- **Saddle Creek Logistics**
 - Long-Haul CNG Trucking Network
- **School Districts**
 - CNG bus fleet(s)



Central Florida Electric Vehicle & Hydrogen Corridor

Central FL Clean Cities Electric Vehicle Charging Network

- Coordinated over 300 charging stations in greater Orlando, and over 500 across I-4 Corridor

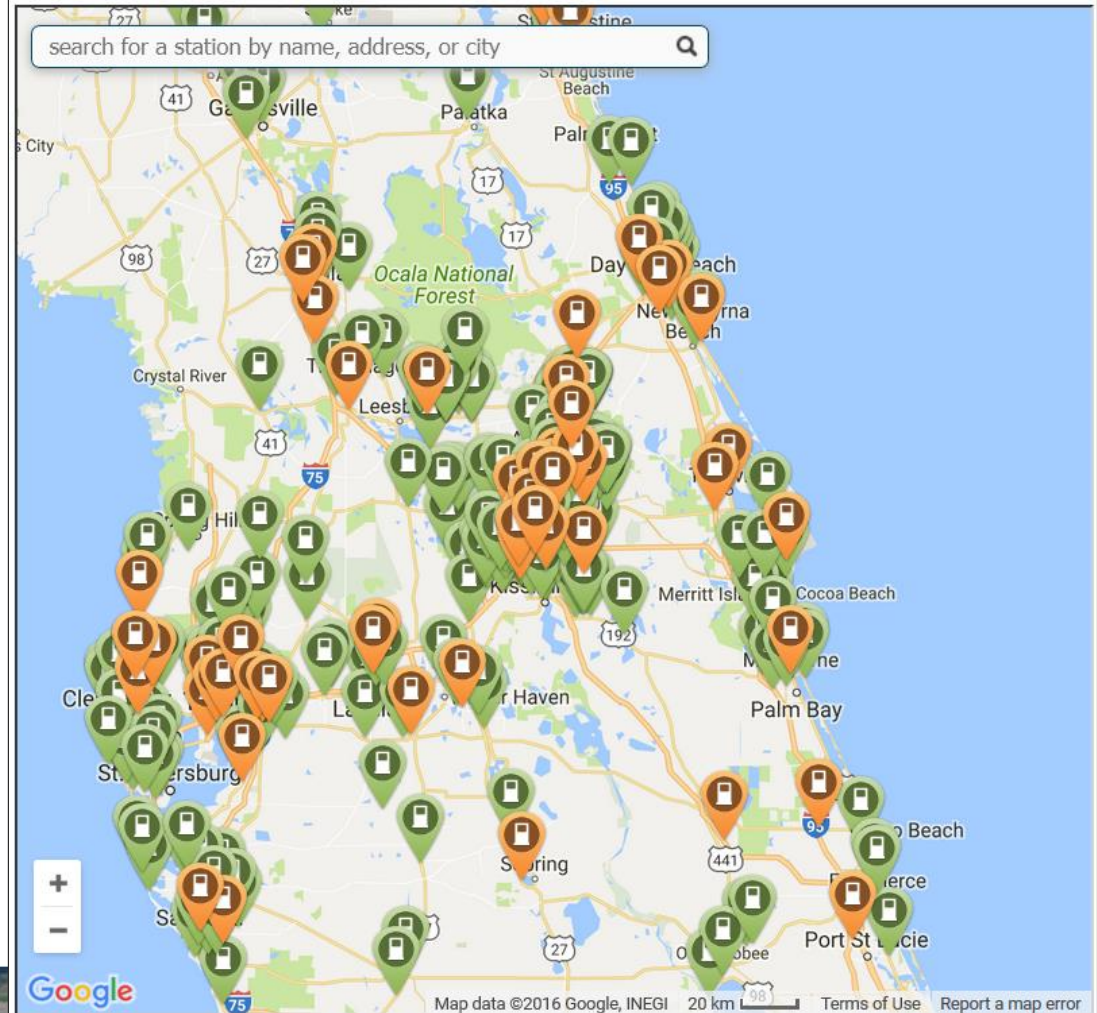
Drive Electric Orlando – first-of-its-kind EV car rental program

Hydrogen Corridor – Fuel Cell Vehicles



Find a Charging Station

The map below only shows the general Orlando area. The greater Central Florida area has over 300 charging stations.



US Dept of Energy Fuel Cell Technologies Cryogenic Storage Tank Insulation Project

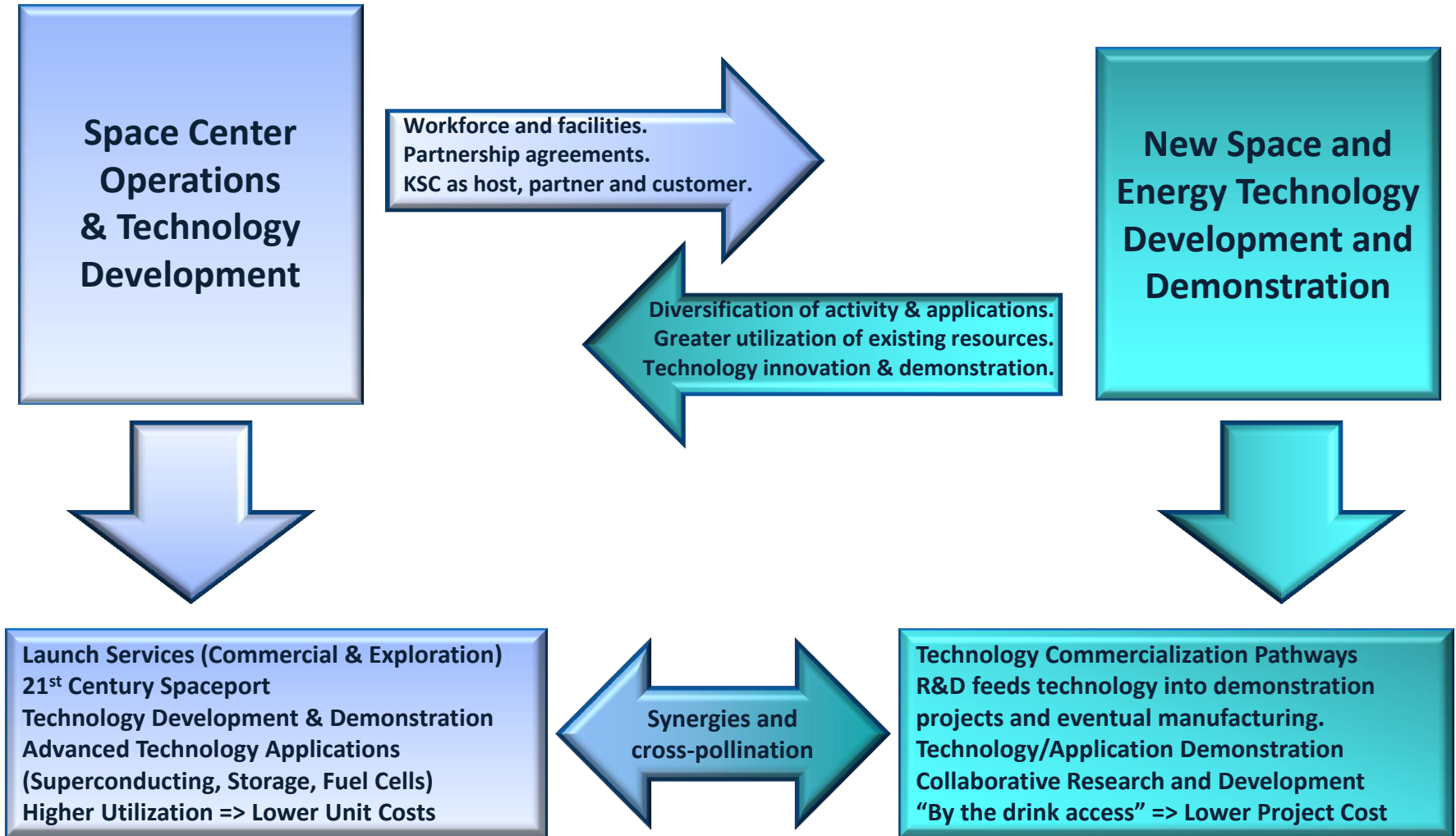
- US Department of Energy - Office of Energy Efficiency & Renewable Energy Fuel Cell Technologies program awarded grant for the Integrated Insulation System for Cryogenic Automotive Tanks (iCAT) project in July 2016.
- Collaboration piloted by the TEST Hub effort led directly to the organization & successful integration of the project team:
 - Vencore (project lead)
 - NASA KSC Cryogenics Lab
 - DOE Savannah River National Lab
 - Energy Florida
 - ITB, Inc.
- iCAT Project is leveraging resources and expertise from NASA KSC Cryogenics Lab with national partners to design and build an innovative integrated insulation system for cryogenic storage tanks for transportation applications (H₂ and LNG) based upon technology developed and used by the US space program for rocket fuel storage and handling



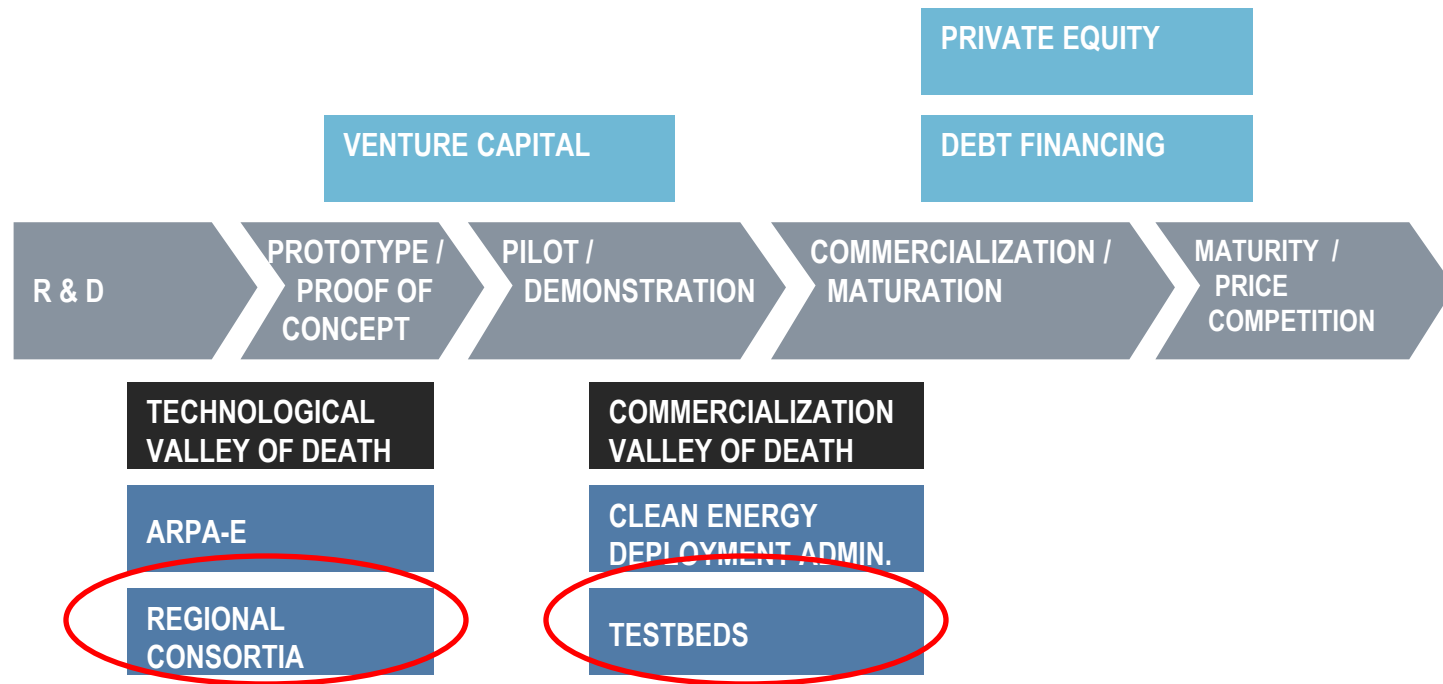
TEST Hub Technology Demonstration has been validated by multiple funders/customers

- KSC Hydrogen and Fuel Cell Technology Summit & Workshop - October 2016
- iCAT project partners held a workshop with US Dept of Energy Fuel Cell Technologies staff to review prior collaboration (including the TEST Hub) and mark the kick-off of the iCAT project
- TEST Hub concept of making use of the unique resources and capabilities of America's spaceport for testing and demonstration of innovative energy technologies has been validated with funding from multiple Federal, state, local and private sector partners:
 - US Dept. of Commerce
 - US Dept. of Energy
 - US Dept. of Transportation
 - Florida Department of Agriculture & Consumer Services
 - Space Florida
 - Delaware North
 - Florida Power & Light
 - General Motors
 - BMW

Technology Transfer Engine



Best Practices: Responses to the “Valleys of Death” for Innovative Technologies



Adapted from “Bridging the Clean Energy Valleys of Death” – the Breakthrough Institute, 2011

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