

2019 Review

Hawaii Center for Advanced Transportation Technologies



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Project # IA025

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HCATT – Who we are



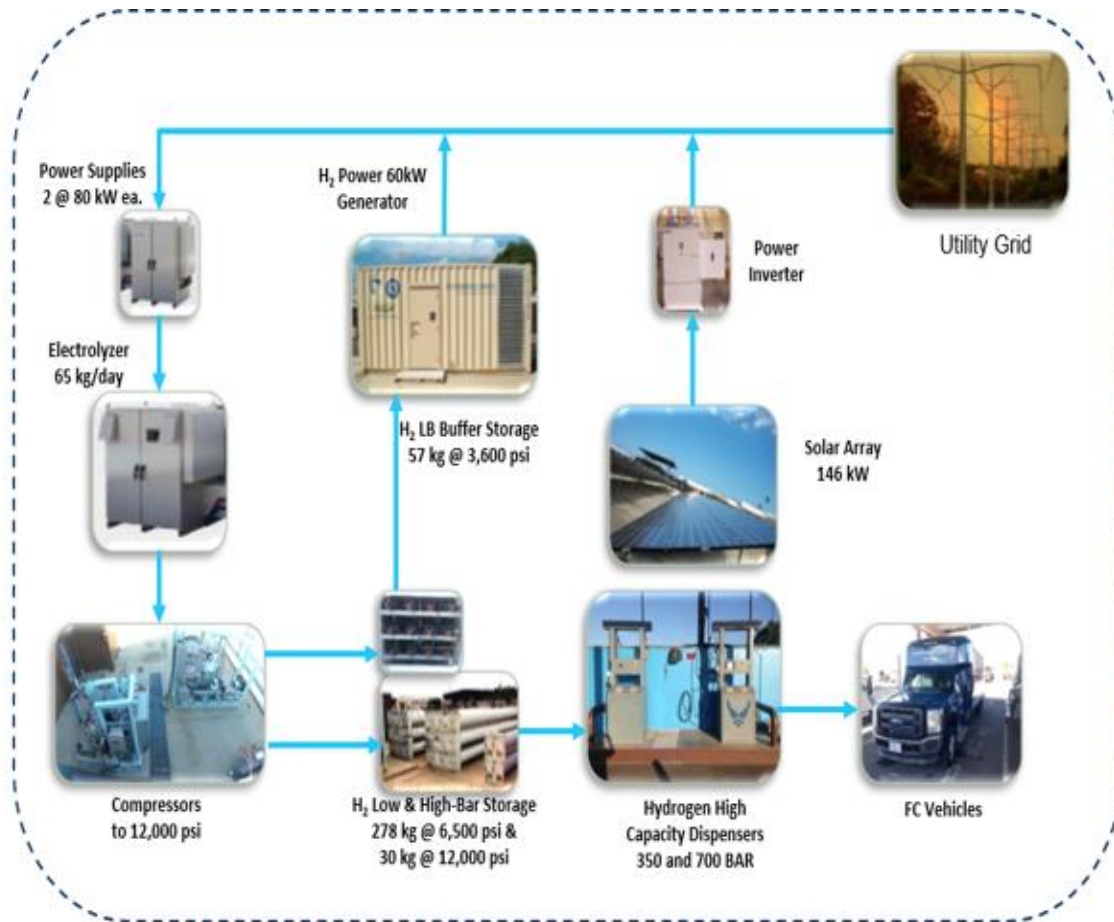
The Hawaii Center for Advanced Transportation Technologies (HCATT) has been demonstrating hydrogen fuel cell technology, energy conservation and renewable energy technology for the U.S. Air Force for over two decades. HCATT's current efforts are focused on development of a system of renewable energy microgrids that allow the wing commander to operate totally independent from the public electric grid for an indefinite amount of time. The end state of HCATT's efforts is to develop the "Flight Line of the Future" for the USAF that is totally energy self-sufficient, but also support the broader goal of reducing USAF aviation fuel consumption by demonstrating that hydrogen energy storage is far superior to any known or anticipated energy storage technology across the full spectrum of military operations, but particularly expeditionary operations.

HYDROGEN

- **Current fossil fuel prices are volatile, and it is a finite commodity, Hydrogen is not**
- **Hydrogen is the most energy dense of all storage options**
 - **In aviation, weight of cargo determines fuel flow, range and operating costs**
 - **Fuel cell equipment weighs less than battery equivalent support equipment**
- **Hydrogen is safer on aircraft than Li Battery technology**
- **Hydrogen can be made on site anywhere there is water and DC Electricity available**
 - **You can eliminate shipping fuel for support equipment**
 - **Making your own energy on site is the ultimate energy security**
- **Storage vessels are far less expensive than batteries and last many years longer**
- **Hydrogen technology is quiet, clean and multifunctional (cooking, heating welding....)**
- **Hydrogen production using electrolysis also produces medical grade oxygen**



Hydrogen Station



- **Total storage capacity – 380kg:**

- 30kg @ 827 Bar (high bar)
- 290kg @ 448 Bar (low/high bar)
- 60kg @ 248 Bar (compressor buffer)

- **Hydrogen production:**

- Capable of 65kg/day (grid powered electrolysis)
- 11kg/day (solar powered [146kW] electrolysis)
- Grid connected electrolysis with option for completely renewable (via solar) electrolysis

- **Hydrogen Dispensing:**

- Can dispense at both 350 and 700 Bar
- Cascade fill with dispense control board for flow control (max rate = 45grams/second)
 - 3- stage 350 Bar
 - 5- stage 700 Bar

Completed Projects

Project	Contract Amount	Location	Status
Advanced Wind	\$99,960	JBPHH H2 Station	Completed in June 2016. Available for testing in a real world environment
Waste to Energy	\$4,908, 200	HIANG Green Field	Completed in August 2017. Planning for Decommission
Zero Net Energy Hangar	\$2,872,741.80	HIANG Green Field and Bldg 3407	1 st phase completed June 2018. Awaiting contracting for final phase (building circuit - system integration)
PEARL Microgrid Survey & Design	\$1,529,402	HIANG Campus	Completed as of August 2016.
PEARL Microgrid 0, Phase1 &15KVA Resiliency Bypass	\$8,374,987.27	HIANG Campus	*May 2019 Contract Award

Secure Power on Demand (SPOD) FCEV

- 30kW Fuel Cell
- Battery Packs
 - Two Valance batteries are integrated. Each have a capacity of 100 Ah @ 175 VDC, for a total capacity of 35 kWh.



Bi-Directional DC/AC

Type 3 Phase AC Input/Output

DC Voltage 350 - 420 VDC

AC Voltage 200 - 240 VAC. 100 - 120 VAC

Maximum Power **33 kW**

Bi-Directional 4Q DC/DC

Operational Voltage Range 60 - 420 VDC

Peak Current Handling 300 ADC

Nominal Current 150 ADC

Maximum Power **60 kW**

U-30 Tug FCEV

Gross vehicle weight -100,000
lbs

Max drawbar pull – 72,000

PEM Fuel Cell – 30kW, 60V-
120V, 500A

10kg of H2 at 350 BAR

Li-Ion Battery – 240kW, 22kWh,
30V nominal

Range from H2 and battery – 12
hours



Hydrogen Shuttle FCEV

- 30kW Fuel Cell
- 30 mile range on battery alone,
 - Range extended by 100 miles with 10 kg of hydrogen and fuel cell
- Seats 25 passengers
- Original design provided prototype for later shuttle buses
 - HAVO
 - MTA



Project Details – Advanced Wind Contractor: Natural Power Concepts

Storm Rider Retractable Wind Turbine (SRRWT)

Showcased efficient performance of turbines in low to medium wind velocities (10-25mph), w/power output from 100W to 3kW

- Max. power output – 2.25kW, w/observed bursts of outputs over 3kW
- Observed average power output at 17mph winds = 1.2kW
- Key feature: auto-mechanical feathering blades that retract as response to higher wind velocities



Project Details – Advanced Wind Contractor: Natural Power Concepts

Spoked Wheel Wind Turbine (SWWT)

Showcased efficient performance of turbines in low to medium wind velocities (10-25mph), w/ power output from 100W to 3kW

- Max. power output – 2.1kW, w/observed burst of outputs over 3kW
- Observed average power output at 17mph winds = 936W
- Key feature: auto-mechanical tilting of the entire rimmed blade assembly around the central horizontal axis as a response to higher wind velocities



Project Details-Zero Net Energy Hangar

Contractor: HNu Energy

Three part project - showcasing energy efficiency retrofits; solar energy generation; advanced technology energy storage to yield a net zero facility Bldg 3407 154th Wing F-22 Fuel System Maintenance Hanger

- Energy efficiency retrofit hanger
- Energy generation showcase of ground mounted solar pv array (with both dual axis tracking module and stationary pv modules for comparative analysis of energy generation technologies)
- Battery Energy Storage System (BESS) showcase of HiVE, lithium iron BESS technology

Project Details-Zero Net Energy Hangar

Contractor: HNu Energy



- Energy Efficiency Measure for Bldg 3407
- LED lighting and advanced controls installation
 - Explosion proof LED light fixtures for areas below hangar doors
 - LED canopy lights w/ daylighting dimming capabilities installed above hangar doors
 - LED T8 bulb in paint and prep room
- Variable Air Volume (VAV) System
 - Vary the airflow going to different rooms/zones based on room/zone demand. When room/zone not occupied, VAV system decreases airflow, saving energy in both fan operation and cooling system operation
- Solar Water Heating
 - Estimated 50% reduction of energy use at facility

Project Details-Zero Net Energy Hangar

Contractor: HNu Energy

- Solar PV Array
- DC rated output : 136.92kW
- AC rated output: 60.00kW
- Comprised of two different arrangements of the same module type
- Dual Axis Tracking PV array: 12 SunPower modules – 2.94kW (245W each)
 - Morgan Solar – dual axis tracking waveguide technology (this yields a optics with large acceptance angles, as compared to typical Concentrated PV optics)
 - Trackers automatically stow the panels when winds exceed 35mph and can survive up to 120mph when stowed
- Fix mount PV array: 308 SunPower modules (345W each)– 133.98kW
 - 162 (84” long) ground screws are drilled deep into native soil and result in a much less intrusive, easily deployable ground mount racking system
- Two Ideal Power inverters (30kW each)



Project Details-Zero Net Energy Hangar

Contractor: HNu Energy

- HiVE*

- Energy Capacity: .25MWh (250kWh)
- Lithium iron phosphate battery technology and battery management and supervisory control systems
- Custom built (made with prefabricated concrete) vault
 - Designed to conform with HIANG aesthetic requirements
- BESS & PV site is fenced and graveled to meet HIANG requirements for site condition

* Project was originally proposed with a zinc-air based BESS, then Hnu was asked to change course to utilize an existing zinc bromide flow battery, which was later eliminated from the project design at the request of AFRL. The HiVE is Hnu's own BESS and was adopted to showcase advanced battery technology in the project



Hawaii National Guard CBRNE Training

Hydrogen fuel tech used for HIANG training

By Senior Airman John Linzmeier, 154th Wing Public Affairs / Published October 22, 2018



[PHOTO DETAILS](#) / [DOWNLOAD HI-RES](#) 1 of 3

Staff Sgt. James Almero, 154th Medical Group Detachment 1, search extraction rescue operations technician, exits a decontamination tent September 8, at Kalaeloa, Hawaii, during a field training exercise. The tent and other medical equipment was the first Hawaii Air National Guard equipment to be powered with a hydrogen fuel cell generator, provided by the Hawaii Center for Advanced Transportation Technologies. (Air National Guard photo by Senior Airman John Linzmeier)

“The system was 100 percent reliable in supporting operations, which in an emergency response environment like CBRNE, is an absolute necessity – and doing so with renewable energy is a game changer for the National Guard.” -CBRNE Exercise Director



Community Collaboration/Industry Development

KAPOLEI CITY LIGHTS – KEIKI ZONE



Luxfer GTM ZeroSet Lite at Kapolei Hale

Clean Energy for the Keiki

Hawaii Center for Advanced Transportation Technologies brought hydrogen fuel cell lights and power to the keiki zone at Kapolei City Lights, the city's annual tree-lighting ceremony.

The inner courtyard of Kapolei Hale was the playground for the future generation this past Saturday. Games and activities were provided free of charge to youth attendees by Hawaii Dental Service, UHA Health Insurance and Hawaii Pacific Health.

Families were able to enjoy the festivities free of noxious emissions and noise.

The clean, quiet power and bright, cool lights were provided by two hydrogen fuel cell light carts and one 5kW generator. These ZeroSet models are made by Luxfer GTM, a California based gas transport module manufacturer.

December 8, 2018 5-9p 🍃 Kapolei Hale

HAWAI'I GAS AND HYDROGEN



Luxfer GTM ZeroSet 5kW at Konane Park (above) and Hawai'i Gas President and CEO, Alicia May

Hawaii's First RNG Facility

Hawaii Center for Advanced Transportation Technologies was invited to provide hydrogen fuel cell power to the Hawai'i Gas dedication ceremony for Hawai'i's First RNG facility.



The City and County of Honolulu and Hawai'i Gas RNG project will capture raw biogas from the breakdown of wastewater, purify it, and integrate it into the services available to residential and commercial customers.

Hawai'i Gas's commitment to a clean energy future for Hawai'i was showcased by welcoming HCATT to provide clean electrical power for the ceremony.

The clean, quiet power and bright, cool lights were provided by two hydrogen fuel cell light carts and one 5kW generator. These ZeroSet models are made by Luxfer GTM, a California based gas transport module manufacturer.

December 12, 2018 🍃 Ho'opili – Konane Park

Pacific Energy Assurance and Renewable Laboratory Microgrid (PEARL)

Objectives

- Provide energy assurance, resiliency, and cyber security to the 154th Wing F-22 mission through the application of a renewable energy microgrid
- Serve as a USAF/AFRL prototype for adapting and transitioning distributed energy generation, storage, and control of renewable energy technologies for DoD
- Demonstrate integration of Fuel Cell Electric Flightline Vehicles and equipment
- Function as a technology and business development laboratory to complement the State of Hawaii's mandated transition to 100% renewable energy by 2045

PEARL Microgrid

Concept

Up to 6 Microgrids

Subdivide the HIANG Campus
Capable of Joining each other

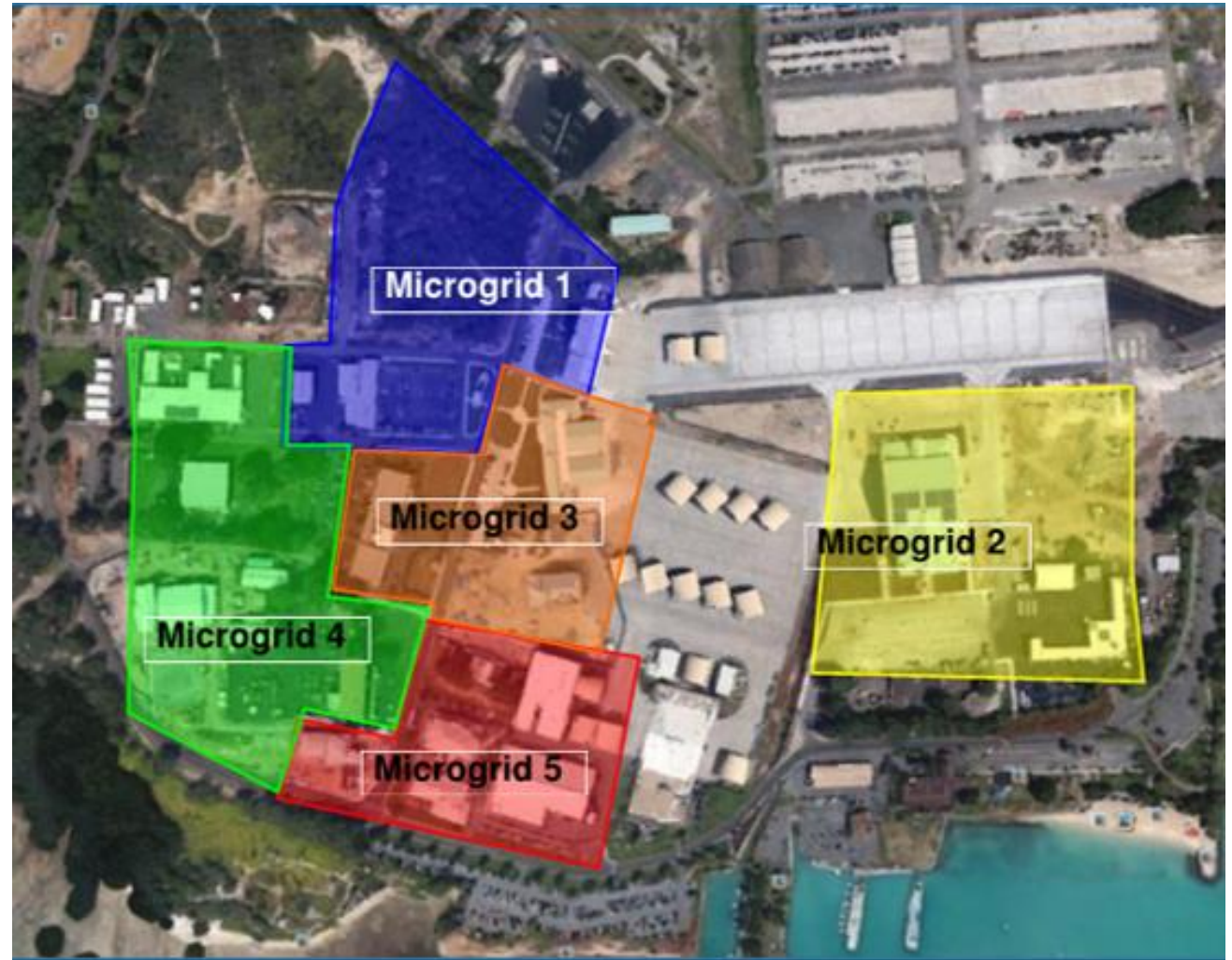
Optimization
Redundancy Resiliency

RE technology focused – H2
centric

Multiple Controllers

Resilient & Cyber Secure

First phase contract awarded
\$8.3M



Any proposed future work is subject to change based on funding levels

2020 Hawai'i Hydrogen FESTIVAL

- Renew Rebuild Hawai'i in partnership with HCATT, Hawaii Gas, and HNEI will host a 2020 Hydrogen Festival planning workshop
- H2 Festival will bring together local, national, and international participants to collaborate and share best practices in hydrogen as well as ideas for Hawaii's hydrogen future.
 - **October 8, 2019** soft launch and planning workshop for H2 Festival 2020
 - Goal: Secure committed partners for 1st Annual Hawai'i Hydrogen (H2) Festival in 2020 (goal of 2,000 attendees)

