

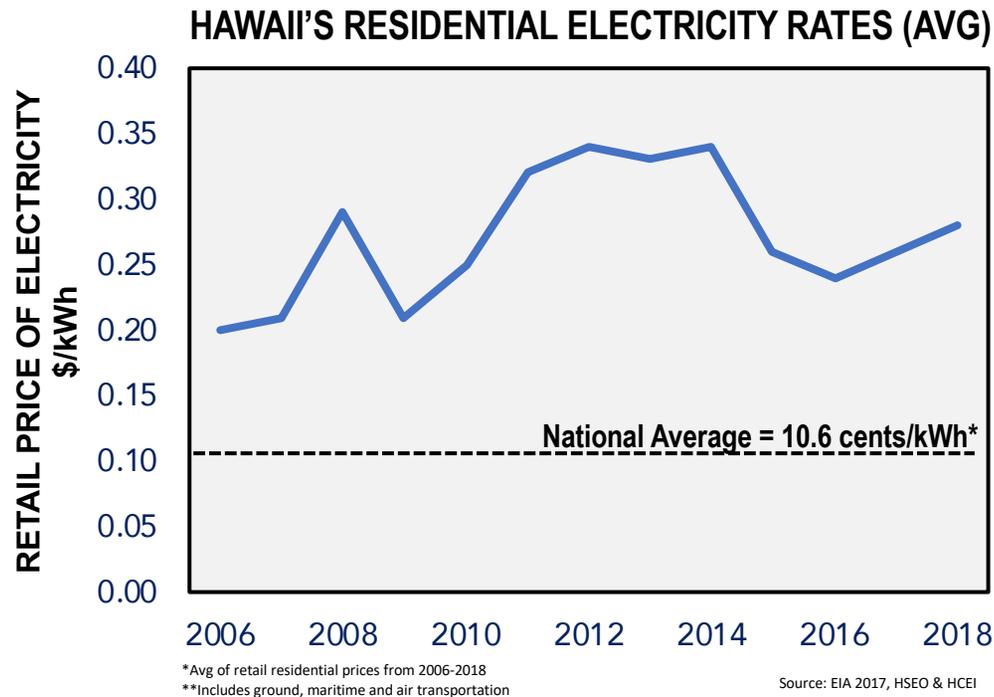
Progress and Opportunities for Hydrogen & Fuel Cells in the State of Hawaii

Hawaii Center for Advanced Transportation Technologies
DOE HFTO Annual Merit Review | May 2020



Hawaii's Energy Outlook

HAWAII'S UNIQUE ENERGY LANDSCAPE



Approximately

\$3.5B on 
foreign oil
import in 2017

Almost

70% of 
electricity production
from
petroleum

About

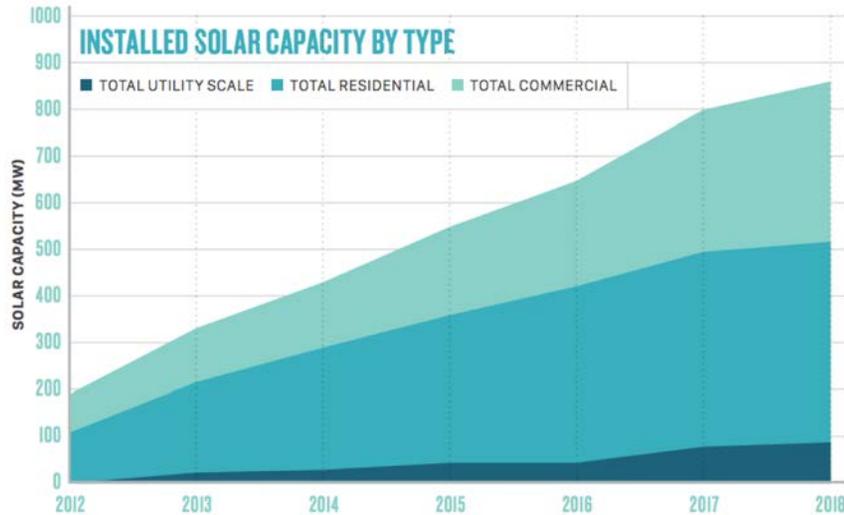
50% 
consumed by
transportation
sector*

About

2-3x 
national average
electricity
prices

- A major driver of Hawaii's **high cost of electricity** is the state's dependence on **imported petroleum**
- Hawaii's unique geographic location and energy infrastructure requires energy solutions that are both **resilient & cost effective**

HAWAII'S ENERGY CHALLENGES



Source: Blue Planet Foundation

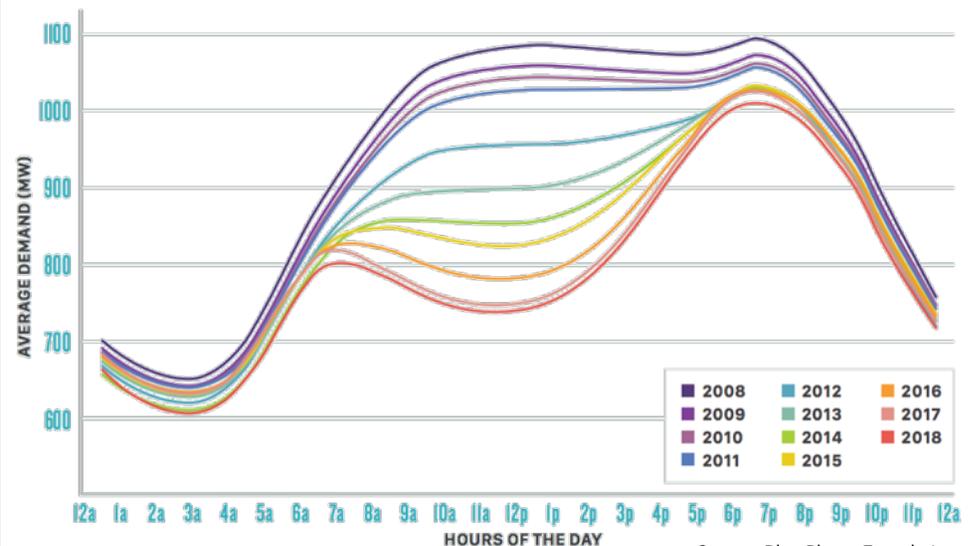
~850MW of installed solar capacity (utility, commercial & residential)

Increasing distribution of solar PV driven by policy incentives and economies of scale

"Duck Belly" is getting bigger

Impact on the electric grid due to:

- 1) Limited flexibility for baseload generation to ramp down during the day
- 2) Other generation sources to ramp up in the evening to meet peak demand



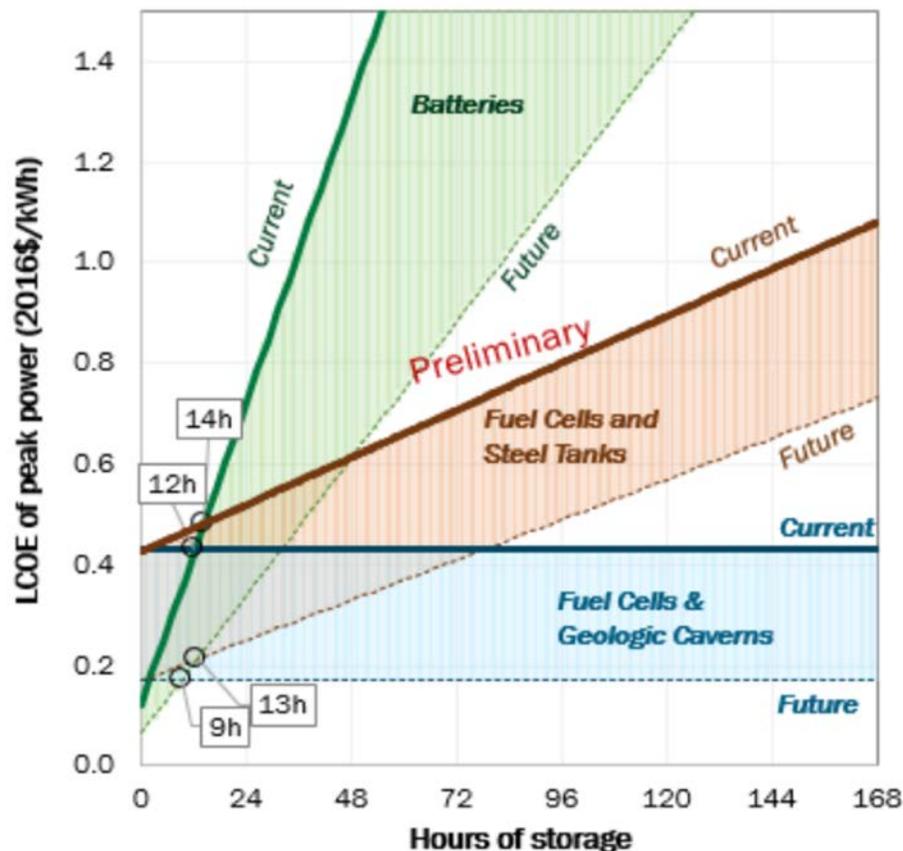
Source: Blue Planet Foundation



How H₂ Can Address Hawaii's Energy Challenges

H₂ AS A GRID MANAGEMENT TOOL

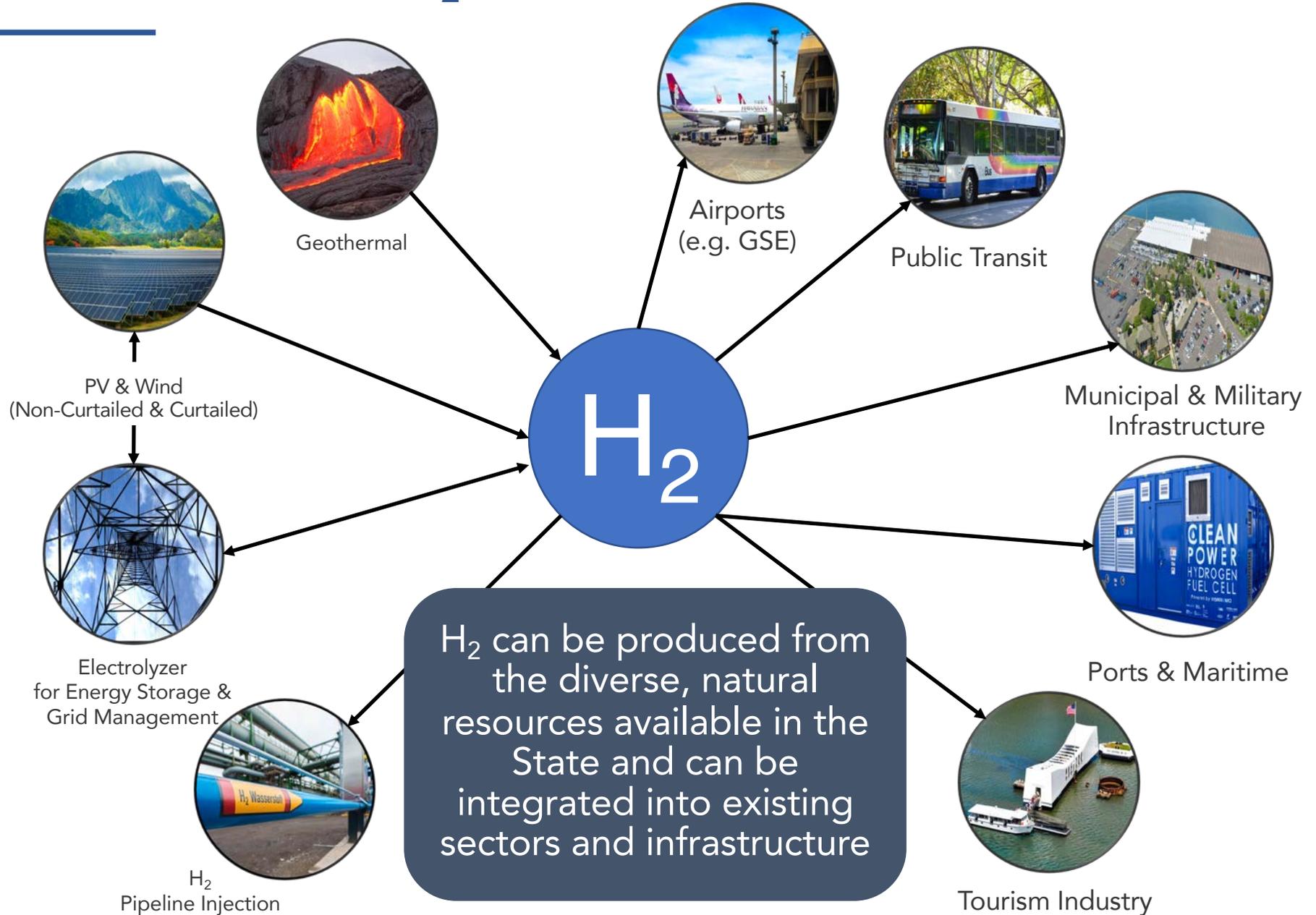
H₂ has the potential to meet high capacity and long term storage duration >10 hours



Source: NREL

- H₂ production and storage as a demand response tool for grid management
- H₂ can mitigate curtailment and grid management costs by allowing real-time demand response to changes in electricity production
- H₂ product can create new revenue streams to producers

EXAMPLES OF H₂ OPPORTUNITIES IN HAWAII





HCATT
The Military-State H₂ Nexus

H₂ DEMONSTRATION ARM FOR THE AIR FORCE & A STATE NEXUS

HCATT was established in 1993 as a demonstration center by the Air Force and the State of Hawaii to demonstrate energy efficient and environmental compliant technologies for military and commercial applications.



VISION

Energy for CH₂ange

MISSION

Inspire & transform Hawaii's clean energy future



INNOVATE

Solutions to meet the state's 2045 RPS



ACCELERATE

Adoption of H₂ & fuel cell technologies



CATALYZE

Collaborations between State, Department of Defense, public and private stakeholders



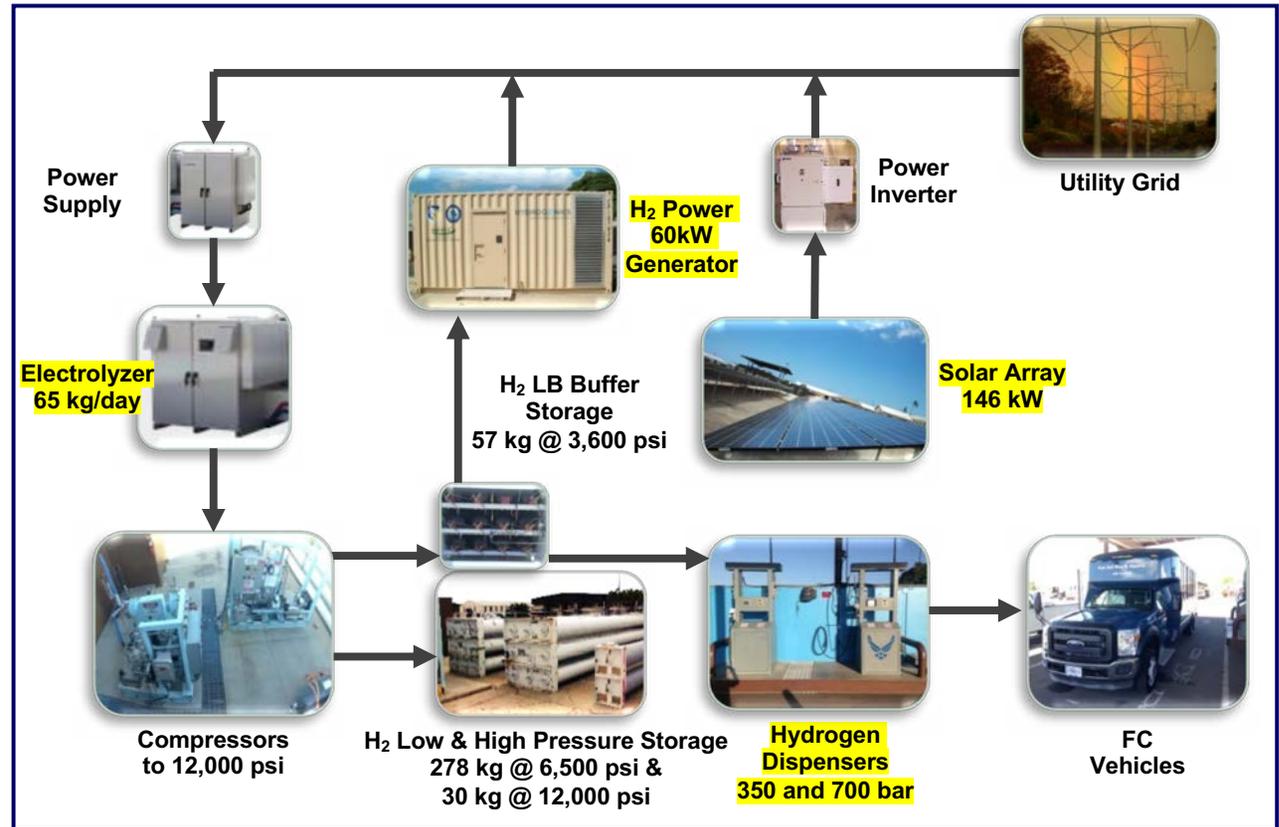
EDUCATE & INFLUENCE

Hawaii to be leaders in H₂ technology

State of Hawaii RPS

100% renewable energy by 2045

RENEWABLE H₂ INFRASTRUCTURE FOR THE MILITARY



HCATT is pioneer of HFC in Hawaii, and has evolved over 20 years of HFC research and demonstration for both military and commercial applications in partnership with the Air Force Research Laboratory and the State of Hawaii. HCATT established the first renewable hydrogen station on a military base, at the Joint Base Pearl Harbor Hickam. The station produces up to 65 kg of H₂/day.

EXAMPLES OF HFC VEHICLES DEMONSTRATION FOR MILITARY APPLICATIONS



FC DISTINGUISHED VISITORS SURREY

A FC shuttle for visitors at the Joint Base Pearl Harbor-Hickam (JPBHH)



FC WEAPON LOADER

Being demonstrated by AFRL/HCATT



SECURE POWER ON DEMAND

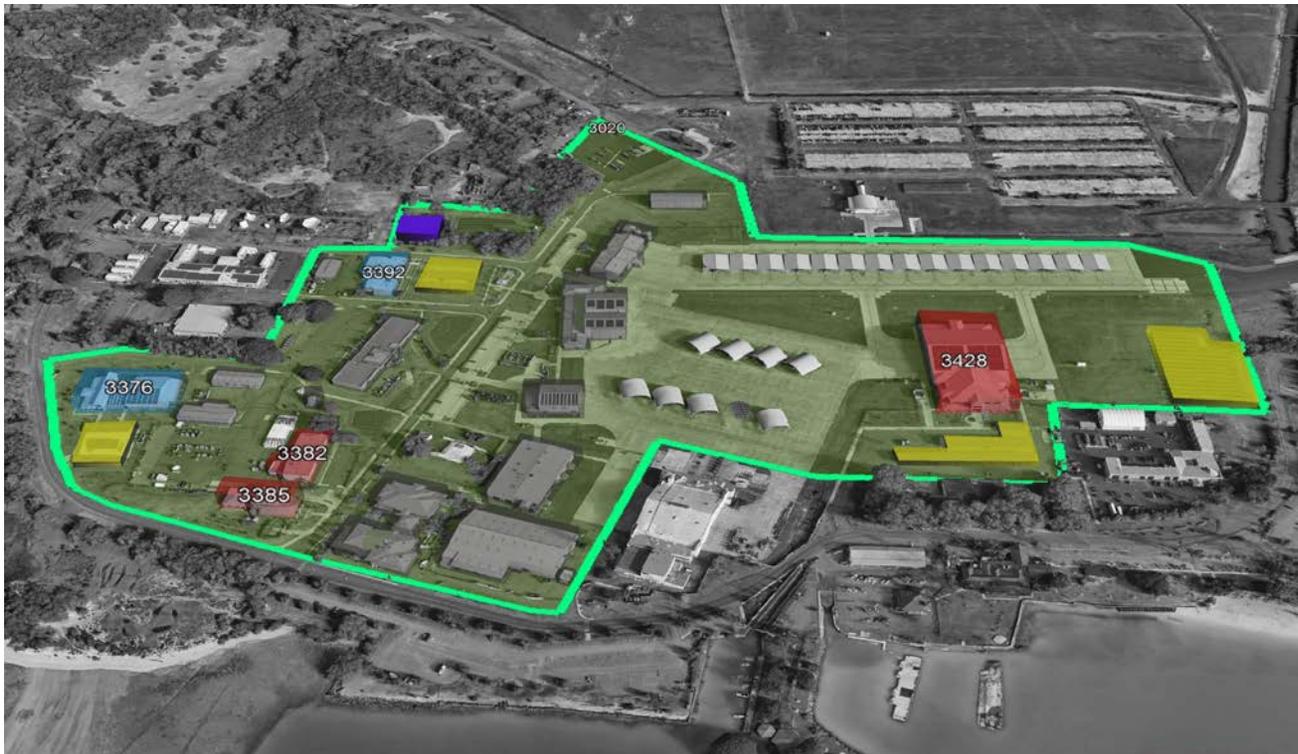
FC powered step van with import & export power capabilities



FC U-30 AIRCRAFT TOW TRACTOR

Towing a 186,000 pound aircraft

PEARL - BRINGING ENERGY SECURITY & RESILIENCY TO MILITARY INFRASTRUCTURE



■ Power Distribution Center ■ Critical Buildings ■ Solar Panels ■ Non-Critical Buildings

Energy assurance & resilience for the Hawaii Air National Guard F-22 campus

Seamless transition to island mode/grid-tied

Locate/remote operation of switches

Black start in island mode

The PEARL microgrid provides mission assurance through energy assurance to the Hawaii National Guard 154th Wing. Construction was completed in May 2020 and the next phase is operation and performance validation of cybersecurity, resiliency, load shedding/shifting



H₂ Initiatives in Hawaii

EXAMPLES OF H₂ INITIATIVES IN HAWAII



Toyota Servco

Established first public H₂ refueling station on island of O'ahu & Mirai Vehicles



Hawaii Gas

H₂ pipeline injection (~12%) for SNG production



Hawaii National Energy Institute

Fuel cell electric shuttles are being developed to transport visitors at the Hawaii Volcanoes National Park on Big Island



Legislation

Two H₂ related bills (for a new public H₂ refueling station and tax incentives for FC bus conversion) were introduced but did not pass due to State's current focus on COVID-19 economic recovery efforts



Education & Outreach

H₂ MOBILE GENERATORS & LIGHT CARTS PROVIDES CLEAN POWER FOR AIR FORCE MISSION AND PUBLIC EVENTS



A H₂ generator being use to set up a decontamination tent and power its lighting systems during a Hawaii Air National Guard emergency response team training exercise



H₂ light cart at a City of Honolulu event

Other Events

- Eat the Street food truck festival - H₂ light cart provided clean lighting
- Hawaii Gas 1st RNG Facility Dedication Ceremony – H₂ generator provided clean power
- Kapolei City Lights – provided clean energy for the Keiki zone at the annual tree lighting ceremony

“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

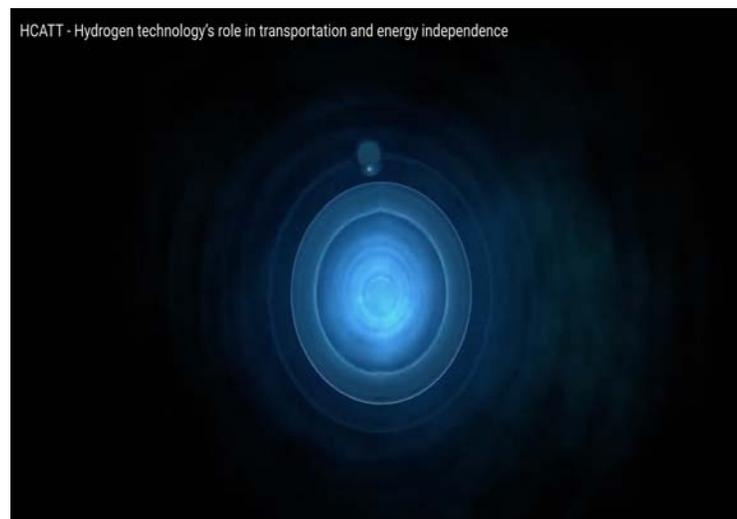
OTHER E&O ACTIVITIES

H₂ Community of Interest



Connecting military and industry together to further H₂ ideas, research and projects

H₂ Education Video



View the full video at
https://youtu.be/XRKLCCMEd_M



Path Forward

OUTLOOK & OPPORTUNITIES

- Transition H₂ FCEVs and technologies from demonstration to mission support for the Air Force
- Expand alliance with other military entities to further H₂ capabilities in the Pacific
- Support State's H₂ development, including expansion of public refueling stations and integrating H₂ technology into existing sectors and infrastructure
- Foster H₂ training, education and policy development in the State
- Perform techno-economic analysis of H₂ potential in different sectors (airports, ports, energy storage)



Coming Soon!

HCATT's new website & mailing list
Expected launch date: Summer 2020
hcatt.org



Follow Us on Social Media

Click on the icons to get the latest updates on
Hawaii's H₂ development



Mahalo!

hcatt@htdc.org