



Hawaii: A Model for Clean Energy Innovation

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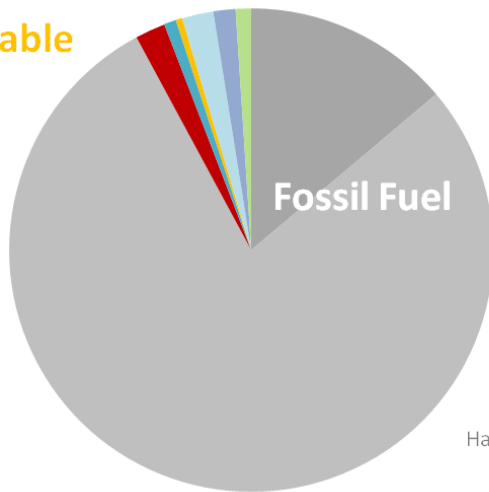
New technologies will be needed for Hawaii to reduce its dependence on oil



Electricity

■ Coal ■ Oil ■ Geothermal ■ Hydro ■ Solar ■ Wind ■ Municipal Solid Waste ■ Biomass

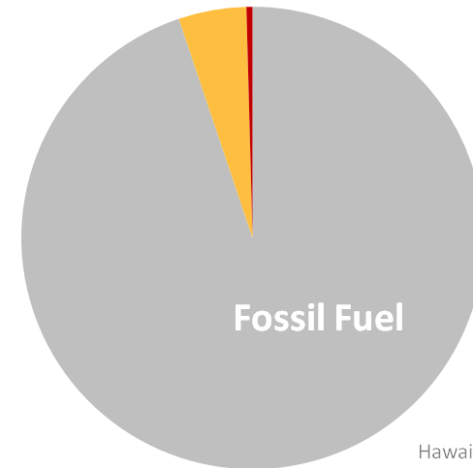
Renewable
Energy



Hawaii Electricity Sector
2007 Net Generation
Source: EIA

Transportation

■ Oil ■ Ethanol ■ Biodiesel



Hawaii Transportation Sector
2008 Fuel Use
Source: State of Hawaii Data Book

Volatility in the price of oil drives volatility in the local price of electricity



Hawaii Residential Electric Cost and Oil Cost per kWh

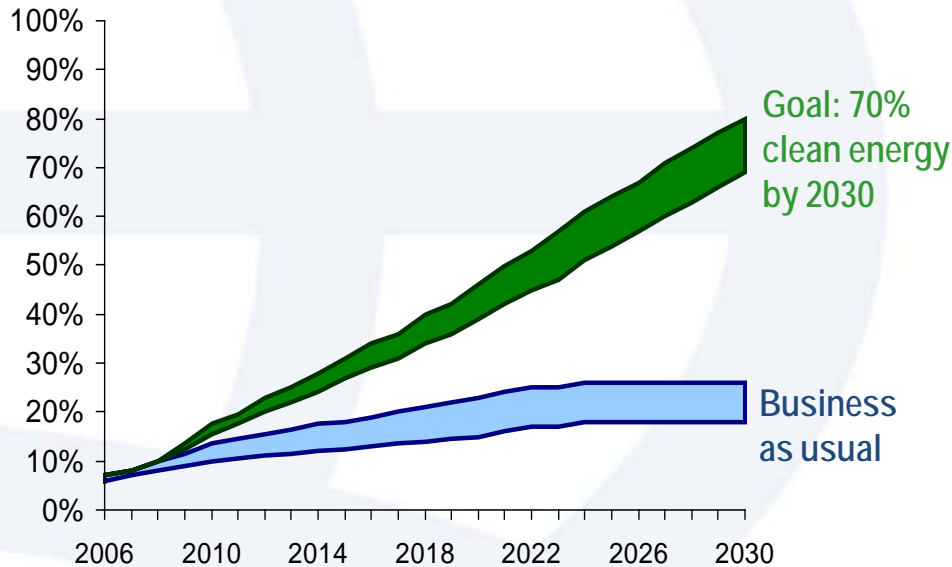


Source: Hawaii Energy Efficiency and Conservation Programs

U.S. Department of Energy (DOE) & the State created the Hawaii Clean Energy Initiative to change this paradigm



Percent clean energy – electricity and transportation



The opportunity: This transformation presents enormous market potential



Avg. Crude Oil Price (2008-2030) per Barrel	Investment Cost	PV of Investment Cost	Savings from Oil Displaced	PV of Savings from Oil Displaced
\$100	\$ 18.1	\$ 9.1	\$ 49.3	\$ 20.0



What companies & technologies will deliver the \$18 billion of capital investment needed to achieve the Hawaii Clean Energy Initiative?



Source: DOE analysis for Hawaii Clean Energy Initiative

A successful clean technology sector in Hawaii would provide wide and lasting benefits



- Local, high-quality, high-paying **jobs**
- **Opportunities** for Hawaii's youth
- **Industry leadership**, and opportunities to export innovative technology
- **Import substitution** & energy security
- Diversified income streams for **agricultural land**
- Reduced **greenhouse gas emissions**

New technologies will be needed to reach high levels of clean energy



Challenge	Possible Technology Solution
Wind intermittence	Energy storage, demand response technologies
Integrating PV	Advanced inverters & controls, visualization tools
Deploying efficiency at scale	Controls for buildings, demand response
Limited transportation options	Electric vehicles integrated with the grid, enhanced fleet efficiency
Cost of new technologies	Advanced materials, increased efficiency
Feedstock limitations	Next-generation biofuels
Oil-based energy costs on farms	Clean energy to power equipment, irrigation, etc.

Hawaii companies are innovating to meet these needs, but the road to commercialization can be long



Honolulu Seawater Air Conditioning, LLC

HREDV was created in 2008 to be a catalyst for the local clean energy industry through...



1. Competitively Awarded Funding

- Accelerate commercialization for local companies
- Support mainland companies investing in commercialization activities in Hawaii

2. Training & Capacity Building

- Enhance the competitiveness of local companies

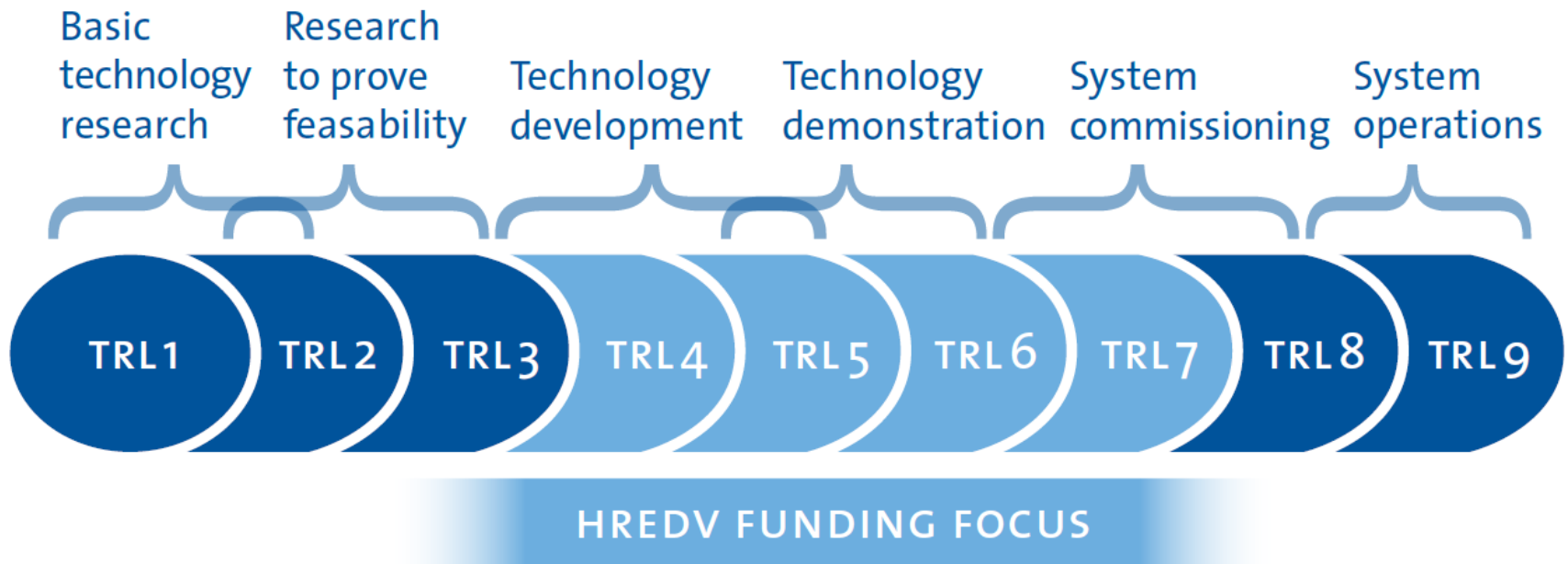
3. Strategic Partnerships

- Facilitate partnerships among industry players
- Coordinate with multiple levels of government

HREDV focuses on technologies that are nearly ready for the commercial marketplace



U.S. DOE Technology Readiness Levels (TRL)



Needs of the community and the utility drive HREDV prioritization



Challenge	HREDV Topic Area for 2010 funding
Wind intermittence	} Grid integration
Integrating PV	
Limited transportation options	} Transportation
Feedstock limitations	
Oil-based energy costs on farms	} Energy in Agriculture

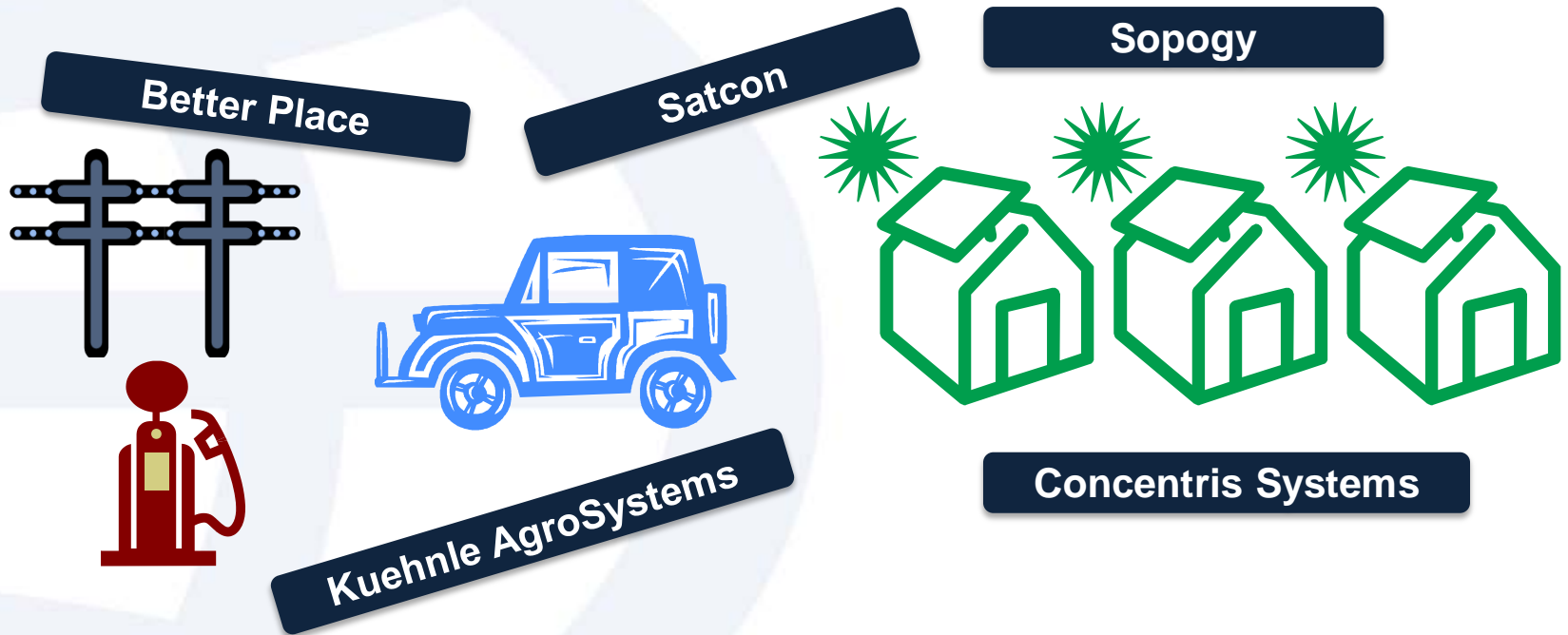
HREDV awarded 5 projects in Round 1, totaling \$2.1 M of federal funding and \$1.4 M of private cost share



Company	Project	Location
Concentris	Meshed Intelligent System for Energy-use Reduction (MISER)	Oahu
Better Place	Hawaii Electric Vehicle Network Initiative	Oahu
Satcon	Grid-Interactive DC-Link PV Charging Station	Lanai
Kuehnle AgroSystems	Algae Biomass for Biofuel Production	Oahu
Sopogy	Micro Concentrated Solar Power Absorption Air Conditioning	Maui

More project info at www.hawaiiirenewable.com

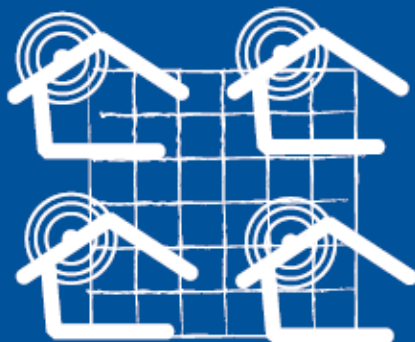
The projects will demonstrate technologies that integrate into Hawaii's whole energy system



How well do these technologies integrate into island grids?

Hawaii is where lab results meet the real world

Concentris
systems



COST \$248,000

HREDV FUNDING 80%

PRIVATE 20%

PROBLEM

Energy use is highly variable in non-metered homes, and is not monitored or managed remotely.

PROJECT

MESHED INTELLIGENT SYSTEM FOR ENERGY-USE REDUCTION (MISER)

Concentris is demonstrating a smart metering technology in Oahu military housing which will enable residents and energy managers to save energy by monitoring and controlling appliances through the web and mobile devices.



COST \$535,033

HREDV FUNDING 50%	PRIVATE 50%
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PROBLEM

High electricity cost for air conditioning; photovoltaics are limited on many sunny circuits because of concerns about grid stability.

PROJECT

MICRO CONCENTRATED SOLAR POWER ABSORPTION AIR CONDITIONING

Sopogy is installing a rooftop array of micro concentrating solar collectors on the Maui Ocean Center; heat from the collectors will drive a double-effect absorption chiller to power the aquarium's air conditioning.



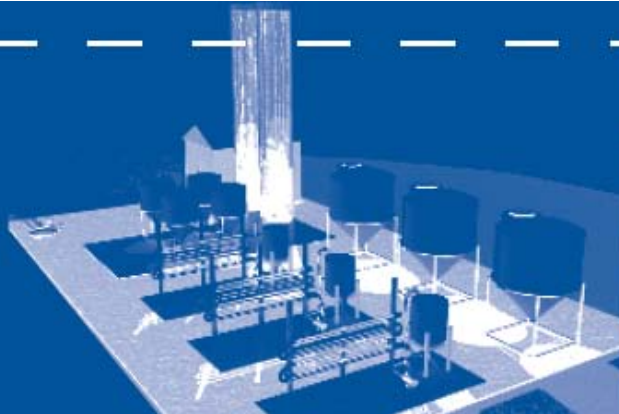
PROBLEM

Photovoltaics supply variable energy and electric vehicles add unpredictable load; both can impact grid stability.

PROJECT

GRID-INTERACTIVE DC-LINK PV CHARGING STATION

Satcon Technology Corporation is developing an inverter to efficiently charge vehicles using direct DC solar power as well as smooth solar power for a better interface with the electricity grid on Lanai.



COST \$662,940

HREDV FUNDING 75%

PRIVATE 25%

PROBLEM

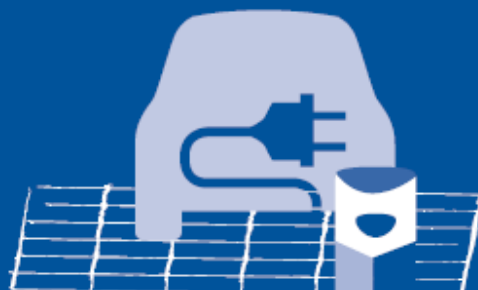
Biofuels that are drop-in replacements for oil often need large tracts of agricultural land.

PROJECT

ALGAE BIOMASS FOR BIOFUEL PRODUCTION

Kuehnle AgroSystems is building a system to continuously produce algae for biofuels; the system will pipe CO₂ and wastewater from an industrial facility into the algae tanks to accelerate algae growth and demonstrate CO₂ emission reductions.

better place



COST \$1,106,877

HREDV FUNDING 45%

PRIVATE 55%

PROBLEM

Electric vehicles present a large new load for the utility but also a potential energy management asset.

PROJECT

HAWAII ELECTRIC VEHICLE NETWORK INITIATIVE

Better Place is installing infrastructure for 9 electric vehicle charging stations and will use 7 electric vehicles to provide the first demonstration of integrated vehicle-to-grid technology on Oahu.

Innovation is a critical part of the future for Hawaii's incumbent energy providers

The success of innovators depends on access to market...

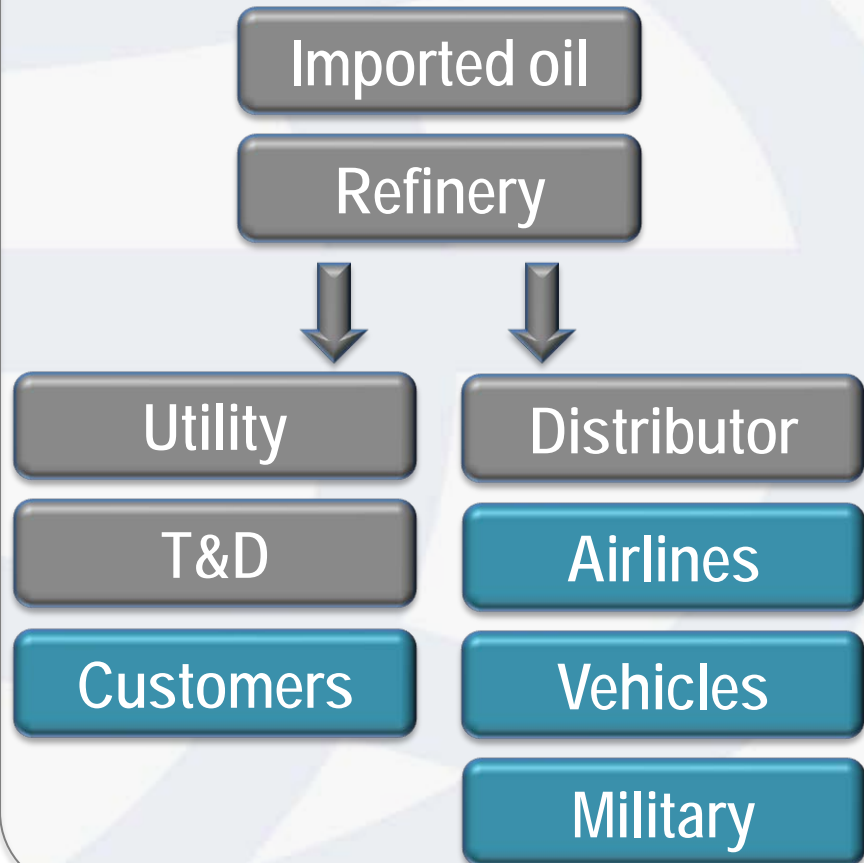
- ▶ State policy can only do so much; tech companies need **customers**
- ▶ The **utility & fuel companies** are the major customer for grid-related technologies, new fuels, and other energy products
- ▶ R&D is valuable to prove initial concepts, but full commercialization requires **demonstration on real energy systems**

... and the success of the utility depends on innovation

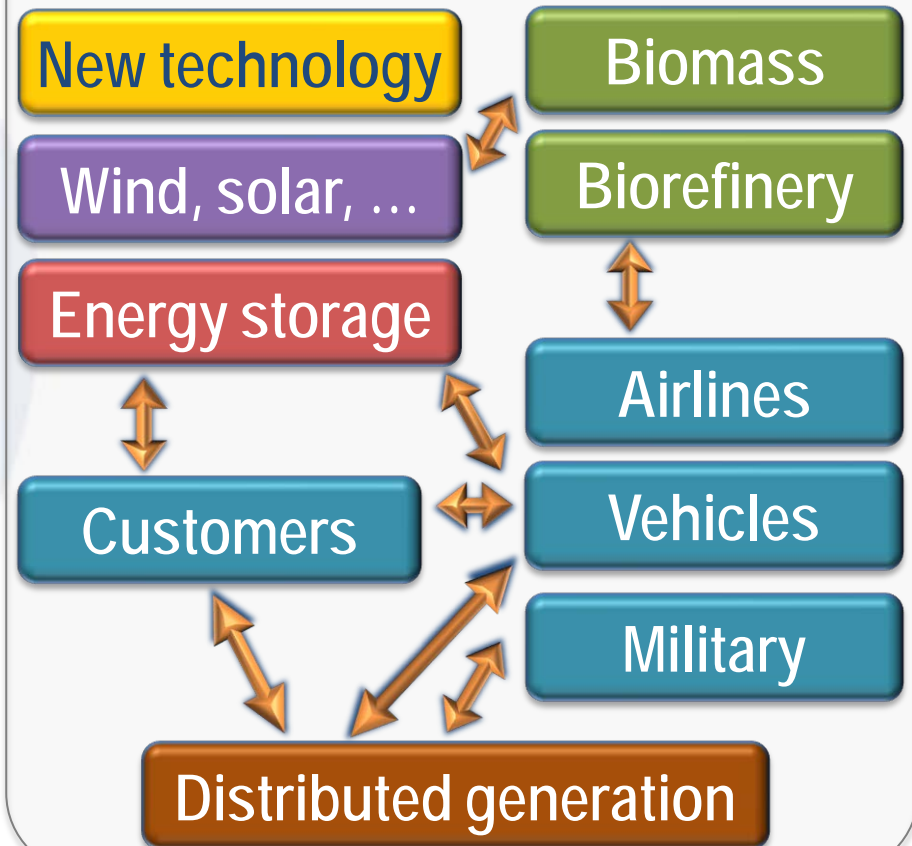
- ▶ Technical challenges require new **solutions**
- ▶ Solutions will be most effective if **needs/requirements** are communicated from utility and other incumbents to tech sector
- ▶ Collaboration and some degree of **risk sharing** can accelerates the deployment of new technology

The energy system of the future may look very different from the one we have today

2010: dominant energy system



2020: new energy system?



As other regions bring on more renewable energy, they will need technologies that have been proven in Hawaii



Hawaii, with its already high levels of solar and wind, is an early proving ground for innovative grid technologies



Mahalo

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