



# Hawaii: A Model for Clean Energy Innovation

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E Kamakani Noi'i: Innovating for Hawaii's Growth  
January 14, 2011

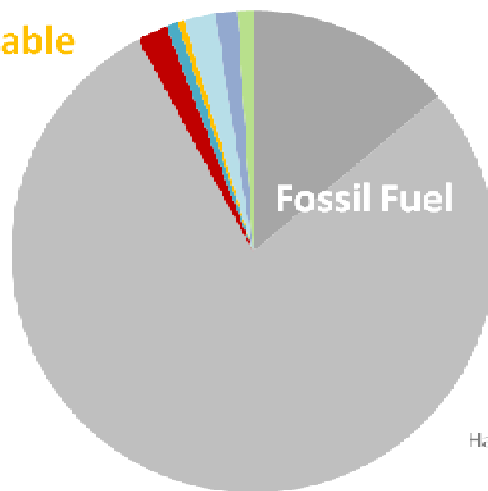
# New technologies will be needed for Hawaii to reduce its dependence on oil



## Electricity

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

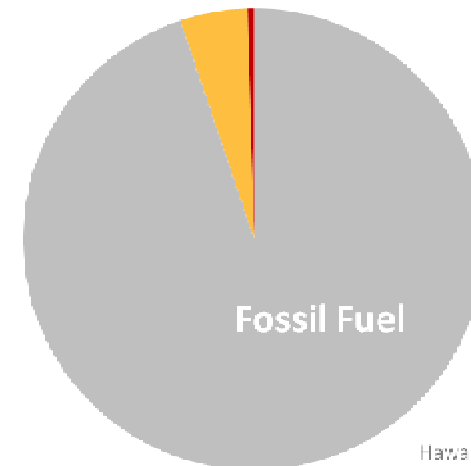
Renewable  
Energy



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

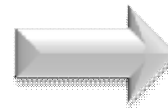
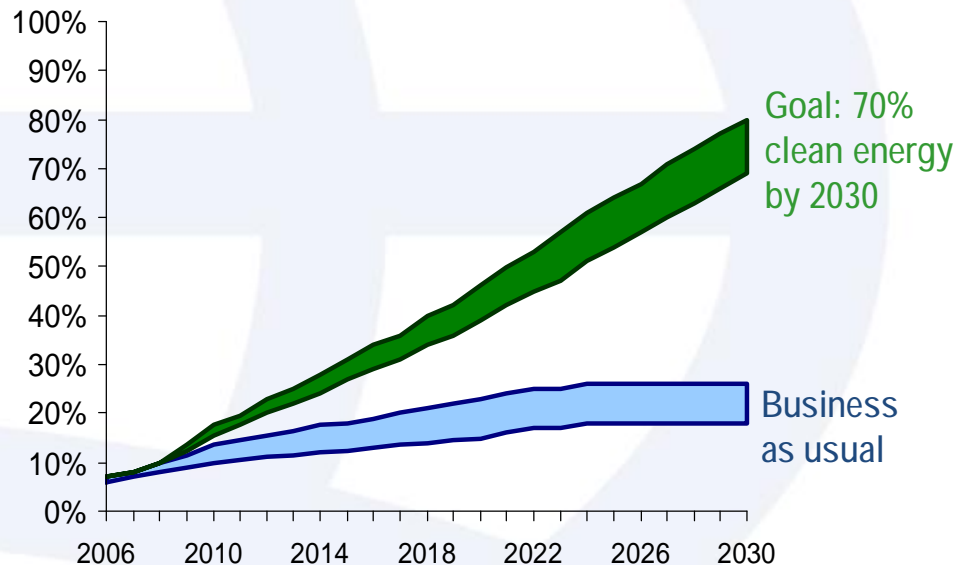


Source: Hawaii Energy Efficiency and Conservation Programs

# 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



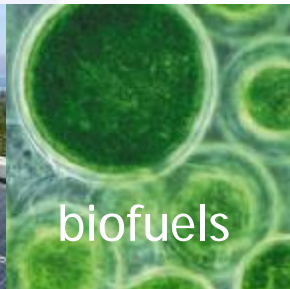
Avg. Crude Oil Price (2008-2030) per Barrel	Investment Cost	PV of Investment Cost	Savings from Oil Displaced	PV of Savings from Oil Displaced
\$100	\$ 18.1	\$ 9.1	\$ 49.3	\$ 20.0



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



solar



biofuels



efficiency



wind



hydro



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

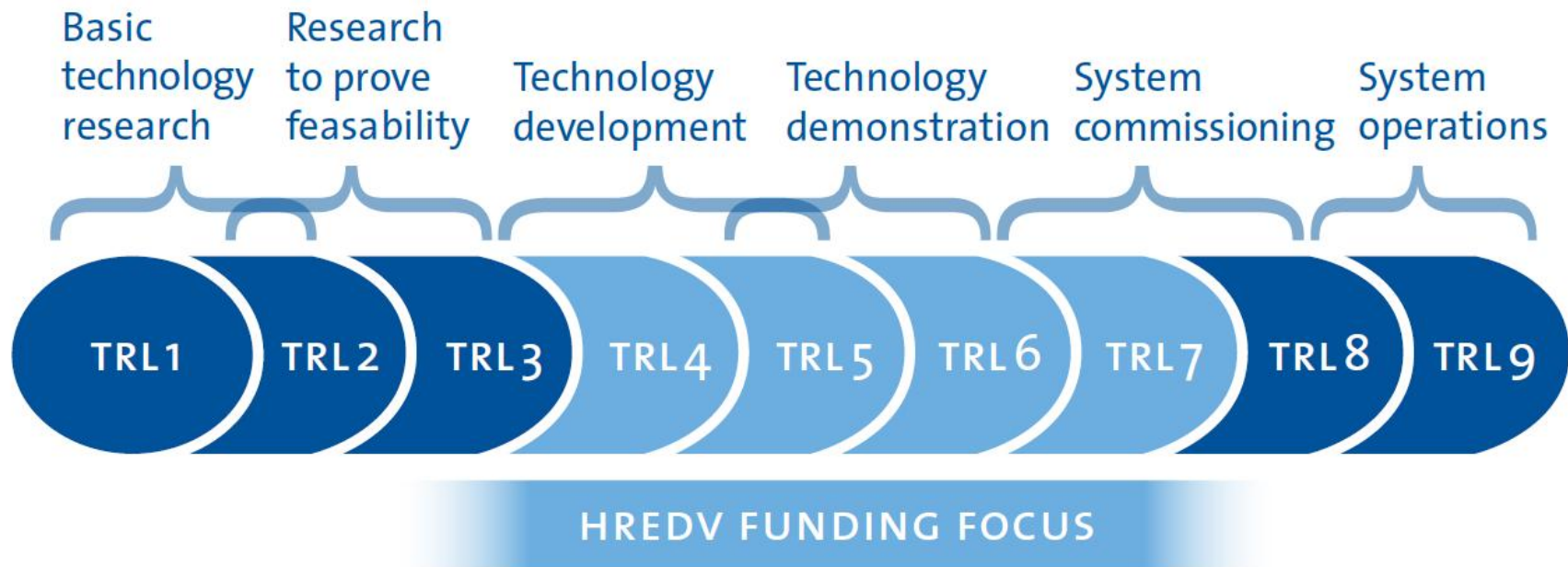
## 3. Strategic Partnerships

- 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

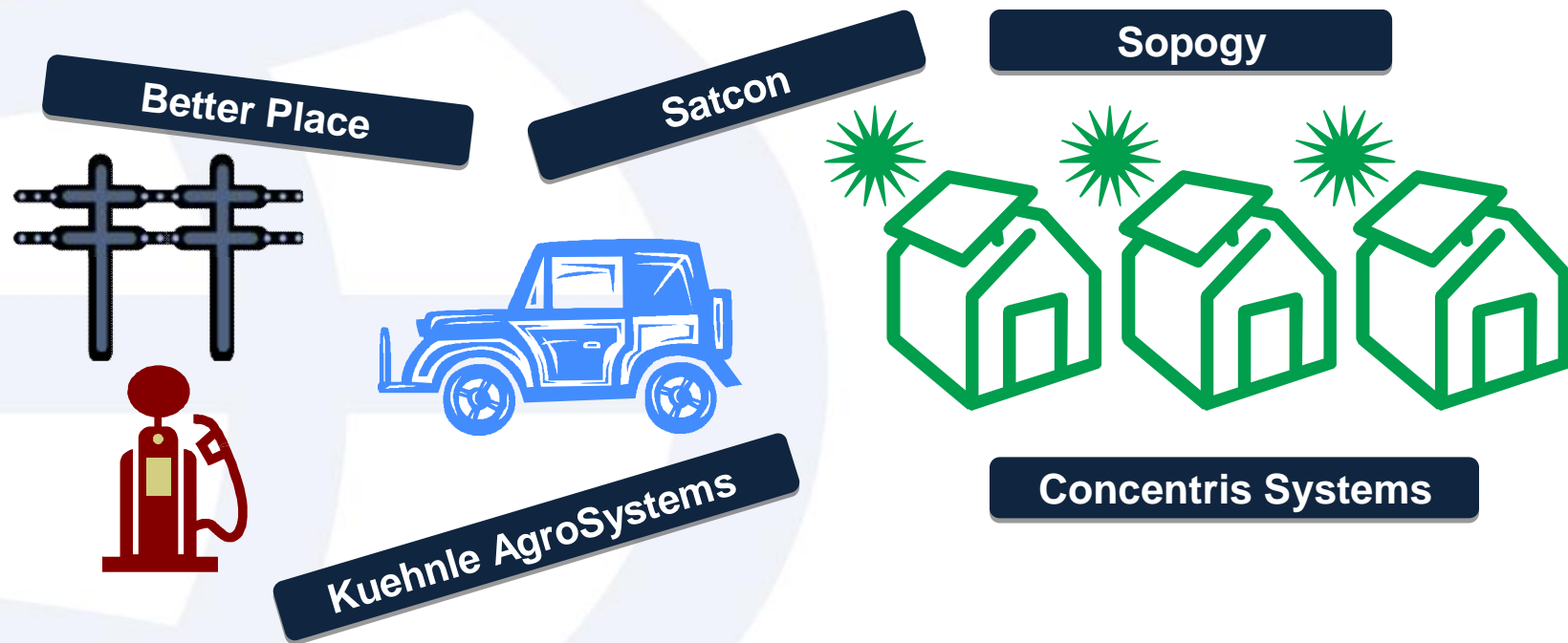
HREDV awarded 5 projects in Round 1, totaling \$2.1 M of federal funding and \$1.4 M of private cost share



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

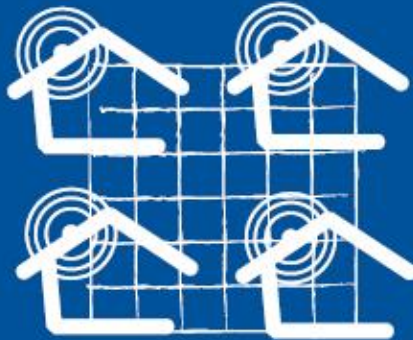
*More project info at [www.hawaiiirenewable.com](http://www.hawaiiirenewable.com)*

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.

A PROJECT OF PICHTR





## 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.





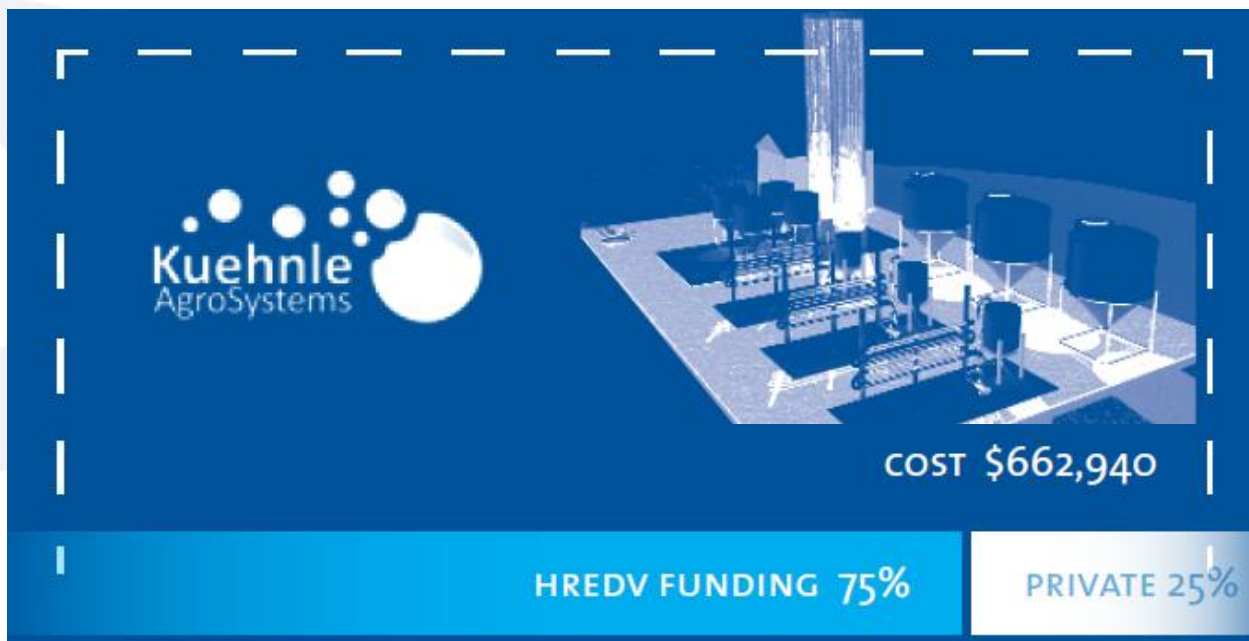
## PROBLEM

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.



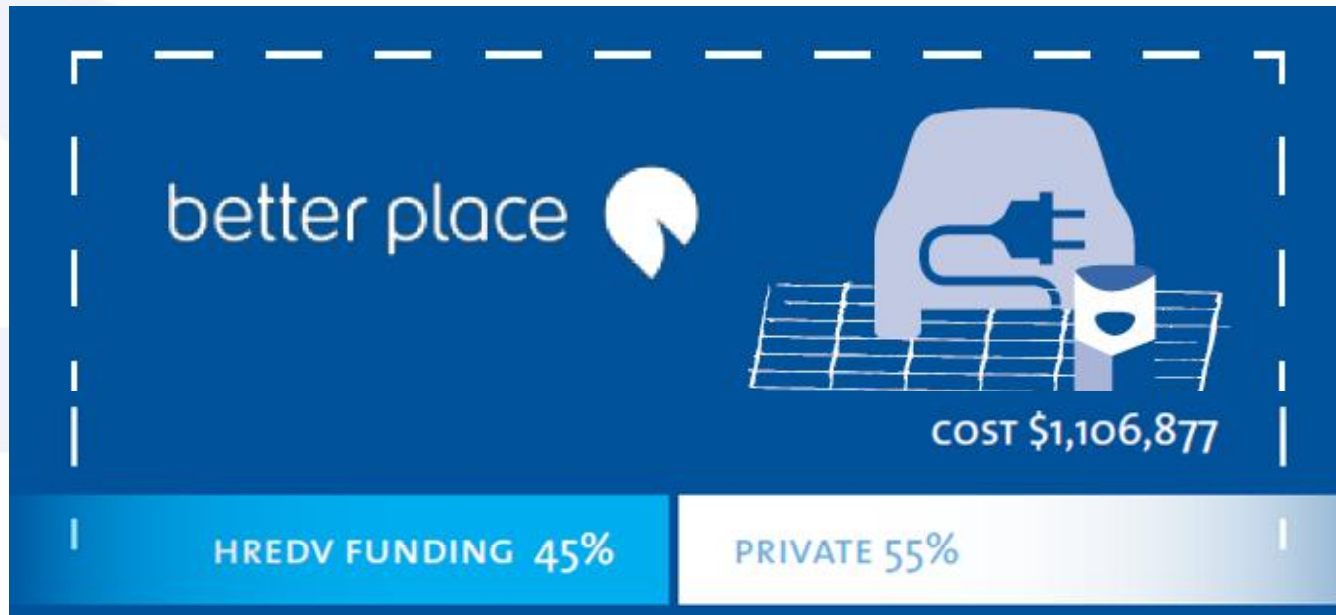
## PROBLEM

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 CO<sub>2</sub> and wastewater from an industrial facility into the algae tanks to accelerate algae growth and demonstrate CO<sub>2</sub> emission reductions.



## 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

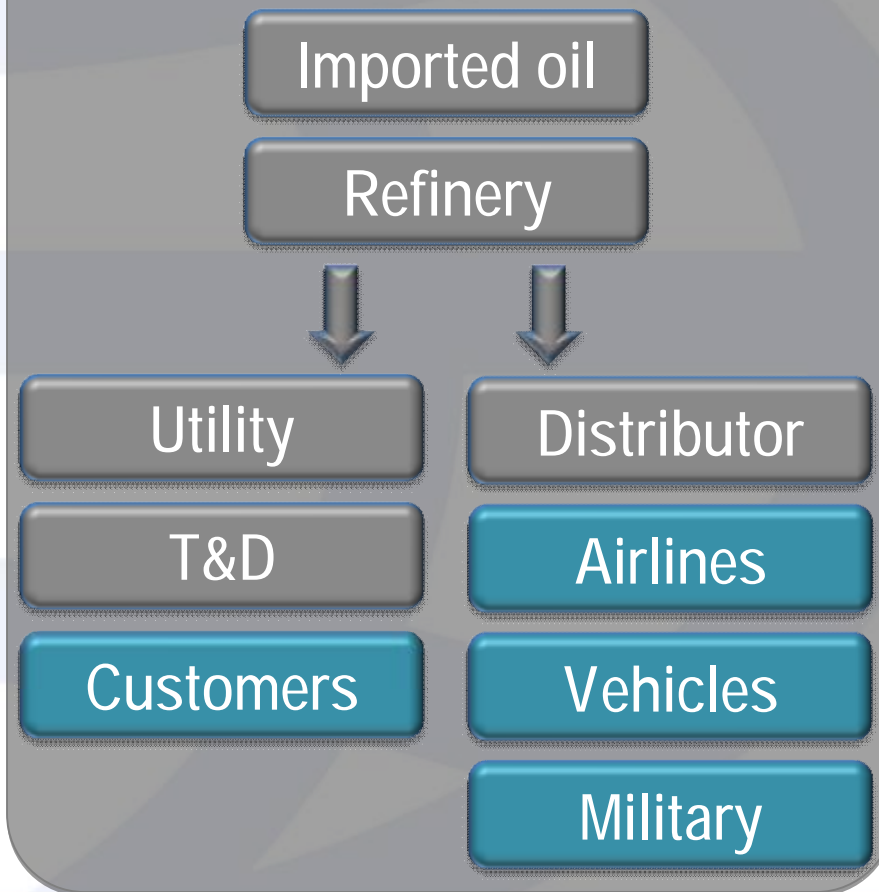
... and the success of the utility depends on innovation

- ▶ 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 accelerate the deployment of new technology

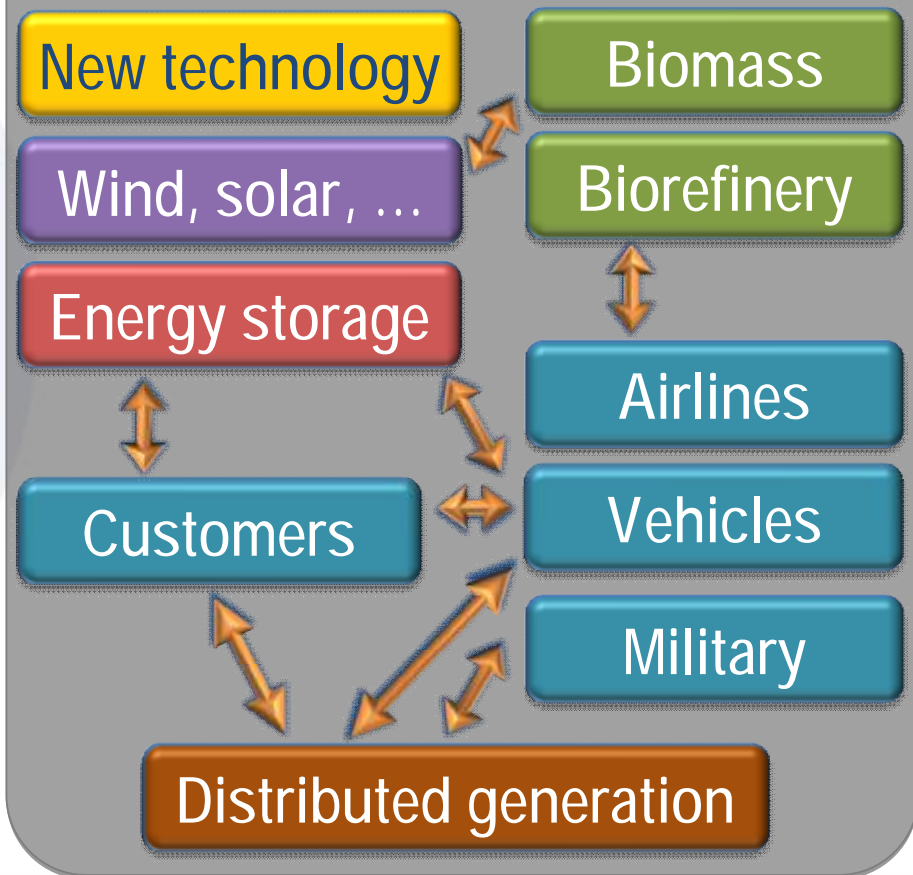
# The energy system of the future may look very different from the one we have today



## 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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