MAUI SMART GRID PROJECT

Hawaii Natural Energy Institute

University of Hawaii at Manoa

Maui Electric Company, Ltd.

Hawaiian Electric Company

imagination at work

GE Global Research

United States - India - China - Ger

GE Energy

Sentech, Inc.

Hawaii Natural Energy Institute

School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

Presentation Overview

Discuss objectives and project site

Describe system and technologies deployed

Illustrate project architecture

Review schedule and progress to date

Maui Smart Grid Project Objectives

Distributed Resources for Transmission-level Support

- Reduce distribution circuit peak loading by >15%
  - By demand response, switching peak loads to energy storage, and reducing voltage
- Improve service quality
  - By using Integrated volt/var control, outage management
- Enable consumers to manage their energy use to minimize electric bills
  - By using customer portals and advanced home energy gateways for a few homes
- Support grid stability
  - Controllable loads, storage, and improved voltage/current information will improve grid stability
- Enable greater utilization of as-available renewable energy sources
  - By providing measurement and estimation of distributed PV to the utility operator

MAUI SMART GRID PROJECT

Technical Challenges

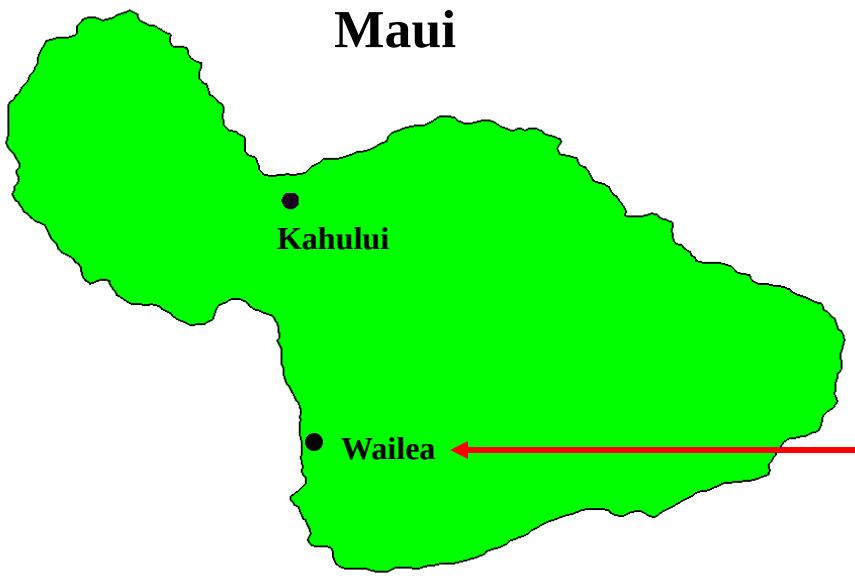
Develop a general Smart Grid architecture that:

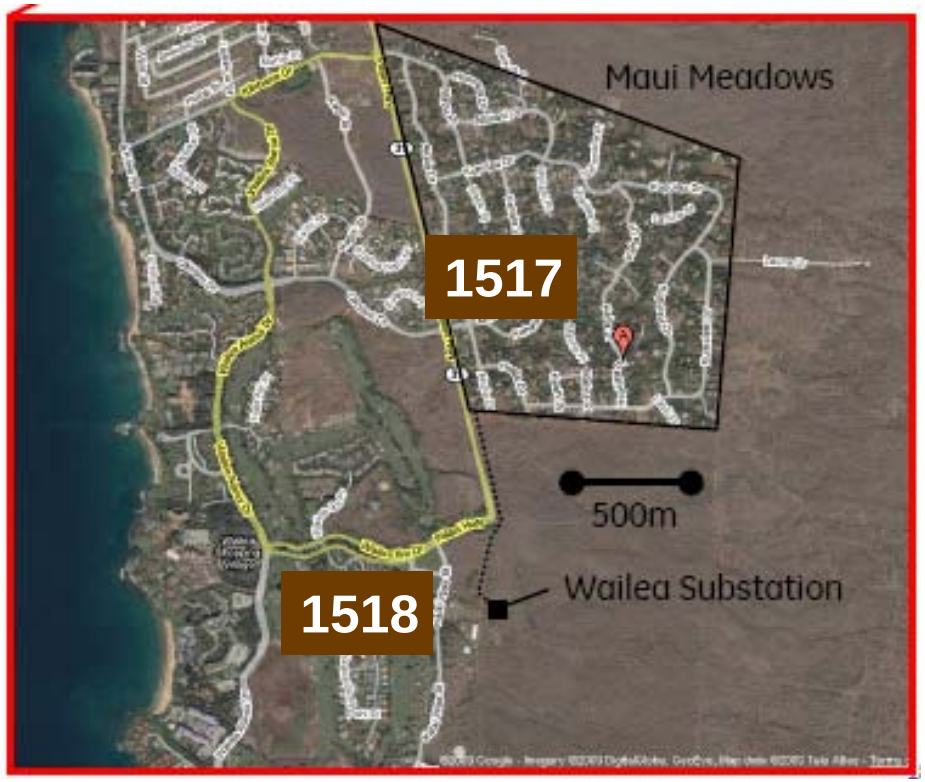
Incorporates legacy equipment (with proprietary protocols)

Avoids overwhelming or reducing control capabilities of the system dispatcher

Integrates system components with *secure* communications systems

Project Located in Wailea Area





Basic System Facts:

MECO system peak load ≈ 200MW

Fossil fuel and biofuel capacity = about 250 MW

Kaheawa Wind plant = 30 MW

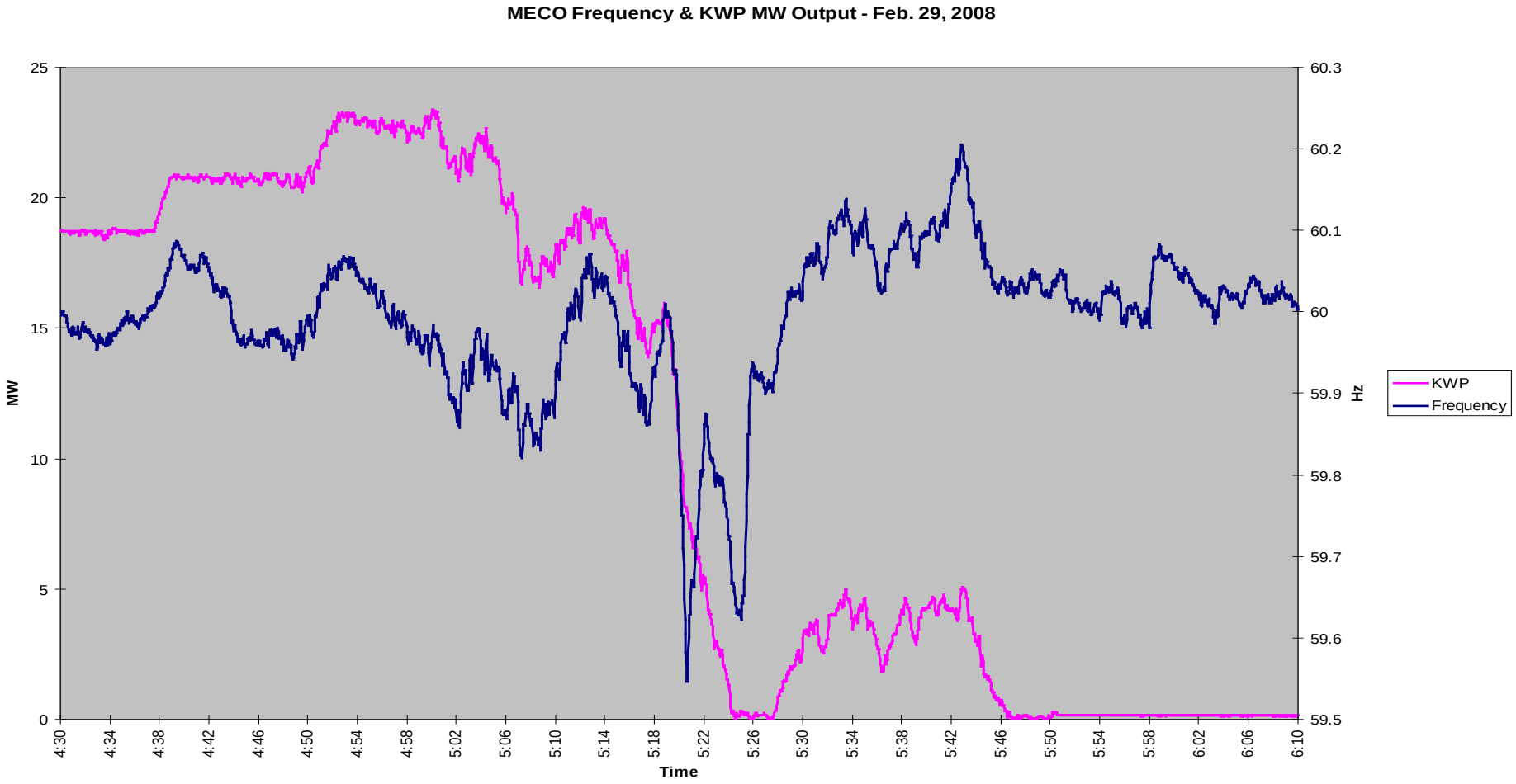
Up to 90 MW of proposed renewables

Project will use 2 circuits @ Wailea Sub. viz. circuits 1517 and 1518

Maui Meadows ≈ 500 homes

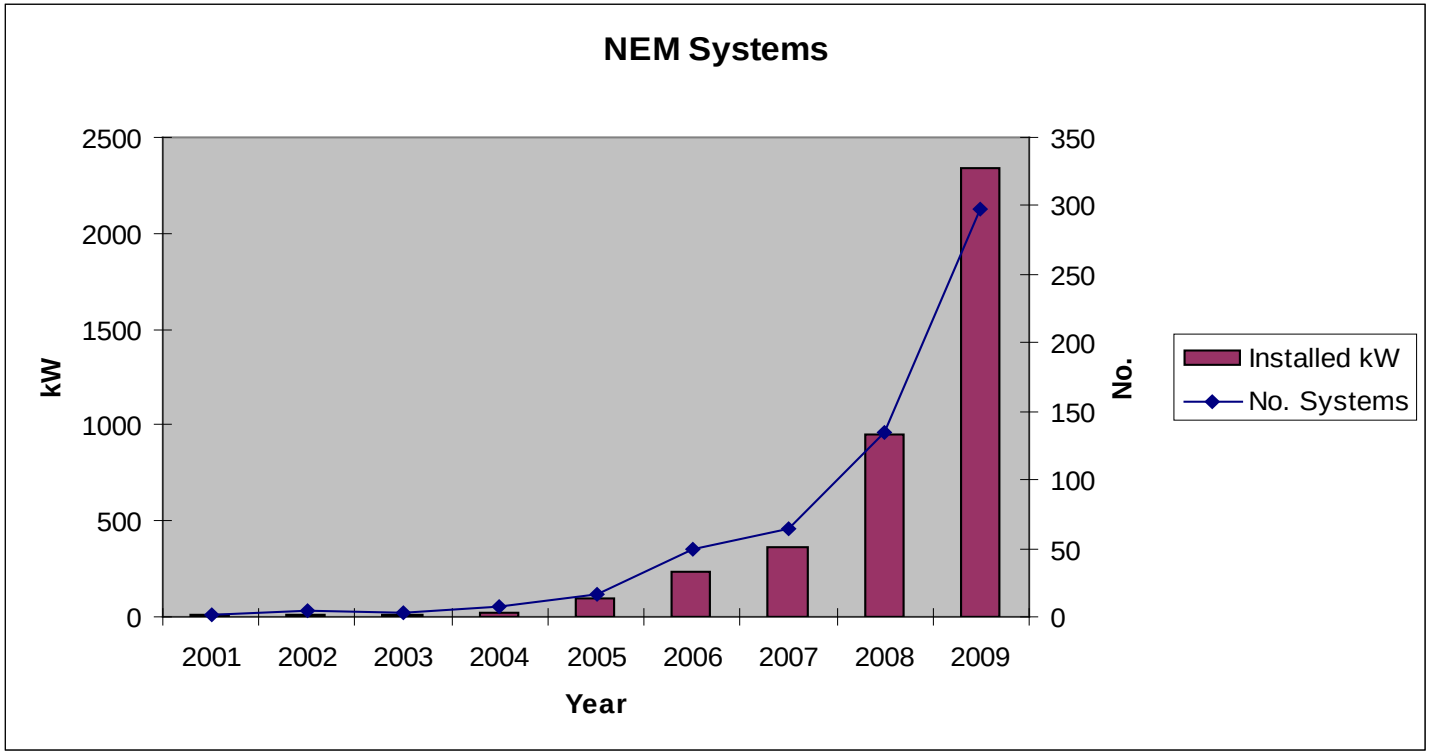
Other circuit with resorts and commercial

Wind Power Adds Variability to MECO Generation System



Small frequency bias means a single as-available generation facility can impact the system frequency

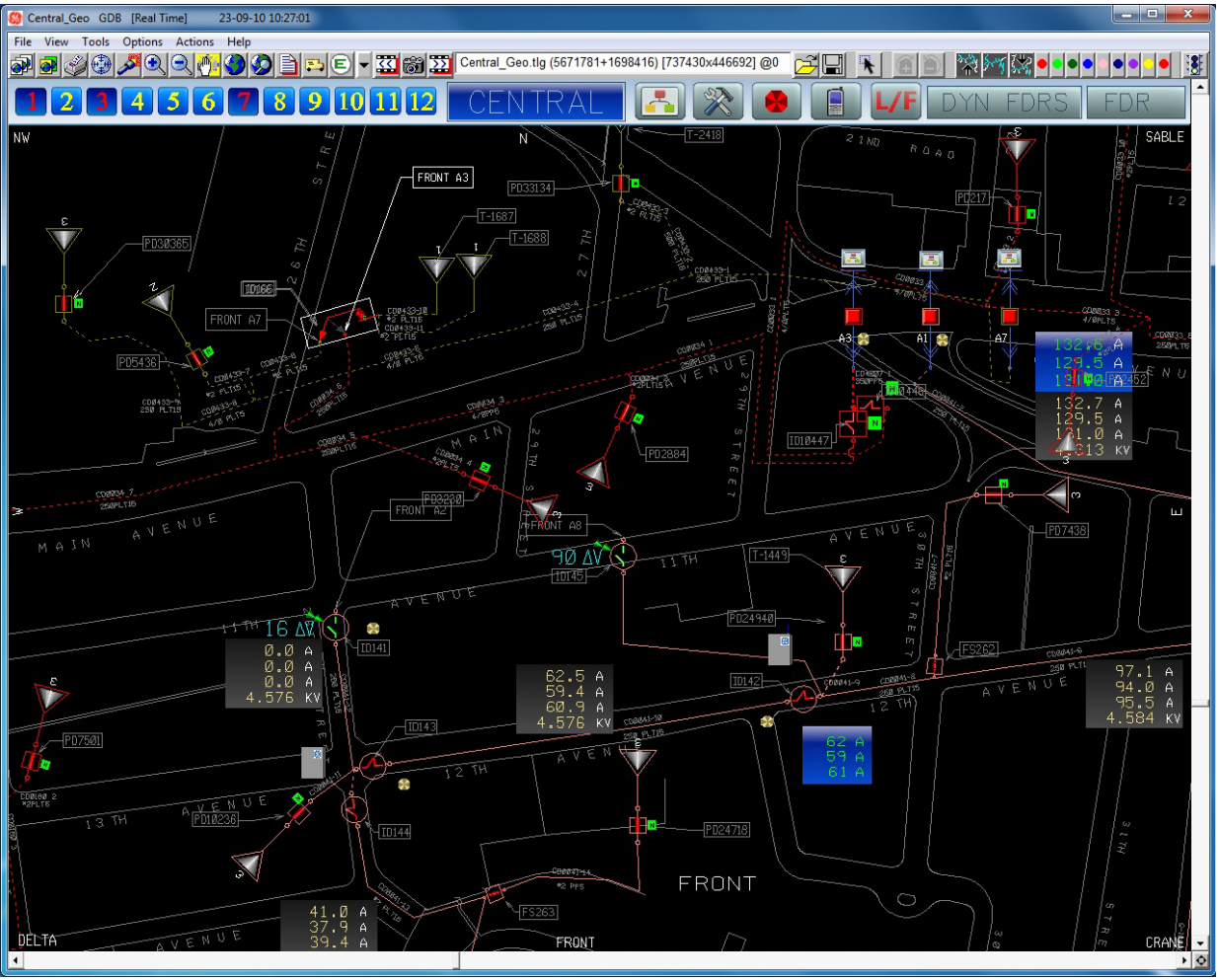
Distributed PV Generation Adding Variability to MECO Load



Increasing number of small as-available generation facilities without SCADA

GENe Distribution Management System (DMS)

Centralized data management and control of distribution system assets



Visualize distribution system data

Dynamic load flow model

Volt/VAR optimization

Developing decision support "dashboard"

GE is supplying and developing product

Offering MECO operations the ability to look within their distribution system will provide benefits.

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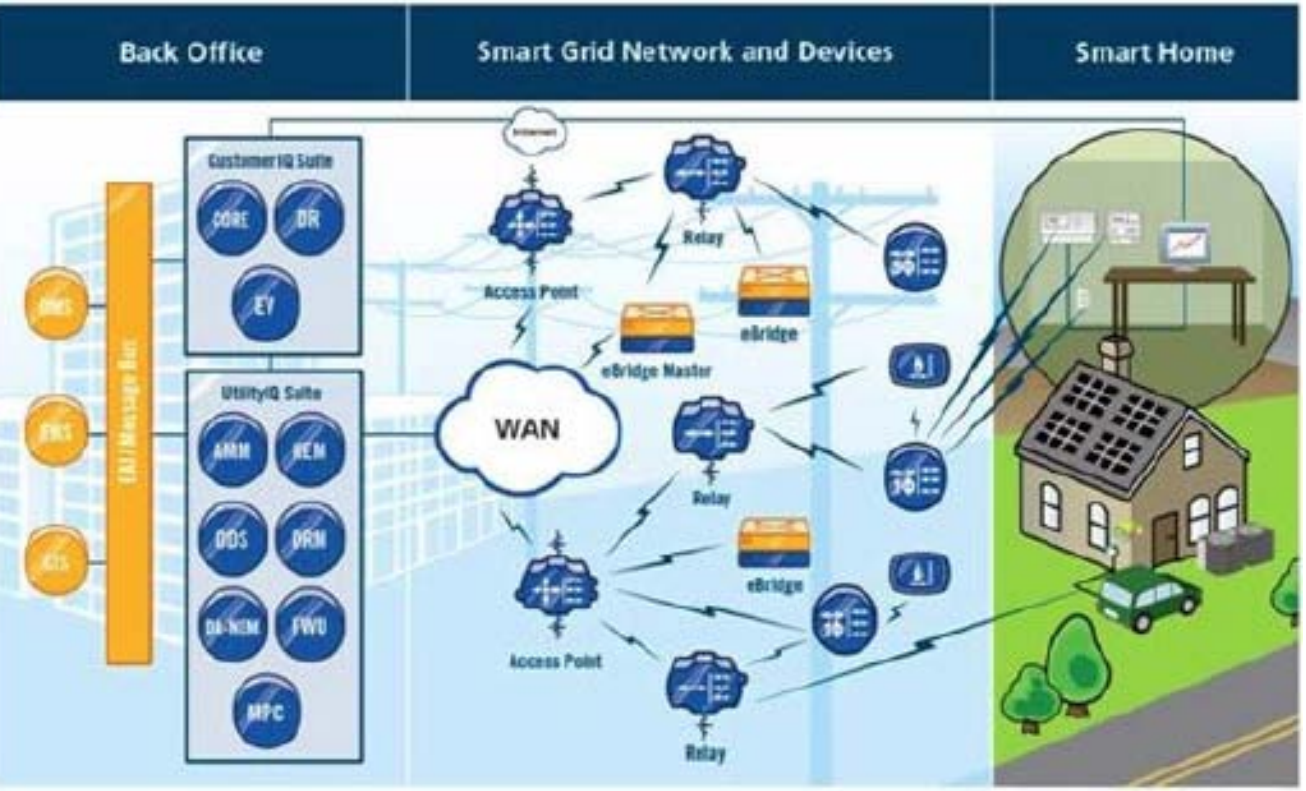
Advanced Metering Infrastructure (AMI)

Providing two-way communications to distribution system assets



Wireless mesh network

AMI supports:

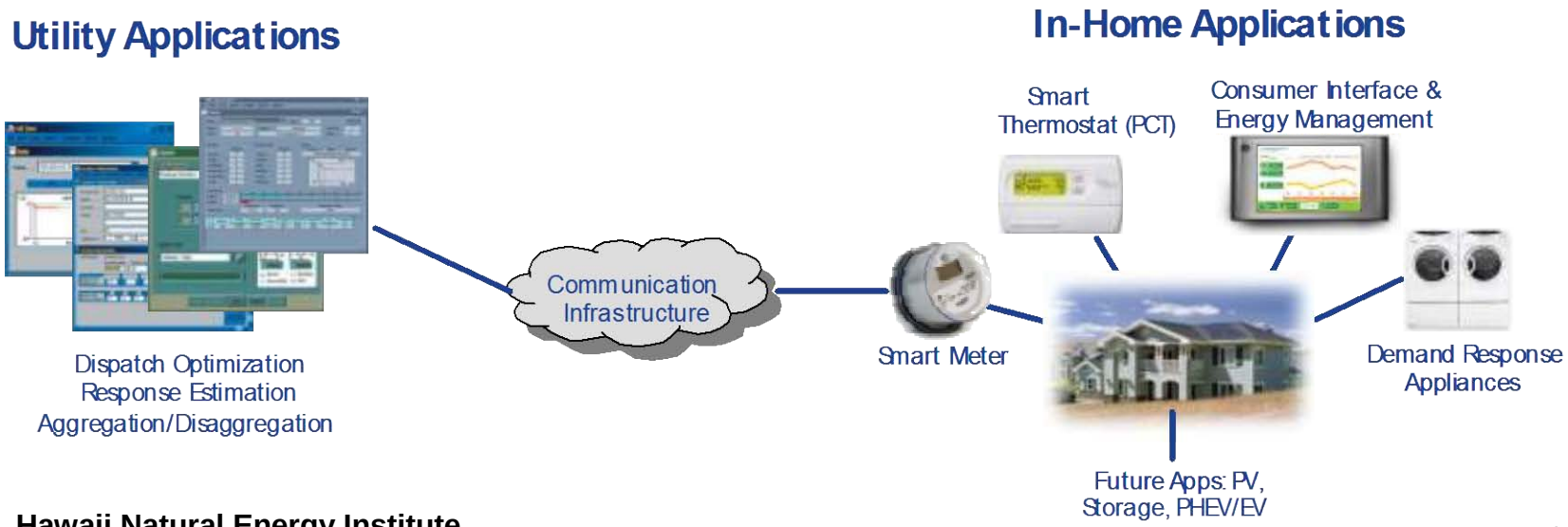
- **voltage monitoring**
- **demand response**
- **PV monitoring**

Silver Spring Networks is technology provider for this system

Demand Response Management System (DRMS)

Manage load during system events and peak load

1. **Load reduction during peak periods**
   - Contribute to 15% peak load reduction on circuit 1517
2. **Increase energy consumption during off-peak hours**
   - Increase energy production from lowest cost generation by reducing peak load and the need to start peaking units
   - Flatten and extend peak load to reduce wind plant curtailment.



Home Energy Management System (HEMS)

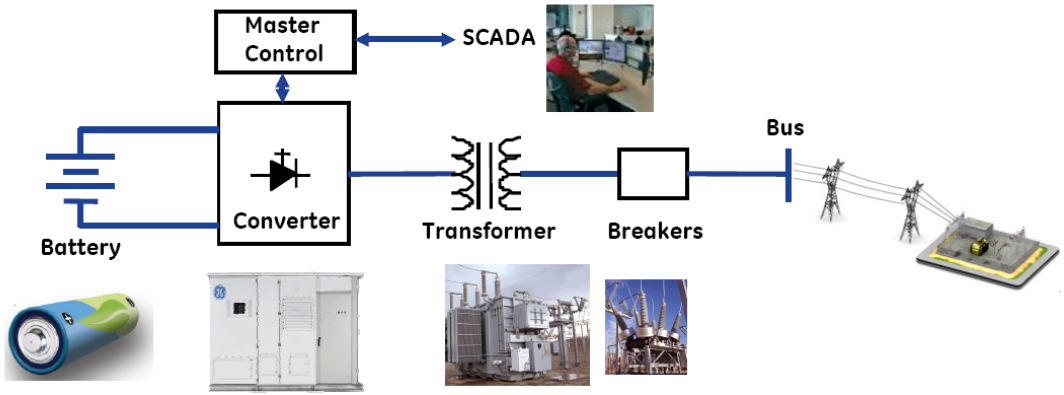
Residential consumer portal

- Monitor electricity usage & solar PV production
- Programmable thermostat, load control switches, and “Gateway”
- Demand response enabled comms for smart appliances
- **Communications:** Supports Ethernet, WiFi, Zigbee SEP 1.0
- **Interface:** In-home display or web interface

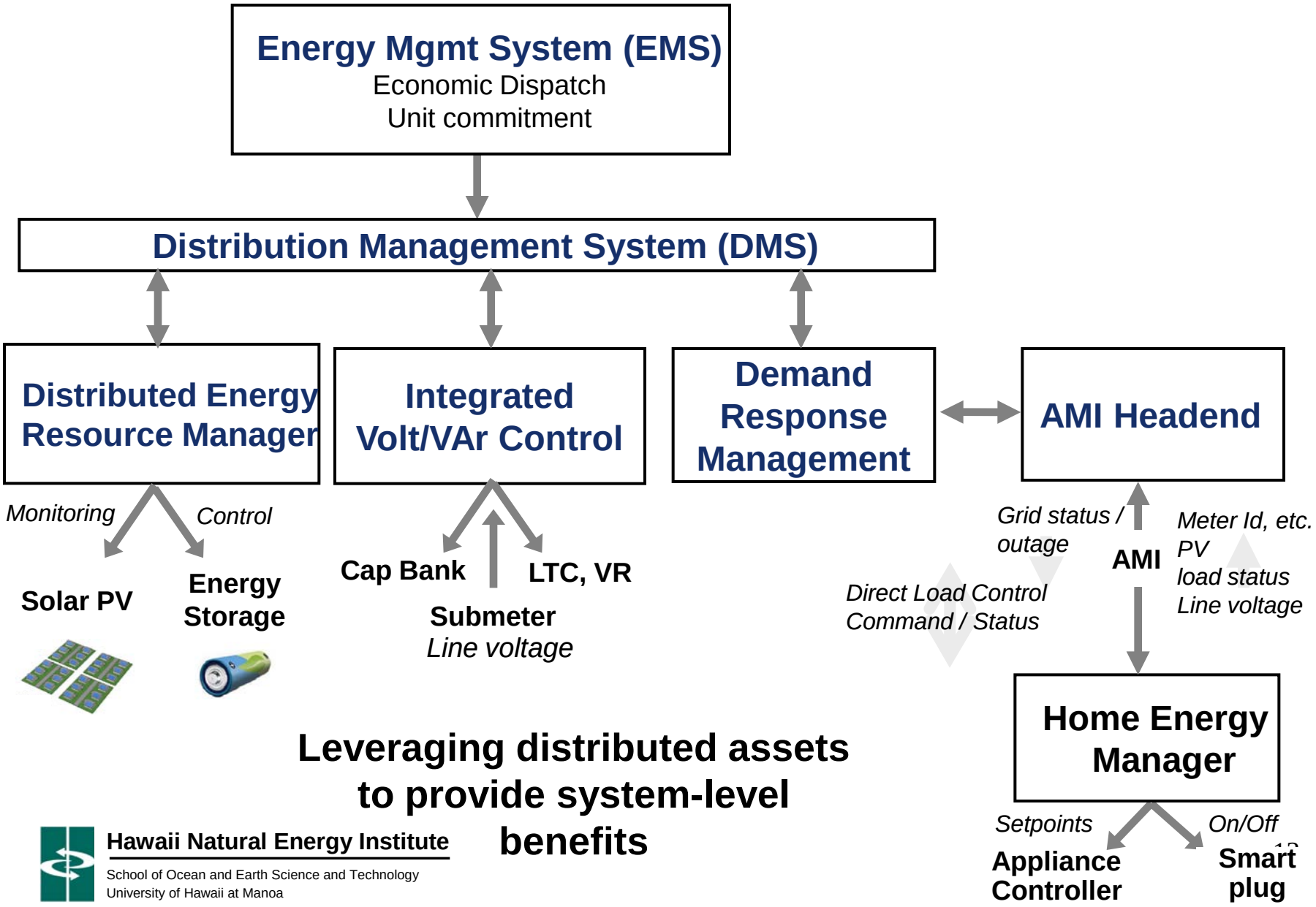
Battery Energy Storage System (BESS)

Multiple Benefits

1. **Manage peak load → Discharge for 1-2hr during peak**
2. **Voltage regulation → Manage variability caused by load and PV**
3. **Renewables Integration**
   - **Non-spinning reserve → Rapidly inject power, and bridge to fast-start generation.**
   - **Reduce wind curtailment → Charge off peak during excess energy periods**



Demonstrating New DMS Functions



Leveraging distributed assets to provide system-level benefits

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Maui Smart Grid Project Objectives

Distributed Resources for Transmission-level Support

	DMS	AMI, DRMS, HEMS, and Monitoring	BESS
Reduce peak load	• Aggregate DER and provide dashboard control • Volt/VAR control	• Enable direct load control • TOU prices (in future)	• Discharge energy to reduce load
Improve service quality	• Provide visibility to operator • Improved outage mgmt • Volt/VAR optimization	• Voltage monitoring validates DMS load flow	• Can help manage voltage
Inform consumer decisions		• Communicate prices • Real-time display • Energy mgmt system	
Grid stability	• Visibility on PV output • Aggregate DER and provide dashboard control	• Real-time monitoring of PV • Enable load control	• Discharge energy during system events
Increase RE utilization	• Provide reserve support (potentially reduce reserves)	• Load shifting	• Charge during off-peak

Project Timeline

<table>
<tr><th rowspan="3"></th><th colspan="2">Budget Period 1</th><th colspan="2">Budget Period 2</th><th colspan="3">Budget Period 3</th></tr>
<tr><th colspan="2">2009</th><th colspan="2">2010</th><th colspan="2">2011</th><th colspan="2">2012</th><th>2013</th></tr>
<tr><th>Q1, Q2</th><th>Q3, Q4</th><th>Q1, Q2</th><th>Q3, Q4</th><th>Q1, Q2</th><th>Q3, Q4</th><th>Q1, Q2</th><th>Q3, Q4</th><th>Q1</th></tr>
<tr><td>DMS</td><td colspan="2" rowspan="2">Develop Functional Spec</td><td colspan="2" rowspan="2">Detailed design, Technology selection</td><td colspan="2" rowspan="2">Development, Testing, Outreach</td><td rowspan="2">Deploy on Maui</td><td colspan="3" rowspan="3">System Operation and Data Collection</td></tr>
<tr><td>AMI, DRMS, HEMS, and Sensors</td></tr>
<tr><td>BESS</td><td colspan="2"></td><td colspan="2">RFP, Select vendor</td><td colspan="3">Design and Build</td></tr>
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Maui Smart Grid Project Benefits

DOE

- Demonstrate distribution management system for microgrids
- Develop general architecture integrating multiple Smart Grid functions

State of Hawaii

- Reduce petroleum use and emissions
- More renewable energy

MECO

- Improve grid stability
- Reduce use of petroleum and emissions
- Better power quality
- Incorporate more as-available renewable energy
- Integrate generation dispatch, IPP, demand response, AMI, distribution management, outage response functions

IPP

- Sell more energy

Customer

- Improved service quality (voltage management)
- More options for customers to lower their energy bills

Mahalo!
Questions?

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