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 - Gerr

GE Energy

Sentech, Inc.

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Maui Smart Grid Project Overview

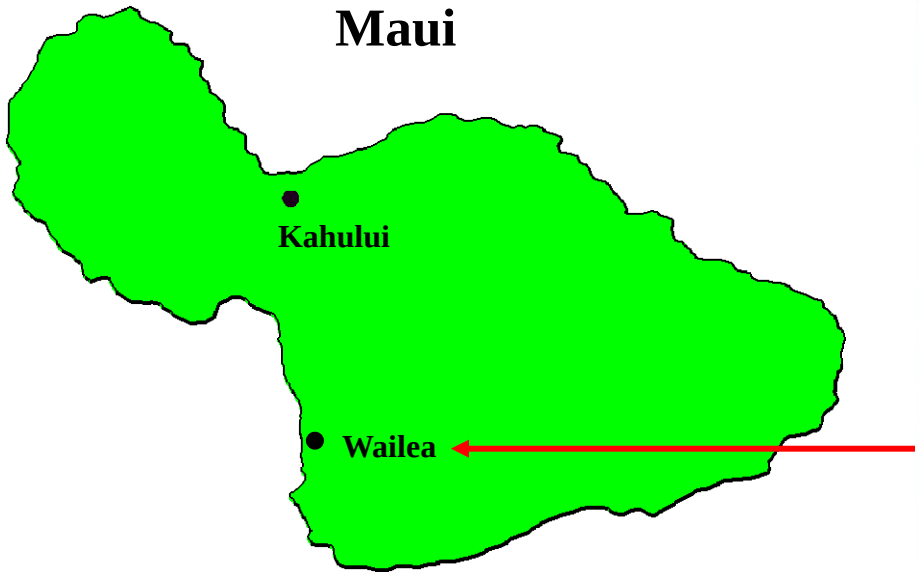
- **Maui Smart Grid Project is a demonstration project funded through U.S. Department of Energy (DOE), Renewable and Distributed Systems Integration (RDSI) program**
  - **RDSI is a R&D program focusing on grid integration of distributed energy resources**
- **In 2007, the RDSI program issued an RFP for demonstration projects**
  - **HNEI-led team won one out of 9 awards - 80 applicants**
  - **Project total budget of $15 million from 2009-2013**
    - **$7 million DOE funds, $8 million cost share with partners**

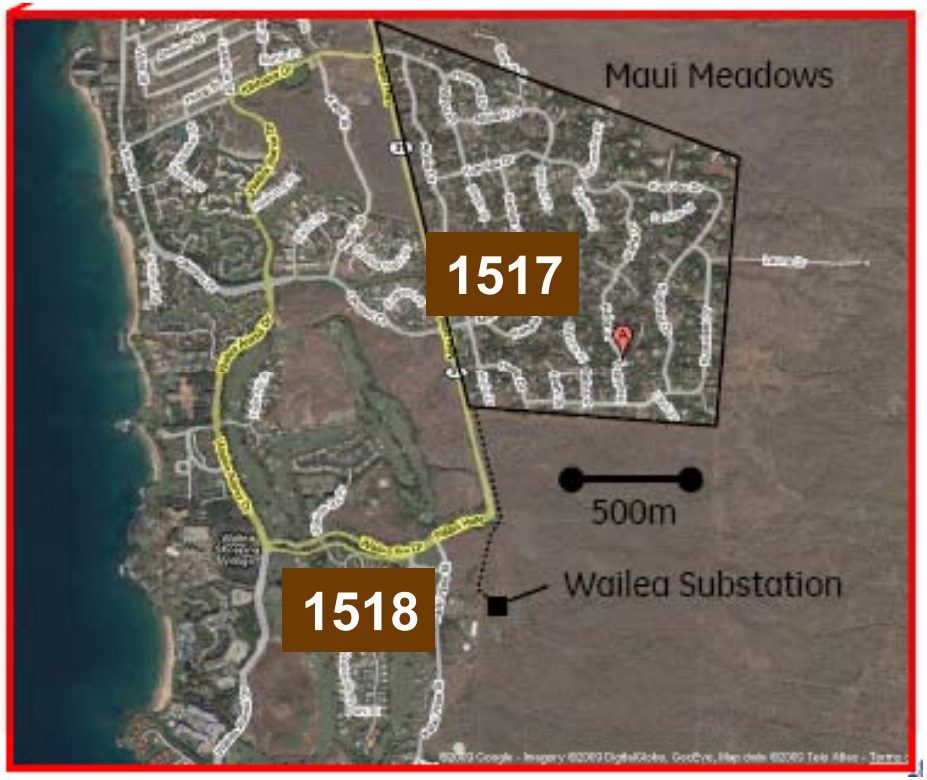
Maui Smart Grid Project Objectives

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

Project Located in Wailea, Maui





Basic System Facts:

MECO system peak load ≈ 200MW

Firm generating capacity ≈ 240 MW

Kaheawa Wind plant = 30 MW

Approx. 90 MW of potential renewables within project period

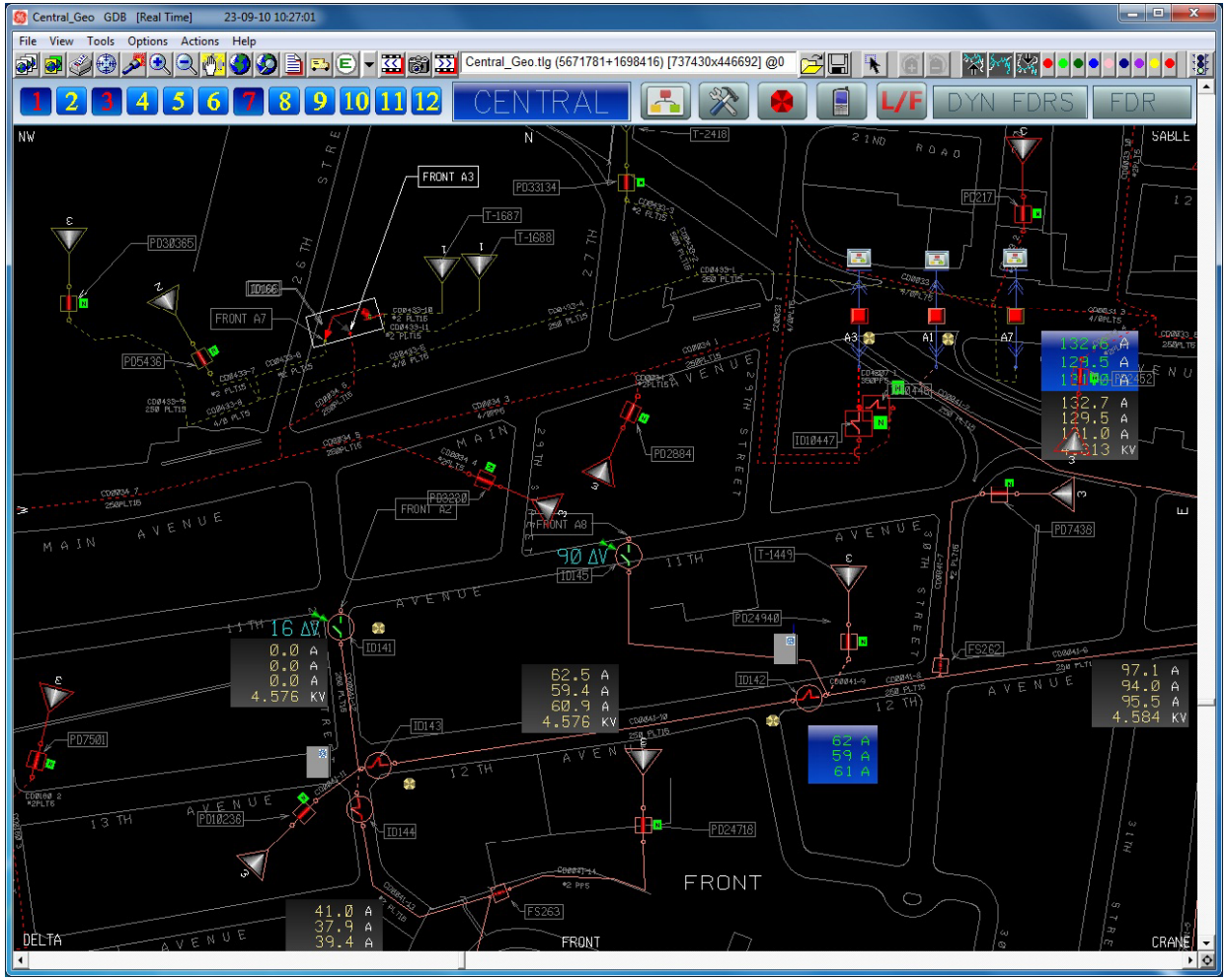
<u>Project will use 2 circuits @ Wailea Sub.</u>

Maui Meadows: 500+ homes

Other circuit with resorts and commercial

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”

General Electric is technology provider for this system

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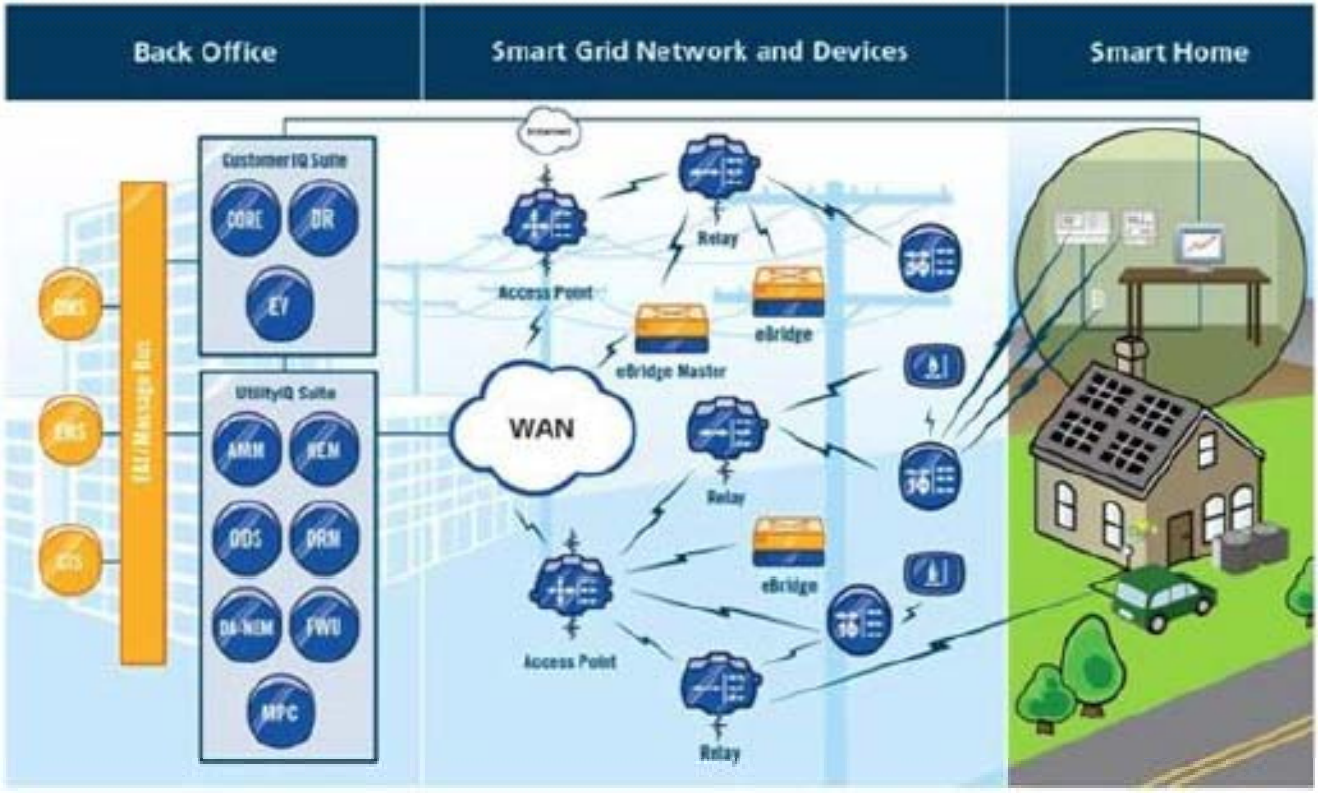
Advanced Metering Infrastructure (AMI)

Providing two-way communications to distribution system assets



Wireless mesh network

AMI supports:

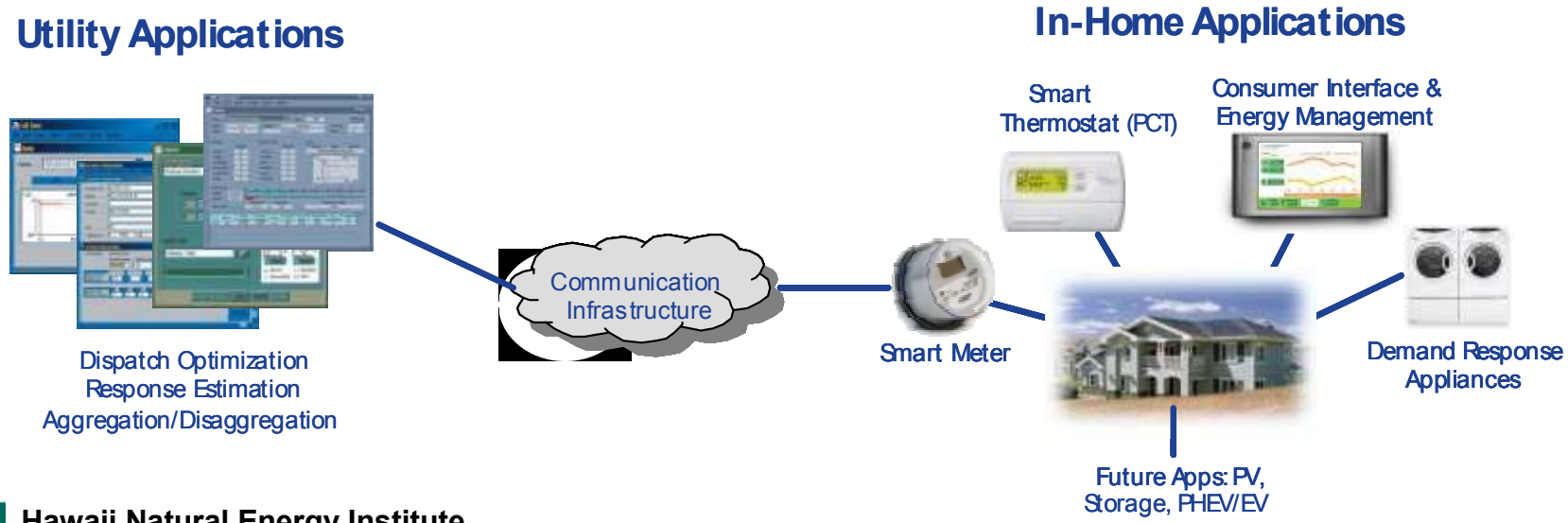
- **voltage monitoring**
- **demand response**
- **PV monitoring**

Silver Spring Networks is technology provider for this system

Demand Response Management System (DRMS)

Manage load during system events and peak load

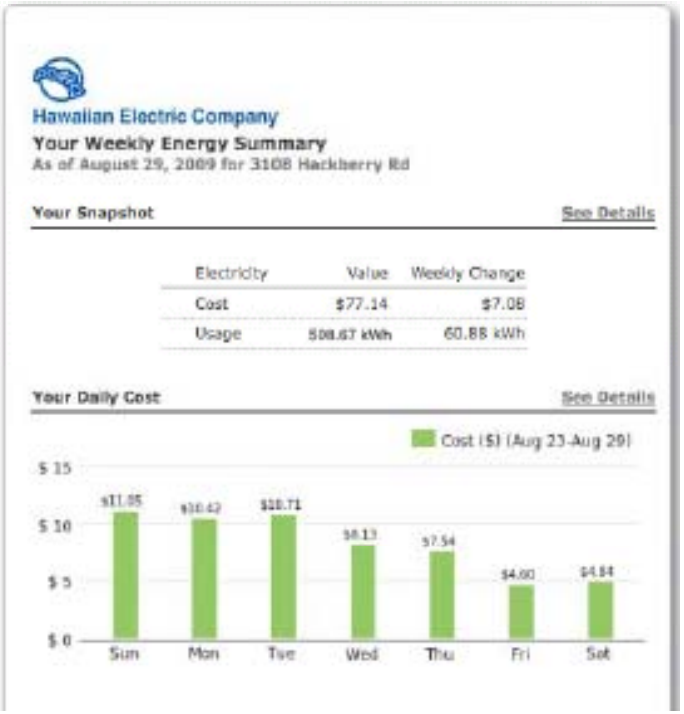
1. **Load reduction during peak periods**
   - Contribute to 15% peak load reduction on circuit 1517
2. **Increase energy consumption during off-peak hours**
   - Increase energy production from renewable generation by shifting energy use from peak to off-peak hours



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



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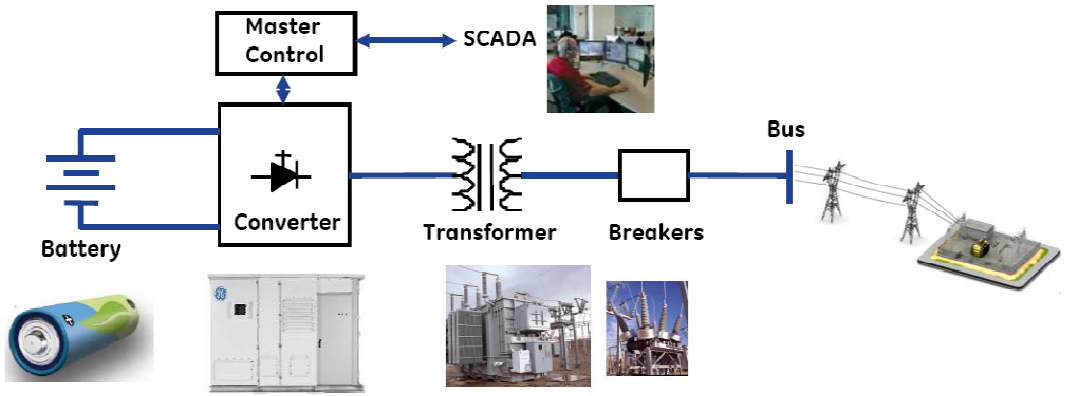
Battery Energy Storage System (BESS)

Multiple Benefits

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



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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Mahalo!
Questions?

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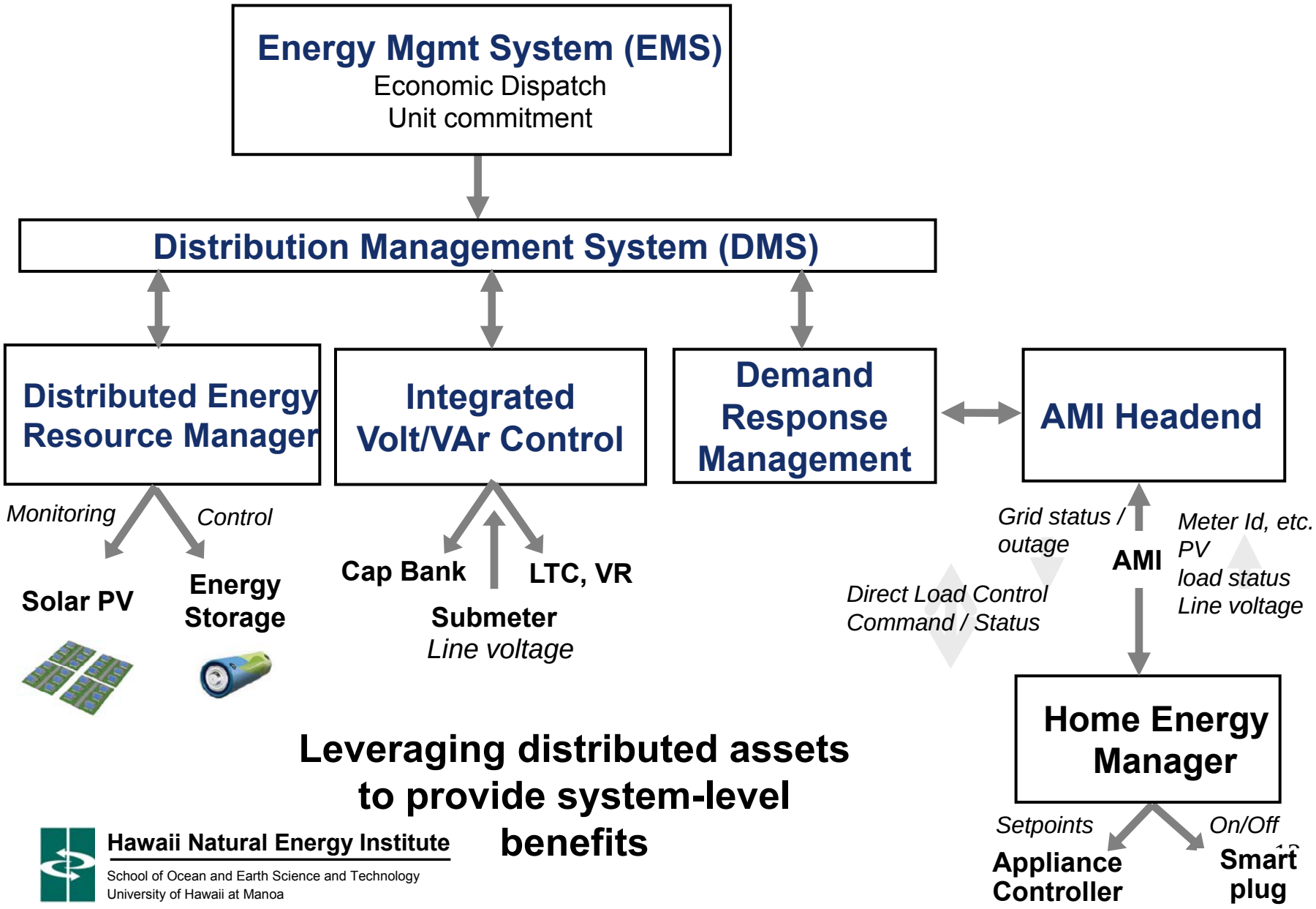
Demonstrating New DMS Functions



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