

GE Energy

# Aloha Renewable Energy

## Maui Smart Grid Project to Uncover Answers that Make Wind and Solar Generation More Viable

As the most remote chain of islands on earth, Hawaii is America's most fossil-fuel-energy dependent state. Almost 90%<sup>1</sup> of the islands' electricity is generated from fossil fuels, mostly oil. And 100% of that oil needs to be brought in by tanker, mostly from foreign countries.

Hawaii's oil dependency challenges its economy with costs and uncertainty. Hawaii's consumers pay nearly three times more for electricity than their counterparts on the mainland. And that cost could skyrocket every time there is a spike in oil prices.

GE is finding ways to help. Working with the US Department of Energy, Hawaii Natural Energy Institute, Maui Electric Company, and Hawaiian Electric Company, GE is fine-tuning solutions to integrate more renewable energy into the generation mix. The ultimate goal is for Hawaii to receive 40% of its electricity from clean, local, renewable energy sources by 2030.

### > Given its location and climate, why isn't Hawaii already using more solar and wind resources in its power mix?

Wind and solar generation is unpredictable – a passing cloud or a shift in the winds causes generation to drop rapidly. Then when the cloud clears or the winds re-shift, generation peaks again. This variability makes it challenging to provide a consistent, reliable stream of power when a small grid system includes very high levels of wind and solar power. Plus, being totally isolated, Maui cannot build a system that uses renewable energy “as available” and then fills gaps by buying energy from other utilities. There are no cables coming in from utilities in neighboring states.

### > So is the Maui smart grid project simply trying to find ways to level renewable generation?

Generation is only one part of the complete project scope. Working with our utility and technology colleagues, GE is deploying a whole host of technologies to help reduce Maui's dependence on oil for electricity. The projects include reducing and managing peak-demand loads, efficiently integrating renewable energy, forecasting renewable availability, better balancing generation with load, and improving ways to store and use excess renewable generation.



Real. Smart. Solutions.



< Maui, Hawaii, USA >

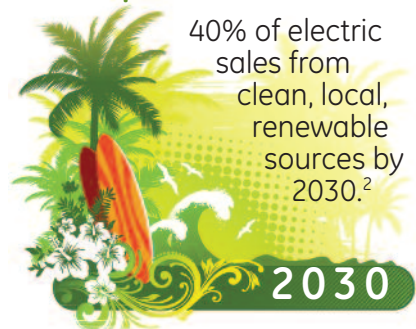



**A stream of clean, healthy, efficient growth**

Maui's independent power grid provides about 200 megawatts of electricity during peak times. Its largest renewable facility, First Wind's Kaheawa wind plant, can produce up to 30 megawatts to help meet that demand. At least another 40 MW of wind power is expected on the island, along with a wave-power plant and increasing customer-sited photovoltaic electricity.

---->40%

**The Hawaiian Islands and Maui Electric Company have a simple goal with a complex solution:**



<sup>1</sup> EIA SEDS Database

<sup>2</sup> Act 155 of the 2009 Hawaii Legislature

# Maui

## > What is GE doing to help reduce loads?

We're deploying a variety of GE technologies to help reduce and manage loads. A demand optimization program will enable the utility to monitor and control devices in homes and businesses, reducing the power being drawn at peak times. We'll do that by raising thermostats on air conditioning units, cycling down pool pumps and controlling other big-draw items during peak demand times. The change in device output will be nearly imperceptible, but the effect on energy demand will be significant.

## > What about those smart appliances that are making the news lately – are they part of your solution?

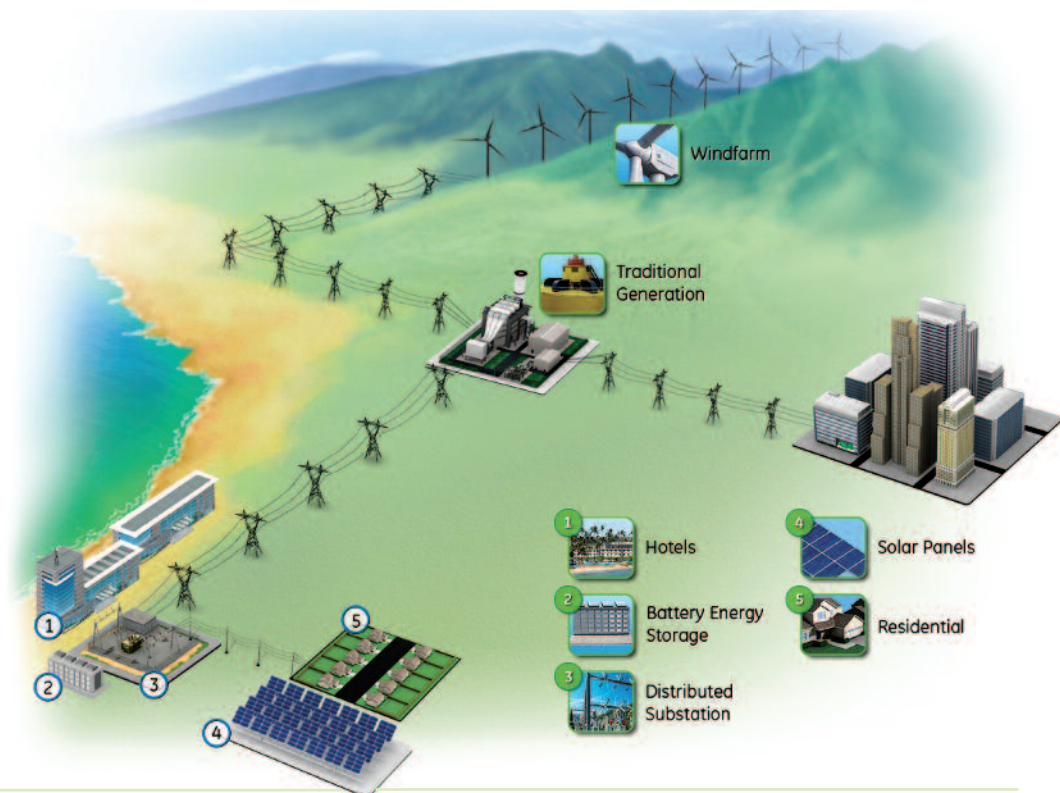
The Maui projects do include smart appliances that can be monitored and controlled to offset peak loads without affecting performance. For example, a smart refrigerator would be instructed to delay its high-energy-consumption defrost cycle during peak times. It's a change that's invisible to consumers, but has a great benefit for the grid. Consumers may opt into the level of control they are willing to allow the utility in exchange for greater potential energy savings.

## > What makes it all work?

The totally integrated system has many important parts, but key to reducing load are smart meters on homes and a smart Distribution Management System (DMS) controlling the entire energy distribution network.

## > What does the Distribution Management System do?

In addition to communicating with household smart meters, the DMS monitors and controls commercial electrical loads, incoming power from wind and solar resources and the systems to move and control the energy. That includes digital substations, capacitor banks, voltage regulators and battery banks. The DMS will also control and smoothly integrate nonrenewable energy sources into the mix – adding and subtracting power sources as needed. The DMS is, in effect, the conductor of the entire Maui energy orchestra, optimizing the performance of each element and calling elements into play as needed for an ideal composition of energy delivery and efficiency.



## An end-to-end solution to manage supply and demand

Only GE has the breadth and depth of services and expertise to make sun and wind power practical elements of a total energy solution for Maui. From forecasting renewable availability that displaces traditional generation, and distributing energy more efficiently, to managing and lowering demand, the Maui smart grid project treats the island's energy challenges as a complete picture.

In the end, Maui residents and businesses will see a shrinking reliance on imported oil, more control over their energy usage and costs, and an infrastructure that can support smart, clean growth island-wide. The project may rewrite the textbooks on how to reliably integrate inherently unreliable wind and power generation into a vibrant energy plan.



## The Answer Is Blowing In The Wind

### > Is there anything else you can do to reduce demand?

The project is also integrating GE VOLT/VAR technology that more tightly controls the voltage needed on power lines to maintain reliable availability. By optimizing voltage and better controlling power flow in response to the real-time load demands, we'll reduce unnecessary power loss and waste in transmission and distribution.

### > How much renewable power is this project delivering?

A lot of generation is in place or under development for an isolated grid that peaks at about 200 MW on a typical day. The 30 MW First Wind Kaheawa wind plant is in operation and adding another 20 MW. Another wind plant being developed will add 20+ MW more. Maui soon expects to host a wave generation pilot project and to fuel existing power generation facilities with plants or algae grown on Maui. And countless PV solar installations are in place and planned on resorts, businesses and homes. The potential volume of renewable energy is huge.

### > Where does forecasting fit in?

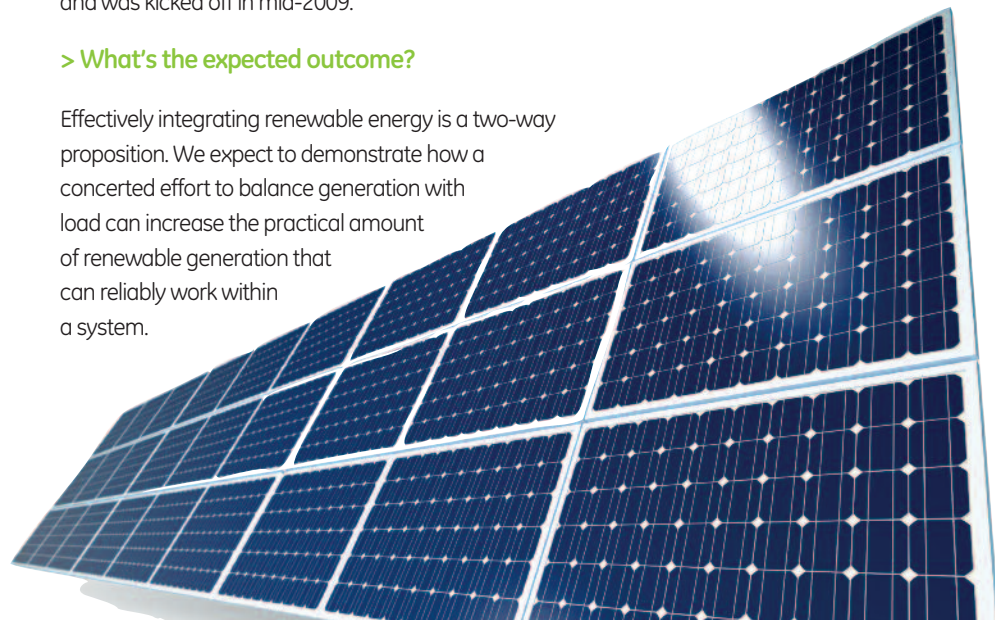
It's inevitable that Hawaii's energy will be generated by a mix of renewable and fossil-fuel generation. Forecasting the availability of wind and solar viability can maximize the efficiency of fossil fuels used in the mix. GE's forecasting tools predict the outlook for volume of renewable energy at any given time. Then the DMS can call on the minimum number of fossil resources needed to keep the system viable.

### > What's the schedule?


The three-year project is being led by GE Energy and the GE Research Center in upstate New York and was kicked off in mid-2009.

### > What's the expected outcome?

Effectively integrating renewable energy is a two-way proposition. We expect to demonstrate how a concerted effort to balance generation with load can increase the practical amount of renewable generation that can reliably work within a system.



**Smart meters** will give consumers the ability to effectively control usage and save money. They'll help the utility effectively control demand and improve service.



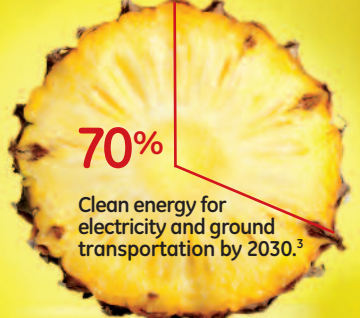
### Cut Peak

The Maui smart grid project has a specific objective to reduce peak distribution loads by 15%. Demonstration on a distribution circuit is targeted for 2012.

15%

2012

**Long-range goals** – To improve security, its economy and the environment, Hawaii is moving to natural, local resources: wind, solar, ocean, biofuel, waste-to-energy and more. The most aggressive renewable goals in the US call for 70% clean energy for electricity and ground transportation by 2030 – 30% from energy efficiency and 40% from renewables.<sup>2,3</sup>



70%

Clean energy for electricity and ground transportation by 2030.<sup>3</sup>



**GE's smart appliances** will help control peak demand and manage energy use to control consumer costs.

<sup>2</sup> Act 155 of the 2009 Hawaii Legislature

<sup>3</sup> Hawaii Clean Energy Initiative, 2008

## Technology and solutions powering the Maui smart grid

### Smart Grid Technology from GE

Preparing us for tomorrow, today



Be better at keeping the lights on.

Maximize life and performance of existing grid.

Easily integrate clean renewables.

Fuel plug-in cars without new plants.

Monitor energy use to reduce costs.

### Real. Smart. Solutions.

**It's simple:** GE's smart grid is real and ready today. And it really is a smarter way to improve reliability, extend infrastructure, increase efficiency, integrate renewable generation and enable new technologies – because it is a collection of complete solutions, rather than one-off product sells. The smart grid is no longer a plan for tomorrow. It's a necessity for today.

### Holistic Smart Grid Vision Powered by a Complete Product Suite

GE Energy is joining forces with utilities across the globe to upgrade the ways we move and consume energy. Our vast experience in every area of energy – from generation, through transmission, distribution and consumer use – gives us understanding and insight available nowhere else. Working with our utility partners, GE Energy is able to understand, plan, execute, evaluate and continuously improve the unique smart grid solution set for the unique operating environment of each individual city, region or country.

We've assembled the technologies, expertise, experience and resources to make the smart grid work for smarter communities. This Maui project is another powerful example of the smart grid at work.

For more information, contact your GE Energy sales representative or send us an email at: [energy.tdsolutions@ge.com](mailto:energy.tdsolutions@ge.com)

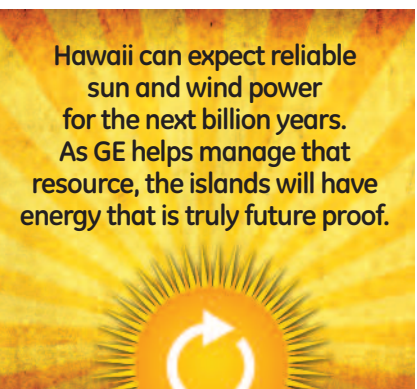
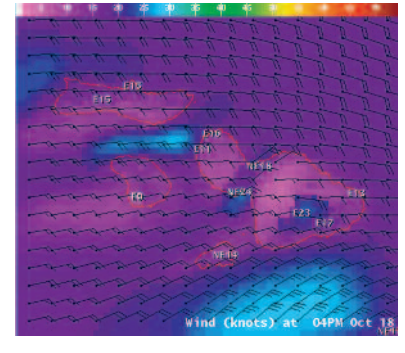
© 2009 General Electric Company. All Rights Reserved.

GEA17953 (11/09)



Printed on recycled paper.

Forecasting wind and sun maximizes the efficient use of clean power, while lowering unnecessary fossil-fuel generation.



Hawaii can expect reliable sun and wind power for the next billion years. As GE helps manage that resource, the islands will have energy that is truly future proof.

Reigning in energy costs will help Hawaii in two ways – making life more affordable for citizens and increasing the competitive viability of the state's number one industry: tourism.



### Go to School on the Smart Grid



Find out more about how the smart grid can help make energy more reliable, efficient and planet friendly at [itsyoursmartgrid.com](http://itsyoursmartgrid.com).