Smart Appliances and their Impact on Energy Usage

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GE Appliances & Lighting
AHAM Smart Grid White Paper from December 2009
The Home Appliance Industry’s Principles & Requirements for Achieving a Widely Accepted Smart Grid

Essential Requirements

1. **Pricing** must provide incentives to manage energy use more efficiently and enable consumers to save money.

2. **Communication Standards** must be open, flexible, secure, and limited in number.

3. **Consumer Choice & Privacy** must be respected; the consumer is the decision maker.

http://www.aham.org/ht/a/GetDocumentAction/i/44191
Market Drivers... Consumer Demand

Residential Summer Loads – California

Demand

Time of Day

Source: Electricity Use in California: Past Trends and Present Usage Patterns; R. Brown, J. Koomey, May 2002; Ernest Orlando Lawrence Berkley National Laboratory, 2002
Peak Potentials

Peak Power Use

<table>
<thead>
<tr>
<th>Device</th>
<th>Power Use</th>
<th>Home Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fridge</td>
<td>685</td>
<td>100%</td>
</tr>
<tr>
<td>Lighting</td>
<td>1000</td>
<td>100%</td>
</tr>
<tr>
<td>Micro</td>
<td>1200</td>
<td>88%</td>
</tr>
<tr>
<td>Dish</td>
<td>1200</td>
<td>58%</td>
</tr>
<tr>
<td>Washer</td>
<td>1600</td>
<td>83%</td>
</tr>
<tr>
<td>HVAC</td>
<td>3300</td>
<td>59%</td>
</tr>
<tr>
<td>Water Heater</td>
<td>4500</td>
<td>50%</td>
</tr>
<tr>
<td>Dryer</td>
<td>5400</td>
<td>61%</td>
</tr>
<tr>
<td>Range</td>
<td>14500</td>
<td>59%</td>
</tr>
</tbody>
</table>

“…feedback programs for the residential sector might generate electricity savings that range from as little as 0.4% to more than 6% of total residential electricity consumption.”
Smart Phone Application

**Resources**

- Adjust programmable thermostat

**Appliances**

- Prototypes

**Thermostat**

- History

**History**

- Prototypes
HOUSEHOLD RESPONSE TO DYNAMIC PRICING OF ELECTRICITY
SURVEY OF THE EXPERIMENTAL EVIDENCE
Ahmad Faruqui and Sanem Sergici1
January 10, 2009

Figure 1:

Residential homes offer as much demand response potential as small, medium and large businesses combined.... FERC
Pilot Programs

GE has been working with utility partners to better understand consumer acceptance and issues with smart appliances.

Utility pilots encompass IOU’s, Cooperatives, and Municipals in sizes ranging from a few homes to over a 1,000.

Key
- **Existing and Planned Pilots**
Demonstrated benefits

Peak time kW reduction per home

<table>
<thead>
<tr>
<th></th>
<th>T-stat, Load Ctrl²</th>
<th>Smart Appliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st hour</td>
<td>1.0</td>
<td>1.8</td>
</tr>
<tr>
<td>2nd hour</td>
<td>0.9</td>
<td>1.6</td>
</tr>
<tr>
<td>3rd hour</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>4th hour</td>
<td>0.6</td>
<td>1.3</td>
</tr>
<tr>
<td>5th hour</td>
<td>(0.4)</td>
<td>(0.1)</td>
</tr>
</tbody>
</table>

*Smart appliances nearly double benefit*

2) Load control device installed on water heater

System Overview – Vineyard

- Whole home energy monitor
  Attached to home main power panel

- In-home-router

- Cloud server

- Display options
  - PC
  - I-phone app (Optional)

- Appliances
Abstract
The Vineyard Energy Project involves the deployment of customer systems to enable real-time load measurement and management while helping customers optimize their electricity usage. The main objective is to assess the effectiveness and customer acceptance of the technologies and determine the extent to which they can help accommodate greater penetration of wind energy. Home area networks, energy management systems, direct control devices (including water heaters, air conditioners, and water pumps), and various smart appliances are integrated into Vineyard Power Management System (VPMS) (i.e., Vineyard Power’s load balancing system). The project also allows participating customers access to a Web portal—allowing them to view their energy usage information and their participation in adjusting the load shape to better match wind generation patterns. A supermarket implementation widely monitors energy use and connects VPMS with a temperature sensor and a load control switch in a refrigeration demand response demonstration responding to the VPMS price signal.

Smart Grid Features
*Communications infrastructure* includes Internet-based, two-way communication networks that integrate the operation of customer

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**At-A-Glance**

Recipient: Vineyard Power
State: Massachusetts
NERC Region: Northeast Power Coordinating Council
Total Budget: $1,574,500
Federal Share: $787,250

**Project Type:** Integrated and Crosscutting Systems

**Equipment**
- Customer Systems for 36 Customers
  - Home Area Networks
  - Customer Web Portal
  - Energy Management Systems
  - Direct Load Control Devices
  - Smart Appliances
- One Electric Vehicle Charging Station

**Key Targeted Benefits**
- Reduced Greenhouse Gas and Criteria Pollutant Emissions
- Reduced Electricity Costs for Customers

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Thank you