Smart Home Energy Management Systems

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General Electric Company – GE Appliances

> Operating in more than 100 countries ... 125+ years
> Over 300,000 employees worldwide
> 2010 revenue $149 B
Global energy demand triples by 2050

Amount of greenhouse gas emissions for which electricity generation accounts

Rise in residential cost of electricity in US, 2000-2008

Cost of power outages annually, US

Source: Army Corp of Engineers
Source: Energy Information Administration
Source: Energy Information Administration
Source: Department of Energy
Demand and Prices Are Going Up

Demand is forecast to increase 1% year-on-year through 2035.

Prices are forecast to increase 2.1% year-on-year through 2035

Source: EIA 2010 Annual Energy Outlook
Major trends in the Utility Industry

• Demand is outpacing supply in certain locations and at peak times

• Legislation and costs are inhibiting new power plant construction

• Smart meters installations are expanding

• Pricing legislation will drive consumer behavior
Flatten the peak
A Move Toward Time of Use (TOU) Rates

> With questions regarding the ability of future supply to meet future demand, states are allowing utilities to move to TOU pricing.

> In a survey of over 2,000 electric utilities, more than 500 have some form of opt-in TOU rate.

> 100 utilities have a Critical Peak Pricing (CPP) rate
Consumer Research
Environment not ‘the’ driving force

37% see environment as top threat*

27% feel highly affected*

Environmental beliefs not ‘firm’*

While consumers favor eco products …

• Cost & quality matter more**

• Green products seen as lower quality/higher price***

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*Yankelovich.


***GE.
Americans are motivated to use smart devices by a desire to save money and gain control.

Drivers to Use a Smart Device

- Any NET: 99%
- Desire to save money: 95%
- Increased control over my energy bill: 90%
- Desire to make a difference for my children or...: 88%
- Helping reduce the number of power outages: 86%
- Environmental concerns: 85%
- Smart meters and smart appliances are the...: 82%
- Patriotism: 55%
- Don't know/Unsure: 0%

Base: Those who are willing to switch (n=884)

Q. Which, if any, of the following would drive you to use a smart device such as a meter, thermostat, appliance, etc. once a smart grid is available in your community?
Technology Challenges
Consumers shop differently for home

Where modern ideas of technology come together with traditional ideas of warmth and care. Green tech must be personal & relevant.

Technology adoption rates can be slow

"If it involves people actually doing something, it won't happen. Just look at everyone who never figured out how to program a VCR." — Richard Thaler, a behavioral psychology economist at the University of Chicago's Booth School of Business

1/3 of Americans have a programmable thermostat. 1/5 use it.

Source: Energy Information Administration

Average monthly electric bill $100 - $120

Average amount consumers will pay for “cost-saving” devices based on monthly savings*

<table>
<thead>
<tr>
<th>$100</th>
<th>21% pay nothing $82</th>
</tr>
</thead>
<tbody>
<tr>
<td>$95</td>
<td>10%</td>
</tr>
<tr>
<td>$90</td>
<td>14% pay nothing $89</td>
</tr>
<tr>
<td>$85</td>
<td>20%</td>
</tr>
<tr>
<td>$80</td>
<td>14% pay nothing $98</td>
</tr>
<tr>
<td>$75</td>
<td>30%</td>
</tr>
<tr>
<td>$70</td>
<td>% savings</td>
</tr>
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</table>

Other studies show consumers willing to pay a $48 one-time fee and $13/month on average for benefits of smart grid.**


Devices need to be networked but…….

- Embedded home devices have very basic electronics
- Most devices do not have a high end display or a keyboard
- Home devices have a fixed place in our home
- Do not need high bandwidth for command & control
- Energy saved > Energy consumed by networking

Devices need to be secure and protect privacy

New products for a smarter home

Solutions need to meet key consumer requirements:

• Set it/forget it
• Ease of use
• Simple installation
• Low maintenance
• Cost-effective
Smart Energy Management Systems
Electronics 7.2%
Other Loads 11.0%
Lighting 8.8%
Dishwasher 2.5%
Laundry 6.7%
Cooking 7.0%
Water Heating 9.1%
Refrigeration 7.0%
HVAC 31.1%
Other Loads 11.0%
Smart Thermostats

50%

Source: www.eia.doe.gov
Home Energy Solutions

Nucleus™

Smart Meter

Internet

Appliances

Other Devices

Nucleus is a Trademark of General Electric Company

Brillion is a Trademark of General Electric Company
PC apps

**Resources:**
Track whole home energy consumption in 15 second intervals in kWh and $.

**Rates:**
Monitor energy rates for any time of day. Especially valuable for variable pricing rates implemented by the utility.

**History:**
Analyze usage trends over time—daily, weekly, monthly, even yearly for up to 3 years.

**Thermostat:**
Program, monitor and adjust home temperature, even with several thermostats.

**Appliances:**
See how the Brillion™ appliances contribute to energy consumption and receive alerts such as “Washer Cycle Complete.”

Prototype*Widgets exist based on what DR devices the Nucleus is bound to.
iPhone® apps

Resources

Appliances

Thermostat

Adjust programmable thermostat

History
# Smart Appliances

<table>
<thead>
<tr>
<th>Refrigerator</th>
<th>Dish Washer</th>
<th>Cooking</th>
<th>Washer and Dryer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed defrost</td>
<td>Delayed wash and dry</td>
<td>Uses of small cavity</td>
<td>Delayed wash and dry</td>
</tr>
<tr>
<td>Temperature shift</td>
<td>Smarter cycles</td>
<td>Cooking efficiency</td>
<td>Manage water usage</td>
</tr>
</tbody>
</table>

![Graph showing energy demand and supply](image)

**Goal:** 20% load shed off of peak
Learnings from pilots.......  

• Technology **fine-tuning** required for consumers

• Networking multiple devices is **challenging**

• Consumers **do change** behavior resulting in energy and money savings

• Consumers **expect conveniences** in addition to energy management

Areas for research

• Scale up of Nega-watts

• Latency and speed

• System stability

• Tariff structures for widespread adoption

• Behavioral aspects of home energy management