Smart Home Energy Management Systems

Natarajan Venkatakrishnan
GE Appliances

General Electric Company – GE Appliances

> Operating in more than 100 countries … 125+ years

> Over 300,000 employees worldwide

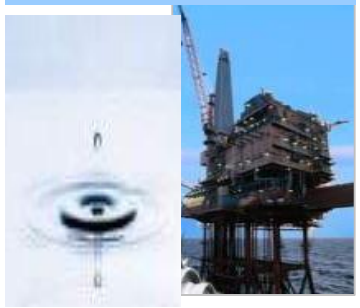
> 2010 revenue $149 B

Energy Infrastructure

Technology Infrastructure

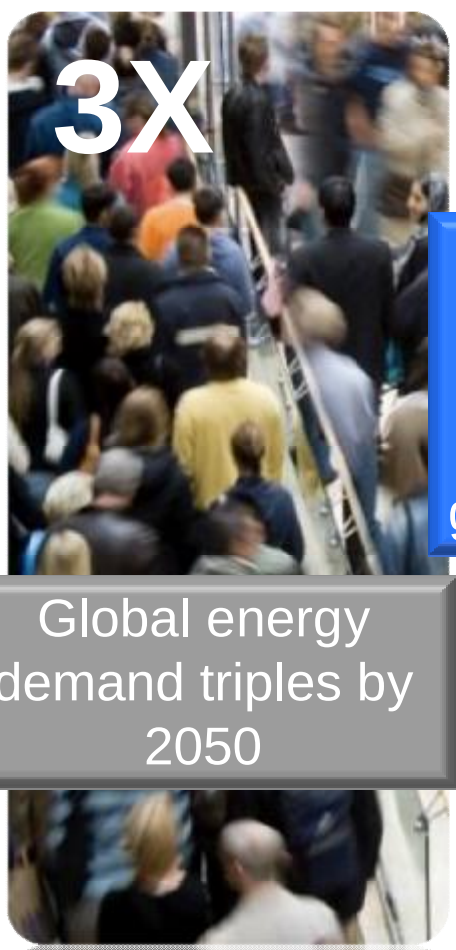
GE Capital

GE Home Solutions



Energy Challenge

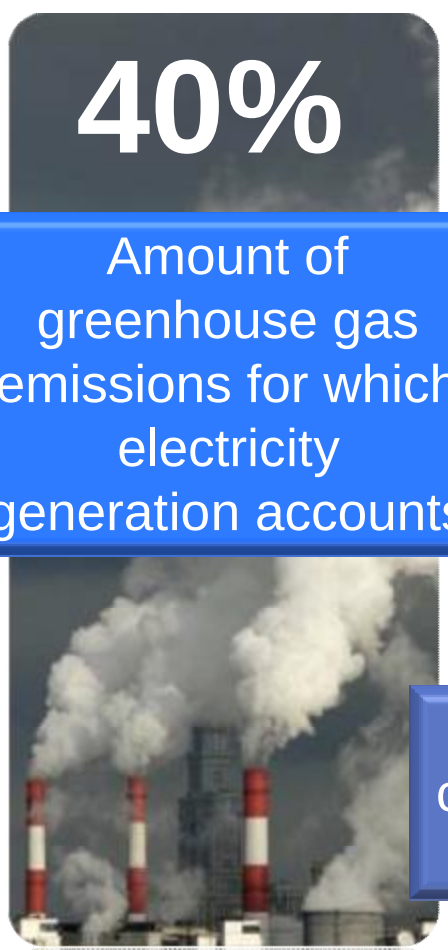
Significant energy challenges



3X

Global energy demand triples by 2050

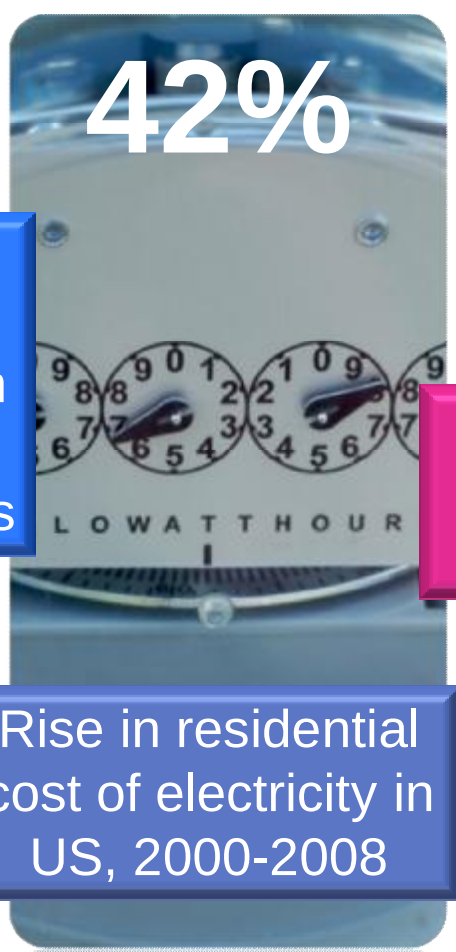
Source: Army Corp of Engineers



40%

Amount of greenhouse gas emissions for which electricity generation accounts

Source: Energy Information Administration.



42%

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

Source: Energy Information Administration

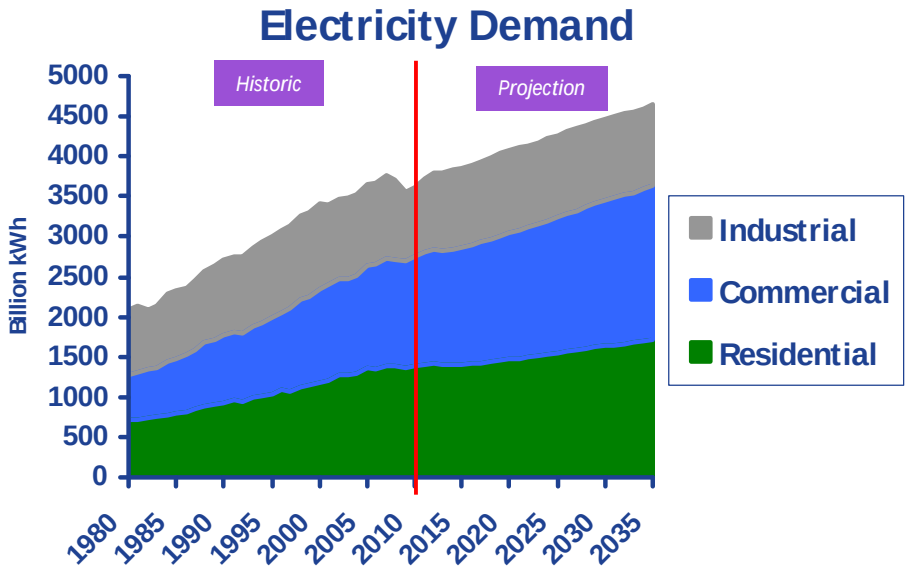
$150B

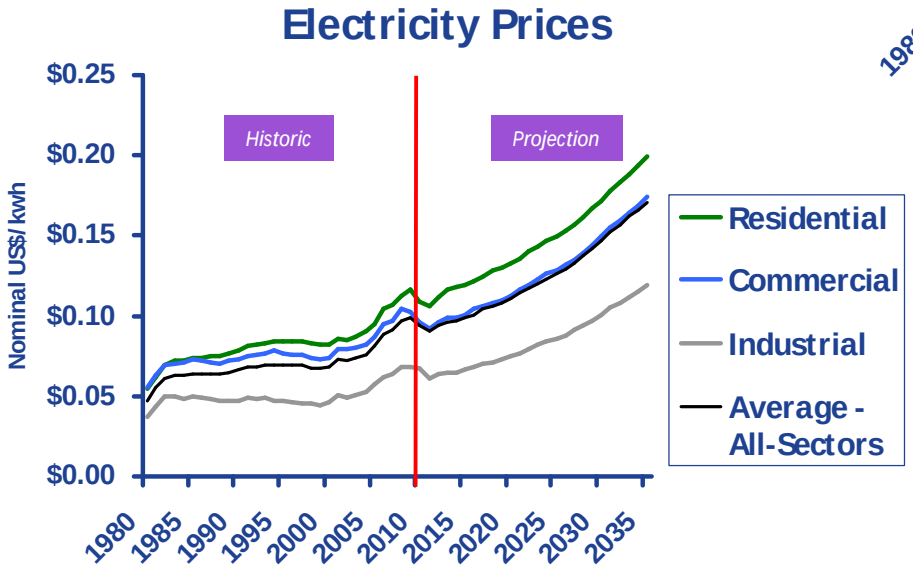
Cost of power outages annually, US

Source:: Department of Energy

Demand and Prices Are Going Up

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





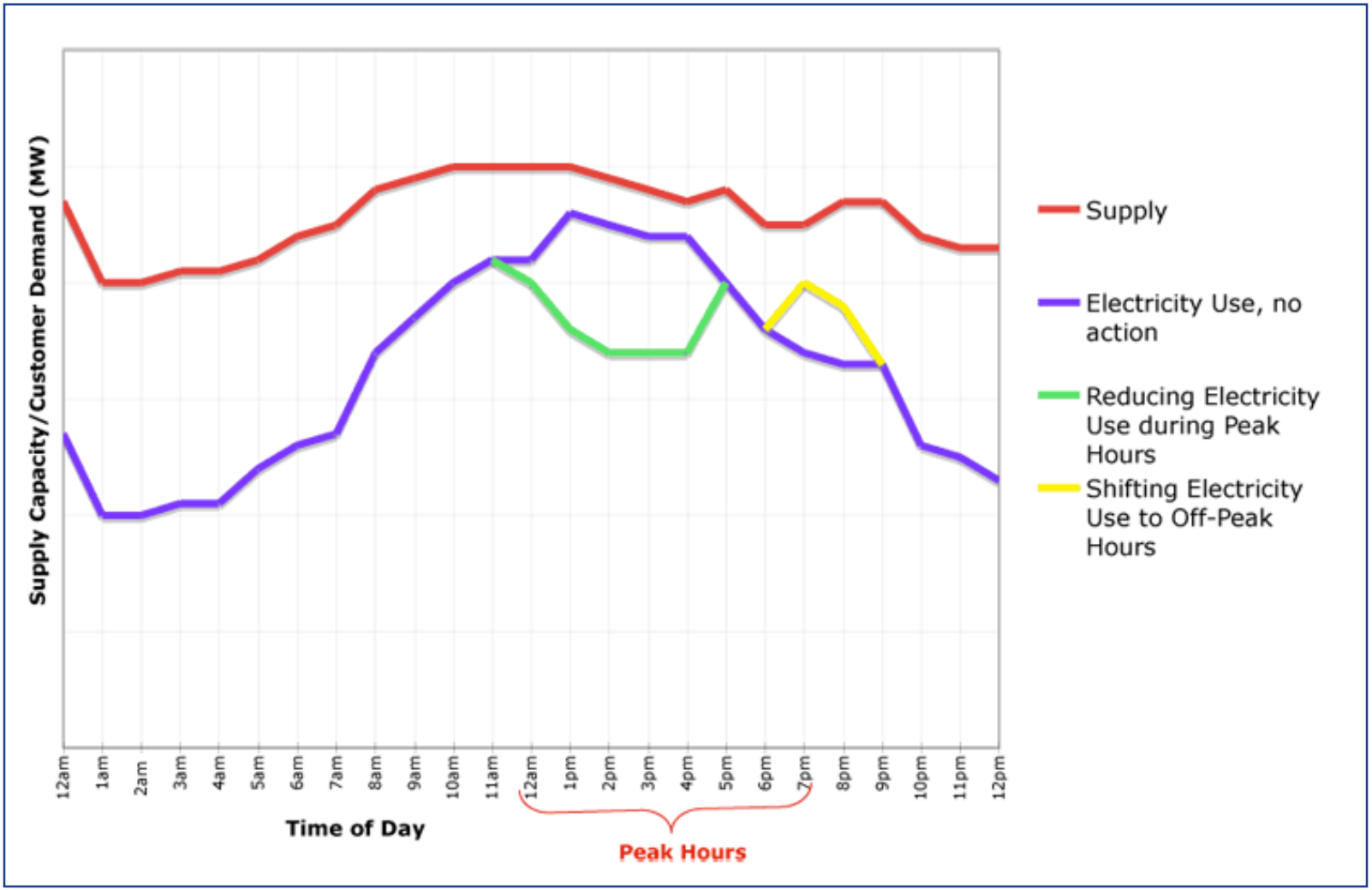
Prices are forecast to increase 2.1% year-on-year through 2035

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

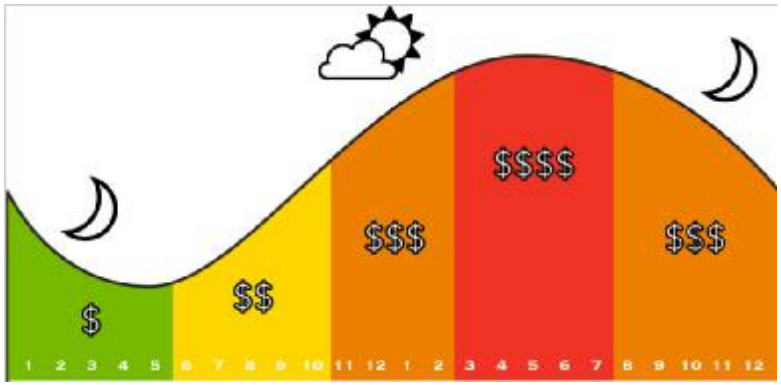


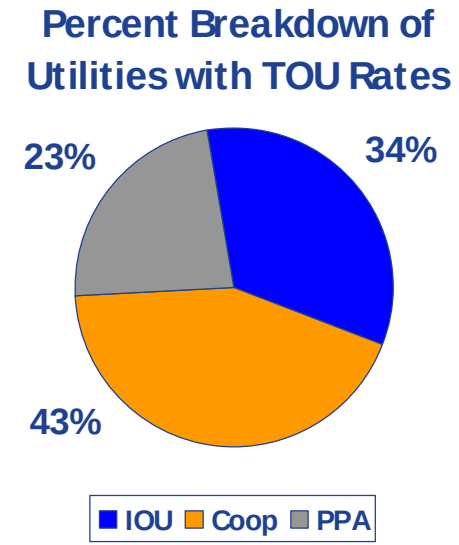
A Move Toward Time of Use (TOU) Rates

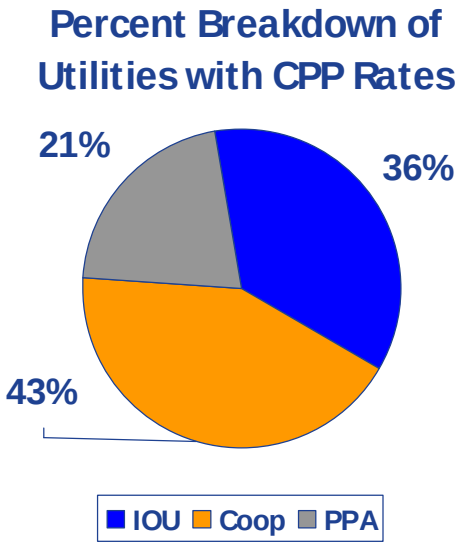
> With questions regarding the ability of future supply to meet future demand, states are allowing utilities to move to TOU pricing.

> 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

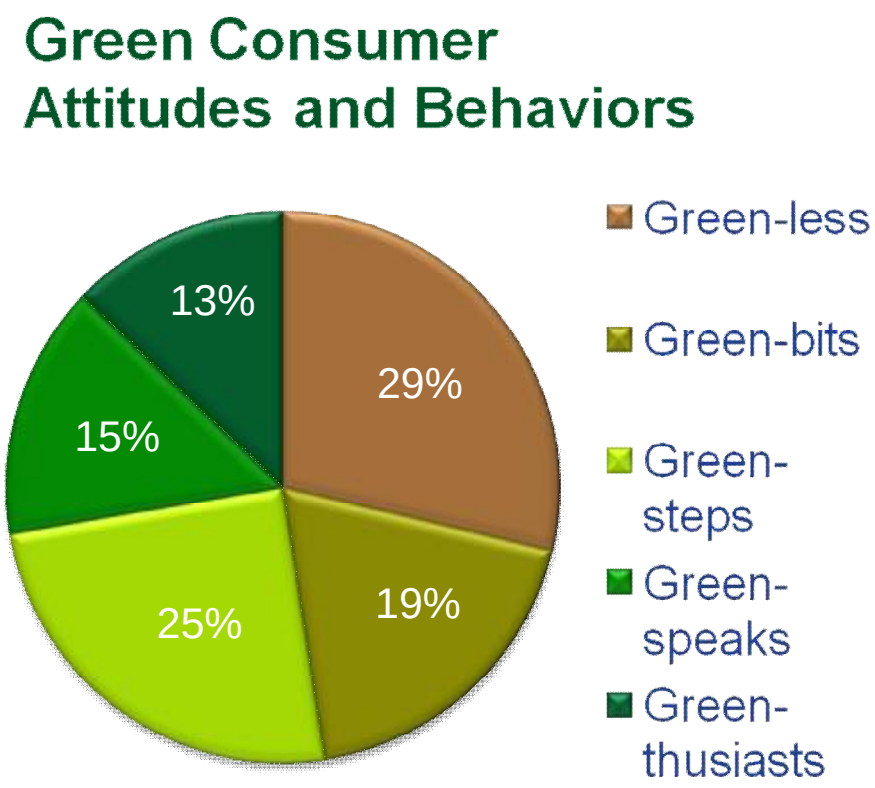






Consumer Research

Environment not *'the'* driving force



Graph Source: Yankelovich, "Going Green: A Yankelovich Monitoring Perspective." July 2007.

37% see environment as top threat*

27% feel highly affected*

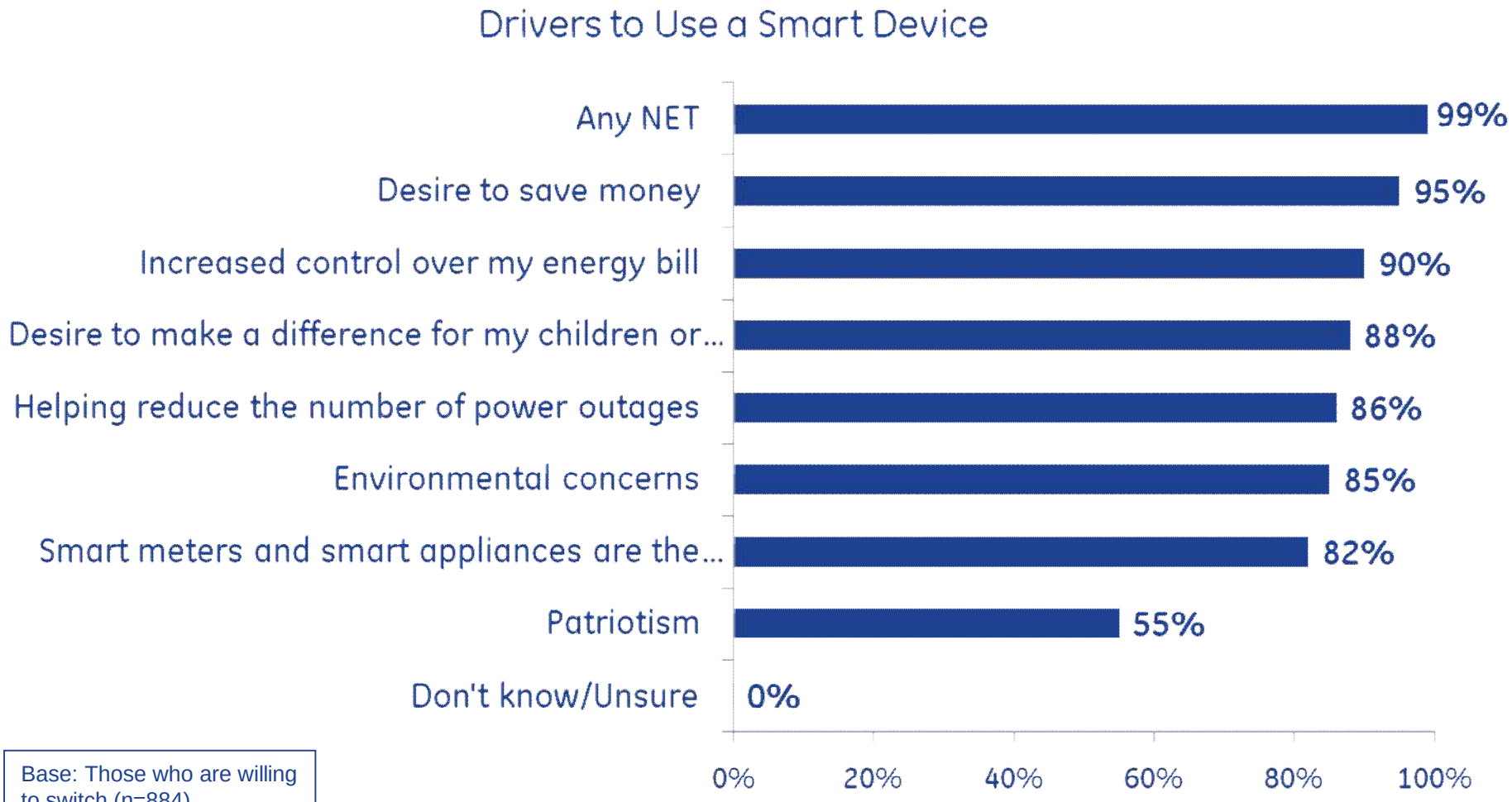
Environmental beliefs not 'firm'*

While consumers favor eco products …

- Cost & quality matter more**
- Green products seen as lower quality/higher price***

*Yankelovich.
**Sources: GE. "Consumerizing Ecomagination. The Lived Experience." Ethnography. 23 November 2009. Data mirrored in IBM Global Business Services. 2007 IBM Energy and Utilities Global Residential/Small Business Survey. http://www-935.ibm.com/services/us/gbs/bus/pdf/2007_ibv_consumer_survey_results_v1_1212a.pdf.
***GE.

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



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.

Source: GE. "Consumerizing Ecomagination. The Lived Experience." Ethnography. 23 November 2009. Ideas also from Yankelovich study. .

Technology adoption rates can be slow

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

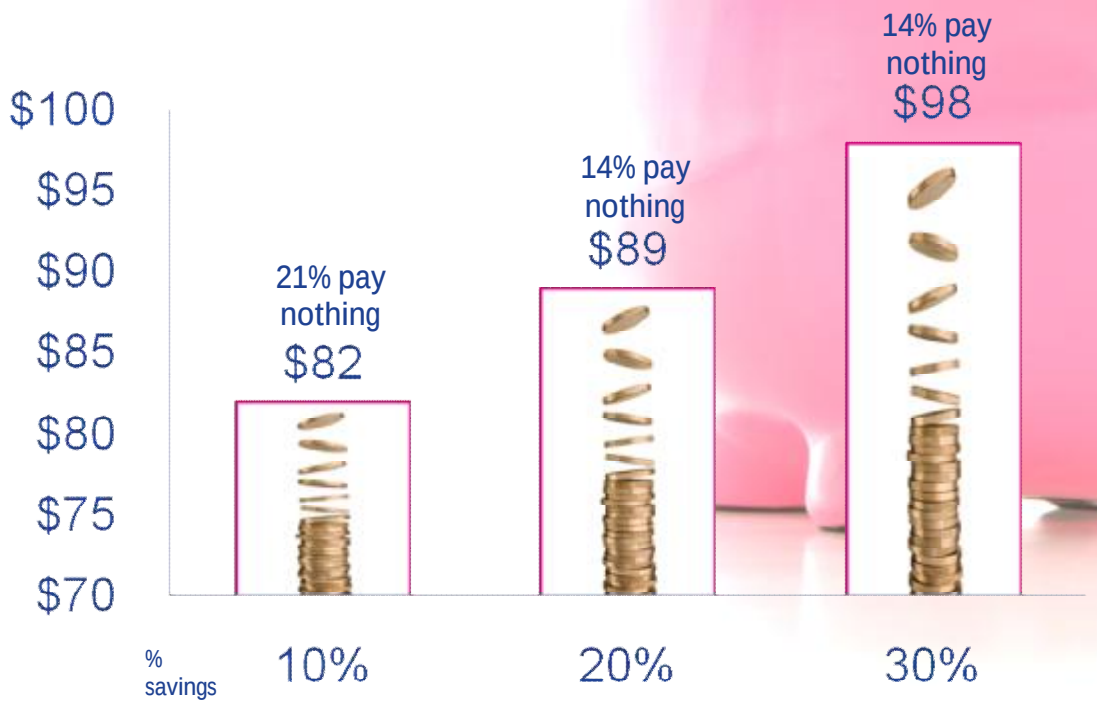
Source: Energy Information Administration

"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*

Source: http://www.forbes.com/2009/05/15/smart-grid-energy-technology-internet-infrastructure-energy.html

Average monthly electric bill $100 - $120

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



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

*Source: Parks Associates Study, *2009 Residential Energy Management Survey*. http://www.smartgridnews.com/artman/publish/Technologies_Metering_News/Bringing-the-Smart-Grid-to-the-Smart-Home-It-s-Not-Only-About-the-Meter-1711.html

**Source: Burson-Marsteller and Penn, Schoen, and Berland Associates. “Green Power Progress Survey.” http://www.slideshare.net/bursonmarstellerUS/2009-green-power-progress-survey-1825331*.

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

Source: GE. "Consumerizing Ecomagination. The Lived Experience." Ethnography. 23 November 2009. Ideas also from Yankelovich study. .

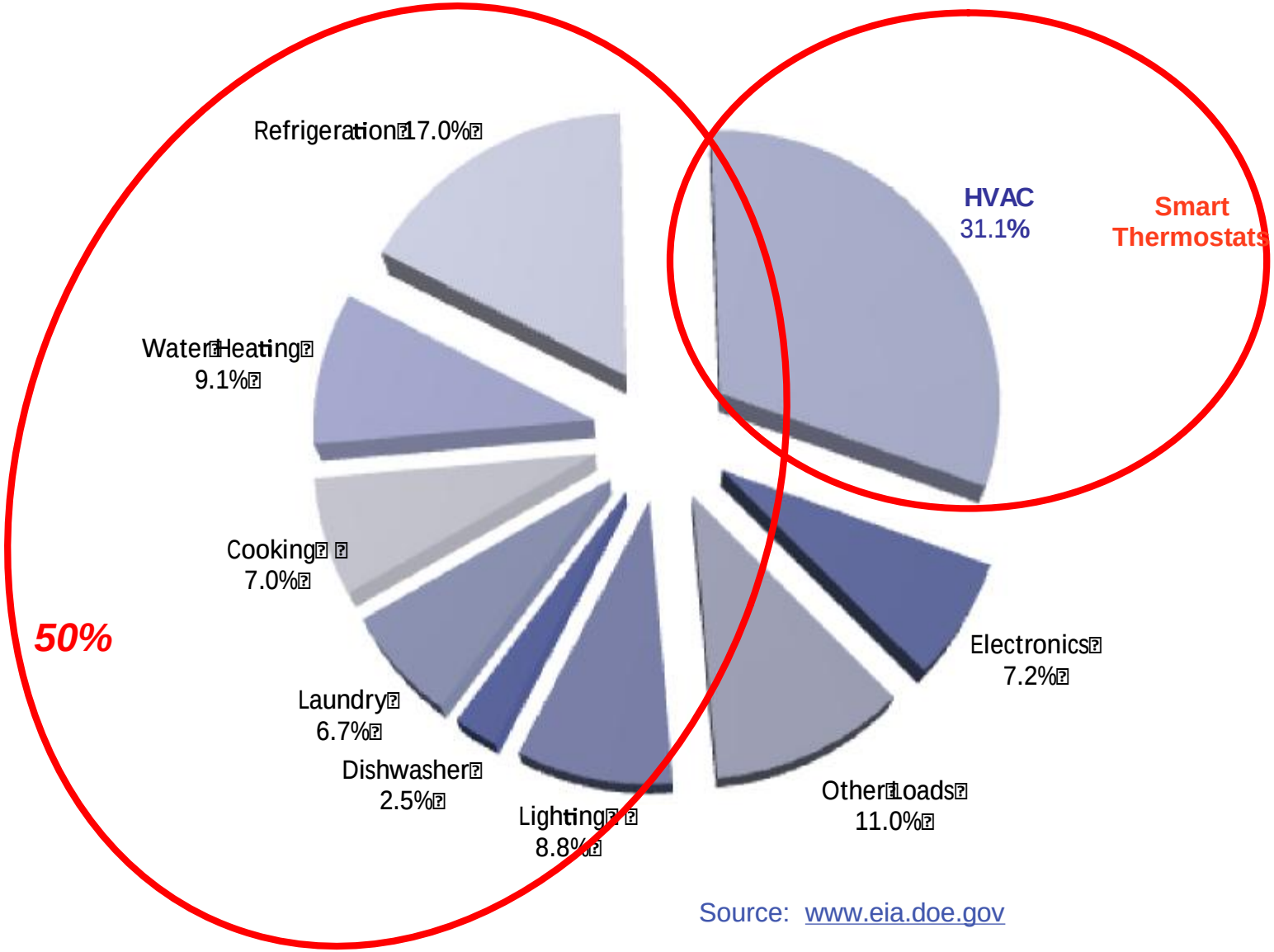
New products for a smarter home

Solutions need to meet key consumer requirements:

- Set it/forget it
- Ease of use
- Simple installation
- Low maintenance
- Cost-effective

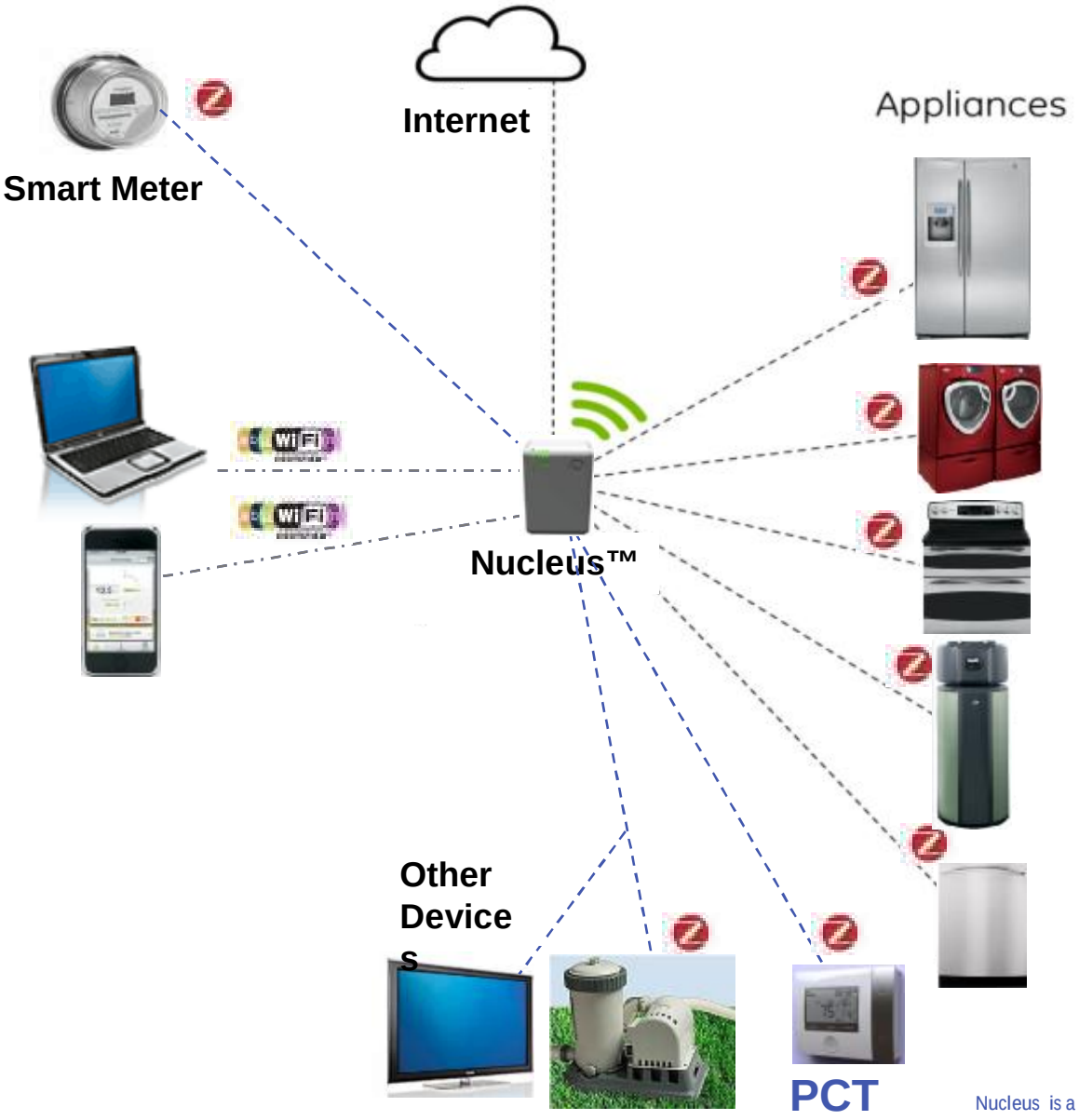
Smart Energy Management Systems

Appliances, Lighting & Climate Control



Source: www.eia.doe.gov

Home Energy Solutions



PC apps

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

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

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

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

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

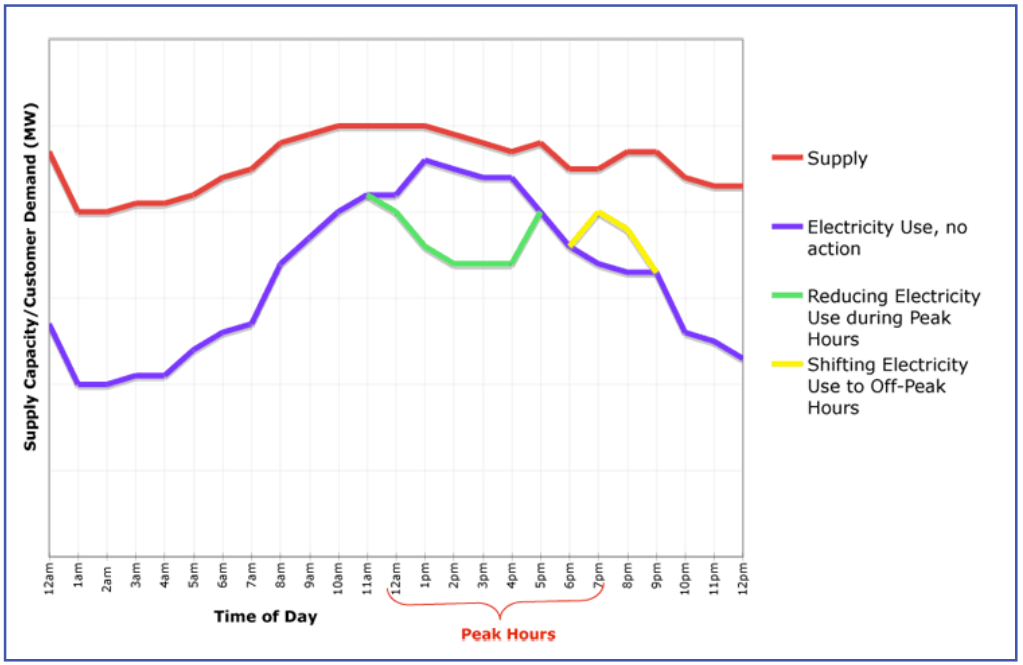
Thermostat

Adjust programmable thermostat

History

Smart Appliances

Refrigerator	Dish Washer	Cooking	Washer and Dryer
 *Delayed defrost* *Temperature shift*	 *Delayed wash and dry* *Smarter cycles*	 *Uses of small cavity* *Cooking efficiency*	 *Delayed wash and dry* *Manage water usage*



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

Source: GE. “Consumerizing Ecomagination. The Lived Experience.” Ethnography. 23 November 2009. Ideas also from Yankelovich study. .

Areas for research

- Scale up of Nega-watts
- Latency and speed
- System stability
- Tarriff structures for widespread adoption
- Behavioral aspects of home energy management