# Smart Appliances: Path to a Smart Grid Enabled Home

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June 4, 2012

AHAM
ASSOCIATION OF HOME APPLIANCE MANUFACTURERS

Leadership ➤ Knowledge ➤ Innovation

# About AHAM

- Represents manufacturers of major, portable and floor care home appliances.
- Standards development organization, accredited by the American National Standards Institute (ANSI).
- Consumer safety education programs.

# 5 Unstoppable Smart Grid Trends

- When not Whether:

It's not whether we will have an end-to-end smart grid.  It's when.

"End use will be increasingly connected to the smart grid, at the meter and behind the meter. Translation—strong growth in demand response, energy efficiency, energy management, grid-savvy appliances and more"

---Jesse Berst Smart Grid News

# Demand Response vs. Energy Efficiency

- Since late 2007 and after passage of a new energy law, efficiency savings from refrigerators, dryers, room air conditioners, clothes washers and dishwashers are a small percentage of maximum achievable potential in 2030 in relation to other residential, commercial and industrial.*

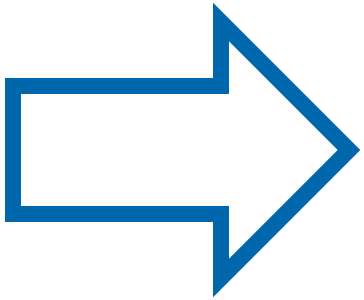
* Rohmund, Ingrid ,et. al (Global Energy Partners, Brattle Group, EPRI, EEI). *Assessment of Achievable Potential for Energy Efficiency and Demand Response in the US (2010-2030).*

# Home Appliances & Energy Efficiency

- Clothes Washer: 70% Less Energy
- Refrigerator: 50% Less Energy
- Dishwasher: 45% Less Energy

1991

100 Watts



2009

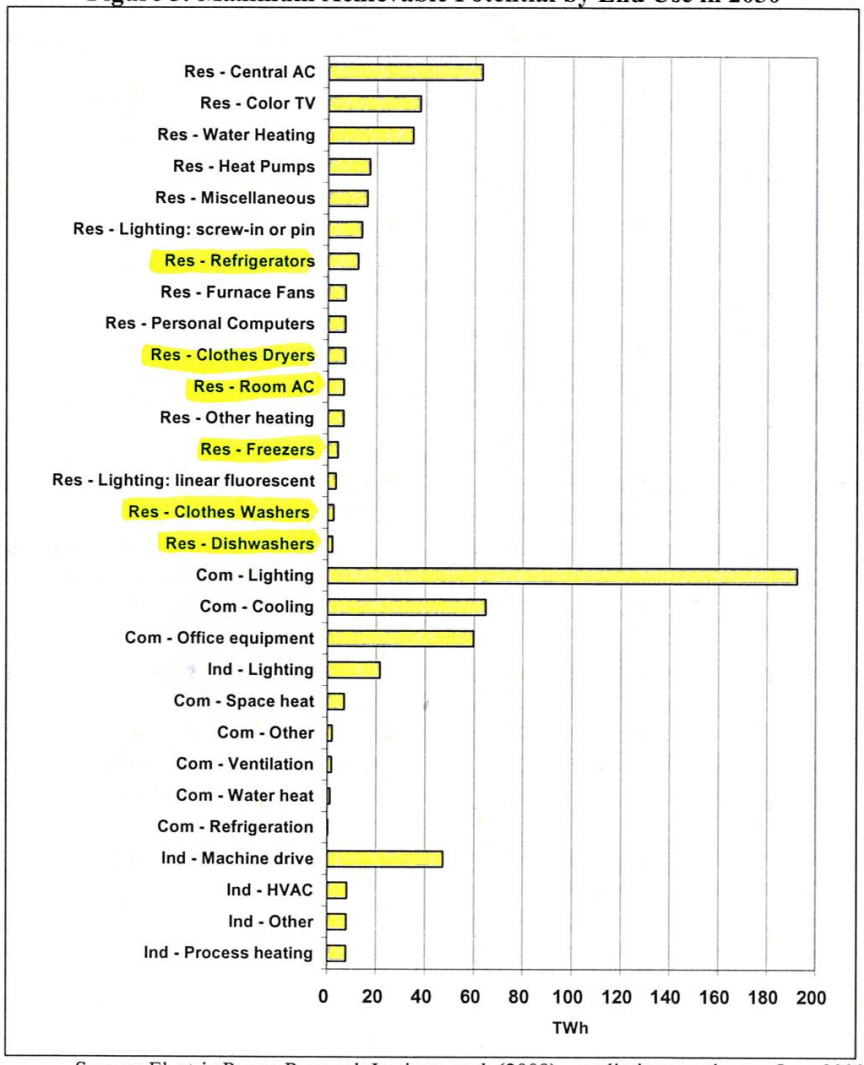
50 Watts

<

60 Watts

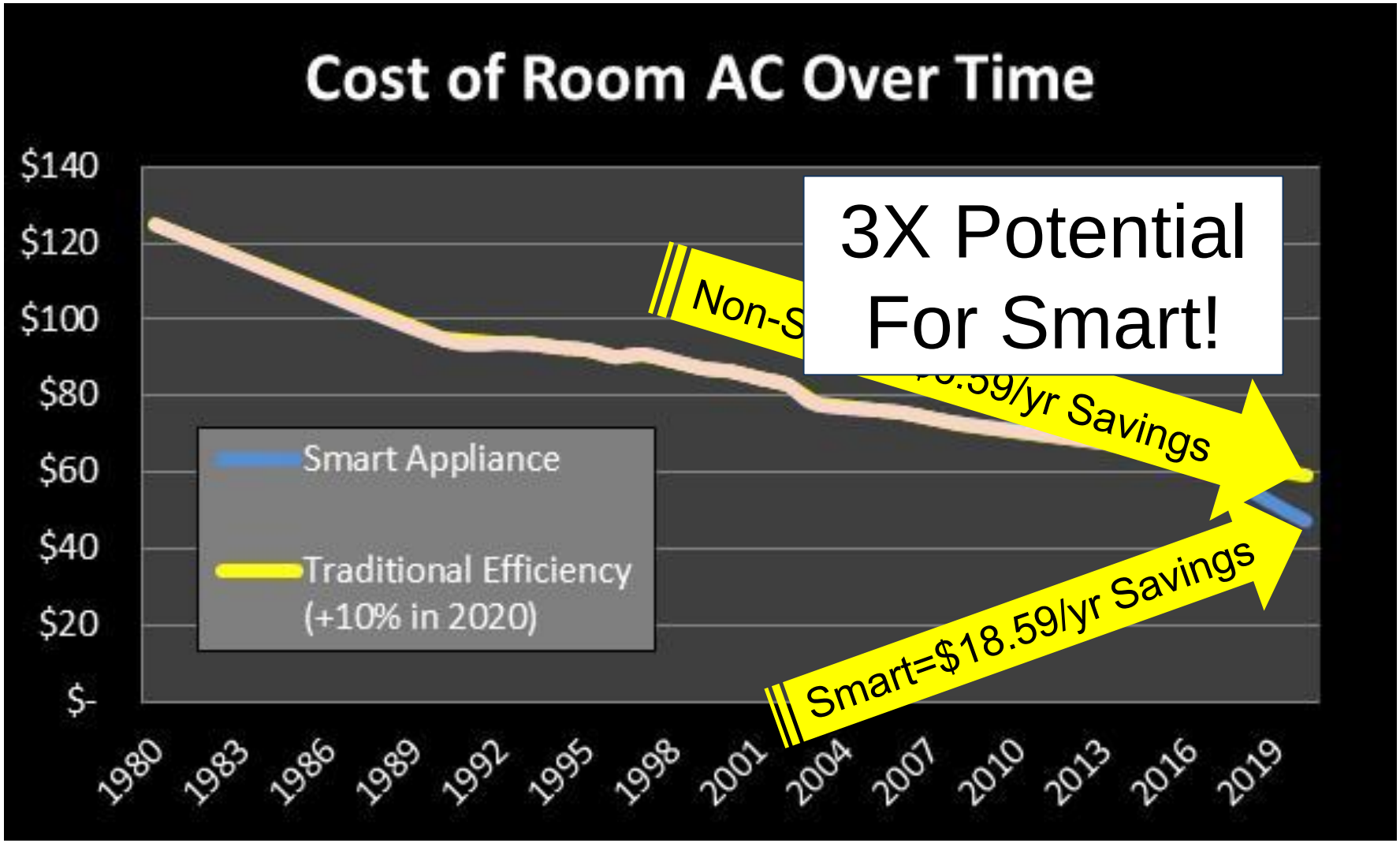
# Demand Response vs. Energy Efficiency

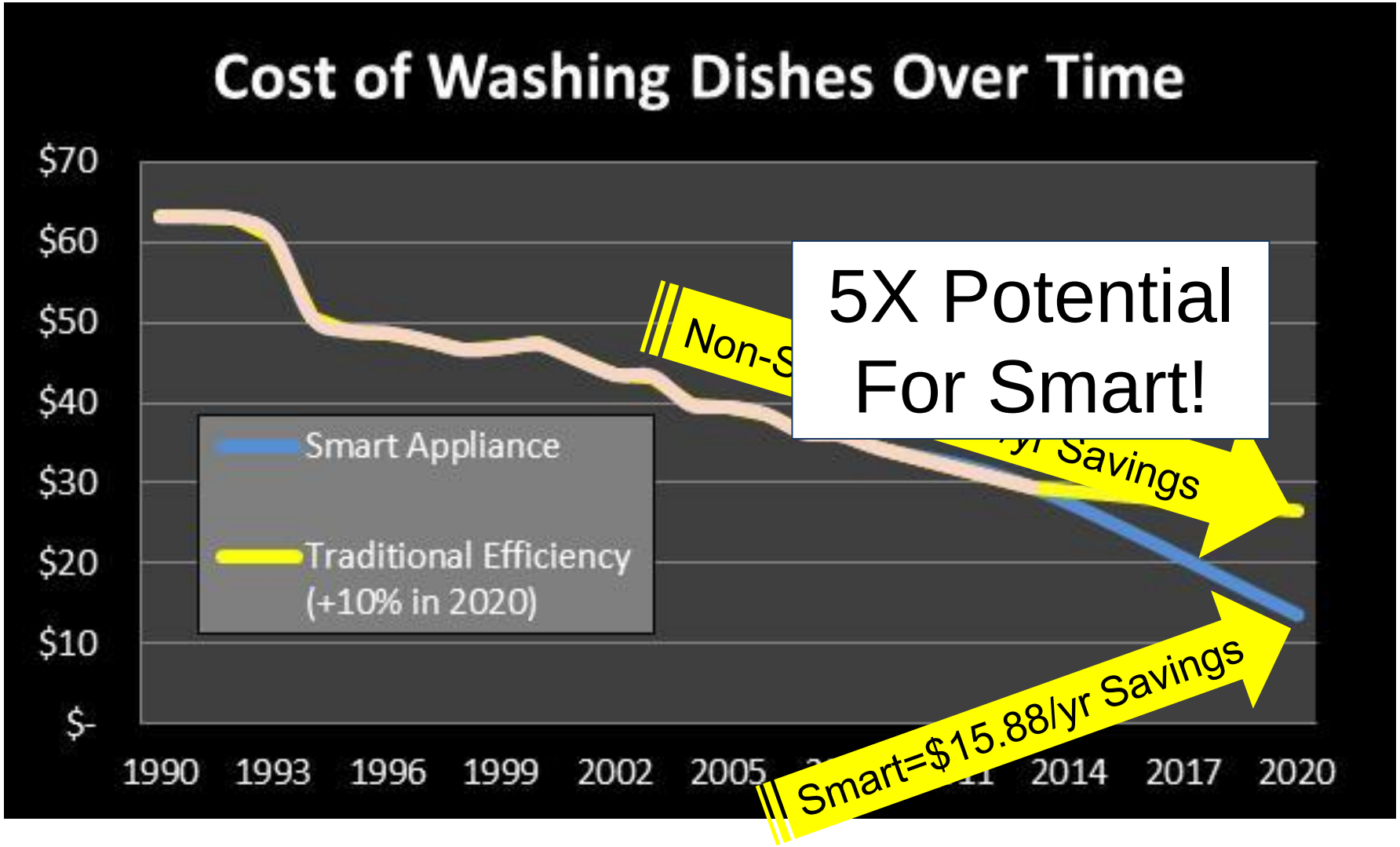
**Figure 5: Maximum Achievable Potential by End Use in 2030**




Source: Electric Power Research Institute et al. (2008) – preliminary estimates June 2008


Cost of Washing Clothes
(water costs not included)
$80
$70
$60
$50
$40
$30
$20
$10
$-
2001
2004
2007
2010
2013
2016
$1.40/yr Savings for +10%

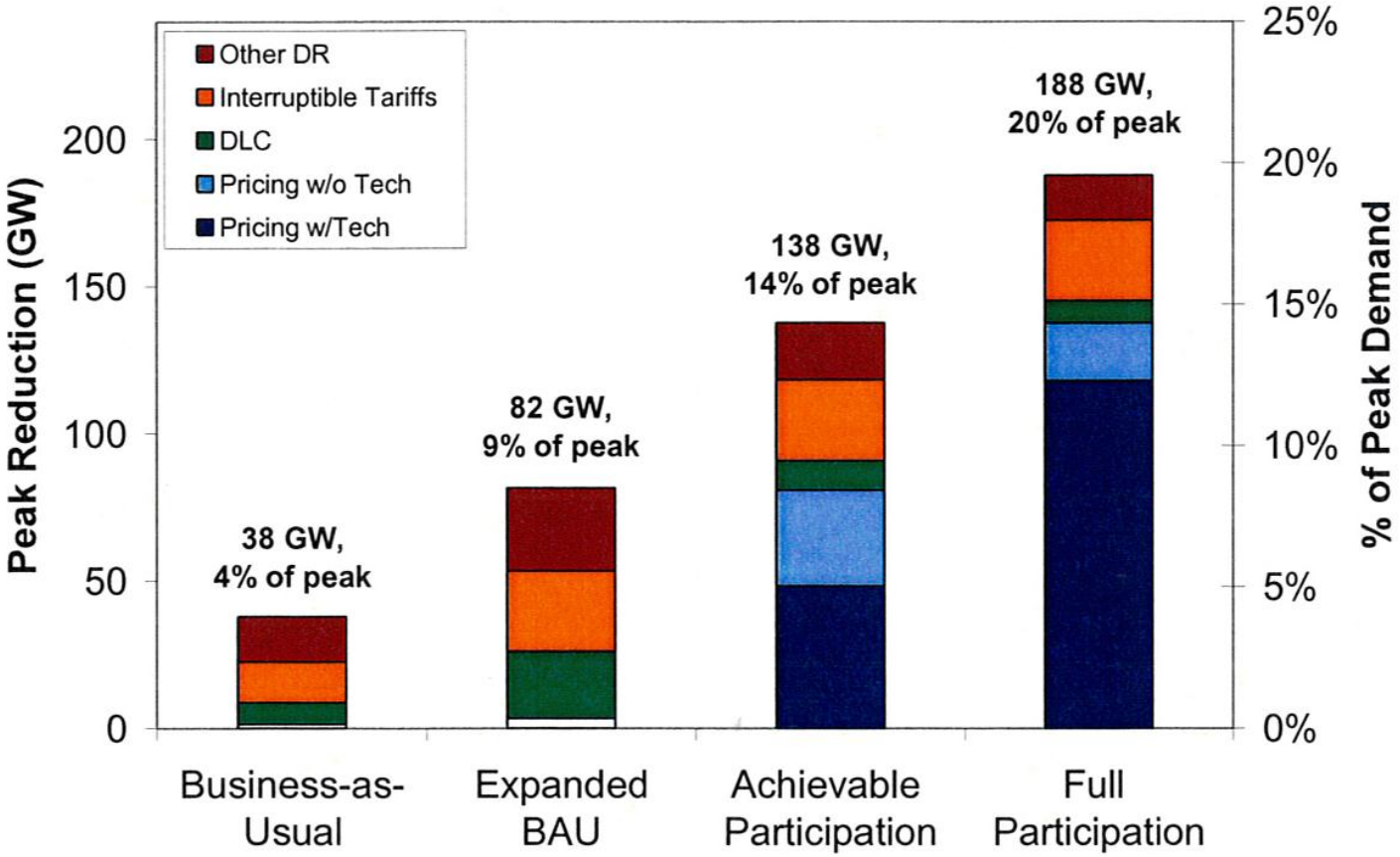

Cost of Room AC Over Time
$140
$120
$100
$80
$60
$40
$20
$-
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016
2019
Smart Appliance
Traditional Efficiency
(+10% in 2020)
3X Potential
For Smart!
Smart=$18.59/yr Savings


Cost of Washing Dishes Over Time
$70
$60
$50
$40
$30
$20
$10
$-
1990
1993
1996
1999
2002
2005
2014
2017
2020
Smart Appliance
Traditional Efficiency
(+10% in 2020)
5X Potential
For Smart!
Savings
Smart=$15.88/yr Savings

# What is a Smart Appliance? Key Features

- Dynamic electricity pricing information is delivered to the user, providing the ability to adjust demand of electrical energy use
- It can respond to utility signals, contributing efforts to improve peak management by automatically shedding or reducing usage based on the consumer's previously established guidelines or manual overrides

# Largest Gains with Smart Appliance



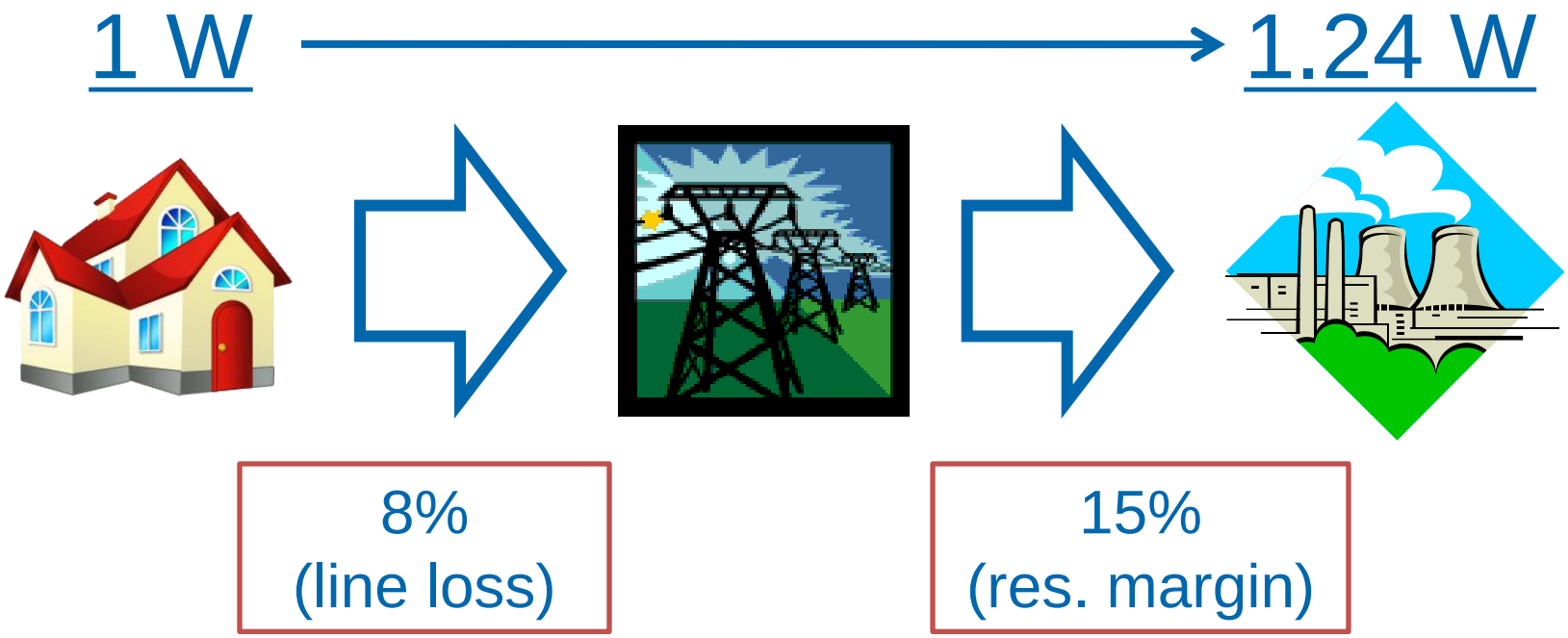

*Source: FERC National Assessment of Demand Response, June 2009*

# Demand Reduction Yields Energy Savings

US Energy Information Administration

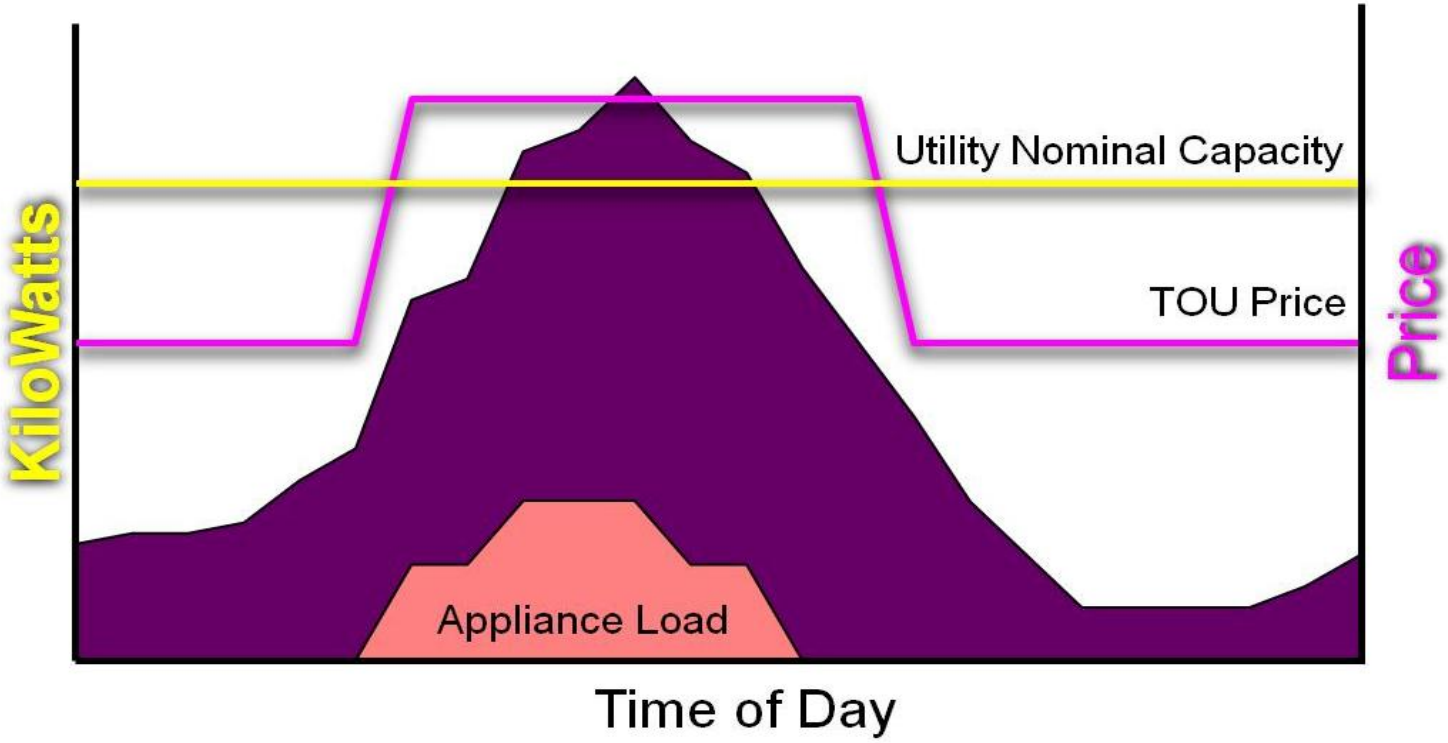
1 kW Peak Load Reduction = 85 kWh Energy Saved

# Demand Reduction Yields 24% More in Capacity Savings

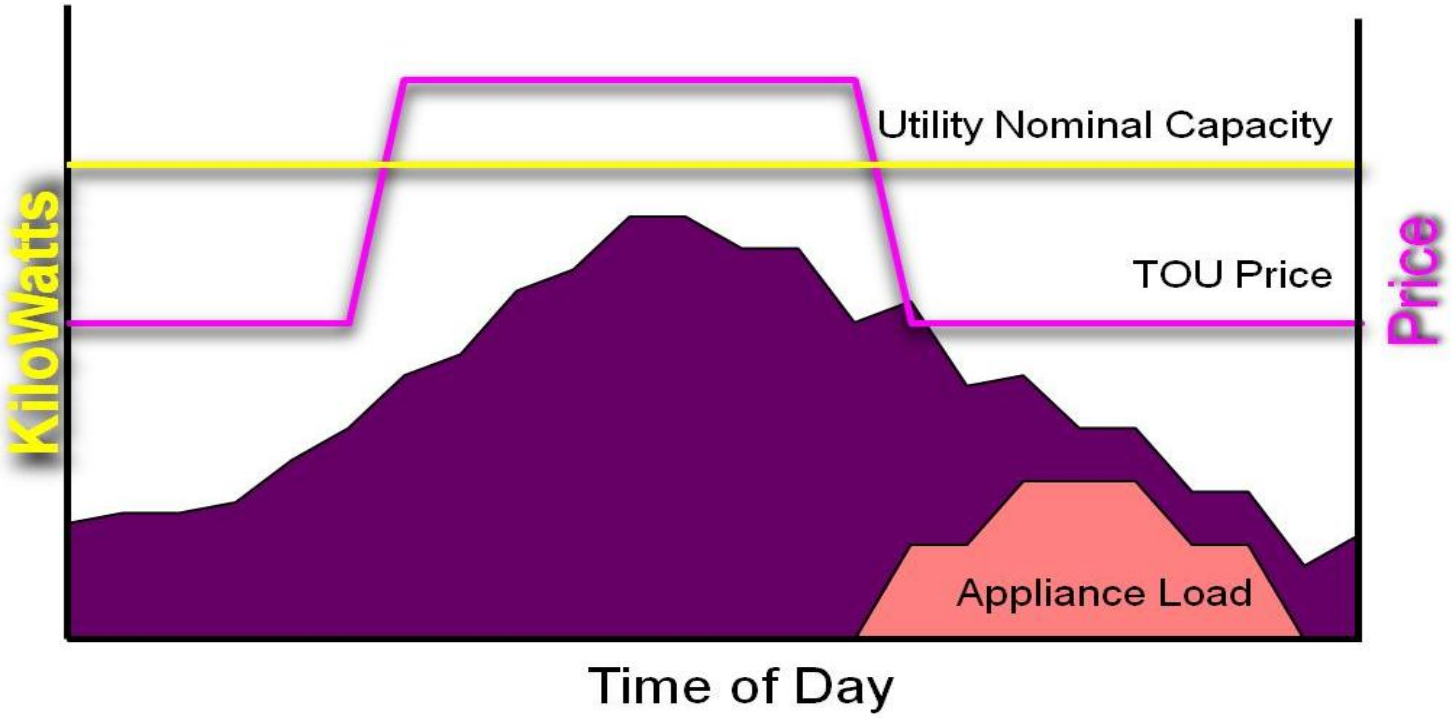



*Source: The Brattle Group*

# Typical Load Curve



# Shifting Load



# Smart Appliances Provide Spinning Reserves

- Spinning reserve requirements are up to 10 minutes.
- Appliance loads can be reduced for 10 minutes or less with little or no impact on the consumer.
- Appliances are environmentally friendly “reserves.”

# Smart Grid & Renewable Energy

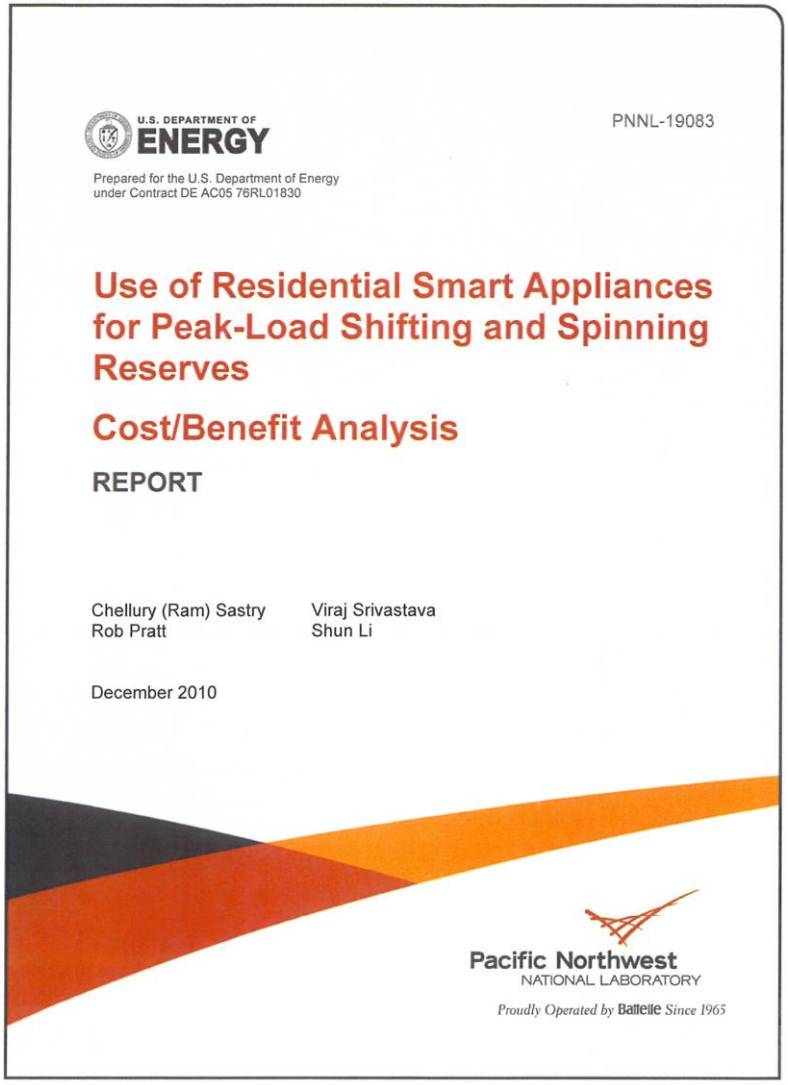
*"The intelligence of a Smart Grid will facilitate greater utilization of intermittently available renewable resources such as solar and wind, from which will accrue reductions in CO2 emissions."*

EPRI's "The Green Grid"

# Smart Appliances Provide Environmental Benefit

- Smart Appliances can operate when renewable energy sources are available
- Utilities with more carbon intensive generation may reduce emissions by integrating intermittent renewable energy sources in demand response programs—this will include smart appliances.

# PNNL Study



U.S. DEPARTMENT OF ENERGY

PNNL-19083

Prepared for the U.S. Department of Energy
under Contract DE AC05 76RL01830

**Use of Residential Smart Appliances for Peak-Load Shifting and Spinning Reserves**

**Cost/Benefit Analysis**

**REPORT**

Chellury (Ram) Sastry
Rob Pratt
Viraj Srivastava
Shun Li

December 2010

Pacific Northwest
NATIONAL LABORATORY

*Proudly Operated by* Battelle *Since 1965*

# PNNL Study

| Percentage of Total Smart DW Benefits Attributable to Load Shift, Spinning Reserves, and Feedback Effect | | | |
|---|---|---|---|
| **Market and Year** | **Peak-Load Shifting** | **Spinning Reserves** | **Feedback Effect** |
| PJM 2006 | 26% | 52% | 23% |
| ERCOT 2008 | 31% | 54% | 15% |
| NYISO 2008 | 33% | 34% | 33% |
| NYISO 2006 | 35% | 31% | 34% |
| CAISO 2008 | 39% | 23% | 38% |

# PNNL Study-Results

Shown in Table 1-1 are the highest possible benefit-to-cost ratios (expressed as percentages) of various appliances based on the "optimistic" set of assumptions.

**Table 1-1**. Benefit-to-Cost Ratios of Smart Appliances Based on "Optimistic" Assumptions

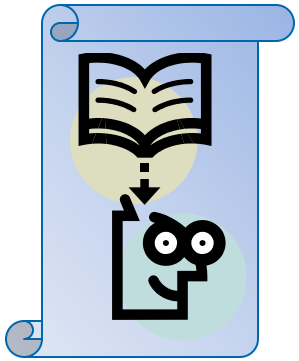
| | DW | CW | RAC | Freezer | Refrigerator | Dryer |
|---|---|---|---|---|---|---|
| PJM 2006 | 528% | 563% | 733% | 539% | 536% | 680% |
| ERCOT 2008 | 817% | 871% | 1060% | 881% | 877% | 1054% |
| NYISO 2008 | 367% | 403% | 585% | 357% | 355% | 462% |
| NYISO 2006 | 353% | 389% | 712% | 346% | 344% | 442% |
| CAISO 2008 | 319% | 356% | 554% | 313% | 312% | 396% |

Shown in Table 1-2 are the low-end benefit-to-cost ratios of various appliances based on "pessimistic" set of assumptions.

**Table 1-2**. Benefit-to-Cost Ratios of Smart Appliances Based on "Pessimistic" Assumptions

| | DW | CW | RAC | Freezer | Refrigerator | Dryer |
|---|---|---|---|---|---|---|
| PJM 2006 | 136% | 134% | 131% | 150% | 150% | 207% |
| ERCOT 2008 | 203% | 200% | 295% | 230% | 228% | 337% |
| NYISO 2008 | 107% | 106% | 139% | 112% | 111% | 147% |
| NYISO 2006 | 112% | 112% | 160% | 119% | 118% | 160% |
| CAISO 2008 | 99% | 100% | 135% | 102% | 101% | 134% |

# AHAM Technical Papers
*(www.aham.org/smartgrid)*



- White Paper: *The Home Appliance Industry's Principles & Requirements for Achieving a Widely Accepted Smart Grid* (Dec 2009)

- Assessment of Communication Standards for Smart Appliances: *The Home Appliance Industry's Technical Evaluation of Communication Protocols* (Oct 2010)

# AHAM White Paper Dec. 2009

## 3 Requirements of a Smart Grid

1. Consumer Choice
2. Pricing Rate Structure & Incentives to Consumers
3. Communication Standards

# Communication Standards Limited in Number

- Minimize number of standards for demand response.
- Due to the size and complexity of the Smart Grid, the potential number of standards is significant and could impede progress
- Cannot have 3200+ protocols

  For each utility

# Assessment of Communication Standards for Smart Appliances: *The Home Appliance Industry's Technical Evaluation of Communication Protocols*

- Technical analysis of smart appliance communications protocols
- Not an industry agreement or proposal
- Evaluated existing technologies with respect to key communications layers –
  - Application (APP)
  - Network (NET)/Media Layers (MAC, PHY)

# Communication Standards Evaluation

- Set of clear, consumer-driven requirements
- Requirements driven scoring system
- Independent consultant ranked the ability of the studied communications technologies to meet the unique needs of appliance consumers.

# HIGHEST SCORING PROTOCOLS

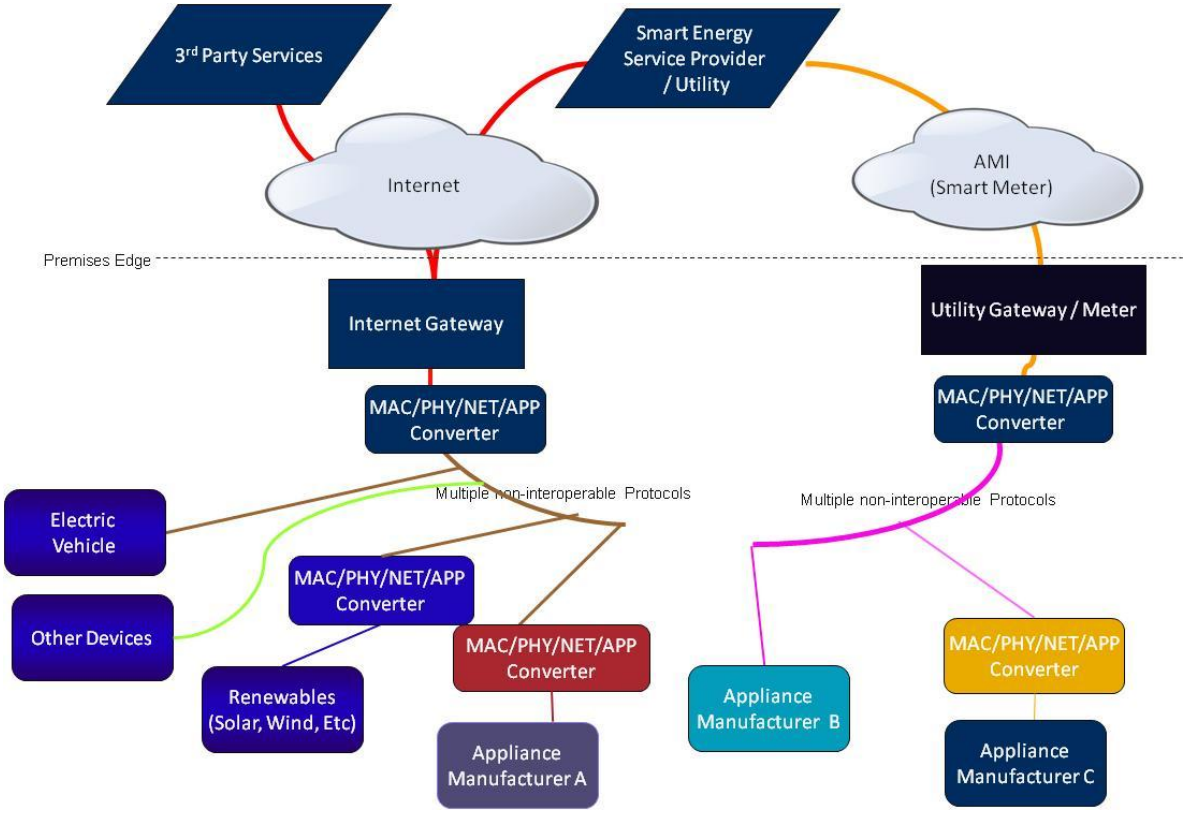
| | |
|---|---|
| **Application Layer** | • **SEP 2.0, OpenADR** |
| **Media/Network Layers** | • **Wi-Fi, Zigbee, HomePlug Green PHY** |

# Communications Architecture

A communication architecture provides the backbone of the home area network. It must be --

- Flexible and adaptable to the consumer's changing needs and environment
- Adapt to future technology changes
- Economical for the consumer
- Communicate with utilities and 3rd party services

# Multiple Protocol Architecture

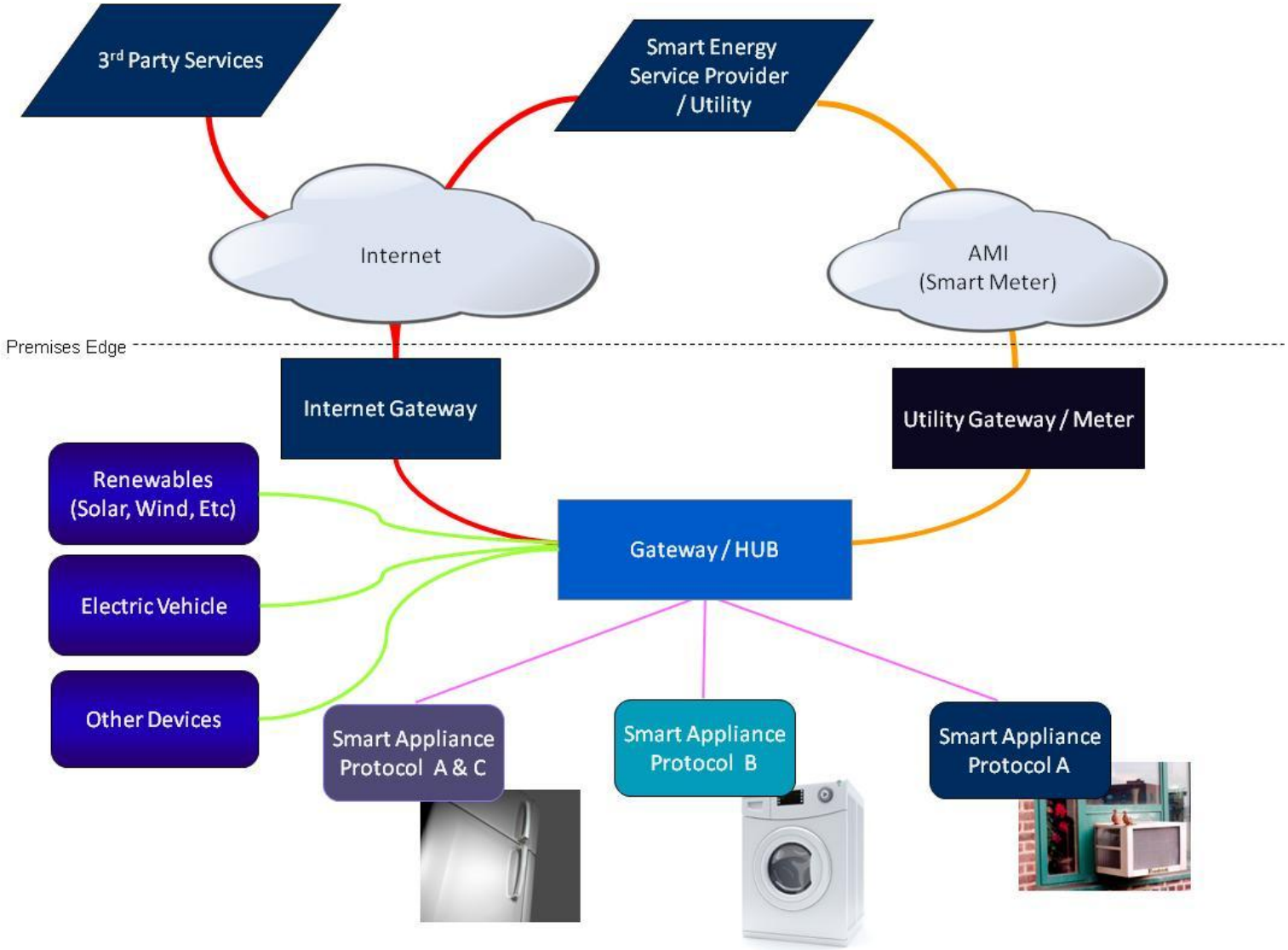


# Industry Preferred Hub Architecture

Assessment reflects a clear preference for a hub-based architecture --

- adapter/bridge to other devices in the HAN
- allows for different connectivity/security implementations
- conversion point for changing protocols
- line of demarcation between utility & HAN
- additional intelligence & adaptability
- Hub may reside within an AMI, an EMS, or other possible devices

# Industry Preferred Hub Architecture



# Machine Efficiency vs. Smart Appliance

## Past
## Machine Efficiency

## Future
## Smart Appliances

# Conclusions

- Smart appliances provide financial and energy benefit to consumers and utilities
- Nationwide communications standards must be established
- Without such standards, risks such as obsolescence, system incompatibility, security faults, and others potentially undermine the vision for the Smart Grid

# Contact Information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