



Smart Grid White Paper

The Home Appliance Industry's Principles & Requirements for Achieving a Widely Accepted Smart Grid

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SCOPE OF PAPER

As the trade association that represents the home appliance industry, the Association of Home Appliance Manufacturers (AHAM) is committed to providing innovative and sustainable products that improve the lives of consumers. Because home appliances are an integral part of the Smart Grid, AHAM has drafted this White Paper to communicate the home appliance industry's principles and requirements for the development and implementation of a successful Smart Grid.

It is beyond the scope of this paper to fully describe the Smart Grid. More specifically, this paper does not attempt to promote any particular communications technology or standards, e.g., wireless or wired. However, the industry does advocate for the need for common communication protocols and standards. If interested, the reader should review the Department of Energy's Smart Grid web site for additional background information regarding the modernization of the nation's electrical system.¹

ABOUT THE ASSOCIATION OF HOME APPLIANCE MANUFACTURERS

AHAM represents manufacturers of major, portable and floor care home appliances, and suppliers to the industry. AHAM's membership includes over 150 companies throughout the world. In the United States, AHAM members employ tens of thousands of people in the United States and produce more than 95% of the household appliances shipped for sale within the United States. The factory shipment value of these products is more than \$30 billion annually. The home appliance industry, through its products and innovation, is essential to U.S. consumer lifestyle, health, safety and convenience. Through its technology, employees and productivity, the industry contributes significantly to the U.S. job market and the nation's economic security. Home appliances also are a success story in terms of energy efficiency and environmental protection. The purchase of new appliances often represents the most effective choice a consumer can make to reduce home energy use and costs.

AHAM is also a standards development organization, accredited by the American National Standards Institute (ANSI). The Association authors numerous appliance performance testing standards used by manufacturers, consumer organizations and governmental bodies to rate and compare appliances. AHAM's consumer safety education program has educated millions of consumers on ways to properly and safely use appliances such as portable heaters, clothes dryers, and cooking products.

¹ Office of Electricity Delivery & Energy Reliability, US Department of Energy, <http://www.oe.energy.gov/smartgrid.htm>

EXECUTIVE SUMMARY

The Association of Home Appliance Manufacturers (AHAM) is interested and involved in the development of the Smart Grid and the policies surrounding a Smart Grid in the United States. The objective of the Smart Grid is to provide technology and systems (integrated into appliances and consumer devices used in everyday activities) that will allow consumers to automatically control their energy use and costs.

AHAM provides a unique perspective to the Smart Grid Vision because many of the products AHAM members manufacture must be part of our nation's future Smart Grid. AHAM represents manufacturers of major, portable and floor care home appliances, and suppliers to the industry. Home appliances are a success story in terms of energy efficiency and environmental protection. AHAM is also a standards development organization, accredited by the American National Standards Institute (ANSI).

In establishing policy on the development of a Smart Grid, the Energy Independence and Security Act of 2007 requires integration of Smart Appliances and consumer devices that can interact with the Smart Grid. This law also requires that consumers be provided with timely information and options for controlling energy use. The U.S. government's Smart Grid Vision is that these goals can and should be met without causing significant disruption or lifestyle changes for the consumer. AHAM fully supports this Vision. Consumers should receive valuable and understandable information about their energy use and costs, thus enabling them to make intelligent and informed choices about how and when to use energy. Armed with this knowledge, consumers will be empowered to use energy more efficiently and to save money on electricity.

AHAM believes that in order for the Smart Grid to be successful, there are three essential requirements for the Smart Grid's interaction with consumers.

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.

These requirements must be addressed by several entities involved with development of Smart Grid architecture and standards, as no one company, association or government agency can

accomplish this alone. Overriding all of this is the consumer. Without proper consideration of consumer needs in the development of these initiatives, the vision of the Smart Grid is at risk.

AHAM is optimistic that with proper coordination, cooperation and communication among the various Standards Development Organizations, associations, government agencies and companies, these requirements can be addressed and the Vision will be achieved. AHAM suggests a cooperative effort among appliance and other product manufacturers, the Department of Energy, the National Institute of Standards and Technology, states, energy regulatory agencies, utilities, and smart meter manufacturers.

Suggested areas of cooperation include:

- **Electricity Rates:** It must be recognized that existing residential tariffs and rate structures do not provide sufficient economic incentive to spur maximum consumer participation in the use of Smart Grid technologies. The current structures do not support the cost, innovation and creativity required to make the Smart Grid a success. Success of the Smart Grid requires dynamic rate structures that are designed to support a total systems approach. Dynamic pricing is an essential component to consumers and energy providers participating in the benefits of the Smart Grid system. Strong consideration should be given to the development of uniform pricing and usage information standards that provide for a harmonized way of communicating local rate and timing information.
- **Communication Standards:** There must be a rapid drive towards open standards, with specific attention to the interface between the Smart Grid and the consumer. The utility industry and state regulatory bodies are encouraged to work with product manufacturers and consumers to establish a common nationwide communication standard that impacts the area between the smart meters or home energy management system and appliances in the home. Efforts to leverage existing communication technologies in the home, such as the Internet, should also be a priority.
- **Consumer Focused Smart Grid Pilot Projects:** Smart meter or other pilot projects that include open standards and architectures that are expandable in the future must be pursued. Consumers should be able to easily transition from a system that controls one device to a whole home energy management system. Projects should emphasize the consumer as the decision maker as opposed to scenarios where the utility possesses absolute control over the consumer's appliances and devices.



- **Funding:** Funding should be allocated for research, development, and demonstration of concepts that achieve the Smart Grid Vision. There are large amounts of complex information that need to be consolidated in a simple and understandable way.

AHAM further recommends these cooperative efforts include the manufacturers of all residential devices such as manufacturers of home appliances, consumer electronics, HVAC equipment, thermostats, lighting, communications, networking, residential generators, and electric vehicles to ensure that the Smart Grid Vision, as it applies to residential consumers, will become a reality.

THE SMART GRID

“The Smart Grid transforms the current grid to one that functions more cooperatively, responsively and organically.”

The Smart Grid: An Introduction, Department of Energy

All the service connections, transformers, transmission infrastructure, substations, generation plants, and everything required to manage the generation and distribution of electrical power is known as the electrical “Grid.” Labeled as the “most significant engineering achievement of the 20th century,” the beginning of the Grid goes back more than 100 years.² But in spite of the Grid’s significance and reliability of 99.97%, there is the problem of the remaining 0.03% that is particularly troublesome and expensive.³ Three massive blackouts in the past nine years, rolling blackouts in Silicon Valley, and occasional power interruptions are signs of an aging system.

In order to ensure the reliable delivery of electricity through the Grid, there is a whole system of peaker power plants and reserve generation capacities, of which some run at less than full power so they can be quickly ready to handle spikes in power demand. Due to the need to meet peak demands on extreme days (very hot or very cold) the system must have plant capacity to meet these loads. Capacity for peak generation costs billions of dollars and causes 10 percent of the generation and 25 percent of the distribution assets to only be used for approximately 400 hours per year (see Figure 1). Additionally, as peak loads increase so do losses of energy through the transmission lines, as well as increased thermal strain on the lines, adding further inefficiency.

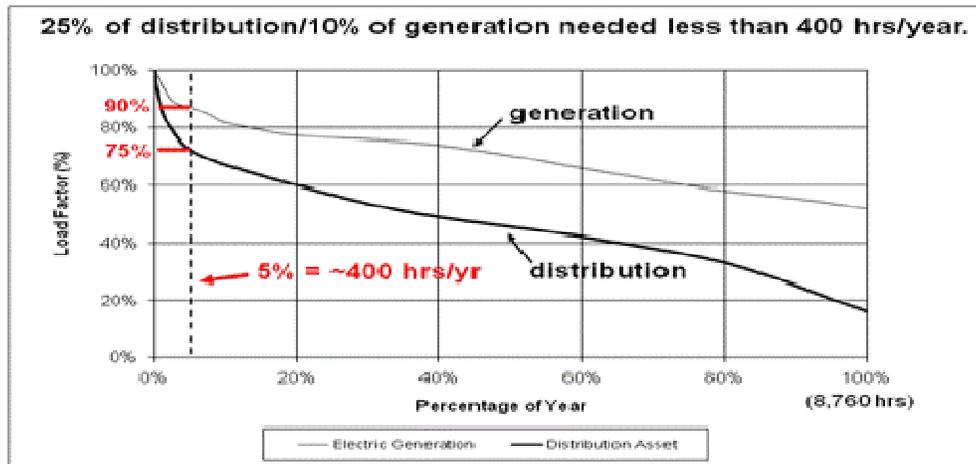


Figure 1: Distribution/Generation Needs (Source: Pacific Northwest National Laboratory)

² “Greatest Engineering Achievements of the Twentieth Century,” National Academy of Engineering, <http://www.greatachievements.org>.

³ Litos Strategic Communication, “The Smart Grid: An Introduction”, US Department of Energy [http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages\(1\).pdf](http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf), 5.

The problem is compounded by the increasing demand for and dependence on electricity in this information age. Demand is expected to grow in the United States and globally. According to the Energy Information Administration (EIA), U.S. electricity demand will increase by 26 percent from 2007 to 2030, and the residential sector comprises 20 percent of this growth.⁴ Globally, the EIA projects the world energy consumption will be 44 percent higher in 2030.⁵

As a solution, the U.S. government has proposed a significant overhaul to this system and labeled it the “Smart Grid” (see Figure 2).



Figure 2: Smart Grid Diagram (Source: Department of Energy)

An objective of the Smart Grid is to provide technology and systems (integrated into appliances and consumer devices used in everyday activities) that will allow consumers to automatically manage their energy use and costs. AHAM provides a unique perspective to the Smart Grid Vision because many of the products AHAM members manufacture will be part of our nation’s future Smart Grid. These products will be essential to an effective Smart Grid. In addition, these products can help the grid increase the use of viable alternative energy sources, such as renewable energy. From a consumer perspective, the current Grid delivers electricity to their home and it includes everything from the electric meter outside their home back to the power plant. In the future, the Smart Grid is no longer everything from the meter and beyond because

⁴ Energy Information Administration, “Annual Energy Outlook 2009 with Projections to 2030,” <http://www.eia.doe.gov/oiaf/aeo/electricity.html>.

⁵ Energy Information Administration, “International Energy Outlook 2009,” <http://www.eia.doe.gov/oiaf/ieo/world.html>.

the integration of the home and the involvement of the consumer will be integral and necessary components.

THE SMART GRID AND THE CONSUMER

How will the Smart Grid involve and affect the consumer?

- The deployment and integration of “smart” consumer appliances and devices are mentioned in two of the ten primary Smart Grid objectives as defined by Congress.⁶
- The Federal Energy Regulatory Commission (FERC) identifies important Smart Grid features that will “...facilitate consumer transactions and allow consumers to better manage their electric energy costs.”⁷
- A key feature of the Smart Grid is Demand Response, where the consumer, utility or designated third party can reduce the consumer’s energy consumption during critical usage periods. Since the residential sector accounts for 37% of electrical retail sales, it is logical that the utility industry would engage residential consumers in efforts to manage consumption.⁸

DEMAND RESPONSE AND RESIDENTIAL CONSUMER

The North American Energy Standards Board (NAESB) has defined demand response as *“Changes in electric use by demand-side resources from their normal consumption patterns in response to changes in the price of electricity, or to incentives designed to induce lower electricity use at times of potential peak load, high cost periods, or when systems reliability is jeopardized.”*⁹ In other words, when the utility encounters a problem, it can send a signal alerting the consumer of the complication so that the consumer can react by reducing their load during this critical time period. This communication can happen manually, such as via email or telephonically, or automatically as in many of the smart meter pilot projects that are in use today. AHAM’s objective is to make this interaction as simple and effective as possible for the consumer.

⁶ Energy Independence and Security Act of 2007 (Public Law 110-140), Title XIII.

⁷ U.S. Federal Energy Regulatory Commission, 18 CFR Chapter I (Docket No. PL09–4–000) Smart Grid Policy, issued July 16, 2009.

⁸ “Table 8.9 Electricity End Use, 1949-2008,” Energy Information Administration, <http://www.eia.doe.gov/emeu/aer/txt/ptb0809.html>.

⁹ “Measurement & Verification for Demand Response Programs,” Recommendation to NAESB Executive Committee (July 29, 2009), 10.

Figure 3 depicts how demand response would impact electricity usage. The “Baseline” shows the electricity usage reaching a peak during a critical time of the day. The “Expected or Contracted Load Reduction” area shows a reduced electricity usage during the critical period. The reduction is a result of a response to a request for lowered energy usage. Critical time reductions of energy use can be accomplished by either “shifting” usage to a non-critical time of the day based on the consumer’s previously established preferences or by shedding load to reduce peak power.

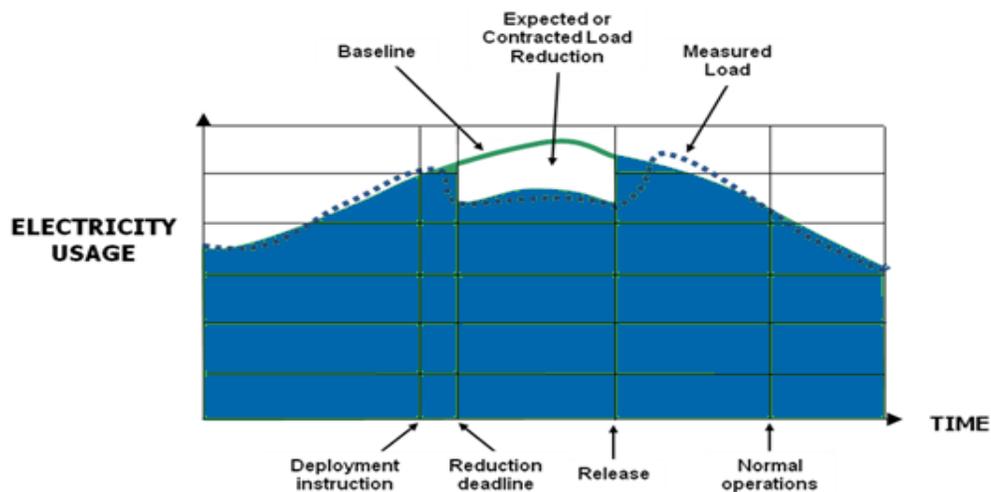


Figure 3: Demand Response Example (*Permission to use from North American Energy Standards Board*)

Is the residential consumer important to demand response? The answer is yes. According to FERC:

“ . . . it is the residential class that represents most [sic] untapped potential for demand response. . . While residential customers provide only roughly 17 percent of today’s demand response potential, in the AP [Achievable Participation] scenario they provide over 45 percent of the potential impacts.”¹⁰

The projected increase in the consumer impact is based on the assumptions that there are “Full Participation” scenarios, which include the following:

- There is a full deployment of the Automated Meter Infrastructure,
- Dynamic pricing is used for 100% of the participants, and
- All eligible customers were offered and accepted automated technology solutions for demand response.

¹⁰ Federal Energy Regulatory Commission, A National Assessment of Demand Response Potential (June 2009), 29.

The untapped potential for the residential consumer is illustrated in Figure 4, which depicts in the Full Participation scenario that residential homes offer as much demand response potential as small, medium, and large businesses combined.

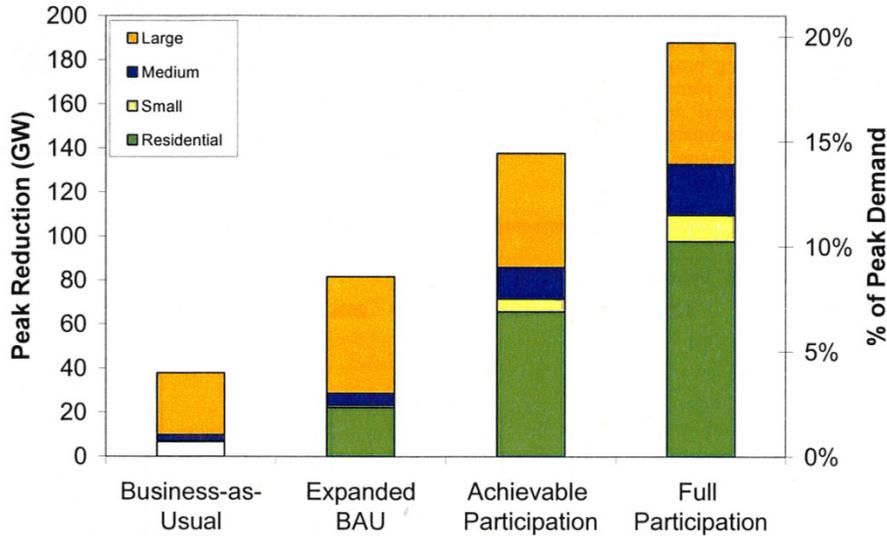


Figure 4: US Demand Response Potential by Class (2019) (Source: FERC)

VISION OF THE SMART GRID AND RESIDENTIAL CONSUMERS

Even though the Smart Grid is envisioned to affect the consumer at a fundamental level, these changes must be as simple and transparent as possible. According to the Department of Energy (DOE):

“Research indicates that consumers are ready to engage with the Smart Grid as long as their interface with the Smart Grid is simple, accessible and in no way interferes with how they live their lives. Consumers are not interested in sitting around for an hour a day to change how their house uses energy; what they will do is spend two hours per year to set their comfort, price and environmental preferences – enabling collaboration with the Grid to occur automatically on their behalf and saving money each time. At the residential level, Smart Grid must be simple, “set-it-and-forget-it” technology, enabling consumers to easily adjust their own energy use. Equipped with rich, useful information, consumers can help manage load on-peak to save money and energy for themselves and, ultimately, all of us.”¹¹

During a keynote speech at Grid Week 2009 Steven Chu, Secretary of the Department of Energy described his vision of a simple Smart Grid. As reported in Telephony Online:

¹¹ Litos Strategic Communication, “The Smart Grid: An Introduction”, US Department of Energy [http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages\(1\).pdf](http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf), 20.



Figure 4: Secretary Chu at Grid Week 2009
(Source: Cleanskies.com)

“To assuage consumers who are resistant to changing their habits, energy savings in the home has to be incredibly simple,” he stressed. “Much like a point-and-shoot camera that lets consumers simply push a button to take a picture, but possess the ability to do much more embedded in the device, the in-home device for energy management must be no more complex than a button – one that says saver, super saver and guilty as charged; this is how I want to live my life,” he joked. “Real-time pricing will lead to demand response and, if done right – meaning consumers are given the right tools, like this ‘magic button’ – energy costs will be driven down,” Chu said.¹²

In summary, the vision of the Smart Grid is to provide consumers with appliances and devices with integrated technology and processes that do not cause significant disruption or lifestyle changes throughout a person’s normal daily life. Consumers will receive valuable and understandable information that will enable them to make intelligent and informed choices about how they use energy. Smart Appliances are the key to helping consumers obtain the most value from this information for their own benefit and the benefit of society.

WHAT IS A SMART APPLIANCE?

The term “Smart Appliance” with respect to the Smart Grid refers to a modernization of the electricity usage system of a home appliance so that it monitors, protects and automatically adjusts its operation to the needs of its owner. Smart Appliances may have some of the following 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 to efforts to improve the peak management capability of the Smart Grid and save energy by --
 1. providing reminders to the consumer to move usage to a time of the day when electricity prices are lower, or

¹² Reedy, Sarah, “Grid Week: DOE Secretary Chu on fighting consumer smart-grid resistance,” *Telephony Online*, September 21, 2009, http://telephonyonline.com/business_services/news/doe-secretary-chu-smart-grid-20090921.

2. automatically “shed” or reduce usage based on the consumer’s previously established guidelines or manual overrides.
- Integrity of its operation is maintained while automatically adjusting its operation to respond to emergency power situations and help prevent brown or blackouts.
 - The consumer can override all previously programmed selections or instructions from the Smart Grid, while insuring the appliance’s safety functions remain active.
 - When connected through a Home Area Network and/or controlled via a Home Energy Management system, Smart Appliances allow for a “total home energy usage” approach. This enables the consumer to develop their own Energy Usage Profile and use the data according to how it best benefits them.
 - It can leverage features to use renewable energy by shifting power usage to an optimal time for renewable energy generation, i.e., when the wind is blowing or sun is shining.¹³

AHAM REQUIREMENTS FOR THE SMART GRID VISION

In order to realize the vision of the consumer interacting with the Smart Grid, there are three key requirements that must be integrated early into the Smart Grid at the planning and concept stage.

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.

¹³ Silva, Vera, et al., “Value of Smart Appliances in System Balancing,” Smart Domestic Appliances in Sustainable Energy Systems (Smart-A) Draft 4.2, (March 2009), 21, http://www.smart-a.org/Energy_Networks_Work_Package_Report_DRAFT.pdf.

Appliance manufacturers have significant experience in providing products that interact with consumers in a user friendly manner. As such, appliance manufacturers are rich in experience and are uniquely qualified in the areas of consumer behavior, user interface and broad interoperability. The AHAM requirements for the Smart Grid Vision are not intended to be all-inclusive or complete. The subsets listed here are intended to provide important information for incorporation into Smart Grid planning and architecture development.

1. PRICING RATE STRUCTURE AND INCENTIVES TO CONSUMERS

Ideally, the usage of electricity should be based on dynamic pricing. As the price changes, the consumer can decide whether or not usage should be adjusted. The Smart Grid and Smart Appliances will not mean much if the consumer is not motivated to participate. According to the National Energy Technology Laboratory's study on how to enable active participation by consumers, "Innovative rate structures that provide economic benefits to both the consumer and the utility are integral to these systems."¹⁴ A report released by the European Intelligent Energy Europe project also endorses the use of economic incentives.

*"There are two main reasons why consumers will adopt smart appliances: either to gain an economic benefit or to contribute to reduce the environmental burden. As the results of the research show consumers clearly expect an economic benefit in order to use smart appliances. They are not prepared to change their behavior without good incentives. Only a small percentage of environmentalists will be ready to buy smart appliances solely for environmental reasons. Following this logic the **main trigger to buy smart appliances will be attractive tariff offers of the utilities to their customers.**"¹⁵*

The Time of Use (TOU) tariff creates the conditions that encourage the consumer to change their or the appliance's behavior by using appliances when the rates are lower, which if properly developed will save the consumer money on their total electricity bill. As previously stated, a Smart Appliance can respond automatically to utility signals requesting the reduction of an appliance's energy usage to a non-critical time of the day by "shifting" load or by reducing peak load by "spreading" the load.

Consider the illustrative graph shown in Figure 6. The figure shows a typical peak demand curve a utility might see with the appliance part of the load differentiated. The nominal capacity line illustrates a load capacity this utility desires to stay under in order to reduce operating costs. The TOU price line represents the time frame the price would increase in the TOU tariff they plan to put in place.

¹⁴ "Smart Grid Principal Characteristics – Enable Active Participation by Consumers", National Energy Technology Laboratory, September 2009.

¹⁵ Mert, Wilma, et al., "Consumer acceptance of smart appliances," Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)(December 2008), http://smart-a.org/WP5_5_Consumer_acceptance_18_12_08.pdf

Figure 7 shows what the resulting load pattern might look like once the TOU tariff is in place and a consumer chooses to shift the use of an appliance. Note that the peak load seen by the utility has dropped below the nominal capacity line as the appliance load has shifted outside of the higher price time of day. As long as consumers are willing to change their behavior, this approach gives the desired results. Studies show that consumer participation in this type of rate structure increases significantly if technology is put in place to provide the consumer pricing information at the time of use.

Another approach is to lengthen or spread out the time it takes the appliance to complete its assigned function to reduce the peak power. Figure 8 shows a possible effect of spreading the appliance load over a longer period of time. This approach provides the consumer an alternative to changing behavior. The task is initiated as usual, but the consumer recognizes that the appliance cycle may take longer than normal. The TOU rate structures must incentivize this capability to ensure a consumer saves money on their electric bill based on the total, completed cycle. Currently, TOU rate structures do not provide this important incentive. However, spreading out the load can provide the utility the desired effect of reducing the peak load sufficiently within the window of time desired. By providing consumers with this additional flexibility combined with a correct incentivized rate structure, consumer participation in the Smart Grid would be increased.

There are other benefits when the consumer is incentivized by the rate structure to intelligently manage energy usage. If the consumer can receive information relating to what type of power is available, in addition to the price, choices can be made to utilize renewable energy sources when they are available. For example, if there is a strong wind blowing across a wind turbine generation facility, it may be advantageous to consume power during that time so that it is not used when a higher emission alternative may be the only option.

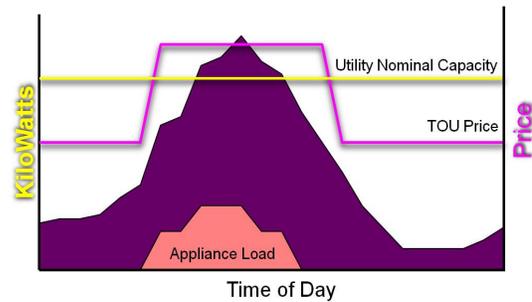


Figure 6: Typical Peak Demand

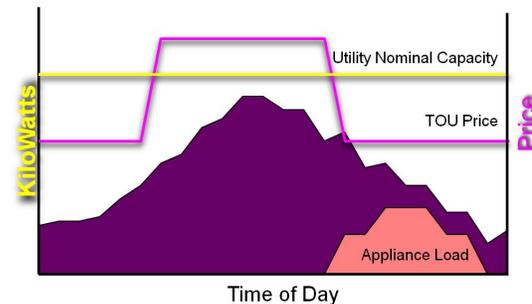


Figure 7: Appliance Shifting Use

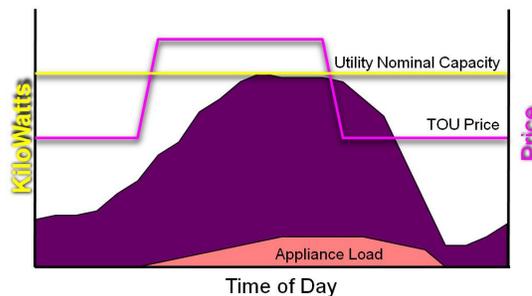


Figure 8: Appliance Spreading Usage

If the consumer can receive information relating to what type of power is available (in addition to the price), choices can be made to utilize renewable energy sources when they are available.

With the proper tariffs in place to incentivize actions, the consumer can reduce costs and manage energy without significant behavior changes. Truly dynamic pricing combined with Smart Appliances will not require large changes in consumer behavior to realize a reduction in peak load. Unfortunately, tariffs that would encourage widespread adoption of these practices are currently not in place.

In order to be effective, dynamic pricing requires the following:

- Clear standards are required to describe dynamic pricing information across the United States. A FERC report on demand response & advanced metering surveyed the various time-based rate programs around the country and found that only 20 programs fit the commission's definition of critical peak pricing programs. The programs that fit FERC's definition are small in size and few in number.¹⁶ Model tariffs and rate structures guidelines should be developed to fully enable the potential of Smart Appliances. Each utility should harmonize according to standards that apply across the United States. A fragmented system of tariff structures across the more than 3,000 utilities would present an impediment to the interstate commerce and use of consumer products. Tariffs, while approved regionally, must collectively provide benefits to consumers that invest in Smart Appliances.
- The pricing structure must allow manufacturers to build devices or appliances that are capable of managing this benefit and provide consumers with the proper incentives. For example, rate charges based on energy (kilowatt-hours) could encourage consumers to "shift" their energy use over time (Figure 7 above). Similarly, rate charges based on power (watts) could incentivize the consumer to "spread-out" their overall usage.
- Timely delivery of the pricing information from the utility is required for the consumer to make well-timed decisions about energy usage.
- The consumer must be able to easily set rules defining their preferences to govern their usage of electricity in the home. This applies to many possible architectural configurations, e.g., from a single Smart Appliance in the homes to including a comprehensive home energy management system. Some configurations may require a

¹⁶ Federal Energy Regulatory Commission, Assessment of Demand Response & Advanced Metering (December 2008), 33.

more sophisticated panel or display in the home or the assistance of web services outside the home.

2. COMMUNICATION STANDARDS

Communication Standards must be open, flexible, secure and not so numerous that they become burdensome, confusing, and conflicting.

Open

The use of open standards is a logical requirement for the Smart Grid. The requirement to use “Open stable and mature industry-level standards” is documented in the Electric Power Research Institute’s (EPRI) report to the National Institute of Standards and Technology (NIST).¹⁷ AHAM recognizes and is participating in the work that NIST is doing to identify appropriate standards.¹⁸ The most pressing area of AHAM’s interest is the communication from the smart meter into the home. The electric utility industry has been conducting smart meter pilots for some time, and many of the pilots include communication to a Programmable Communicating Thermostat. However, any protocol also must provide capability for communication with other devices, Smart Appliances, or to an Energy Management System.

Open standards for communications and data exchange between meters, demand response technologies and appliances should be encouraged and supported, particularly the efforts of the National Institute of Standards and Technology to develop interoperability standards for Smart Grid devices and systems.

Some meter manufacturers have developed proprietary protocols for communicating with devices inside the residence. These proprietary protocols create challenges for appliance and device manufacturers. Appliance manufacturing is an investment-intensive activity that results in standardized products for national distribution. Customizing products for every proprietary communication protocol would be impractical. Moreover, every time a consumer moves or otherwise relocates to another utility service area they should not be forced to replace or change appliances in order to accommodate the specific technology being utilized by the utility in their service territory.

AHAM strongly encourages the adoption of a single common Home Area Network communication standard among meter manufacturers. AHAM also fully supports NIST’s position that development of new technologies and equipment be based on the use of open

¹⁷ “Report to NIST on the Smart Grid Interoperability Standards Roadmap,” Electric Power Research Institute (EPRI), August 10, 2009.

¹⁸ NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 (Draft).

standards for all communication protocols related to Smart Grid.¹⁹ An Internet-based solution, for example, combines open communication standards with near-universal acceptance both in the United States and globally. The Internet can provide robust and secure data transfer and demand response messaging, while adapting to evolving needs and capabilities in the future.

Flexible

Smart Grid enabled homes will have varying levels of sophistication, depending on the type of appliances, devices, and networks that are installed. There are many configurations, combinations, and options for energy management inside the home. Some possibilities could include a simple email notice for a manual demand response by the consumer, a smart meter directly communicating with a specific appliance to ask it to turn on and off, or a meter communicating with a Programmable Communicating Thermostat allowing for temperature adjustment. As a more sophisticated example, a smart meter communicates with an Energy Management System (EMS) home controller inside the house. This EMS home controller could wirelessly connect in-home Smart Appliances simultaneously to the Smart Meter and to the

With so many flexible options, there must be standardized communication protocols available that allow proper interaction from the smart meter (and possibly through the Internet) to controllers, gateways, displays, and devices.

demand response backend system over the Internet using an existing broadband connection. An Internet-based approach also could provide users with control and flexibility to define their energy saving profiles, and an established, secure suite of communication protocols that manages several Smart Appliances while connecting to the Internet to receive messages and rate information. With so many flexible options, there must be standardized communication protocols available that allow proper interaction from utilities demand response systems to the smart meters, home controllers, gateways, displays, and devices.

Much of today's Smart Grid discussion is based on existing pilots and models where the smart meter controls the thermostat. This is a very early and limited concept. When there is more than one Smart Appliance in the house, the utility would need to individually register and control each appliance. Under this current approach, many utilities are limiting the number of devices to which the smart meter will manage, partially due to bandwidth limitations. One means to eliminate this limitation is the use of an Energy Management System, which could be Internet-based, in the home. Therefore, it is necessary that standards must address today's pilot projects as well as future architectures and solutions.

A related concern is that there is no existing established communication standard that allows seamless upgrade of the energy management inside the home. For example, a consumer may want to upgrade from a simple smart meter/thermostat to an Energy Management System with multiple devices. In this situation, the Energy Management System should assume control of

¹⁹ NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 (Draft), page 81.

the programmable communicating thermostat and communications with the smart meter. Standards must accommodate modernization and improvements.

Secure

Any communication coming inside the home with the potential to alter or change the behavior of an appliance must be secure. Only trusted and pre-authorized entities should adjust or affect the operation of an appliance. As more devices become part of the Smart Grid's in-home network, it will be increasingly important that the utility operator's information be securely transmitted over the home network, which would be a total system including not only energy management, but also home security, communications, entertainment and home automation applications. The process of registration and binding within the home network presents significant complications. Communication protocols and utility administration must make this process as simple as possible. AHAM is willing to work closely with protocol standards developers and utilities to ensure the security of the consumer is addressed, including the leveraging of existing Internet technologies to authorize, authenticate and encrypt data transfers, and securely navigate the home network.

Significant effort is being made to develop secure communications architecture for the electric utility's portion of the Grid, but the effort may not be interoperable with existing or future home networking technologies. Security standards must be developed with the Home Area Network in mind. Specific attention must be given to device and appliance operation, in particular:

- Utility companies, regulators, and standards setting bodies should not impose multiple, locally unique encryption, authentication or related certification requirements on devices in the home. AHAM supports the NIST's effort to develop common and open cyber security standards²⁰.
- Cyber security requirements for utilities to maintain a secure electric Grid should ensure that the home networking technologies are not adversely affected.
- Any security requirements for in-home connections to smart meters should be defined on a national basis in order to avoid impeding interstate commerce of Smart Appliances, home energy management systems, or communication interfaces/adaptors.
- Interoperability procedures should be handled on a national basis in order to allow manufacturers to ship nationwide and provide consumers with confidence that the Smart Appliance they purchase in one state will continue to function if they move to another state that is served by a different utility provider. AHAM endorses NIST's plan

²⁰ "Smart Grid Cyber Security Strategy and Requirements", Draft NISTIR 7628, The Cyber Security Coordination Task Group, September 2009

to establish guidelines and requirements for interoperability and security testing in Phase III of their current Smart Grid effort.²¹

Limited

Significant effort is being expended by the Department of Energy and the NIST to identify standards that are applicable to the Smart Grid. From the perspective of the home, the applicable standards should be simplified and minimized to target the specific interfaces and interactions that may be present.

Due to the size and complexity of the Smart Grid, the potential number of standards is significant and could impede progress. The number of regulatory agencies that are involved magnifies the problem. This results in a large number of possible configurations, protocols and transports. The number of potential in-home communication standards impacts investment and development from the appliance industries, as well as increases the development costs required to support different standards. Therefore, it is critical that Federal Energy Regulatory Commission, NIST, and the utility industry work towards simplified, uniform standards for demand response in the consumer domain. For this reason, AHAM has taken a position to influence existing work on standards that have been identified by the National Institute of Standards and Technology rather than to develop proprietary solutions.

3. CONSUMER CHOICE & PRIVACY

In all cases, the Smart Appliance will retain control of the appliance response to a signal from the utility company. Utilities do not have expertise in the use and operation of appliances. A utility does not need to have control of appliances in someone’s home nor do they need to monitor how someone is using their appliances. The purpose of the Smart Grid is to provide a more efficient use of energy, not for utilities to control or monitor appliance usage. Smart Appliances would likely always allow the consumer the option to override a demand response request.

The boundary of the utility’s reach should end at the smart meter. Communication or interaction inside the home should be under the control of the consumer. Ideally, the smart meter should appear to the residence as a one-way, read-only device to provide pricing, usage, and requests for load reduction.

In the Smart Grid, consumers will be an integral part of the electric power system.
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and Energy Reliability*

There may be a justification for two-way communication if it is required by the accepted standard for communication and security. A method of managing that type of communication is to develop sophisticated Smart Appliances or an energy management system that could

²¹ NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 (Draft), page 80

control simpler devices that are not capable of such communication. The architectural design of having the utility exchange multiple messages and acknowledgements with a single device is the current practice with some smart meter pilot projects. The problem is that the practice does not scale into the future where many appliances and devices will be participating as a networked home following the preferences and procedures determined and controlled by the consumer.

In some Smart Grid use cases and scenarios, there is the notion of an emergency command from the utility to stop an appliance mid-cycle that cannot be overridden by the consumer. AHAM believes the implementation of this functionality is not acceptable. Utilities have no expertise in controlling appliances in a home. While appliances are manufactured to ensure basic safety and functionality while in use, consumers should always be able to override a remote signal to the appliance. Appliances are an essential part of the development of a Smart Grid and eliminating any concerns of invasions of privacy should be a primary objective to increase household participation and involvement.

An interruption and subsequent resumption of operation by a utility directed by someone in a remote location with no expertise and for which the product has not been designed and tested might subject the consumer to unexpected risks and consequences, especially in products that have heating elements and motors. Standards development organizations must incorporate these safety expectations into all use case and requirements discussions related to consumer-based products. The consumer and/or appliance must always retain control and management of itself. The simplest and most straightforward way for the utility to verify that its message was received and the load was reduced is to read the meter.

Additionally, many consumers have growing concerns over the amount of data collected about their lives and for what reasons that information may be used. Intensive monitoring and registration of appliances and devices within the home can lead to data collection that allows

Eliminating concerns of privacy invasion should be a primary objective to increase household participation and involvement.

for behavioral patterning and other data mining to be completed on individuals and groups of consumers. Regardless of the intent, this perception can cause concern from members of the population about the perceived invasion to their privacy and create an unnecessary hurdle to people becoming excited about participating in the Smart Grid. These concerns should be put to rest. It is important that the management of energy consumption and device profiles remain within the realm of the home and be invisible to the utilities in order to prevent such data mining, unless the consumer specifically allows it. Furthermore, it is critical that significant privacy policies and violation penalties be in place for Smart Grid programs to ensure protection of the user and their privacy and protect against use and collecting of data without consumer approval.

AHAM is also concerned that the smart meter pilot projects of today, which in many cases allow utilities to receive information about how a consumer uses their appliances, will result in the

default course for the future. This would severely limit the Smart Grid's effectiveness and widespread participation, because today's pilots may not comply with Smart Grid standards that are currently under development and ensure consumer privacy. A more flexible, scalable, and consumer-centric approach is required to achieve the Smart Grid Vision.

CONCLUSION

The goal of a Smart Grid, as it relates to consumers, is to manage energy use more efficiently, save money on electricity, and provide technology and processes that are integrated into the appliances and devices consumers use in their everyday lives – all without causing significant disruption. A successful Smart Grid will allow consumers to receive valuable and understandable information that enables them to make intelligent and informed choices about how they use energy, all while minimizing consumer cost and out-of-pocket expenses that could arise with the implementation of the Smart Grid. The willingness of consumers to accept and participate in the Smart Grid could be severely impaired if the cost outweighs the benefits.

Based on AHAM's observations and participation in the Smart Grid architecture development activities, there are many requirements, which left unaddressed, will result in a Smart Grid that falls well short of the stated objectives. However, in stating the requirements and concerns above, AHAM remains optimistic and enthusiastic about the Smart Grid and the opportunity to contribute. None of the requirements and concerns are insurmountable or technically intimidating. The largest challenge is in facilitating an open exchange of information, ideas, perspectives, and experiences with a multitude of organizations. But even this challenge is within the capabilities of a committed appliance industry working with the Smart Grid community.

AHAM remains optimistic and enthusiastic about the Smart Grid and the opportunity to contribute to its development.

A CALL TO ACTION

AHAM members endorse the vision of the Smart Grid and will support the investment and planning of products designed to take full advantage of its benefits, especially for the residential consumer. AHAM has developed the following suggested action items for each stakeholder group to address some of the concerns outlined above:

Action To:	Suggested Action:
1. NIST & DOE	<ul style="list-style-type: none"> a) Continue to encourage open standards, with specific attention to the boundary between the Smart Grid and the consumer domain. Ensure that consumer privacy and data protection is provided for in the standards. b) Encourage the utility industry and the state regulatory bodies to adopt a uniform, nationwide communication standard to be used between the smart meter and the home. c) Encourage development of a national uniform standard for pricing and usage information. d) Continue encouragement of security requirements and standards, with specific attention to appliances and devices in the residence e) Allocate funding for research, development, and demonstration of user interface concepts that achieve the Smart Grid Vision of greatly simplifying a large amount of complex information. f) Allocate research funds to develop model tariffs that will properly incentivize consumers to engage in the Smart Grid and encourage innovation in the appliances and devices industries. Such tariffs should look at the flexibility Smart Appliances and home energy managers provide to the total Grid system.
2. State Energy Regulatory Agencies	<ul style="list-style-type: none"> a) Participate in the development of a national standard for pricing and usage information. Work with utilities to adopt tariffs that will properly incentivize consumers to engage in the Smart Grid and encourage innovation in the appliances and devices industries. Such tariffs should look at the flexibility Smart Appliances provide to the total Grid system. b) Adopt policies that encourage nationwide uniform standards for communication between the smart meter and the residence.
3. Utilities	<ul style="list-style-type: none"> a) Participate in selecting one national standard for smart meter communication to the residence.

	<ul style="list-style-type: none"> b) Strive to leverage existing communication technologies in the home, such as the Internet. c) Begin steering smart meter pilot projects towards standards and architectures that are expandable for the future. d) Remove absolute control of in-home appliance scenarios from use cases, requirements, and standards. e) Participate in developing a national uniform standard for pricing and usage information. Work with state public utility commissions to adopt tariffs that will properly incentivize consumers to engage in the Smart Grid and encourage innovation in the appliances and devices industries. Such tariffs should look at the flexibility Smart Appliances provide to the total Grid system.
<p>4. Smart Meter Manufacturers</p>	<ul style="list-style-type: none"> a) Participate in selecting one national uniform standard for smart meter communication to the residence. b) Assist in developing an upgrade path from controlling an individual thermostat to connecting with an energy management system inside the home.