Regulatory Assistance Project
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SMART GRID OR SMART POLICIES: WHICH COMES FIRST?

With the great expectations for smart grid – and billions of dollars in smart grid grants to be divvied up under the American Recovery and Reinvestment Act – Commissions are looking for value in the concept and trying to determine what consumers will get in return for their money.

Smart grid functions represent an inevitable evolution of the electric sector. But if smart grid is to contribute to economic efficiency, consumer welfare, and environmental protection, its potential must be properly and fully exploited. This, in turn, depends crucially on adopting a few basic policies that make sense with or without a smart grid, plus a sober assessment of its value in relation to other clean energy investments. States must consider the net benefits of smart grid in the context of other high-value actions.

There's a risk that the glitter of a golden grid will divert attention and funds from cost-effective energy efficiency and clean supply-side resources available today, as well as transmission that must be built to carry those resources to consumers. Regulators should not be distracted from taking the other actions that are urgently needed to prepare for a low-carbon future.

In this *Issuesletter*, we examine the potential values of smart grid for consumers and recommend policies Commissions should adopt now before committing ratepayer dollars for such investments.

What Is the Smart Grid?

There's no standard answer, but the following definition lays out a reasonable vision, if combined with appropriate policies:

The smart grid is an interconnected system of information and communication technologies and electricity generation, transmission, distribution and end-use technologies that has the potential to:

- enable consumers to manage their usage and choose the most economically efficient energy service offerings,
- enhance delivery system reliability and stability through automation, and
- improve system integration of the most environmentally benign generation alternatives, including renewable resources and energy storage.[1]

Advanced metering infrastructure (AMI) – solid-state digital meters with two-way communications between the meter and utility – is part of the smart grid. While many utilities have made AMI their first step, it is just a part of the smart grid technology suite which also includes sensing and measurement technologies, advanced components (superconductivity, storage, power electronics, and diagnostics), distribution automation systems, end-use technologies like smart appliances and advanced control systems for buildings, distributed generation, and integrated communication systems throughout.[2]

Will Smart Grid Deliver What Consumers Want at the Right Price?

Smart grid technologies enable a host of useful applications. But consumers will not see the value unless appropriate market mechanisms and policies – including business case requirements to demonstrate net benefits – are in place. Here are the major values of smart grid and what's needed to capture net benefits for consumers: [3]

Enhanced system reliability – Continual system monitoring and smart controls will better maintain power line stability and rapidly detect and respond to overloaded components, components with more capacity than expected, and abnormal conditions. That means the number, duration, and magnitude of outages will be reduced. What are consumers willing to pay for this additional reliability? Will smart grid resolve the utility's particular reliability problems? To tease out potential value, Commissions should: [4]

- Clarify reliability objectives – For example, reduce frequency of outages, reduce their duration, reduce the number of customers affected, reduce customer outage costs
- Consider alternatives to addressing these objectives, such as improved tree-trimming practices, distribution-level storage solutions, and, for customers needing high levels of reliability, on-site storage or micro-grids [5]
- Pinpoint where in the system reliability investments will have the greatest value
- Develop criteria for determining effectiveness of potential reliability investments
- Review utility reporting requirements for reliability, including metrics
- Review changes in grid operating procedures and evaluate any needed changes in service quality measures

Improved energy efficiency – Continual optimization of distribution voltage will directly reduce energy consumption by minimizing line losses and resistive loads. Smart grid also can help consumers use energy efficiently by conveniently providing usage and cost information in near real-time as well as customized analysis – if the requisite policies and investments are in place. At the same time, we already have enough opportunities for cost-effective energy efficiency measures to reach zero load growth or get very close to that goal.[6] What we don't have are the policies to achieve it. Commissions should ensure that regulatory policies are in place to effectively tap these opportunities. For example:

- Where organized competitive markets exist, rules should be revised to allow energy efficiency to fully compete with other resources to provide its full range of potential services.
- Energy efficiency should be treated on a par with or as superior to other resources in integrated resource planning/portfolio management and competitive bidding processes, considering both expected cost and risk mitigation as well as other measures considered by the Commission.
- Commissions should address the strong disincentive utilities face because energy efficiency reduces sales, reducing profits. Decoupling, "decoupling plus," and third-party administration of programs are among the approaches states have taken to remove this barrier.[7]

Better rate design and more customer choice – Smart grids will give Commissions the means to better reflect costs in rates and offer consumers more rate options and more control over their energy bills. These options can reinforce other policy actions on energy efficiency, sustainability and climate change. Smart pricing and automated controls (pre-set by the customer to respond to prices) will enable consumer loads to interact dynamically with the smart grid. Commissions need to consider what they want the future to look like and adopt policies to achieve that vision. For example, should all consumers be able to choose among a portfolio of rate options, including dynamic pricing? Should time-varying pricing be the default option, with customers able to opt-out and pay the appropriate hedging cost for traditional fixed rates? What's the role of the marketplace in bringing innovative products and services to consumers? Utilities are unlikely to open the door to third-party vendors on their own. Utilities also should be required to provide the aggregated data public agencies and vendors need to make efficient offerings. In addition, procedures must be developed to make site-specific information available, subject to consumer consent. First priority, and with no smart grid needed, are "inclining block" rates that promote energy efficiency.[8] Commissions also should adopt hook-up fees to address the "split incentives" between the developer or builder and the building occupant that pays the energy bills.[9]

Reduction in peak demand – Smart grid can enable consumers to automatically reduce loads in near real-time when market prices are high or when system reliability or power quality is at risk. Such demand response may offer large operational savings. It also acts as a check on generator market power and on-peak market prices. Commissions should examine how much demand response to develop and for what purposes – for reserves, to meet seasonal peaks, to defer expensive distribution system upgrades, and to quickly address pricing excursions and reliability events, for example. Commissions also should assess new demand response capabilities that smart grids can enable compared to traditional programs. Further, demand response should be treated at least on par with other options in resource planning and acquisition, and policies and market rules for demand response should be aligned with its environmental costs and benefits.

Capacity and O&M savings – The direct and indirect ways smart grids reduce energy usage and peak demand will reduce the need for costly new generation, transmission, and distribution capacity. Smart grid also enables automation of processes like meter reading, outage reporting, connect/disconnect and feeder reconfiguring, all of which can reduce utility operation, and maintenance costs.[10] The savings depend on investment in the appropriate devices and applications. Savings from remote connection/disconnection also are contingent on allowing the utility to forego a last knock on the customer's door and a regime that permits safely re-energizing the premises. Commissions should examine whether rule changes are needed to take advantage of remote disconnection while ensuring utilities make every reasonable effort to keep customers connected, paying particular attention to the health and safety of vulnerable customers as new disconnection procedures are put in place.[11]

Better integration of renewable resources – A smart grid can dynamically manage intermittent renewable energy sources. But resource planning and acquisition processes in many states do not fully account for the environmental and diversity benefits of renewable resources. In addition, transmission policies developed to meet the needs of a thermal-based system – and more recently to support competitive markets – must be revamped to align with national environmental policies.[12] And while smart grid-enabled demand response will moderate the mismatch between intermittent sources and consumer demand, economical storage and higher capacity factor renewable resources still must be developed.[13]

Better integration of distributed resources – A smart grid also can better integrate generating and storage resources at customer sites. But we lack the information, policies, and market rules to determine the value of distributed generation at specific locations on the grid, while avoiding applications that don't stack up economically or environmentally. The value of all customer-side resources, including energy efficiency, demand response, and distributed generation and storage, must be revealed to consumers and the marketplace. Smart grids can provide customer-specific load profiles to help consumers become more efficient, shift loads to off-peak periods, and install distributed generation at favorable locations on the distribution system. Commissions also should adopt policies that allow third parties to see the value of customer-side resources throughout the distribution system and capture a portion of that value through their activities.

Right charging of plug-in hybrid electric vehicles (PHEVs) – PHEVs hold promise as distributed energy storage, for improving load factors (by charging off-peak and discharging on-peak) and reducing total carbon emissions. Without regulatory changes, however, PHEVs are likely to exacerbate peak demand. Dynamic pricing and smart controls and communications are needed to ensure benefits to the electric system from the mass introduction of PHEVs. [14]

Reduced greenhouse gas emissions – A 2008 study by the Electric Power Research Institute (EPRI) estimates that a smart grid in the U.S. could reduce carbon dioxide (CO_2) emissions by 60 million to 211 million metric tons per year in 2030 through energy-saving mechanisms, integrating higher levels of intermittent renewable resources, and higher PHEV market penetration.[15,16] But without adoption of key clean energy policies, these potential reductions will not be realized. Further, analysis of any climate change benefits should account for regional changes in emissions due to modified power plant operations.[17]

Nascent State Strategies to Achieve Consumer Benefits

Commissions and legislatures in several states have established policies for AMI or smart grid generally that lay the foundation for their smart grid future by:

- Providing guiding principles and objectives in terms of consumer value consistent with sound regulation
- Specifying minimum functional requirements – the services the system must provide in order to receive cost recovery in rates
- Requiring commonly accepted/open standards and protocols
- Giving utilities direct experience with smart grid technologies and applications through pilot programs
- Specifying business case requirements, including a framework and parameters for benefit/cost analysis[18]
- Ensuring consumer access to information and privacy of data
- Mandating third-party access to consumer data and provision of services with suitable privacy protections
- Providing for automated control of loads, set by the consumer
- Establishing a process that promotes discussion of the smart grid among stakeholders to flesh out foundational policies and develop a comprehensive smart grid plan

We recommend Commissions also consider the following strategies:

- Focus on high-value technologies and applications, especially in high-value locations – for example, where substations or feeders are congested
- Require the regulated utilities to file periodic studies on technology readiness and estimated costs and benefits
- Direct the utility to develop a smart grid transition plan that addresses the Commission's principles and objectives, forecasts phased deployments of technologies and applications, and establishes an evaluation plan
- Determine whether the utility has any incentive to optimize smart grid deployment or, conversely, to deploy a suboptimal system and adopt mechanisms that align utility and consumer interests
- Assure that assistance and information are available to consumers to enable them to take advantage of options and functions enabled by the smart grid

Smart Policies Should Not Lag Behind Smart Grid Investments

Regulators should adopt as soon as possible the smart policies described throughout this *Issuesletter* that are needed to justify investment in the smart grid. Without them, much of the investment will be wasted and the benefits will be untapped. Here's a summary of key policies to substantially scale up energy efficiency, peak load management, and renewable and distributed resources:

1. Treat energy efficiency as a resource on a par with or as superior to supply-side resources.

- In organized competitive markets, revise rules to allow energy efficiency to fully compete with other resources to provide its full range of potential services.
- In integrated resource planning/portfolio management and competitive bidding processes, evaluate energy efficiency as a resource option that competes with alternatives on both expected cost and risk as well as other measures considered by the Commission.
- Address the strong disincentive utilities face because energy efficiency reduces sales, reducing profits.

2. Reveal the value of energy efficiency, demand response, and distributed resources to consumers and the marketplace.

- Use customer-specific load profiles available through smart grids to provide the information needed to help consumers become more efficient, shift loads to off-peak periods, and install distributed generation at favorable locations on the distribution system.
- Adopt policies that allow third parties to see the value of customer-side resources throughout the distribution system and capture a portion of that value through their activities.

3. Rethink transmission access and pricing policies to meet our long-term climate and environmental challenges.

- Incorporate emission reduction goals into transmission planning.
- Facilitate large-scale investments in transmission to tap areas rich in renewable resources.
- Revise transmission pricing and access rules to give weight to the environmental attributes of generation alternatives.

4. Adopt renewable portfolio standards where they do not yet exist.

5. Adopt rate design approaches that provide the appropriate price signals for energy efficiency.

- Adopt inclining block rates to reflect that the marginal cost of supply exceeds the average cost.

- Enact hook-up fees for developers and builders to address the "split incentives" between those who build the facility and those who pay the energy bills.

Bottom line: Smart grids should be accompanied by smart policies or their full potential will not be realized and the cost to consumers will exceed the benefits. Like the Internet, another communications technology, it all comes down to content. Smart policies create the content for smart grids and should not lag behind their roll-out. A smart grid without smart policies is anything but smart.

[1] Adapted from Roger Levy, lead consultant, Smart Grid Technical Advisory Project - Lawrence Berkeley National Laboratory, presentation to the Utah Public Service Commission, May 13, 2009, available at www.raponline.org.

[2] For an overview of smart grid technologies, applications and additional resources, see the smart grid FAQs and annotated bibliography by the National Association of Regulatory Utility Commissioners, May 2009, available at www.naruc.org.

[3] The last sections of this issue brief lay out strategies and policies for achieving Commission goals and objectives.

[4] Adapted in part from Mr. Levy's presentation.

[5] A microgrid is an interconnected network of loads and distributed resources that can function connected to or separated from the utility grid. During a disturbance, a microgrid isolates itself without disrupting loads.

[6] The American Council for an Energy-Efficient Economy (ACEEE) cites a median level of cost-effective, achievable potential for electric savings in the U.S. of 18 percent. See Maggie Eldridge, R. Neal Elliot and Max Neubauer, *State-Level Energy Efficiency Analysis: Goals, Methods, and Lessons Learned*, proceedings of 2008 ACEEE Summer Study on Energy Efficiency in Buildings, 2008. A 2005 study by Northeast Energy Efficiency Partnerships, Inc. found that cost-effective investments in energy efficiency could more than offset projected growth in regional energy use and peak demand, deferring the need for 28 combined-cycle power plants with an output of 300 MW each by 2013. See "The Economically Achievable Energy Efficiency Potential in New England" at http://www.neep.org/policy_and_outreach/NEEP_Achievable_Potential_Presentation_UPDATED.pdf. Similarly, a new study by the Northwest Power and Conservation Council finds that achievable conservation savings would meet 85 percent of forecasted load growth (medium case) in the region over the 20-year study period. Results at http://www.nwcouncil.org/energy/crac/meetings/2009/06/Default.htm.

[7] "Decoupling" removes the link between utility sales and revenues so that the utility is indifferent to (rather than financially harmed by) energy efficiency on the customer side of the meter. Decoupling also addresses utility disincentives to facilitate distributed generation and demand response. "Decoupling plus" removes utility disincentives and provides positive financial incentives to utilities to pursue cost-effective energy efficiency. Some states have adopted policies to combine decoupling for utilities with third-party administration of energy efficiency programs. See Regulatory Assistance Project, *Revenue Decoupling Standards and Criteria: A Report to the Minnesota Public Utilities Commission*, June 2008, available at www.raponline.org, and National Action Plan for Energy Efficiency, *Aligning Utility Incentives With Investment in Energy Efficiency*, November 2007, available at http://www.epa.gov/cleanenergy/energy-programs/napee/resources/guides.html.

[8]See, for example, Ahmad Faruqui, The Brattle Group, "Inclining Toward Efficiency," *Public Utilities Fortnightly*, August 2008.

[9]A hook-up fee is a one-time charge to connect to the grid generally based on the building's peak connected load. A fee that is higher for inefficient buildings and lower – or even waived – for buildings that meet stringent energy efficiency standards gives builders and developers efficient price signals.

[10]Prudent investments in equipment that will be replaced are sunk costs from a ratepayer perspective. Any accelerated write-off of equipment remaining to be recovered in rates moves the revenue requirement forward in time but does not change the net benefits of investing in smart grid except for tax treatment in a utility-perspective analysis.

[11]For example, besides traditional mailed notices, updated rules on customer disconnection notification adopted by the Oregon Public Utility Commission specify a phone calling regime – calls on multiple days, at various times of day, with messages left if an answering machine or service is available. In addition, remote disconnect must first be implemented outside the heating season. See OAR 860-021-0405 at http://arcweb.sos.state.or.us/rules/OARS_800/OAR_860/860_021.html. Further, the adopted Stipulation for Portland General Electric's AMI filing includes several provisions that address disconnection and other issues for vulnerable customers. See pp. 9-12 of the Stipulation adopted in Order No. 08-245, available at http://apps.puc.state.or.us/orders/2008ords/08-245.pdf.

[12]See Regulatory Assistance Project issue paper, "Clean First: A New Approach to Transmission Planning, Access and Operations" (in process).

[13]Demand response can include ramping up consumer demand to use wind energy during low load hours.

[14]Some of the policies needed to achieve the promise of PHEVs also are needed to achieve significant levels of demand response.

[15]See EPRI, *The Green Grid: Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid*, Technical Update, June 2008, available at www.epri.com. Excluding PHEVs, the reductions represent a 2 percent to 5 percent decrease in CO_2 emissions in the electricity sector in 2030 based on Energy Information Agency projections (http://www.eia.doe.gov/oiaf/archive/aeo08/emission.html). EPRI also estimates smart grid-enabled PHEV impacts will result in an additional net reduction of 10 tons to 60 tons of CO_2 in 2030. Personal communication with Ellen Petrill, EPRI, June 26, 2009. Energy savings are from continuous commissioning for commercial buildings, distribution voltage control, enhanced demand response and load control, direct feedback on energy usage, and enhanced measurement and verification capabilities.

[16]A recent analysis by The Brattle Group estimated that a "conservative" implementation of smart grid in the U.S. could reduce annual emissions of CO_2 in the power sector 5 percent by 2030, while a more aggressive approach could lead to a reduction of nearly 16 percent by 2030. The conservative case assumed only smart grid components commercially available today. The aggressive scenario included high-potential, long-term technologies such as smart distribution systems and large-scale storage devices. PHEVs were excluded from the analysis. See Ryan Hledik, "How Green Is the Smart Grid?" in the April 2009 issue of *The Electricity Journal*.

[17]For example, when coal is serving baseload needs, emissions may increase when customers shift loads from on-peak to off-peak periods. The analysis also should account for the effects of increased levels of distributed generation.

[18]Commissions should require an analysis of the uncertainties related to key assumptions.

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