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Critical Policy Issues for Smart Grid Adoption by Utilities

Jason Dedrick, Jeffrey Stanton, Murali Venkatesh
School of Information Studies, Syracuse University[1]
USA

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jdedrick@syr.edu

SUMMARY

Electric utilities in the U.S. need to replace aging infrastructure, integrate renewable energy sources, improve reliability and accommodate growing demand. Smart grid technologies offer potential solutions, but adoption has been slow and uneven. One reason is the patchwork of state and federal policies and agencies that regulate the industry. This paper focuses on policy and regulatory issues influencing grid modernization. We will address the questions: (1) What are the critical policy and regulatory drivers and barriers to adoption of smart grid technologies by utilities? (2) How do these policy and regulatory factors interact with characteristics of utilities themselves, such as ownership form, degree of vertical integration, and organizational culture? And (3) What policy changes are needed to encourage adoption of economically and socially desirable investments in the electrical grid?

We have interviewed individuals from over 20 U.S. utilities and collected extensive documentation about the policies and regulations that affect their smart grid adoption decisions. We have found that state public utility commissions play a critical role in allowing or constraining smart grid investments, new pricing schemes and new revenue models. The relationship between utilities and regulators is important, and varies from cooperative to adversarial in different cases.

State legislation has been important in driving adoption in some cases, such as California's legislation requiring the PUC to develop a smart grid deployment plan. Another example is state renewable portfolio standards (RPS) which indirectly drive smart grid investment needed to accomodate renewables. Federal grants under the 2009 ARRA helped stimulate smart grid investments by utilities that had projects ready to go, and the federal government has stimulated competition by forcing utilities to buy power from independent generators and creating regional ISOs to manage wholesale markets.We have found that municipal and cooperative utilities, which usually are not regulated by PUCs, can be more flexible and aggressive in adopting smart grid technologies. This is surprising, as it is usually assumed that private sector firms have more incentive to invest in innovation and greater resources to do so.

Based on this research, we offer several recommendations for policy changes that would encourage smart grid adoption.

- New pricing schemes are needed to provide incentives to utilities and customers to reduce and shift demand, such s delinking utility revenues from volume of electricity delivered.
- New regulatory models need to be developed that provide flexibility and allow the experimentation with new technologies.
- Policies need to encourage adoption of technologies or practices that have proven effective in other contexts without continued retesting
- State and federal regulators, policymakers, utilities, vendors and customers need to become partners in solving problems and encouraging innovation.

- All of the parties involved in the policy and regulatory process need to become more knowledgeable about the various issues presented by grid modernization.

KEYWORDS

Public Utility Commission, regulatory, FERC, decoupling, investor-owned utilities, municipal utilities, electric cooperatives, grid modernization,

Introduction

Electrical utilities in the U.S. face an uncertain and challenging future. The utility sector is marked by deteriorating infrastructure, aging technology, overloads and outages, and public resistance to location of new generation and transmission facilities. Smart grid technologies offer potential solutions to those problems, but adoption by utilities has been slow and uneven. In a highly-regulated industry, technology adoption can be either enabled or constrained by government policies and regulations. Yet the electric utility industry is regulated by a patchwork of federal and state policies and agencies, which at least partly explains the slow and uneven nature of smart grid adoption.

This paper will focus on policy and regulatory issues influencing grid modernization. We will address the questions: (1) What are the critical policy and regulatory drivers and barriers to adoption of smart grid technologies by utilities? (2) How do these policy and regulatory factors interact with characteristics of utilities themselves, such as ownership form, degree of vertical integration, and organizational culture? And (3) What policy changes are needed to encourage adoption of economically and socially desirable investments in the electrical grid?

Research methodology

In order to address these questions, we have been conducting a study supported by the U.S. National Science Foundation (SES-1231192) on the adoption of smart grid by U.S. utilities. We have interviewed over 30 individuals in 23 U.S. utilities, including investor-owned, cooperative and municipal forms, covering 16 states with a variety of policy and regulatory contexts. We also have interviewed representatives of three vendors to the utilities.

In our utility interviews, we ask about their history with grid modernization, motivations to adopt smart grid technologies, organizational challenges and impacts, extent of smart grid implementation, and the impacts of federal and state policies and regulations. We also have collected a large number of documents produced by utilities, federal and state government agencies, analysts and academics. We have analyzed the interviews and other documents using qualitative methods.

For this paper, we are focusing on regulatory and policy issues. These include:

- State regulation by public utility commissions
- State legislation
- Federal grants and incentives
- Renewable portfolio standards
- Competition policy
- Relationships between utilities and regulators

Drivers and barriers to adoption

State regulation: The regulatory process of public utility commissions is often a barrier to smart grid adoption by utilities. The process involves rate cases, in which utilities request rate increases to cover costs and earn an acceptable return on investment. The process can be inflexible and subject to political pressures, limiting the autonomy of regulated utilities to experiment with new pricing schemes, business models, or technologies (Kiesling, 2010). One utility's smart grid plans were scaled down when it failed to gain a requested rate increase which would have covered the costs of implementation.

> "We requested a rate increase, but the commission only approved one-third of it. This caused us to cancel a pilot project on smart grid."

Some regulatory bodies have been more supportive of smart grid experiments and investments. In one case, a particular commissioner was identified as a champion of grid modernization and encouraged the utility to pursue a DOE demonstration grant.

> "The commission encouraged us to submit the application for the (ARRA) smart grid funding", and once the funding was obtained, "we got the regulatory approval for moving forward" on the adoption.
>
> "The decision was mutually driven. We definitely want to achieve the operational efficiency...(and) then, on the regulatory side, they are highly supportive. They definitely wanted (consumers) to…have a platform that can support the dynamic pricing…"

In general, the regulatory process is a remnant of the regulated monopoly era, and tends to reinforce the cautious approach that utilities have towards innovation. Also, the process is geared more towards long-term capital investments with predictable costs and benefits than ongoing investments in dynamic technologies such as information technology (MIT, 2011). Grid modernization requires ongoing investment in systems that need to be integrated to achieve the potential benefit of the smart grid. In this sense, it is more like investing in large management information systems, which involve unpredictable innovation paths, frequent upgrades, proliferating standards, rapid depreciation and potential obsolescence of technologies.

State legislation: State legislation can also drive adoption, notably in the case of California[2], which in 2009 passed legislation (SB17) requiring the Public Utility Commission to develop a plan for smart grid deployment. In California, major utilities such as Southern California Edison had already installed millions of smart meters by then, but after the passage of SB17 the PUC required the three major IOUs to develop comprehensive smart grid plans (PG&E, 2011). Initially, the three utilities worked with the Electric Power Research Institute to develop the "Defining the Pathway to the California Smart Grid of 2020" report for the California Energy Commission. Then each utility developed its own comprehensive smart grid plan. This kind of comprehensive approach is not common among U.S. utilities, according to our interviews and review of published materials, and is clearly an outcome of SB17.

In addition to SB17, California utilities also face renewable portfolio standards and other energy and environmental policies such as the California Solar Initiative, Zero Net Energy Homes, Electric Vehicle targets and AB 32 to fight global warming. Smart grid is seen in part as a response to these multiple policy demands.

> "There are aggressive and progressive energy policies in California. In the absence of better ways of doing things, these could substantially increase the cost of service. We are using smart grid technologies to achieve policy goals at a reasonable cost"

Federal grants and incentives: The federal government subsidized smart grid investments in a competitive process as part of the 2009 American Recovery and Reinvestment Act. These funds, distributed by the Department of Energy, included grants for smart grid technology installation as well as demonstration projects. There were 99 smart grid investment projects, funded by $3.4 billion in federal grants

[2] In one report on state smart grid and demand response regulation and legislation activity over two years, 18 pages are devoted to California; other states range from 2 paragraphs to 6 pages. (Pietsch, 2012)

(http://www.smartgrid.gov/recovery_act/overview/smart_grid_investment_grant_program). There were 32 regional demonstrations and energy storage projects, receiving $700 million (DOE, 2013). The grants led to over $8 billion investment, including matching funds from the utilities.

According to our interviews, some of the investments made by grant recipients would not have been made without the subsidy, while others were merely accelerated to take advantage of the grants. The selection process favored those who already had smart grid plans in the works and were "shovel-ready" for implementation.

There is concern that smart grid investment may fall off since the grants ran through 2012. To the extent that the grants accelerated projects it might be expected that there would be a dropoff after the grants were completed. It remains to be seen if the investments provided a base upon which utilities expand into other technologies or applications, or whether they will be one-time investments.

Renewable portfolio standards: Thirty seven states have renewable energy targets for electricity production. Incorporating renewable sources such as solar and wind is a challenge for utilities, especially as the share of renewables grows. These sources are variable and unpredictable, so investments are required to maintain power when the sun or wind are not available. This can involve backup generators or storage. Another option is demand response to reduce the load on the system when supply is reduced or demand peaks, either through a price mechanism or through automated control of customer energy use. Investments in the grid also are necessary to maintain system stability as the share of variable resources in the energy mix increased.

As such, renewable standards can be a driver of smart grid adoption, as smart grid can provide the infrastructure for demand response programs. This is cited by a small number of interviewees in locations with high penetration of renewables. However, most utilities that we interviewed have not implemented dynamic pricing or automated demand response. Many do not even have time-of-use pricing for residential customers to encourage them to reduce energy use at peak hours. At most, some utilities have offered TOU pricing on a voluntary basis. This is true even in states with renewable portfolio standards.

Competition policy: In 1978, the federal Public Utilities Regulatory Policies Act stimulated competition by forcing electric utilities to buy power from independent power producers. The Energy Policy Act of 1992 had a similar impact on the wholesale and retail electricity markets by giving all wholesale power producers access to investor-owned and public utility transmission grids (Energy Information Administration, 2000). Later, FERC Orders 888 and 889 required vertically integrated IOUs to provide all qualified wholesale purchasers with open and universal access to their transmission grids. These policies helped lead to divestiture of generating capacity by many utilities and led to the creation of regional independent system operators (ISOs) to operate wholesale power markets.

In 2008, FERC passed Order 719, requiring grid operators in the six organized wholesale markets to accept bids from demand-response resources for reducing demand at a given time to match load to generation capacity. This was followed by Order 745 in 2011, which requires grid operators in wholesale markets to pay the same price to demand-response providers who reduce load that they pay to generators. The result is that a "negawatt"[i] of load reduction can generate revenue equal to a megawatt of power generation (Plumb, 2013).

Retail competition policies vary greatly by state. In the case of Texas, policies have unleashed competition in the retail market, leading to innovation by newcomers to the retail electricity industry. Retail competition allows new companies to enter the market with new technologies and services such as energy management systems, and creates incentives for traditional utilities to offer new services such as energy management technologies to customers.

> "In Texas, the utility industry was deregulated into 3 different markets about 10 years ago: the power generation in the wholesale market; the traditional transmission and distribution utilities… and retail electricity providers...Now we compete with 40 companies every day. We are a market leader. We are very innovative and new things that we roll out to customers include things like pricing plans as well as these technologies and services".

Relationship of utilities to regulators: Some utilities have relatively cooperative relationships with regulators, while for others it is quite adversarial, even for different utilities in the same state. The ability of utilities and regulators to work cooperatively is critical to modernizing the grid and replacing obsolete business models. When the relationship works well, regulators respond to utility efforts to innovate while keeping the public interest in mind.

> "(Our state) is kind of different. In our case, we decided that this is the course of action and we put together a business case and plan and then we went to our regulators and said 'this is what we want to do' and we requested their approval of it. So in some places it's a mandate but in our case, we request their (regulator) approval for this"

Yet utilities and regulators often do not seem to find common ground on key issues such as pricing or the need for innovation. Sometimes two different utilities in the same state will have much different relationships with the same regulatory body. For instance, the same utility commission that turned down one utility's rate request (discussed above) has been mentioned as quite cooperative with another utility in that state.

Interaction of policies with structure and ownership of utilities

The impacts of the regulatory environment on smart grid vary across different utility structures. For instance, the incentives to adopt dynamic pricing or other measures to reduce peak demand are greatest for vertically integrated utilities who are faced with major capital investments in generation capacity to meet growing demand. Yet the policy trend in the U.S. has been towards de-verticalization through utilities selling off power plants, and encouraging competition at the retail level. These policies could reduce the payoffs from smart grid investments by transmission and distribution utilities.

> "[When] we started out, we were a fully integrated utility and then part-way through, the commission ruled that we needed to separate our generation from our transmission and distribution businesses. They were moving towards deregulation and making it more attractive for competitive electric retail suppliers. But as an unintended consequence of that, it kind of negated some of the consumer programs that we were exploring. All of the savings for the program were related to shifting load to an off-peak period or pricing based on the actual cost of the electricity in the (wholesale) market. If we're not the generator anymore, that component of the bill went away. So it creates a bit of a hiccup as customers have switched to another supplier's generation, and they are no longer eligible for our program."

The regulatory and policy environment also depends on the ownership structure. Municipals and cooperatives often feel they have more autonomy to adopt new technologies than IOUs, as most don't need regulatory approval to make investments or set prices. Some of the leading adopters we interviewed were municipals and coops. Most municipals and co-ops do not have to ask for rate approval from public utility commissions, and also do not have to pay dividends to shareholders. This may make them more willing to invest in technology that provides value to customers by improving service quality and reliability. In the words of one municipal utility:

> "IOUs will not make an investment in anything without having a guarantee of return for their stakeholders. We don't have a dividend that we have to pay, our dividend is our decent rates and good service. We just look at all our costs and say how we can manage all our costs and all our rate structures in a way that's gonna be the most competitive for our customers."

Policy implications

While our research is still in progress, we can offer some preliminary answers to our third question about policy changes needed to encourage grid modernization by utilities.

1. New pricing schemes are needed to provide incentives to utilities and customers to reduce and shift demand. There doesn't appear to be a single best pricing model that fits the many different ownership, market and competitive environments across the states. Yet there could be agreement on basic principles, such as the idea that customer prices and utility revenues should reflect the cost of production, which varies greatly at different times, and the value of electricity to users, which also varies by customer and time. One option is decoupling a utility's revenues from kWh sold, so that it does not lose revenue by encouraging customers to conserve. Under decoupling, customer bills are still based largely on volume of use, to encourage them to conserve. Today, 15 states have decoupled revenues from volume, and such a policy is pending in six more (Morgan, 2013). A critical issue is determining the factors on which a utility's revenue is based. To encourage investment in smart grid technologies, factors should include quality measure's such as reliability of service, outage restoration, peak demand reduction or reduction in carbon emissions.
2. New regulatory models need to be developed. These should continue to protect consumers but provide flexibility and allow the experimentation that is necessary for any industry to try out new technologies and business models. This requires encouraging some degree of risk, because there is no risk-free way to implement new technologies, especially when they are part of a complex system of operational and information technologies such as the smart grid.
3. Policies need to encourage adoption of technologies or practices that have proven effective in other contexts without continued retesting. Each utility seems to feel that it must do extensive pilot testing, rather than relying on results from testing by other utilities. An example is time-of-use pricing. There are numerous tests showing that customers can save while helping to shave peak demand, yet most utilities are reluctant to try it beyond voluntary tests with a few customers. Regulators could help provide cover for the utilities, but are likewise conservative about changes that may affect some consumers adversely, even if that could provide the incentive for consumers to change their usage habits.
4. State and federal regulators, policymakers, utilities, vendors and customers need to become partners in solving problems and encouraging innovation. Collaboration needs to replace the often confrontational relationship seen between utilities and regulators, and in some cases between different policy and regulatory bodies. This does not assume that the interests of these groups will always align, but it means that there needs to be a better way of negotiating these interests than the periodic rate case process. What is needed is more of an ongoing communication where each group is heard and feels its interests are represented in the

outcome. At the same time, once a decision is made, the utilities need to be able to carry it out without being challenged over every step of implementation.

5. All of the parties involved in the policy and regulatory process need to become more knowledgeable about the various issues presented by grid modernization. There are many good reports from government agencies, industry representatives, consultancies, think tanks, and others. It is not realistic to expect all legislators or consumers to digest all of these, but there needs to be a better understanding of the issues to have the kind of collaborative policy process that is envisioned here.

BIBLIOGRAPHY

[1] DOE, 2013. Audit Report: The Department of Energy's $700 Million Smart Grid Demonstration Program Funded Through the American Recovery and Reinvestment Act of 2009. U.S. Department of Energy Office of Inspector General Office of Audits and Inspections. Washington, D.C.

[2] Energy Information Administration. (2000). The changing structure of the electric power industry 2000: an update. http://www.eia.gov/cneaf/electricity/chg_stru_update/toc.html

[3] Kiesling, L.L. 2010. "The Knowledge Problem, Learning, and Regulation: How Regulation Affects Technological Change in the Electric Power Industry," Studies in Emergent Order, 3: 149-171.

[4] MIT, 2011. The Future of the Electric Grid, An Interdisciplinary MIT Study. Massachusetts Institute of Technology.

[5] Morgan, P., 2013. A Decade of Decoupling for US Energy Utilities: Rate Impacts, Designs and Observations. http://switchboard.nrdc.org/blogs/rcavanagh/Decoupling%20report%20Final%20Feb%202013%20-%20pdf%20%282%29.pdf

[6] PG&E, 2011. Pacific Gas and Electric Company Smart Grid Deployment Plan: 2011-2020.

[7] Plumb, L.D. 2013. "U.S. Energy Ecosystem: Entering a New Era?" in Noam, E.M., Pupillo, L.M. and Kranz, J.J. (eds.) *Broadband Networks, Smart Grids and Climate Change*, pp 121-134

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[i] The term negawatt was coined by Amory Lovins in 1989. http://www.ccnr.org/amory.html