The Future of the Utility Industry and the Role of Energy Efficiency

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ABSTRACT

In the past year there has been much discussion about threats to the current utility model, such as declining energy sales and growing use of distributed generation, that could perhaps lead to a "death spiral" in the long term where fewer and fewer customers pay for infrastructure, causing rates to climb and inducing more customers to leave the utility grid. As a result there have been calls for new utility business models, sometimes dubbed "the utility of the future."

In this paper we construct several scenarios for electricity sales and conclude that sales may decline, but a death spiral is unlikely. We also summarize options for the utility of the future culled from suggestions in more than 50 reports and papers and develop a list of 18 options. We discuss some of the pros and cons of these options and conclude that many are worth pursuing if done well. Suggestions for the short, medium, and long term are made. Many questions remain, and each utility and state will ultimately make its own choices.

Introduction

The environment in which electric utilities operate is going through a fundamental shift. For electric utilities, for the first time since Thomas Edison, demand for their product is no longer growing.[1] While historically electricity sales grew at 10% or more per year, since the turn of the 21st century, sales growth has been more in the neighborhood of 1.5% per annum, and since 2007 sales have actually declined (EIA 2013). This latter circumstance was driven in part by the Great Recession of 2008–09, but since then electricity sales have continued to decline, even as U.S. gross domestic product increased.

At the same time, the electric grid is aging, and many observers have called for major new investments in transmission and distribution (for example, see MIT 2011). New power plant emissions standards are taking effect and natural gas prices have come down, putting pressure on the economics of coal plants, and even nuclear plants in some cases. Traditional power plants are also facing competition from new sources, including energy efficiency programs run by utilities and third parties and distributed generation (DG) systems ranging from large combined heat and power systems at major facilities to small residential rooftop solar systems.

Thus, while electricity sales are declining—and could continue to decline—needed investments are increasing, which will likely cause rates to go up. Some utility industry observers are worried that as rates go up, more customers will seek to self-generate, further reducing sales and causing a "death spiral" as fewer customers are left to pay for the cost of the grid (see, for example, Martin, Chediak, and Wells 2013). On the other hand, Moody's Investors Service believes that "rooftop solar [and] distributed generation [are] not expected to pose [a] threat to U.S. utilities" because they "expect regulators to intervene should it ever begin to have a significant [financial impact]" (Moody's Investors Service 2013). There are also intermediate viewpoints such as that of Denning (2013), who argues in the *Wall Street Journal* that talk of a

[1] According to Energy Information Administration data, there were very small declines in U.S. electricity use in 1974, 1982, and 2001, but the first multiyear decline has been in the period after 2007 (EIA 2014).

looming death spiral for utilities is “hyperbole . . . but only up to a point” and further suggests that “mass adoption [of DG] is likely years away, but it is no longer over the horizon.”

Natural gas utilities also face substantial changes, although they are significantly different from those affecting electric utilities. In the case of natural gas, due to the “fracking revolution,” supplies of natural gas are increasing and prices are lower than price peaks reached during the first years of the 21st century. At the same time, gas sales per household have been declining, primarily due to energy efficiency improvements. Gas utilities are now looking to grow loads, particularly in increased market share for gas space heating (such as displacing oil in the Northeast), distributed generation (including cogeneration and small-scale generation), industry, and transportation (IHS CERA 2014).

In recent years, the utility sector (electric and gas) has increasingly embraced energy efficiency programs for end-use customers. Spending on energy efficiency programs totaled about $7.2 billion in 2012 (Downs et al. 2013), with energy savings of about 139 billion kilowatt-hours in 2012, amounting to about 3.7% of total 2012 electricity sales (EIA 2014). This latter figure includes measures installed in 2012 as well as measures installed in earlier years that were still in place and saving energy in 2012. This represents a substantial increase over earlier years, as shown in Figure 1. Energy efficiency savings generally cost much less per kilowatt-hour saved than it costs to build and operate a new power plant (Molina 2014).

The challenge, then, is how to re-envision the utility industry so it can provide important and needed services in a changed environment while also allowing cost-effective energy efficiency services that benefit customers. Many other observers have commented on visions of the “utility of the future,” and we summarize their work later in this paper. As energy efficiency practitioners, we are particularly interested in identifying appropriate roles for cost-effective energy efficiency in this new environment, and thus relative to other work on this topic, we focus on the role of energy efficiency in the context of the much broader set of issues facing the utility industry. In this paper we next look at several scenarios for what future electricity sales might be. Future sales trends are important because models for the future may well be different if sales are increasing, decreasing modestly, or decreasing rapidly. Given the rhetoric about “death spirals,” it is useful to explore how probable such an event might be. Following these scenarios,

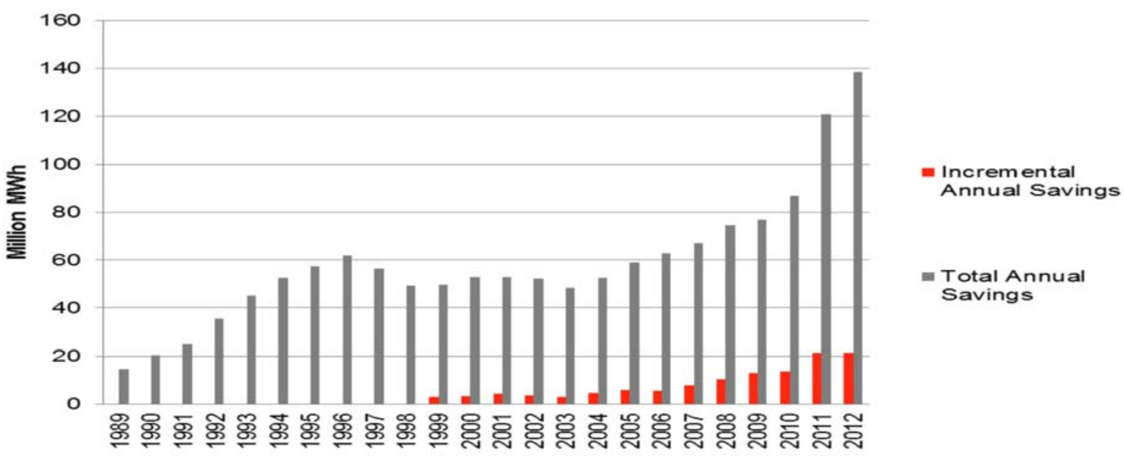

Figure 1. Energy efficiency savings by year. “Incremental annual savings” are the savings from energy-saving measures installed that year. “Total annual savings” include savings from all measures in place in a given year, regardless of when the measures were installed. The latter measure accounts for the fact that the typical energy efficiency measure has a service life of multiple years. Data are from EIA 2014.

we review various options for the future found in the literature and assess the pros and cons of these options. We then summarize our discussion on the role of energy efficiency and discuss pathways to the utility of the future over the short, medium, and long terms, including recommendations for utilities and policymakers.

Scenarios for Electricity Sales: Is a "Death Spiral" in the Offing?

Our analysis is based on the 2014 *Annual Energy Outlook Early Release* prepared by the Energy Information Administration (EIA) and published in December 2013 (EIA 2013). Since trends are likely to vary by region, we separately analyzed 20 electric market regions using the EIA forecast. For each region, we used the EIA's reference case as one scenario. We then prepared two enhanced scenarios for each region based on consideration of four factors: (1) enhanced energy efficiency investments, (2) increased use of end-use photovoltaic systems, (3) increased use of combined heat and power (CHP) systems, and (4) increased use of electric vehicles. We did not include fuel switching in our scenarios because climate advocates are actively promoting fuel switching *to* electricity and gas utilities are doing the same *away from* electricity, and it is unclear how these efforts will ultimately balance out.

We consider the EIA reference case scenario to be a medium-change scenario and therefore developed medium-high-change and high-change scenarios for each of the four factors. For energy efficiency, our two alternative scenarios involve ramping up annual energy efficiency savings to 1.5% and 2.0% per year. For CHP, we developed two scenarios based on estimates of potential generation by state in different payback bins as estimated by Hedman, Hampson, and Darrow (2013). For end-use photovoltaic systems, we used a Solar Energy Industries Association forecast of sales to 2016 (SEIA 2013), assumed a drop in sales in 2017 after federal tax credits end, and then ramped sales up by 10% or 15% per year within the constraint of never developing more than 80% of the technical potential for rooftop solar estimated by Lopez et al. (2012). Our scenarios included rooftop but not community-scale photovoltaic systems, as the latter are commonly considered utility systems (Lopez et al. 2012). For electric cars, we based our high-change scenario on an optimistic projection developed for a National Research Council study (NRC 2013). Our medium-high-change scenario was based on the "probable" penetration given in an earlier NRC study (NRC 2010).

The medium-high-change scenario is designed to be highly plausible, but more aggressive than the EIA reference case. The high-change scenario is even more aggressive, and while clearly plausible, the changes included are at a level that many observers would consider unlikely. Details on the analysis are provided in our full report (Nadel and Herndon 2014).

National Results

On a national basis (the sum of all regions in the Lower 48 states), EIA projects that electricity sales will grow an average of 0.70% per year over the 2014–40 period. In our medium-high-change scenario, this declines to average annual growth of 0.04%. In our high-change scenario, on a national level, electricity consumption *declines* modestly (average annual growth rate of -0.39%). Thus, while national sales are unlikely to grow as they have in the past, even our high-change scenario casts doubt on some alarmist projections: A sales decline of 10% over nearly 30 years cannot be called a "death spiral." The three scenarios are illustrated in Figure 2.

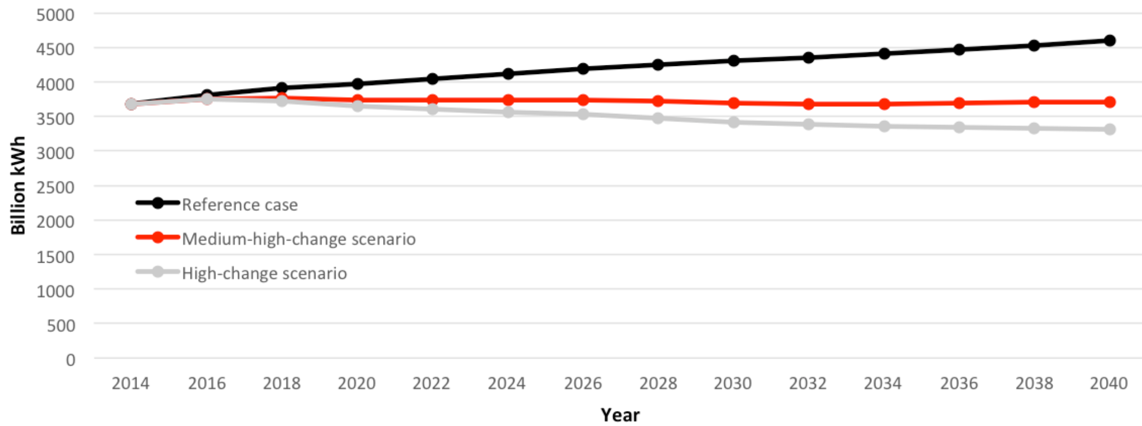

Figure 2. Electricity sales in the Lower 48 states over the 2014–40 period under three scenarios.

It is also useful to look at the factors causing the differences between the EIA reference case and our two alternative scenarios. At the national level, in the medium-high-change scenario, energy efficiency is the biggest contributor to the reduced sales relative to the reference case, with photovoltaics second. Electric vehicles cause a modest increase in electricity sales and the contribution of CHP is negligible since the EIA reference case includes a lot of CHP and other distributed generation. In the high-change scenario, energy efficiency is again the largest cause of sales decline relative to the reference case, followed closely by photovoltaics. The sales increase from electric vehicles is more substantial in this case than in the medium-high-change case, but it only offsets about half of the electricity produced by photovoltaic systems. Again, CHP makes a very small contribution in this case because so much CHP and other DG are included in the reference case. These trends are illustrated in Figure 3.

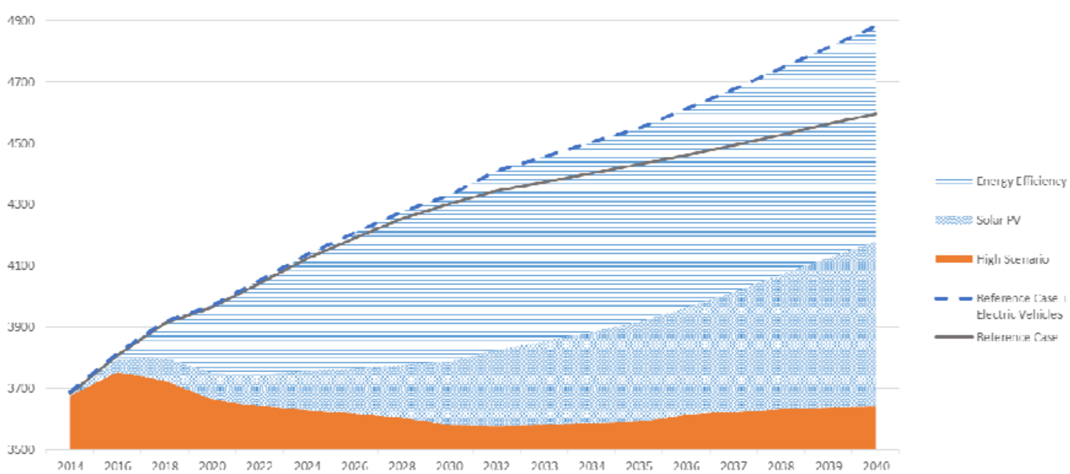

Figure 3. Increases and decreases in electricity consumption in the Lower 48 states in the high-change scenario relative to the reference case.

Regional Results

Results in some regions are very similar to the national results, but in other regions they vary substantially. For example, in the majority of regions, in the medium-high-change scenario electricity consumption grows modestly over the 2014–40 period, with sales growth at less than 0.5% per year. However, in eight regions, consumption decreases (see Table 1).

In the high-change scenario, electricity consumption falls modestly in most regions, but there is only one region (MRO East) where sales decline by more than 1% per year. In this scenario there is still modest growth (less than 0.5% per year) in three regions –SPP South, WECC Southwest, and WECC Northwest. Thus, even at the regional level, there is no "death spiral". Compound growth rates by region, as well as which primary states make up each region, are summarized in Table 1.

Table 1. Electricity consumption growth rates by region over the 2014–40 period

Compound Annual Growth Rates				
Region	Primary States Included	Reference Case	Medium-High-Change-Case	High-Change Case
New York State	NY	0.10%	-0.35%	-0.73%
TRE All	TX	0.89%	0.02%	-0.66%
FRCC All	FL	0.84%	0.10%	-0.74%
MRO East	WI	0.46%	-0.48%	-1.44%
MRO West	MN, IA, NE, ND, SD	0.58%	0.06%	-0.47%
NPCC New England	ME, NH, VT, MA, RI, CT	0.21%	-0.13%	-0.37%
RFC East	East PA, MD, DE, NJ	0.40%	-0.55%	-0.54%
RFC Michigan	MI	0.41%	-0.12%	-0.58%
RFC West	North IL, west PA, IN, OH, WV	0.48%	-0.10%	-0.46%
SERC Delta	AR, LA, west MS	0.85%	0.04%	-0.44%
SERC Gateway	East MO, south IL	0.49%	-0.42%	-0.92%
SERC Southeastern	AL, GA, southeast MS	0.86%	0.19%	-0.04%
SERC Central	KY, TN, northeast MS	0.86%	0.08%	-0.49%
SERC VACAR	VA, NC, SC	0.86%	0.12%	-0.53%
SPP North	KS, west MO	0.57%	-0.11%	-0.38%
SPP South	OK	0.88%	0.23%	0.03%
WECC Southwest	AZ, NM, south NV	1.15%	0.34%	0.01%
WECC California	CA	0.74%	0.23%	-0.21%
WECC Northwest	WA, OR, ID, MT, UT, west WY, north NV	0.87%	0.63%	0.32%
WECC Rockies	CO, east WY	1.15%	0.41%	-0.04%
United States	**All states, excluding AK and HI**	**0.70%**	**0.04%**	**-0.39%**

There are also significant differences between the regions on the effect of energy efficiency, photovoltaics, and electric vehicles. Energy efficiency effects are particularly strong in regions that have not historically implemented many energy efficiency measures since these regions have relatively little efficiency imbedded in the reference case. The effects of photovoltaics are particularly strong in the medium-high change scenario in California, MRO East, RFC East, and WECC Southwest. This list expands to other regions in the high change scenario. Electric vehicles are strong in the medium-high change scenario in New York State, New England, RFC East, and California. The regional differences in photovoltaics and electric vehicles are all a reflection of trends in the EIA reference case.

Options for the Future

Dozens of articles, papers, and reports have been written about the future of the utility industry and ways it can or should adapt. In our full report (Nadel and Herndon 2014) we summarize more than 50 of these pieces. We also conducted interviews with about a dozen utility industry participants and observers to get their insights into these issues. These materials show that there is a wide range of opinions on where the utility industry is or should be heading. Some observers, such as Peter Fox-Penner (2010) and the Rocky Mountain Institute (2013), suggest that radical change is needed, while others suggest implementing only incremental changes and many observers suggest substantial but not radical changes. In this section, we list and very briefly summarize the many changes to the utility system that have been suggested, starting with the most modest changes and ending with the more radical ones. The exact order in which we list these options is a matter of judgment and should be considered approximate.

1. *Better management:* Management improvements are suggested to improve functions and reduce costs. Examples include improving field services and call centers and upgrading grid operations in a variety of ways.
2. *Expand customer options and response:* These suggestions are intended to enable customers to better make informed decisions. This includes a variety of demand-response initiatives, including a "set and forget" option that emphasizes the use of automated load management, with customers choosing their own settings.
3. *Decoupling and shareholder incentives:* Decoupling adjusts rates based on actual sales so that utilities fully recover their fixed costs, but do not over-recover. Decoupling is particularly useful when sales may decline. Shareholder incentives reward shareholders for meeting goals established by regulators. About half the states are now implementing both strategies (Downs et al. 2013).
4. *Reform electricity pricing:* Suggestions include net metering, reforms to how fixed network costs are recovered, and new tariff structures, such as increased employment of time-of-use rates, demand charges for all customers, and minimum bills as well as higher fixed monthly charges.
5. *Foster innovation, including expanded R&D and more competition:* Calls to expand R&D, competition, and partnering between utilities and more innovative firms in other fields are proposed.
6. *Improve infrastructure:* The U.S. grid is aging and portions need to be replaced or upgraded in order to maintain reliability. Recently, in the wake of Super Storm Sandy, there are also calls to improve resiliency by better protecting the grid and making it more flexible so fewer customers are affected by an outage.
7. *Long-term planning:* Given the need to balance a variety of potential distribution, transmission, generation, and energy efficiency resources, several observers see long-term planning as an important attribute for the utility system of the future.
8. *Expand energy efficiency and renewable energy:* Many reviewed sources recommend expanding programs to encourage energy efficiency and renewable energy in order to save money, extend available energy supplies, and provide a valued customer service.
9. *Expand the transmission system:* A number of observers suggest that the transmission system should also be expanded in order to make the grid more efficient and reliable by alleviating congestion, promoting bulk-power competition, reducing generation costs, and allowing grid operators to balance supply and demand over larger regions.

10. *Limit generation expansion:* With electric sales potentially declining, it's debatable whether a lot of new generation is needed or whether expansion should be limited to critical needs such as fast-ramp-up plants to help balance intermittent renewable generation.
11. *Performance-based regulation:* Performance-based regulation (PBR) is the implementation of rules that include explicit financial incentives to encourage a regulated firm to achieve certain performance goals, while still affording the firm significant discretion in how the goals are achieved. This discretion is intended to enable the firm to employ its superior knowledge of its operating environment to achieve the desired goals.
12. *Expand utility services:* This involves offering customers new services that provide a new source of revenue. Many of the suggestions related to core utility competencies, such as helping to finance, engineer, and operate DG systems, particularly community-scale systems or systems for large customers. New services could be regulated and/or unregulated.
13. *Establish long-term climate policy:* Establishing clearer direction on climate policy would allow utilities and other market participants to make better-informed business decisions. Some utilities are already making assumptions about such policies in their planning, and some states are establishing limits on carbon dioxide emissions.
14. *Improve ability of utilities to invest and to recover costs:* EEI (2013) suggests a variety of ways to make investments more attractive to utilities, such as faster depreciation, higher rates of return, and customer advances in aid of construction.
15. *Energy efficiency utility:* Vermont has established a separate utility to run energy efficiency programs in most of the state. Several other states have somewhat similar models. VEIC (2013) suggests that other states consider such an option.
16. *Utility as "FinanceCo":* Under this model the distribution utility provides on-bill financing for customers to invest in efficiency and/or DG, working with approved third-party service providers. The utility pays service providers based on verified performance for installing and managing resources (RMI 2013).
17. *Utility as a smart integrator:* A smart integrator is a utility that operates the power grid and its information and control systems but does not actually own or sell the power delivered by the grid. The role of the smart integrator utility will be to deliver electricity from a multitude of sources (traditional generators, distributed generators, renewables) at prices set by regulator-approved market mechanisms to customers who have been empowered through smart-grid technologies to alter their personal energy demand based on price signals. A smart integrator may or may not offer other services.
18. *Energy services utility (ESU):* An ESU is a regulated electricity-producing entity whose prices and profits are controlled. It is responsible for supplying all retail generation customers' demand with high reliability while also providing demand response, energy efficiency, and smart-grid services and technologies to its customers. It can own the generators that provide its supply, whether large upstream plants or small local ones, but it is also required to purchase or transmit power generated by others attached to its wires.

Impacts of the Options

Many of these 18 different options for the future can be combined, so it will ultimately be a choice of which option(s) to pursue. In an effort to help make sense of these options, we performed a high-level assessment of each one along the five dimensions of their effects on: (1) energy efficiency, (2) cost of service (energy bills, which in turn depend on both consumption and rates), (3) quality of service, (4) utility profits, and (5) the environment. In the paragraphs below we summarize these results. Our fuller analysis can be found in Nadel and Herndon (2014).

We find that a significant majority of the options are positive or neutral for these five criteria, particularly if done well. But in nearly all cases it is also possible to do things poorly and cause negative consequences. Overall, we found that the following options are generally positive or neutral *if* done well:

- Better management
- Expansion of customer options and response
- Decoupling and shareholder incentives
- Fostering innovation (we treat competition separately below)
- Long-term planning
- Performance-based regulation
- Expand utility services
- Energy-efficiency utility
- Utility as “FinanceCo”

For a number of options there are tradeoffs, or there is a significant chance they can be done poorly. Many of these will be worth pursuing with care. These options include:

Reform electricity pricing: Care is needed to make sure reforms do not unduly hinder energy efficiency and renewable energy investments by reducing variable costs below the long-term cost of new resources or by imposing punitive charges. In addition, new pricing models need to be understandable and workable for customers or else they may not have the desired impact.

Improve infrastructure: Some infrastructure improvements will be needed, but care must be used to prioritize improvements and to keep costs in check. The Australian experience is a case in point; there, too much was invested in infrastructure and electric rates skyrocketed (CSIRO 2013). In some, but far from all, cases, targeted energy efficiency investments can be of a lower cost than infrastructure investments (Neme and Sedano 2012).

Expand energy efficiency and renewable energy: Energy efficiency helps reduce customer bills and can help utilities keep rates down and customer satisfaction high. Decoupling and shareholder incentives are needed to avoid negative impacts on utility profits.

Expand transmission system: As with infrastructure, this option should be undertaken with care. Some projects will be needed to increase the size of balancing areas and bring renewable resources from rural areas and major load centers. But overinvestment can needlessly raise the cost of service, and transmission projects do have some environmental impacts.

Limit generation expansion: Low load growth means less new generation will be needed. Some new generation will be required in rapidly growing areas or where substantial existing generation is being retired. In some regions, new generation that can quickly ramp up production to balance fluctuating renewable production will be needed. Before building new generation, it makes sense to first confirm that additional central generation will be less expensive than energy efficiency, renewable energy, or distributed generation. However, less new generation limits opportunities for utilities to earn financial returns, so other opportunities to earn money may need to be explored, such as shareholder incentives for energy efficiency or marketing of additional services. If generation expansion is constrained too much, service quality can suffer. Some of these problems can be avoided if development of new generation is left to the market, with investors (including unregulated utility subsidiaries) taking on the risks rather than the ratepayers.

Establish long-term climate policy: A long-term climate policy is good for the environment and will be generally helpful for energy efficiency and renewable energy. However, climate policy is likely to raise the cost of service a little, and will hurt the profits of companies owning substantial coal generation. Climate policy details will need to be designed in ways that permit utilities with a lot of coal generation to adjust.

Utility as "smart integrator": Utilities and other grid operators will need to play a smart integrator role. We believe that a smart integrator can and should continue to offer energy efficiency services. If utilities that now own generation are required to divest their generation resources, their revenues will likely decline. A smart integrator role makes sense for utilities that do not own significant generation. Smart integration can also make sense for integrated utilities that want to avoid the risks of long-term investments in generation or do not think that generation will be profitable in the future. Unless these situations apply, integrated utilities may prefer the "energy services utility" model.

Energy services utility: This model may make sense for currently integrated utilities. But with loads barely growing, and with inherent incentives for capital investment in order to increase profits, this model requires more regulatory oversight than most of the other options.

Competition: Competition can be useful for many services as well as at the wholesale level (including competition for capacity and ancillary services). However, retail competition, while often positive for large customers, has performed poorly for residential and small commercial customers (Joscow 2003). Also, energy efficiency programs have generally been very successful, and while market competition can be useful, if programs are discontinued to rely exclusively on the market, then experience indicates that there will likely be reduced levels of efficiency investment, resulting in an increased need for more expensive resources (see Kushler and Witte 2001).

The Role of Energy Efficiency

Energy efficiency features prominently throughout the discussion above, but it is only one of many factors considered. We believe such a broad approach is appropriate since the role of energy efficiency in the utility of the future cannot be considered in isolation and is only one of many issues that utilities and policymakers need to grapple with as they chart a path to the future. Still, it is appropriate at this stage to focus a little more on the role of energy efficiency by weaving together some of the strands from the various previous discussions.

Energy efficiency is typically the lowest-cost resource for electricity (Molina 2014). The same is largely true for natural gas, although not to quite the same degree (Young, Elliott, and Kushler 2012). As discussed previously, energy efficiency may also be used to defer transmission, distribution, and generation investments in some cases. A variety of examples are discussed by Neme and Sedano (2012). Energy efficiency can also be a low-cost emissions reduction strategy, which will likely be important as the Environmental Protection Agency sets and states implement new carbon dioxide emissions rules for existing power plants (Hayes et al. 2014). Furthermore, by lowering consumption, energy efficiency lowers bills, making rate increases to pay for required new infrastructure more affordable. Thus, energy efficiency investments are an important tool as utilities seek to manage costs and risks while benefiting customers. Energy efficiency is a service valued by many customers, and its use can contribute to improved customer satisfaction (SEE Action 2011) and be an important part of utility customer engagement efforts, including providing efficiency services and using efficiency as a gateway to other services.

However, energy efficiency does lead to a decline in utility sales and as a result does affect utility revenues. Electricity use in the United States peaked in 2007, and while some of this decline is due to the Great Recession, recent analysis indicates that increased savings from energy efficiency are a significant factor (Nadel and Young 2014). EIA projects very modest growth in electric consumption over the 2014–40 period, but our scenarios for increased use of energy efficiency, photovoltaics, other DG, and electric vehicles show that it is possible for consumption to level off, and perhaps modestly decline. The effects of energy efficiency are the largest of these four contributing factors.

For energy efficiency to flourish, use of decoupling needs to be expanded so that utilities can recover their fixed costs, even if sales decline. Shareholder incentives for achieving efficiency goals will also need to be expanded so utilities can earn some return on energy efficiency investments, just as they earn a return on investments in power plants and infrastructure. Another option is performance-based ratemaking. Where this is employed, success in achieving energy efficiency savings should be among the metrics used.

Energy efficiency programs funded by utilities have saved a substantial amount of energy, as shown in Figure 1. In the United States, such programs are most commonly operated by distribution utilities, although there are other models in use, such as operation by a state agency or state-chartered organization. All of these can work if the lead organization is motivated, has the right staff, and is not unduly impeded by red tape. The important point is that having proactive energy efficiency programs can dramatically increase savings relative to just relying on the market (Kushler and Witte 2001). Utility-funded energy efficiency programs are needed to help overcome market barriers (see, for example, Vaidyanathan et al. 2013) and help create a stronger market that includes contractors hired by utilities as well as increased demand for energy efficiency services. Without such programs, efficiency savings will be lower and needed investments in generation, transmission, and distribution higher, increasing rates and bills.

To be most useful for the utility of the future, energy efficiency programs should be well integrated with demand-response and DG efforts. Such integration includes the possibility of utilities directly investing in CHP and other DG at customer sites or in communities, using low-cost utility capital and leveraging utility expertise in power plant development and operation.

For energy efficiency investments, power prices need to be fair to all. A particular issue is how to balance fixed monthly charges with variable rates based on energy consumption and peak demand. In our view, variable prices need to be based on long-run marginal costs, including the costs of new generation, transmission, and distribution investments that will be needed. Some reasonable level of costs can be included in fixed monthly charges, such as recovering the costs of billing, but in general we prefer recovering grid costs through time-of-use rates, variable demand charges, and/or minimum bills rather than through high fixed charges. The higher the fixed charge and the lower the variable charge, the less incentive there is for customers to invest in energy efficiency.

Utilities that use energy efficiency as their first resource can contain rate increases and risk while providing customers with valued services and lower bills. But for this to happen, regulators need to send the right signals through decoupling, shareholder incentives, and/or performance-based ratemaking. Without energy efficiency, customer bills will be higher, and while utilities may profit from increased sales in the short term, in the long term unhappy customers and regulators may make for weaker financial performance.

Paths Forward

The road from the present to the utility of the future is likely to be winding and bumpy, but it will become clearer over time as the many unknowns are resolved, and as utilities and policymakers explore new approaches and see what works. In particular, we note that since the utility industry is at its core a regulated monopoly, regulations and business practices must evolve in tandem for progress to be made. Furthermore, there is no single answer, and it is likely that each state and each utility will pursue its own path, although many of those paths will be similar and ultimately will likely evolve into a few primary routes. There is also the question of timing, with some decisions to be made soon and others a decade or more off. Using timing as our organizing principle, in the sections below we suggest some primary paths forward for the short term (the next three years), medium term (the following five years), and long term (eight or more years from now).

Short Term

As the need for change is becoming more apparent, there are many things that utilities and policymakers should consider over the next few years.

- Expand the use of energy efficiency as a way to replace retiring generation, minimize rate increases, meet environmental requirements, and provide a valued customer service. This path includes using energy efficiency as an alternative to transmission and distribution investments wherever energy efficiency is a viable alternative.
- Institute decoupling and shareholder incentives for meeting energy efficiency goals.
- Increase the use of demand response and smart pricing, and better integrate these mechanisms with energy efficiency programs and policies so the grid can be better managed at lower cost. To provide just a couple of examples, the wealth of data supplied by smart meters can be better tapped to identify good opportunities for energy efficiency and demand response to better inform and motivate consumers about these opportunities, and also to better optimize voltage on individual distribution circuits.
- Establish fair pricing to pay for fixed costs without unfairly discouraging investments in energy efficiency and distributed generation.
- Look at infrastructure needs and prioritize them so that key projects with significant net benefits can move forward. Other states should consider what Massachusetts is doing in this regard (Massachusetts DPU 2013). Where balancing areas are small, operating areas should be combined.
- Experiment with new utility services to see what works in particular situations. In our opinion, utilities will ultimately have to rely more on value-added services for earning financial returns, starting with some experimentation in the near term. Many of these services will be unregulated or subject to light regulation since they will be optional for customers. Fair rules need to be established so utilities and third parties can compete on a level playing field, including: (1) rules on affiliate transactions so utility-owned service subsidiaries do not have an unfair advantage, and (2) limited and quick utility commission reviews so utility affiliates can be nearly as nimble as unregulated firms. Given the need for utilities to earn some profits, we see additional services as a key area for growth and preferable to having their profits depend in substantial part on growing their rate base.

- Manage well. While utilities and regulators generally seek to improve performance to lower costs and increase value, in coming years, good management will be increasingly important.
- Experiment with performance-based regulation. If done well, PBR can benefit both consumers and utilities, but if done poorly, adverse consequences are likely. Initial experimentation will help utilities and regulators find out what works and what pitfalls to avoid. Performance metrics will likely differ from state to state and between vertically integrated and wires-only utilities.
- Increase efforts to better manage a diverse grid with large contributions from DG and variable resources. For example, balancing and scheduling should be done over shorter periods of time, weather forecasting should be upgraded so renewable energy output is better predicted, demand-response resources should be deployed more extensively, experiments should be undertaken with various forms of power storage, and fast-ramp-up generation should be added where needed. These efforts will require good planning as well as implementation of flexible grid-management approaches. EPRI (2014) discusses these issues in more detail.
- Reduce uncertainty about future environmental regulations by completing a variety of pending rulemakings that affect the power sector. These include pending regulations on carbon dioxide emissions for existing and new power plants, impacts of power plant cooling on water bodies, and proper storage and disposal of coal ash. Power plant owners can best make decisions about how to manage their resources and systems when they know all the rules they will face. Getting air quality and economic regulators to work jointly in the same docket to address these issues proactively will generally result in better long-term decisions with lower costs to consumers.
- Think very carefully before proceeding with decisions to build new generation. With loads barely growing in most of the country and the potential for future declines, before proceeding with decisions to build that will affect bills for 40 years or more, utilities and regulators should first carefully consider alternatives, including energy efficiency, demand response, and encouragement of DG. As discussed by Binz et al. (2012), regulators should practice "risk aware regulation."

Medium Term

Over the medium term, utilities and policymakers will increasingly need to pursue the following options:

Develop and offer optional services, moving from the pilots discussed above into broader-scale offerings. We see these services as an important part of future profitability. In particular, utilities can leverage their expertise in power-system and energy efficiency engineering and operations to build on their traditional core competencies. Such services should grow from customer needs, and in many cases they will compete with services offered by other nonutility service providers.

Develop and implement new systems and capital plans for managing increasingly complex grids. The growing use of renewables and other DG will make new techniques for managing a complex grid increasingly essential.

Establish and implement best practices for performance-based regulation, building on initial experiences in the short term that show which practices work.

During this period, many of the efforts begun in the near term will continue, including expanding energy efficiency and demand-response efforts and prioritizing needed infrastructure improvements. This medium-term period should also be used to experiment with new long-term structures such as the utility as smart integrator and the energy services utility. Climate change policy may also become clearer during these years, through both government action and the actions of consumers and businesses.

Long Term

By the mid-2020s, each state and utility will likely have to choose a long-term model. All such models show a clear need for a single wires operator and a system integrator to ensure reliability, a.k.a. “the utility.” In our view, this entity should play an important role in funding and implementing energy efficiency investments, because these help to lower costs for all customers. Without such programs, the rate of energy efficiency adoption will be lower and the demand and costs higher.

A key question will be whether the system integrator also owns generation. In some states, utilities have already divested their power plants and there is wholesale competition. In others, integrated utilities are required to plan for generation needs and to acquire generation through open bidding. These states are more likely to employ the smart integrator utility model. Still other states have vertically integrated utilities that own generation. These states and companies will have to decide whether to continue with exclusive utility control of new-generation additions and vertical integration, or to open the market for new plants to the utilities’ competitors.

The energy service utility model is likely to be used where utilities continue to own substantial generation. There are also a variety of options somewhere in between the smart integrator and energy service utility models. Furthermore, the choice as to whether a utility owns generation may not be black-and-white, since in either of these two models it may be possible for utilities to invest in small generation to help foster this market and provide new sources of investment return. In states with the smart integrator model, there could be caps on such generation (e.g., no more than a chosen percentage of load) or requirements to spin off such investments after a defined period of time, such as five years.

In addition to the options mentioned in this section, some of the options discussed in prior sections may be pursued in a few states, but we do not think they will become widespread. For example, some states may improve the ability of utilities to invest and recover costs, but our sense is that most states will not, preferring to leave risks to the utilities and other market players. Some states may pursue an energy efficiency utility model, but in most states they are likely to have distribution utilities provide energy efficiency services as long as they perform well (which depends in part on the incentives they are given). Some utilities may establish a FinanceCo, but thus far few utilities seem very interested in this approach, with the possible exception of providing financing for systems that are within their core expertise.

Conclusion

The future of the utility industry is far from clear, with uncertainties related to future sales, the role of distributed generation, environmental regulations, and future business and regulatory models. One thing that is clear is that we are likely to face the old Chinese curse “May you live in interesting times.” The next few decades will probably be challenging for the utility industry as utilities and regulators grapple with roughly level demand, increasing use of distributed generation, and a more complex grid. A utility industry with substantially increasing sales driving increasing profits is unlikely, but our analysis indicates that a "death spiral" is also unlikely. In this environment, utilities will likely need to pursue new services, good management, decoupling, and incentives for achieving energy efficiency goals to increase profits. In this environment we believe that energy efficiency should, and will, play a strong role, as utilities can help their customers use energy more efficiently as a way to moderate rising utility risks and customer bills while also providing valued customer services and protecting the environment. However, preparing for a strong utility of the future while also meeting public goals will require getting the rules right and establishing fair policies and robust systems in many areas, including the pricing of power, decoupling profits from sales, and coordinating the grid. To get on this path, important decisions will need to be made in the short term and built upon over the medium and long terms. But if we can get these rules and systems right, utilities can profit, customers will get services they want without high bills, and we can all enjoy a clean environment.

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