

The changing utility industry and opportunities to improve energy efficiency: Insights from the U.S., Germany and Australia

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Abstract

The electric utility sector in Australia, Germany and the U.S. are all going through major changes driven by declining sales, increasing use of distributed energy sources and policy responses to global climate change. This paper discusses efforts in each of these countries to reform their electric industries, address climate change and promote energy efficiency. Going forward, we see a role for government, utilities and private market energy efficiency efforts in all three countries, although the emphasis will vary by country and will evolve over time. Where all three parties can work together with a common vision, reform efforts are likely to be more successful and more sustained. In all three countries the future is uncertain. In the face of this uncertainty, energy efficiency supporters need to keep abreast of these changes, and find more flexible and nimble policy strategies for energy efficiency to prosper, as the future is likely to unfold in unexpected ways.

Introduction

In many countries there is increasing discussion about how the utility industry is changing and how old utility business models may be unsustainable. These discussions are generally focused on the electric sector (although also relevant to gas utilities) and are particularly prominent in the U.S., Germany and Australia. In all three countries total electricity sales have declined in recent years, even as GDP and population grows (Figure 1).

This decline is driven by energy efficiency as well as increasing use of distributed generation (DG), particularly user-owned photovoltaic systems and in Australia, by a sudden increase in electricity prices in recent years. (Nadel and Young 2014; Langham et al. 2010; Saddler H. 2013; Prognos/IAEW 2014).

Likewise, in all three countries new industry structures and service offerings are being discussed, which offer both opportunities and challenges for energy efficiency investments. However, the falling energy consumption and changing technology represents a challenge not just to the utilities but to energy efficiency itself, as some policy makers and utilities are arguing that in this context it does not make sense to promote energy efficiency. This paper summarizes the evolving electricity industry in each of these three countries, with an emphasis on opportunities to expand energy efficiency investments, and also pitfalls to avoid in such industry restructuring. We also discuss the symbiotic relationship between utility leadership and government policy – we need both in order for energy efficiency and the utility industry to both flourish.

Dozens of articles, papers, and reports have been written about the future of the utility industry and ways it can or should adapt. More than 50 of these are summarized in a recent ACEEE report. These materials show that there is a wide range of opinions on where the utility industry is or should be heading. Some observers suggest that radical reform is needed, while others suggest implementing only incremental changes and many observers suggest substantial but not radical changes (Nadel and Herndon 2014).

Below the major suggested reforms to the utility system that have been suggested are summarized, starting with the most modest reforms and ending with the more radical ones. The

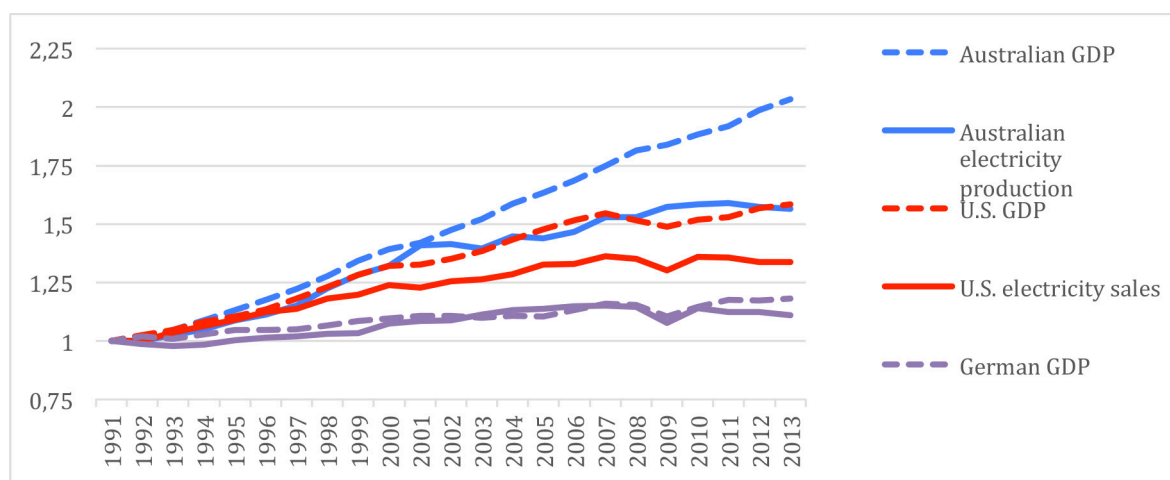


Figure 1. Electricity use and real GDP in Australia, Germany and the U.S. based on government data for each country. Data are in real (inflation adjusted terms) and normalized to 1991, with 1991=1 and other years a multiple of 1991. Australian electricity data is for production, German for gross consumption, U.S. for sales.

order listed is a matter of judgment and should be considered approximate. The original list derives from Nadel and Herndon (2014) but is modified here based on issues and experiences in all three countries. These reforms are illustrated in Figure 2 which also highlights the impact that each proposed reform may have on the development of energy efficiency. Reforms likely to promote energy efficiency are shown in green, while those likely to detract from energy efficiency are shown in grey.

REFORM OPTIONS

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, particularly demand 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, cost recovery and shareholder incentives*: Decoupling adjusts utility tariffs based on actual sales so that utilities fully recover their fixed costs, but do not over-recover. Decoupling is particularly useful to utilities when sales may decline, for example due to energy efficiency programs. Shareholder incentives reward shareholders for meeting goals established by regulators. About half the U.S. states are now implementing both strategies (Gilleo et al. 2014). Germany has partial decoupling.
4. *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.
5. *Improve/expand network 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. Australia and Germany have done more in recent years to improve their grids, but questions remain about how suitable these upgrades are for the changing energy market. In addition, 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, promote bulk-power competition, reduce generation costs, and allow grid operators to balance supply and demand over larger regions.
6. *Make the distribution network smart*: A smarter network can include improved sensors and controls on the distribution system and may include smart meters on customer premises. Making the network smart makes it easier to identify and address problems, improving reliability and potentially reducing costs.
7. *Long-term, least cost 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. Such planning could be done by government or bodies responsible for the electric grid.
8. *Increase energy efficiency*: Many reviewed sources recommend expanding programs to encourage energy efficiency in order to save money, and provide a valued customer service, noting that energy efficiency programs tend to be positively correlated with customer satisfaction. This option can include setting of mandatory targets (now in place in 24 U.S. states) and tradable certificate schemes (currently applies in Australia’s two most populous states).
9. *Increase renewable energy*: Many reviewed sources recommend expanding programs to promote renewable energy in order to extend available energy supplies. This option can

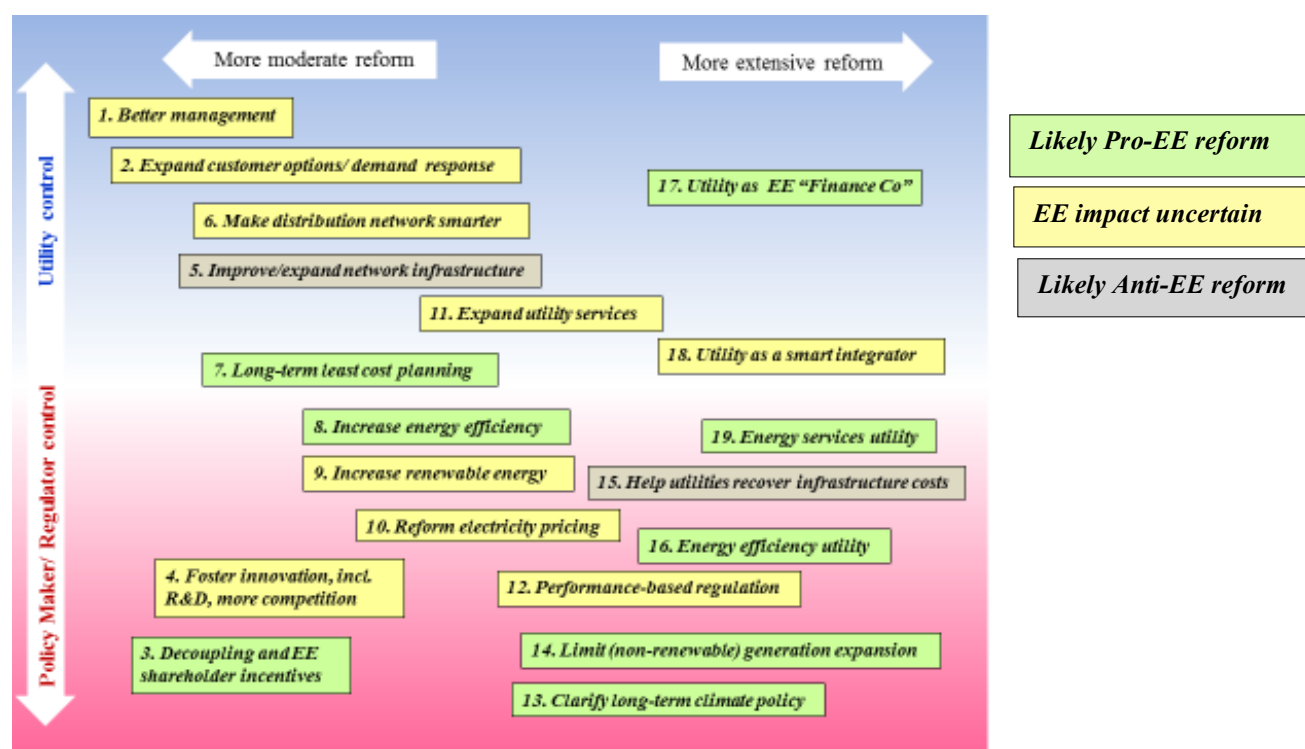


Figure 2. Electricity reform options by locus of control and degree of ambition.

include setting of mandatory utility targets or "portfolio standards" as applies in many U.S. states and tradable certificate schemes as applies in Australia.

10. *Reform electricity pricing:* Suggestions for the USA include reforms to retail net metering and to how fixed network costs are recovered, including increased use of time-of-use rates, demand charges for all customers, and minimum bills as well as higher fixed monthly charges. For Germany, there have been suggestions to modify network charges to foster shifting of loads to times with low load and high wind/PV generation, and to make PV self-generators cover the cost of the back-up grid.
11. *Expand utility services:* This involves offering customers new services that provide a new source of revenue. Many of the suggestions relate 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.
12. *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 knowledge of its operating environment to achieve the desired goals. Performance-based regulation can be used to enhance energy efficiency performance of utilities if efficiency metrics are explicitly included. Alternatively, if poorly targeted it can discourage energy efficiency, e.g. by encouraging sales if increased sales will decrease the price per unit of kWh supplied.

13. *Clarify long-term climate policy:* Establishing clearer direction on climate policy in Australia and the U.S. 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. In Germany, policies have been established but could be further clarified.

14. *Limit (non-renewable) 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. Government regulators could carefully consider whether generation and transmission projects are needed before approving them or authorizing cost recovery.

15. *Improve ability of utilities to recover infrastructure costs:* EEI (2013) suggests a variety of ways to make infrastructure investments more attractive to utilities, such as faster depreciation, higher rates of return, and customer advances in aid of construction.

16. *Energy efficiency utility:* In the U.S. the state of Vermont has established a separate utility to run energy efficiency programs in most of the state. Several other states have somewhat similar models. In Germany there have been suggestions to *create an energy efficiency authority and fund* to establish coherence between the efforts of all actors (including energy companies), develop additional policies and measures if needed, monitor progress and evaluate policy impacts (Wuppertal Institute 2013).

17. *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.
18. *Utility as a smart integrator*: A smart integrator is a utility or network operator 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, energy storage) 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 could offer energy efficiency programmes with the right incentive regulation, and it may or may not offer other services.
19. *Energy services utility (ESU, for USA)/Supply company as an energy service supplier (ESS, for Germany)*: 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.

United States

CURRENT SITUATION

In the U.S., about 54 % of sales to ultimate customers are by investor-owned utilities (IOUs), about 27 % is by publicly-owned utilities (municipal and cooperative utilities and federal power marketing agencies) and the remaining 19 % by power marketers (APPA 2014).

The IOUs are regulated by state utility commissions, with policy changes sometimes initiated by the utilities and sometimes by the commissions. In some states the IOUs are vertically-integrated (own generation, transmission and distribution) while in some states these functions have been separated. Public utilities typically respond to local government (municipal utilities), cooperative boards (cooperatives) or boards appointed by the President (federal power marketing agencies). In states where vertically-integrated utilities have sold their generation assets, power marketers have been the primary purchasers. Some power marketers have also built new generation plants as largely unregulated plants that participate in power markets. Recent changes, as well as discussions about future industry changes, are primarily focused on IOUs and power marketers, although these changes will affect public utilities and ultimately public utilities will also likely need to make changes.

In the U.S., 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. While historically electricity sales grew at 6 % or more per year, in the years after World War II, 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 2014a). 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. Projections going forward range from modest consumption increases to modest consumption decreases (EIA 2014b, Nadel and Herndon 2014).

At the same time, the electric grid is aging, and many observers have called for major new investments in transmission and distribution. 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 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, EEI 2013).

THE ROLE OF ENERGY EFFICIENCY

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 \$7.7 billion in 2013, with energy savings of about 24 billion kilowatt-hours in 2013, amounting to about 0.67 % of total 2013 electricity sales. This represents a substantial increase over earlier years (Gilleo et al. 2014). Energy efficiency savings generally cost much less per kilowatt-hour saved than it costs to build and operate a new power plant (Molina 2014). In the U.S., while there are some federal, state and local energy efficiency programs, these tend to be much smaller than utility programs due to opposition to a large role for government by the rightward half of the American political spectrum, and due to resistance to tax increases. In the U.S., it is generally easier to finance efficiency programs through utility rates than through taxes.

RECENT DEVELOPMENTS

A number of the ideas listed in the introduction are starting to be implemented. In the paragraphs below some recent major trends are discussed.

New directions by leading utilities and regulators

A few state utility regulatory commissions have opened regulatory dockets to look into how utility industry business models and regulations need to change in order to prepare for the future. Most advanced is New York State where the regulatory commission is proposing a model where distribution utilities will be responsible for spurring investments that are needed to keep the grid reliable and prices reasonable, including investments in energy efficiency, demand-response, distributed generation, and transmission and distribution system upgrades. Under this

system, investments by independent market-based entities are encouraged, with the utilities as a backup. New York also plans to propose performance-based ratemaking and new rate designs (NYPSC 2015). Several other states are beginning to discuss their own changes, including Hawaii, California and Minnesota.

Likewise, a few utilities are looking to transform themselves in ways to prepare for the future. Particularly notable are NRG, National Grid USA, and Public Service Electric and Gas (PSE&G). NRG owns many merchant generating plants but sees its future in distributed generation, clean energy, individual choice, and the empowerment of the American energy consumer. Their CEO writes that “we are in the process of reorganizing ourselves from the customer’s perspective” and that we want to be “a leader in the area of renewables-driven ecosystems” (Crane 2014). National Grid, a subsidiary of the British company of the same name has issued a blueprint, “Connect21”, which combines a “resilient backbone” that can address extreme weather events and growing demand for renewable energy sources, a “market enabler” function that provides customers with price and other information they can act on, and “customized solutions” for customers including technical and financing assistance (King 2014). PSE&G has proposed to emphasize energy services, particularly energy-efficiency services. Their CEO has said, “I think we could make more money by selling less.” He suggests that utilities invest in energy-saving improvements in customer facilities such as factories and hospitals, earning a return on those investments just as they do on power plants. The customer may still hold legal title to the property, but the utility investments would be treated as a “regulatory asset” upon which returns could be earned. He acknowledges that utility investments in smart grid and distributed generation may be sexier, but he sees energy efficiency investments as smarter (Kuckro 2014).

Rate design

Several utilities have proposed to substantially increase fixed monthly customer charges, sometimes for all customers and sometimes just for customers with their own photovoltaic or other distributed generation system. Some utilities are also proposing to reduce payments for excess power provided to the grid by customer-owned renewable energy systems. Currently, in most of the U.S., fixed monthly charges are generally less than \$10 per customer per month, with the majority of the bill based on charges per kWh of consumption. Higher fixed charges increase revenues to the utility if sales are declining and can also, by reducing the charge per kWh, discourage customer investments in energy efficiency and distributed generation. Likewise, most states now mandate “net metering” whereby excess power from small renewable energy systems are sold back to the grid at the retail price of power. Proposals to increase fixed charges and eliminate net metering have typically met with substantial opposition from clean energy advocates and companies and from “Tea Party” advocates who promote self-reliance. So far, most states have chosen to make modest rather than extensive changes to fixed charges and net metering. In the medium-term, new more sophisticated rate designs are likely to come into use including expanded use of time-of-use rates, demand charges (charges based on a customer’s maximum kW demand) and minimum bills (so even low users contribute a minimum amount to covering system costs).

New emissions regulations

In June 2014 the U.S. Environmental Protection Agency proposed new regulations to regulate carbon dioxide emissions from existing power plants. Under the proposal state-specific emissions-reduction targets are set and each state must develop and implement a plan for meeting their target. Proposed state-specific targets are based on several “building blocks” but one of the building blocks is to ramp-up energy efficiency programs for end-users so that programs incrementally reduce electricity consumption by 1.5 % per year (i.e., annual savings more than double from current levels) (EPA 2014). If this rule is finalized in something like its current form many states are likely to expand their energy efficiency efforts since energy efficiency is often the least-cost way to meet the requirements (Hayes et al. 2014).

Energy efficiency

Given slowing electricity growth, a few utilities and free-market legislators and regulators have proposed to scale back energy efficiency efforts, arguing that if load is not growing, energy efficiency efforts can be reduced. As a result, programs in a few states are being reduced (Florida, Indiana and Ohio). On the other hand, due to declining natural gas prices and increasing environmental regulations, quite a few old coal-fired power plants are being closed, and some states and utilities are increasing their energy efficiency efforts including in Arkansas, Connecticut, Massachusetts, Missouri, Oklahoma and Rhode Island. A few additional changes – both increases and decreases are being discussed at the state level. And as noted above, if the new EPA emissions regulations for existing power plants are similar to the draft regulations, expansion of energy efficiency efforts is likely.

In most states, for the time being energy efficiency programs are likely to be operated by utilities as they generally have a good track record with such programs, and it is unclear how good a job other actors can do. This said, for market segments where the private sector can do a good job, they are likely to play a larger and larger role. For example, energy service companies have achieved large savings from hundreds of projects in the so-called “MUSH” market (municipalities, universities, schools and hospitals) and are looking to expand to some other large customer segments. Energy and home control companies, such as Nest, hope to grow their market share, using energy savings and load management as key services. As noted above, some traditional utilities, such as National Grid and PSE&G plan to play prominently in this space, and if they are successful, we expect other utilities to also expand their market-based energy efficiency efforts. But some market segments will be very difficult to reach such as low-income households, rental buildings where owners do not pay energy bills, and residential and small business customers who are not high users. For these segments it is most likely that distribution utilities will continue to lead efficiency efforts.

WHERE TO FROM HERE?

Many questions face the utility industry in the U.S. and many companies and regulators are looking for more information before making decisions. Is the decline in electricity sales permanent or only a temporary aberration? How successful are the initial efforts by leaders such as New York State, NRG and

National Grid? What are the details of the final EPA regulations on existing power plants? Once the answers to these questions are clearer, many more companies and regulators are likely to act. In general the consensus of most observers is that utilities, both IOUs and public utilities are here to stay. They will need to change, perhaps radically, but most regulators see them as playing a critical role, and will make sure they can remain viable businesses.

In terms of energy efficiency, expanded programs are probably more likely than reduced programs, driven by such factors as the new EPA regulations, the fact that energy efficiency is generally less expensive per kWh than new power plants, and by the interest of at least some customers in receiving energy efficiency services. Private-sector efficiency offerings are likely to grow, but utilities will often partner with these firms, and for market segments where the private sector cannot reach high market shares, utility energy-efficiency programs are likely to remain the primary energy efficiency effort. Since energy efficiency can lower customer bills and provide other important amenities, it is important for government to continue to encourage utilities to offer energy efficiency services, working with private-sector partners. Such involvement should include continued efficiency targets, providing a strong business case for utility investments in energy efficiency, and clearly delineating long-term climate policy. Without active government encouragement, and involvement, energy efficiency savings will be lower, and some of the economic and environmental benefits of energy efficiency will be lost.

Germany

CURRENT SITUATION

As in all of the EU, generation, transmission and distribution network, and supply (sales to final customers) are unbundled, with generation and supply fully competitive and unregulated in principle. We therefore do not use the term "utility" any more for energy companies in Germany. The network has a performance-based revenue regulation, with partial decoupling of revenues from power/electricity transmitted. In the liberalised wholesale electricity market, participants have the opportunity to trade electricity bilaterally on the over-the-counter market (OTC) or through the European Energy Exchange (EEX). With a view to trading volumes, 65 % of the electricity volumes have been traded OTC in 2013; nevertheless the share of exchanges is increasing as new regulation favors exchanges (Reuters 2014).

Policies promoting renewable energies and energy efficiency in Germany have a long tradition. In 1991, Germany enacted the Grid Feed-In Law (German: Stromeinspeisungsgesetz, StromEinspG) that obligated the energy companies to purchase electricity from renewable energy sources at minimum prices. It was replaced by the Renewable Energy Sources Act (German: Erneuerbare-Energien-Gesetz, EEG) in 2000, designed to increase the share of renewable energies in the German electricity generation. After the nuclear accident in Fukushima in March 2011, Germany has decided to phase-out nuclear energy by 2022. The revised version of the EEG is a crucial part of the German 'Energiewende'. The Combined Heat and Power Act (German: Kraft-Wärme-Kopplungsgesetz, KWKG) was en-

acted in 2002. According to the latest revision of the KWKG in 2012, the target of the law is to increase the share of combined heat and power in the German energy mix from roughly 15 % to date to 25 % by 2020.

Since 1993, as shown in Figure 1, gross electricity consumption grew continuously until 2008. Due to the economic crises there was a drop in 2009; in the years 2010–2012 the figures levelled off. Since 2013 electricity consumption is decreasing (also driven by mild weather in 2014) (AGEB 2014a). The policy target is for shrinking electricity sales (see below). In addition, the German government aims for 80 % of electricity generation from renewable energies by 2050, coupled with phasing out the remaining 9 nuclear power plants by 2022. Therefore, the challenge that energy companies in Germany are facing is much higher than in the USA: they basically have to completely reinvent themselves, their role, and their business model. This is particularly the case for the 'big four' (RWE, E.ON, Vattenfall Europe, and EnBW) who used to dominate power generation with their nuclear and coal-fired power plants, but also for many larger municipal companies with high shares of coal- and gas-based cogeneration. Although the current share of renewable energies in the German grid is 'only' 27.3 % (figure for 2014) (AGEB 2014b), they have driven down wholesale market prices despite the close down of 7,000 MW of nuclear capacity in 2011, and driven up net electricity exports to neighbouring countries to around 5 % of gross production. The latter effect is, however, also due to the low carbon prices in the EU Emissions trading scheme, making use of Germany's excess coal power capacity for those exports economically attractive. On the other hand, over 30 GW of PV power capacity has eliminated high daytime peak power prices on sunny days. Therefore, all major energy companies have been losing money on conventional power plants. The need to integrate fluctuating wind and photovoltaic power (currently 15 % of electricity generation but expected to grow) drives the development of new business models using, i.e., smart grids, storage, and demand response. The critical situations in the electricity system of the future will not necessarily be those of high system peak load, but those with high load but low wind and PV power generation—creating the need for load management, electricity storage but also to maintain fossil-fuelled reserve power capacity that will only be needed ever fewer hours per year—and those with low load and high wind and PV power generation—needing flexible loads and power plants that can easily be shut down for several hours.

THE ROLE OF ENERGY EFFICIENCY

In 2010 the German Government adopted the Energy Concept; the aim is the restructuring of the energy system towards a supply system mainly based on renewable energy instead of energy from conventional sources. With view to energy efficiency, a reduction of electricity consumption in absolute terms by 10 % between 2008 and 2020, and by 25 % in 2050 is envisaged. This is less than the target for primary energy overall (minus 20 % by 2020, and minus 50 % by 2050) and much less than the target for heating in buildings (minus 80 % of primary energy by 2050), as it anticipates increased electricity consumption for electric vehicles and heat pumps replacing oil and gas heating. The Energy Concept contains more than 120 individual measures that will be gradually implemented in several areas

of action, with energy efficiency seen as one of the key success factors besides the further development of renewable energies (BMW 2012).

These targets may also create opportunities for energy companies to include energy efficiency measures into their supply portfolio. However, these have been based on markets in Germany so far, as a supportive regulatory framework still is lacking. Art. 7 of the recent EU Directive on Energy Efficiency (EED) requires EU Member States to obligate their energy network or supply companies to achieve 1.5 % per year of energy savings through energy efficiency, and studies proved the feasibility of such energy efficiency obligations (e.g. ecofys/Wuppertal Institute 2013). However Germany is very likely to adopt the alternative allowed in the EED of using alternative measures, i.e., ramping up government-funded energy efficiency programs. Policy-makers do not dare to add another component to electricity prices, which would be needed to finance energy efficiency programmes by energy companies under an energy efficiency obligation, even though it would only need to be around 0.3 Eurocents/kWh and would effectively reduce customers' bills. The high price component to finance the renewable electricity generation (currently more than 6 Eurocents/kWh) has blocked the possibility for a further price adder.

Still, many German energy companies offer small rebate programmes on efficient appliances, heating systems or electric vehicles. These are mainly to satisfy and retain customers, but for many municipal companies they are also a contribution to climate change mitigation, be it on their own values and objectives or on request from the cities owning them. Many companies also offer commercial energy (efficiency) services, such as supply of heat, cold, or compressed air, and energy performance contracting.

A study on the benefits of energy efficiency on the German Power sector underlines that with higher energy efficiency the costs of the German electricity system could be lowered significantly. The improvements of energy efficiency in the electricity sector can be achieved in a cost-effective way: one saved kWh would cost between 4 and 8 Eurocents but would save long-run marginal electricity system costs of between 11 to 15 Eurocents by 2035. It would reduce the long-term need for transmission grid extensions; between 1,750 and 5,000 km in additional transmission lines would be needed by 2050 instead of 8,500 km in the 'business as usual' scenario. As a consequence of reduced power consumption, CO₂ emissions and fuel costs would be reduced; reducing power consumption by 15 % will lead to a reduction of 40 million tCO_{2eq} per year and saves 2 billion Euro annually for coal and natural gas imports in 2020 (Prognos/IAEW 2014). These benefits would also be available through energy sufficiency (Brischke et al., 2015 and Thomas et al. 2015).

RECENT DEVELOPMENTS

Changes in energy market structure

The German Energiewende has already had enormous effects on the structure of the German energy market. The four big energy companies E.ON, RWE, EnBW and Vattenfall have seen their share of the German power market decline, contributing to a sharp drop in their profits. The two largest companies,

E.ON and RWE, have among other things aborted their plans to invest in new nuclear power plants in the UK. In the end of 2014, E.ON announced plans to restructure and therefore split the company in two, spinning off the fossil-fuel and nuclear assets. The company that will keep the name E.ON will focus on renewable energies, distributing power, and energy efficiency.

As a consequence of the reduced market share of the four large energy companies, the share of smaller companies is rising. Besides, in some cities in Germany, a social movement has pushed for a remunicipalisation of the grid and, in the long run, the entire energy supply. In Hamburg a referendum on the remunicipalisation of the energy grid was successful; in Berlin, where the concession to operate Berlin's electricity network ended in 2014, a similar referendum failed only because of a few missing votes. In both cities the social movement has resulted in a paradigm change in the local energy policy. Overall, more than 70 new municipal utilities have been established since 2005.

New policy initiatives for energy efficiency

In December 2014, the German government adopted the Climate Action Programme 2020. Several measures shall be implemented by the year 2020 to achieve the CO₂ emission reduction target of at least 40 % compared to 1990. The National Energy Efficiency Action Plan (NAPE) is a key instrument: The government will introduce a competitive tendering model for energy efficiency programme providers, such as energy companies, promote energy performance contracting, further develop existing energy efficiency programmes and initiate industrial energy efficiency networks. With the implementation of the NAPE, a reduction of approx. 25–30 million tCO_{2eq} per year is intended by 2020.

Experiments towards a decentralised power system based on 100 % renewable energies.

Germany has developed ambitious targets for the future energy system mainly based on renewable energies. In order to demonstrate the feasibility of a secure and reliable future electricity supply from renewables, the research project 'Kombikraftwerk2' simulated an entirely renewable energy scenario of electricity supply based on real weather data and consumption values. As a result, the researchers ascertained, that a reliable and stable power supply based on 100 % renewable energies is possible, provided that there are appropriate adjustments to the energy system including large storage capacities, load management, grid expansion, a large installed capacity of bioenergy and methane power stations, and a network of decentralized systems, e.g. as virtual power plants (IWES 2014). Many electricity network companies are now also experimenting with decentralised Smart Grid solutions, e.g., SAG Deutschland, Stadtwerke Augsburg, EnBW and DKE.

WHERE TO FROM HERE?

In Germany, policy still needs to clarify the role of the energy supply industry (not only for electricity) for implementation of energy efficiency (and demand response), following on from the targets of Art. 7 EED and the Energy Concept. It is clear that more needs to be done to achieve these targets, and energy companies could contribute more, but the implications and needs for creating a supportive policy and regulatory en-

vironment for energy company involvement (e.g., energy efficiency obligations; explicit allowance of cost recovery; the fact that energy efficiency will reduce bills despite the need for a small price increase of at most 0.3 Eurocents/kWh) are still poorly understood by many in both policy-making and energy industry. Policy also needs to clarify the future of power market—will a capacity market be needed or will backup capacity secured on a yearly basis be enough; will coal be phased out over the decades to come, and if so, how? The federal ministry of economic affairs and energy (BMWi) recently launched a green book and will organise a discussion process during 2015. Further testing of smart grid, demand response, and storage concepts will also be needed to clarify by around 2020 which technologies are needed to which extent, and to create the necessary regulatory and market incentives.

Australia

CURRENT SITUATION

The Australian electricity supply sector has been subject to continual reform since the early 1990's. The primary focus of this reform has been to encourage more competition in the electricity sector. However, the consumer and environmental benefits of this reform process are far from clear. For example, the falling trend in average electricity prices from the 1990's until 2007 has been reversed by rapid price increases in the past seven years (Ison et al, 2011). Meanwhile, the carbon intensity of electricity, which has fallen since the 1990's, has also begun to rise again (Hannam 2015) and the recent rapid growth of the renewable energy industry has stalled (Climate Council of Australia 2014).

Coal plays a major role in Australia's energy sector. Australia is the world's second biggest coal exporter and coal is Australia's second most valuable export. Coal comprises about 80 per cent of Australian electricity generation (ESAA, 2014). The impact of energy efficiency and renewable energy policy on the coal industry is therefore important to policy makers and this often affects support for alternatives, including energy efficiency.

As in Germany, the Australian electricity supply industry is unbundled or "vertically disaggregated". Owning and managing electricity generation and retailing has been split from electricity transmission and distribution network services. However, since this split was enacted in the 1990's, the generation and retailing functions have mostly re-integrated to form private investor owned "gentailers", the largest three of which AGL, Origin and Energy Australia represent over 70 per cent of both the generation and retail market in the National Electricity Market (ESAA, 2014). The transmission and distribution sectors remain regional regulated monopolies, owned by state governments (except in the states of Victoria and South Australia where they have been privatised). The network businesses are regulated by the Australian Energy Regulator (AER), subject to rules set by the Australian Energy Market Commission. Overall control of energy policy is shared between the Federal and State/Territory governments. As a consequence of this unbundled industry structure, it is necessary to consider how these different industry players – competing retailers and generators, and regulated monopoly network businesses – can adapt to the rapidly changing market conditions.

Similar to Germany and the US, electricity consumption from utilities in Australia has been falling since 2007, even though the Australian economy has grown continuously throughout this period. Rising electricity prices, which doubled between 2007 and 2014 (AEMC 2013a) have been a major driver of reducing electricity consumption. Other factors that have contributed to this consumption decline include energy efficiency policy, the uptake of solar PV and the closure of some energy intensive industry in Australia. The major contributor to the rapid price rise was a massive increase in network capital expenditure, which rose from about \$5 billion per annum between 2004 to 2009 to about \$9 billion per annum between 2010–2014 (Langham et al. 2010).

A very strong influence over current energy policy in Australia is the recent introduction and then abolition of a price on carbon emissions. The Labor Federal Government was elected in 2007 with a strong mandate for action on climate change. Its first act in government was to ratify the Kyoto Protocol and it subsequently established the most comprehensive climate action policy in Australian history – the Clean Energy Future package. This reform program included a wide range of energy efficiency and renewable energy initiatives, including expanding the Energy Efficiency Opportunity program for business, and providing funds for energy efficiency upgrades by local municipalities, low income consumers and small business. However, despite a pre-election commitment, this policy package did not implement a national energy efficiency target.

While majority public opinion supported strong action to address climate change, the carbon price was very unpopular and was a major factor in the defeat of the Labor Government in 2013. There were several reasons for this unpopularity, including the government's prior commitment during the 2010 election campaign not to introduce a carbon tax, design flaws and poor communication. However, a major factor in the carbon price's unpopularity was that it was introduced at the same time that electricity prices were rising steeply. While the carbon price represented "approximately 9 per cent of the national average representative residential electricity price" (AEMC 2013b) it was widely associated in the public mind with the doubling of prices as outlined above.

When the new Coalition Federal government was elected in 2013, it sought to cut government spending, and reduce electricity prices. It set about dismantling much of the Clean Energy Future package, including the carbon price and several energy efficiency initiatives and it has attempted to abolish the 20 % Renewable Energy Target. The Government has committed to support energy efficiency projects through its \$4 billion Emission Reduction Fund, which is due to hold its first "auction" in April 2015 (Clean Energy Regulator, 2015).

THE ROLE OF ENERGY EFFICIENCY

Electricity retailers

In the period 2006 to 2013, there was a modest but gradual increase in electricity retailer activity in energy efficiency. This was driven primarily by the establishment of legally binding energy efficiency targets in the two most populous states, New South Wales (lifetime savings of 5 % of electricity sales per annum) and Victoria (currently equivalent to 5.4 million tonnes of CO₂ per annum -- Victorian Government 2014).

However, since the change of the Federal government in 2013, the abolition of the carbon price, and the fall in electricity consumption, the large energy retailers have wound back their involvement in energy efficiency and focussed more on maximising returns on their existing (mainly coal fired) power station assets, which are generally operating at well below capacity. These retailers have been criticised for seeking to retard the development of clean energy through advocacy for policy change and shifting to higher fixed charges and relatively lower energy usage tariffs (Greenpeace 2014).

This relatively conservative business environment has recently seen the emergence of fast growing, innovative new retailers, such as Powershop, which focuses on providing low cost, renewable power to consumers and near real-time information on energy use and time of use pricing via a smartphone application to encourage consumers to manage their energy use (www.powershop.com.au/).

Electricity network businesses

The electricity network businesses in Australia have traditionally had modest involvement in demand management, and even less in energy efficiency. For example, a survey in 2010 found that demand management by network businesses in Australia represented only about 1 % of peak demand (Dunstan et al. 2011). Even when added to energy efficiency activity by retailers this only rises to about 1.5 % which compares to a reported average for US utilities of about 5 % (Ison et al. 2011).

A major review of this relative neglect of demand management and energy efficiency was undertaken for the New South Wales Government in 2002 (IPART 2002). This review made a number recommendations for reform, including the establishment of a Demand Management (DM) Fund financed by a small levy on electricity prices to support DM delivery independent of the utilities. This proposal was implemented as a \$200 million Energy Savings Fund in 2004. This fund was subsequently merged with a Water Savings Fund to become the Climate Change Fund in 2007 and then in 2011, the remaining funds were redirected away from energy efficiency in order to fund a budget over-run in the government mandated solar power feed-in tariff (NSW Auditor General 2011). This experience highlights the challenges of establishing and maintaining effective energy efficiency reforms in the electricity sector in Australia.

In the past few years, as electricity prices have risen, solar PV has grown rapidly and technology has developed, and some network businesses have sought to slow the rise of distributed generation and energy efficiency by, for example, seeking to lower energy charges and raise fixed charges (Edis 2014a). However, other network businesses, such as Ergon Energy, SA Power Networks, and Transgrid have started to advocate and adopt new approaches to energy efficiency and demand management.

These developments highlight an unprecedented level of interest by network businesses in new business models including energy efficiency. The networks' economic regulator, the Australian Energy Regulator (AER) has sought to reduce the barriers to DM and energy efficiency by, applying a revenue cap instead of a price cap for network businesses in the five states and one territory that it regulates. This will "decouple" electricity sales volume from revenue, as described in reform option 3 above. However, the AER has yet to provide balanced incentives to assist network business to supporting energy efficiency.

This alone will not address all of the regulatory barriers and is unlikely to facilitate a rapid acceleration of DM and energy efficiency activity by network businesses. The National Electricity Rules have for many years empowered the AER to establish a Demand Management Incentive Scheme (DMIS). The AER has so far refrained from doing so, apart from making a very small Demand Management Innovation Allowance focussed on DM research (Dunstan et al. 2013). The AER currently seems unconvinced that providing clear incentives for energy efficiency and DM is warranted to redress the long-standing obstacles.

To redress this omission, changes are now being formally considered to change the National Electricity Rules to *require* the AER to adopt an efficient DMIS (Dunstan et al. 2013). Such reform could provide the crucial kick-start towards a more balanced, decentralised and energy efficient utility industry.

WHERE TO FROM HERE?

As noted in the introduction to this section, the focus of Australian electricity reform over the past 25 years has been on increasing competition in order to reduce energy *prices*. The potential to reduce energy *bills* through increased energy efficiency has seldom been a focus of energy policy. However, there are four key areas where energy efficiency could make significant progress in Australia in the next few years.

Firstly, the recent sharp rise in electricity (and gas) prices has led to more consideration of energy efficiency as an economic issue. Energy policy makers are increasingly speaking about energy efficiency in terms of lifting "energy productivity", that is *increasing economic output* per unit of energy used, instead of simply *reducing energy consumption*. This emerging trend was evident in the recent decision of the Council of Australian Governments Energy Council to "develop a new policy framework for energy productivity" (COAG Energy Council, 2014). Secondly, the AER has a reform opportunity over the next twelve months to establish a "level playing field" where electricity network businesses are able to provide and recover the costs of energy efficiency services and demand management services on the same financial basis as investing in network infrastructure. Thirdly, the NSW Energy Savings Scheme (ESS) and Victorian Energy Efficiency Target (VEET) provide a sound basis for extension to other States and Territories, or even for establishment of a national scheme. Fourthly, the growing realisation among senior energy utility staff that the past industry trajectory is not sustainable and needs fundamental transformation provides an unprecedented opportunity to effect change.

To sum up, there already exist several key elements in Australia for effective reform for utilities that supports energy efficiency. These elements include a developing energy services market, energy efficiency targets and trading schemes in NSW and Victoria, recognition by some key utility leaders and regulators that change is necessary and a vibrant public debate about energy policy including the importance of "energy productivity". What is now required is for Federal and State governments and the Australian Energy Regulator to recognise that energy efficiency is crucial to meeting the energy needs of Australian businesses and consumers, and to provide clear and stable regulatory signals to allow utilities to participate fully in this rapidly growing market.

Discussion

The electric utility sector in Australia, Germany and the U.S. are all going through major changes driven by declining sales, increasing use of distributed energy sources and policy responses to global climate change. Of the three countries, Germany is the most aggressive in addressing climate change and has a government-led series of initiatives to substantially reduce greenhouse gas emissions, including a major role for energy efficiency. Utility energy efficiency efforts have been limited. Government policies, particularly the renewable energy feed-in tariff, have applied substantial pressure on the country's electric suppliers, and both the major suppliers and the municipal companies are developing new business models, including for some, expanded efforts to provide distributed generation, renewable energy and energy efficiency services. Likewise, government policies are promoting a larger role in energy efficiency for third-party energy efficiency providers. Still, energy savings achieved are lower than in some U.S. and EU front-runner states and need to be increased to achieve the targets.

In the U.S., government plays less of a role in promoting energy efficiency than in Germany, and the focus in recent decades has been on services offered by regulated energy utilities, with the services often delivered by private firms. While the changes to the U.S. utility industry have not been as dramatic thus far as in Germany, leading U.S. utilities and states are preparing for major changes, including a greater role for utility-provided value-added services (including energy efficiency) and more competition with third-party service providers. Pending U.S. emissions regulations could drive increases in the energy efficiency activities of both utilities and state governments since under the draft regulations the states are given the lead but generation plants are regulated.

Australia's utility industry is also going through profound changes driven by a rapid rise in electric rates. While government and utilities have offered some energy efficiency programs, the future direction of these efforts is unclear as the current national government is deemphasizing climate change while some state Governments, notably NSW, are reinvigorating energy efficiency policy. Meanwhile, the network businesses are trying to develop new business models that are more consistent with energy efficiency, but it is not yet clear if their regulator will allow these new business models to flourish.

Energy efficiency efforts are increasing in Germany, and probably in the U.S., due to climate change policies. Efficiency trends in Australia are mixed. All three countries are increasing their focus on energy efficiency markets and service providers, with this being the primary approach in Australia and a complementary approach to the traditional government focus in Germany and the traditional utility focus in the U.S.

So what does this mean for the future for Utilities? In our view, in the long-term, utilities must embrace energy efficiency and renewable energy or risk being left behind. Recent experience in Germany illustrates this need. Going forward, we see a role for government, utilities and the private market energy efficiency efforts in all three countries, although the emphasis will vary by country and will evolve over time. The evidence to date suggests that where all three parties can work together with a common vision, reform efforts are likely to be more successful and more sustained. This common vision needs to be

clearly focussed on the ultimate goal of meeting customers' energy needs at lowest overall cost while protecting the environment. As energy efficiency is often the best way of meeting this goal, policy and utilities that optimise energy efficiency are more likely to succeed in the long term.

In all three countries there is an interest in growing the role of the private sector, although it is unclear how successful private sector efforts can be. For example, in the U.S. private energy service providers have been most successful with large owner-occupied institutional buildings, and somewhat successful with industry and sophisticated residential customers, but much less successful with other market segments that include small businesses, multifamily housing and the majority of residential customers (Nadel 2015). Government and utility programs have successfully reached such customers and need to continue, even as we experiment with new private sector approaches, including value-added services provided by utilities.

Conclusions

Energy efficiency has provided important benefits in all three countries and contributed to declining electricity sales. In response to climate change policies, the need for energy efficiency efforts is likely to grow. Utilities, government and the energy users all have a role to play in delivering these services, although the size of the different roles will vary by country and will evolve over time.

Utilities are playing a major role in delivering these services in the U.S. and while major changes are in store for the U.S. utility industry, energy efficiency efforts are likely to continue, both by regulated distribution companies and by unregulated companies including utility subsidiaries. In Germany, opportunities for energy companies to include energy efficiency measures into their supply portfolio have been based on markets, as a supportive regulatory framework still is lacking. This is likely to be the future too; although the country needs to increase its efforts to reach its energy savings targets. The government apparently does not intend any energy efficiency regulation for energy companies. In Australia, there are several key ingredients present for effective reform. However, Federal and State governments and regulators have yet to adopt the comprehensive reforms required to unlock the potential of energy efficiency to meet business and consumers needs and to allow utilities to participate fully in this rapidly growing market.

All three countries are leading changes in the utility industry, with the future uncertain. In the face of this uncertainty, energy efficiency supporters need to keep abreast of these changes, and find ways for energy efficiency to prosper, as the future unfolds in sometimes unexpected ways.

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