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King Abdullah Petroleum Studies and Research Center

Is Unbundling Electricity Services the Way Forward for the Power Sector?

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October 2016 KS-1653-DP047A

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Key Points

High penetration of distributed energy resources (DERs) will lead to further fragmentation of the power sector, both in the services offered and its value chain. The ‘‘local’’ component of energy policies will probably become increasingly important.

- Electricity supply has multiple attributes, each valued differently by consumers. DERs eliminate opportunities for implicit cross subsidy between these.
- Successful new business models would find a way to monetize the value of each of these attributes, separately, according to the consumer’s preferences, without increasing transaction costs.
- The principles of what is known as the ‘‘sharing economy’’ could be applied to redefine products and manage the fragmentation of the industry without increasing transaction costs.
- There is a risk of technological lock-in unless regulators stay abreast of innovations in the industry and act to prevent this.

Summary

High penetration of DERs will lead to further fragmentation of the power sector, both in the services offered and its value chain. Thus, successful future business models will be those that are able to create new products, establish more efficient pricing mechanisms and monetize services, which customers could no longer receive free-of-charge. We suggest that the principles of what is known as the ‘‘sharing economy’’ could be applied to redefine these products and manage the fragmentation of the industry while keeping transaction costs in check.

The important feature for business models is that DERs eliminate opportunities for implicit cross subsidy between these attributes, exposing the presence of potential free riding among customers and making it difficult to lump all services into a single tariff. Therefore, the challenge for new business models would be to find a way to monetize the value of each of these attributes, separately, according to the consumer’s preferences.

Future electricity business models can borrow elements from companies that operate on the sharing economy principle. The analogy with the sharing economy is relevant in the organization of the electricity sector as underutilized assets are the norm rather than the exception. Also, because technological advances could lead to a world of distributed autonomy in which no single entity has full information or is able to bring about collective coordination. Thus, the new role of utilities could be as a system integrator and platform provider.

The experience of regulating sharing economy firms can also illustrate the challenge ahead for electricity regulators. Representative companies from the sharing economy act in parallel to the formal sector, such as taxis or hotels, and in overregulated sectors. Most DERs operate behind the meter, alongside the formal power sector. Incumbent firms and regulators have not challenged new entrants’ behavior until they have achieved a noticeable market share. The same logic applies to incumbent utilities and regulators with a growing number of prosumers. The challenge for regulators would be to create functional markets, which can handle unbundled services and prevent technological lock-in. There is a risk of technological lock-in unless regulators stay abreast of innovations in the industry and act to prevent this.

Introduction

This paper follows on from the workshop brief New Business and Regulatory Models for Utilities of the Future (KAPSARC, 2016). The workshop was held in New York in March 2016. Key insights from the workshop were that high penetration of DERs could result in two market altering outcomes, which the industry and regulators cannot ignore. First, that increased levels of DERs may result in regulation and policy becoming more local with increasing fragmentation, both in the services offered and the power industry value chain. Second, that vertical unbundling may be augmented with a teasing apart of the elements of electricity supply and allow the emergence of platforms on which any resulting new products and services can be traded.

In this paper, we try to envisage what new business models might arise by revisiting existing models in the electricity sector. The risk for incumbent utilities is the emergence of innovative new technologies that is taking place that may destabilize the industry with large sunk costs, and where infrastructure is already in place. We suggest that utilities may evolve their business models and learn to compete in bilateral, platform-based markets that incorporate some features of what is known as the ‘‘sharing economy.’’

DERs are relatively small, geographically disseminated sources of energy that are connected directly to the distribution system, rather than through the bulk transmission system. They operate in parallel with the electric utility or stand-alone units. Power can be sold back to the grid where permitted by regulation. Among the most widely used DERs technologies are photovoltaic (PV) panels. PV generation is intermittent, dispersed and uncertain (MIT, 2015).

We use the term ‘‘business model’’ to describe the way an organization delivers value to customers, encourages customers to pay for value and converts those payments to profit (Teece, 2010; Casadesus-Masanell and Ricart, 2009). The business models of today’s utilities are largely constrained by what regulation allows them to do. We will imagine in this exercise that electric utilities are able to set their business model without requiring regulatory approval – after all, electricity markets are opening up, creating demand for many different goods and services.

There are some limitations to the arguments we put forward. The first, obviously, is that no one can accurately predict the future. The second is that, because electric power markets are so idiosyncratic, it is not realistic to have a one-size-fits-all business model. Our aim is to provide a general framework and to identify business characteristics that are applicable to a variety of areas.

Business Model

In many markets, the prevailing business model for electric utilities is a cost-plus structure, in which the utilities pass on the majority of their costs plus a return on their capital investment to customers as a variable rate ($/kWh). The objective is to operate in a cost minimization fashion, and the model sustains itself with further capital investment, sales growth and sustainable prices. This has led to a business model where adding new infrastructure is the bread and butter of utilities' revenues. But can we still expect future utilities to operate within this framework, given massive investment requirements and lower sales? With lower sales, will the need to invest in new infrastructure be as great? The companies themselves need to find a new way to grow, and regulators need to ensure that the fixed cost element of the system is not too great, as this would increase prices.

One obvious option for a utility is to cannibalize its core business with affiliate companies that provide DERs. Utilities themselves can be holding companies, where new, independent sister units cannibalize the legacy utility part and these sister firms help finance the holding company. However, it is unclear whether it is sustainable to plow earnings from the new businesses into a losing legacy segment. In other words, would this be profit maximizing or, rather, a strategy to delay the inevitable profit decay?

We suggest that there are other alternatives, though. A utility does not only offer energy to its customers, but also spare generation capacity, ramping flexibility, operating reserves, ancillary services, etc. Customers do not value all these items in themselves since they do not see them or think about them. In the next section, we will consider alternative roles for the utility based on these attributes.

Unbundling services

New technologies make it clearer that electricity is a multidimensional commodity. The most straightforward dimension is ''energy'', determined by the amount of energy delivered, the timing and location. But we should also consider the reason for using energy, such as charging a battery, running a fridge or watching TV, end use – cooling and heating – and its reliability, i.e., the probability that supply would be available. For example, different people may have different thresholds of comfort or convenience, which are indirect services provided by electricity suppliers. Other intangibles can also be taken account of, such as the value of emissions not emitted, or even the value of non-consumption of energy for the system, a term coined as negawatts.

The important feature for business models is that DERs eliminates opportunities for implicit cross subsidy between these attributes, exposing the presence of potential free riding among customers and making it difficult to lump all services into a single tariff. Successful new business models will find a way to monetize the value of each of these previously described attributes, separately or combined, according to the consumer's preferences, without increasing transaction costs.

Sharing economy

The value proposition of the sharing economy is the use of Internet to bring together people with underused assets and others that might like to use of them, or rent them, in a timely manner; with low transaction costs, as information from both parties becomes more transparent, through the use of a platform. It is also known as collaborative consumption or the collaborative economy,

the asset-light lifestyle or the access economy. The cornerstone of this concept is the existence of underutilized fixed assets and, therefore, excess capacity.

Experience from the sharing economy can shed light, as some of its principles are applicable to the power sector.

In the organization of the electricity sector, underutilized assets are the norm rather than the exception. This is because grid investments are dictated by the need to meet peak load requirements that occur in very short periods of time throughout the year. This underutilization raises concerns on the best way to cover grid maintenance costs and to finance expansion.

New technologies in the electricity sector will create nested markets to which some principles from the sharing economy can be applied. A multiple-sided market is a meeting place of a number of agents that interact through an intermediary or a platform (Rochet and Tirole, 2004). In these types of markets, an intermediary captures the value of the interaction between user groups and network externalities may lead to one of these being charged a non cost-reflective price (Weiller and Pollit, 2013). The distribution platform can act in similar ways to this.

The analogy with the sharing economy is relevant because technological advances have led to a world of distributed autonomy in which no single entity has full information or is able to bring about collective coordination. However, individual agents' actions affect the rest through the grid.

Representative firms from the sharing economy act in parallel to the formal sector, such as taxis or hotels, and in overregulated sectors. The electric power sector can also be characterized as overregulated. Most DERs operate behind the meter, alongside the formal power sector.

Thresholds are important. Incumbent firms and regulators have not challenged new entrants' behavior until they have achieved a noticeable market share. The same logic applies to incumbent utilities and regulators with a growing number of prosumers (See Adjali et.al., 2016). Utilities have accommodated small-scale generators for decades, but it has only been recently that DERs have made greater inroads that threaten a utility's revenues.

How to Price Unbundled Services? An Example of Risk

There is an inherent dilemma in the sharing economy in the definition of products and prices. This is because products are based on spare capacity, but in economics prices should reflect scarcity. So the definition of products and prices is not straightforward. We argue that unbundling services in the power sector will reveal what elements of attributes are spare and what are scarce.

Let us illustrate this with the example of reliability in domestic markets, viewed as an unbundled service. We know that in the future a growing share of generation would be at low or zero marginal costs. This would mean traditional utilities would end up having unused capacity for long periods of time. That, paradoxically, would make this dispatchable capacity more important as they could act as suppliers of last resort.

So, even if every household is completely self-sufficient, these consumers would still find value in staying connected to the grid because utilities can offer options to provide coverage. If utilities are to leverage their infrastructure as insurance, they will need to change the way they charge customers – for example, by redefining who pays what, changing the basis of tariffs or the frequency of payments. A health insurance company's business model, for example, is based on healthy people financing the treatment of ill people.

The way forward for the utility could be to charge a fixed price to customers for them to retain the option of access to back up. In one version of this alternative, customers could pay a one-time access fee for a fixed amount of energy per year. Though the tendency is to have more real-time decisions with smart metering, in effect incrementally increasing the frequency of transactions, this proposal would, counterintuitively, decrease the number of transactions by charging a membership scheme, similar to Netflix for example, instead of volumetric rates.

There is at least one caveat to this argument, though. Contracts for streaming services such as Netflix are feasible since there is no rivalry in consumption in their service. In other words, streaming to one viewer does not prevent viewers simultaneously using the same. By contrast, electricity is a rival good in consumption, although it can still be argued that not all of a utility's customers will need backup at the same time. This is the same argument as: not all people would claim on their health insurance or cash-in their bank accounts at the same time.

Value chain

Another example of the increasing fragmentation of the electric power industry, driven by the penetration of DERs, is shown in proposals to create a distributed system platform (DSP). The distribution operator business may move from pure asset management to managing a portfolio of services, such as energy transport, access services, market facilitation services and system operator services (Ruester et.al., 2014). With such a platform, new entrants can offer products and services, via their own bilateral markets, such as home management systems, demand response and electric vehicle platforms.

The idea of unbundling the value chain is not new. Vertically integrated utilities exist to reduce transaction costs. The logic of past electricity reforms, dating from the 1990s, was that segments in the value chain would be separated to allow greater market participation. Although this

fragmentation of the value chain would increase transaction costs, the argument was that private participation and competition would make these activities more efficient and offset additional costs.

The creation of a distribution platform is one of the most notable aspects of New York's electricity reform, Reforming the Energy Vision (REV). REV combines this with transparency on the valuation of products and services. The importance of this bill is that New York is set to be the first to codify a new market design and standards, in goals for 2030. If successful, the developments there may prove to be a blueprint for other states and countries. New York's REV consists of two tracks. Track 1 focuses on the role of distribution utilities. This includes the deployment and management of DERs, customer engagement and wholesale market issues that may arise. Track 2 covers the regulatory changes to the ratemaking process, incentive structure and market design (NYDPS staff, 2014).

Regulatory Cycle

In this section we discuss the dynamics between business models and regulatory adaptation. The question here is whether future electricity business models respond to new and existing regulations, or whether business models develop faster than the regulations and thus force regulators to adapt and accommodate the new models.

We draw analogies from the sharing economy to provide a framework for analysis. The most relevant segment for DERs may be the domestic market. In this market, households can operate these technologies in parallel to the formal sector – behind the meter – in a similar way to some services in the sharing economy. Also in the domestic market, the frontier between the personal and professional sectors is blurred: a household's main activity is probably not energy trading – similar to, for example, an on-demand UBER driver whose main occupation is probably not driving a taxi.

The cycle begins with utilities' business models being considerably constrained by what regulations allow them to do. For example, the rate of return converts a utility's business model predominantly into one based on infrastructure. But the status quo can be disrupted by technological innovations that alter the landscape. The experience of UBER illustrates this point. In a response to this sort of development, new business models reflect the elements of the emerging technology.

After such a disruption, regulation no longer responds to the main features of the new business models and falls behind sector developments. Regulators then adapt the legal framework to cope with the altered elements of the new technologies. Examples include changes made to local regulations to accommodate taxi firms like UBER and Lyft or property letting company Airbnb. Finally, other jurisdictions facing similar disruptions tend to follow the precedents of the first mover regulator. This has been observed in the power sector where electricity reform in the United Kingdom became the standard model for deregulation and other countries followed the main elements of their reforms.

The dominant strategy for new entrants, in this case, would be to quickly grab market share in order to lock-in their new technology, and to push regulators to take account of their new business practices by adopting the emerging standard regulation. By this means, companies facilitate their geographical expansion because they are dealing with homogenous regulations across their main markets. While this would be beneficial for firms, regulators would potentially be contributing to locking in technologies. If regulators fail to keep pace of innovations in the industry and act to prevent this, they risk slowing further innovation.

The schematic shown in Figure 1 is more complicated, though. Technological innovations are not neutral. In stage 2, the technological innovation that changes the landscape may be subsidy or policy driven, as some would argue is the case with renewable technology. In other words, regulation can proactively allow for innovation rather than be reactive. We also assume that a new business model would be based on technological innovation, stage 3, but it is entirely possible that the innovation in question could simply be taking advantage of regulatory arbitrage. The response of the regulator might not be automatic. Regulators may decide, for example, not to adapt to the business model of the innovator, but to deregulate the entire sector to eliminate the source of the arbitrage.

Firms, on their part, may further decide to self-regulate in order to pre-empt regulators from

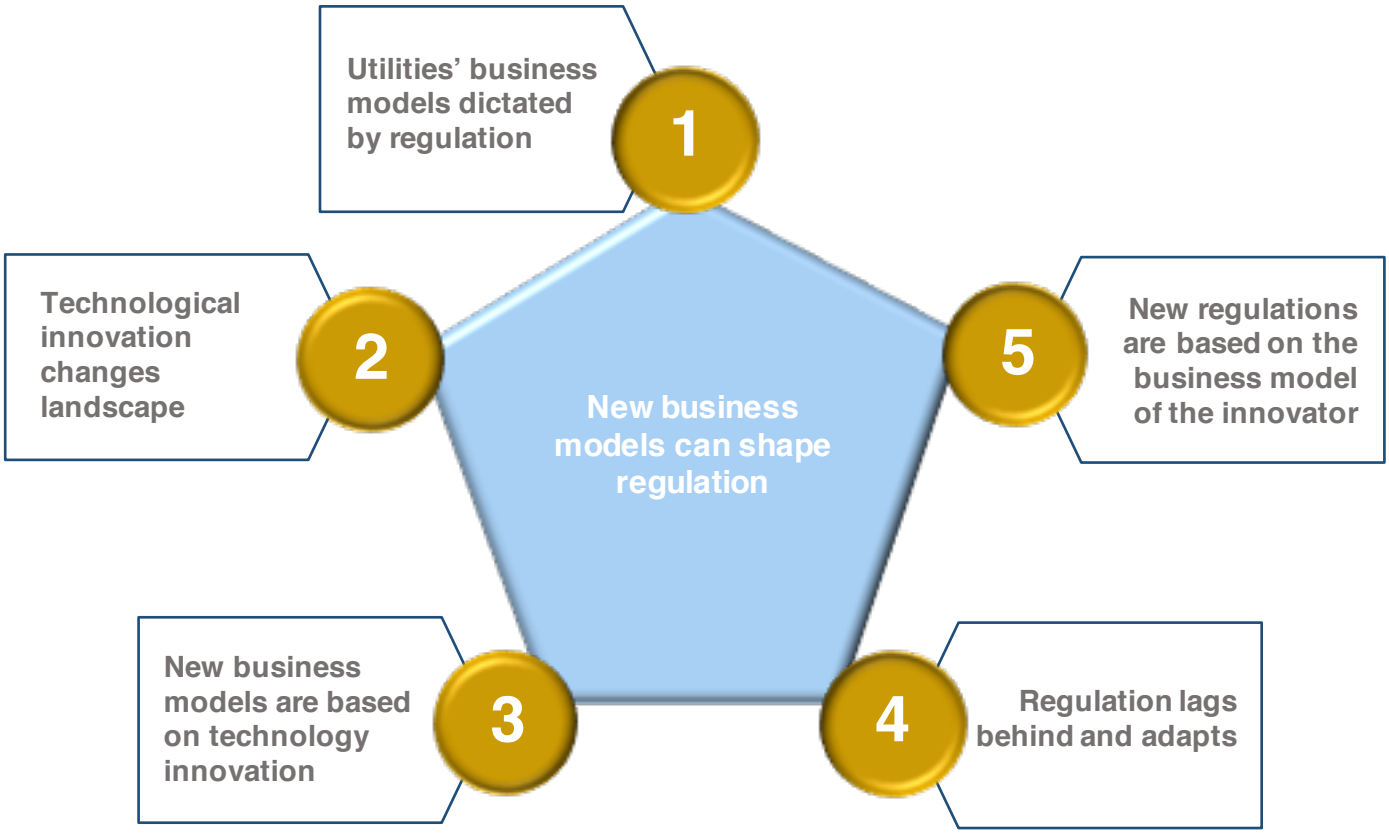

Figure 1. Business model and regulatory dynamics.

Source: Author.

blocking the source of the arbitrage. Widespread adoption of DERs, however, could increase system risks and transfer costs to other customers in the absence of an organized market. So, if the regulatory framework fails to keep pace with the changing nature of the electric power system, large inefficiencies could result. The dilemma for policymakers and regulators is to find the balance between what can be left to grow as "uncoordinated" markets, and what needs to be given fixed limits, via regulation.

Local Energy Policies

The ability of DERs to deliver resources when they are most needed defines their value. This value depends on how well operational characteristics align with peak loads in a distribution area. The impact is thus mostly local. If DERs were to be become the dominant technology, this would imply that energy policy can transition from being stabilized at national levels to more ‘‘local’’ energy policies. Governance of energy would be an important aspect since operations and responsibilities can lie within federal, state and municipal levels.

The locational value of DERs depends on two variables: the current infrastructure position and the demand profile of the location. Distributed energy resources have different response times, ramp speeds, periods during which individual customer reductions can be sustained and limits on utilization. The amount of excess capacity depends on the initial conditions, or on the ability to reduce demand through energy efficiency measures. The magnitude and urgency of the distribution investment deferred or avoided depends on future demand and whether deferred investments are incremental or not. The peak load patterns of the distribution area depend on the customer mix, energy efficiency and demand shifting capabilities.

Some authors have posited that policies are modular constructions – elements that can be designed independently, one from another and connected through interfaces (Baldwin, 2008; Dubois, 2009: Wilson, 2002). For example, for the management of electricity transmission, networks can be designed independently of wholesale markets. We argue that in the case of DERs, new modules would encompass network, coordination and generation.

Among the key questions to be addressed in such modules are:

- What activities will be regulated?
- How can market operators ensure DERs provide the greatest value to the system and preserve system reliability?
- How will system operations change?
- How will DERs affect long-term planning?
- What are the roles and responsibilities of third party market entrants?
- Should regulated utilities facilitate and manage competitive distributed energy markets?

The table below identifies modules and potential alternative policy questions. The outcome of the modules’ interactions depends on how well each design aligns with the other, i.e., a variant of one module fits best with a specific variant of another module. This does not necessarily mean the ‘‘first best’’ design for each module is compatible with the ‘‘first best’’ design of the next or, indeed, the system overall. This creates the possibility of a range of policy templates.

Table 1. Modules and potential alternative policy questions for high penetration of DER.

Modules	Options	Comments
Coordination		
Transmission and distribution	Merge ISO/DSO, keep them separated, Super ISO, Super DSO	Could either disaggregate or aggregate the platforms, for example in terms of location, function (transmission and distribution), etc.
Who operates?	Utility itself, independent entity, no coordinator	Utility may be able to exercise its market power by operating the platform. Regulation would be needed to prevent this.
Failures	Utility, extra service, independent	Clear assignment of roles and procedures in case of failures must be established. The utility can act as a resource of last resort to back-up the system.
Network		
Rates	Fixed vs. flexible	Fixed rates will benefit utilities while variable rates would benefit intermittent flow from new entrants.
Access	Constrained vs. open	There are two aspects to consider: access to the physical system and access to data. Open and non-discriminatory access is a necessary condition for new entrants to succeed.
Transactions		
Products	MWh, MW, NWh, emissions	Power is a multidimensional product. Most of its attributes are intangible, so regulation would be needed to establish a market for positive and negative externalities. The enforcement of markets would benefit incumbent utilities as these are products that they can provide more easily.
Type 1	Bilateral, over the counter	Issues to consider are transaction costs and penalties for non-compliance. A more fragmented market will bring about more transaction costs, but market creation in each segment can increase efficiencies. At the end would be an empirical question whether benefits exceed costs.
Type 2	Wholesale or retail?	This would bring a governance question as regulators are not the same for wholesale and retail. Responsibilities of federal or local governments may overlap.
Generation		
Ownership	Network operator may own generation capacity	Some stakeholders advocate that distribution utilities should not own generation assets as this would be advantageous for them.

Source: KAPSARC analysis.

Conclusion

A high penetration of DERs in the power sector will lead to further fragmentation, both in the services offered and its value chain. The ‘‘local’’ component of energy policies could become increasingly important. Successful business models would need to find the way to monetize the intangible services provided together with energy provision. We suggest that the sharing economy can provide a good framework for analysis of how this is to be carried out.

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Notes

About the Authors

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Rolando Fuentes is a research fellow working on new business and regulation models for the Utilities of the Future project. He holds a PhD from the London School of Economics.

About the Project

The Utilities of the Future project focuses on how new technologies in DERs are transforming customer/provider relationships. Advances in distributed generation technologies and associated cost reductions are providing customers with potentially attractive alternatives to standard electric utility service, perhaps turning them into ‘prosumers’. Utilities around the world are re-evaluating their business models, and regulators are considering multiple market reforms. The project aims to develop analytical tools and techniques to help address the key market, regulatory and energy policy issues in a power sector with high penetration of DER.

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