KAPSARC
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King Abdullah Petroleum Studies and Research Center

New Business and Regulatory Models for Utilities of the Future

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About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology, and the environment across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

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Key Points

Technological advancements have the potential to disrupt the fundamentals of the electric power sector and to some extent make the current role of utilities obsolete. Many countries face this challenge but so far a generic business and regulatory model has yet to emerge that would resolve this issue.

New technologies could result in two market altering outcomes, which the industry and regulators cannot ignore:

- First, the penetration of distributed energy resources (DER) could lead to policies becoming increasingly local and the power sector being more fragmented, both in its value chain and services traded.
- Second, the value chain can be unbundled further by creating a platform, potentially operated by the utility, where new products and services are traded.
- The challenge for regulators is to create functional markets, which can handle unbundled services, prevent technological lock-in and protect the vulnerable.

Summary for Policymakers

The electricity sector could soon be in turmoil as technological advances, mainly in DER, threaten to disrupt the market, both upstream and downstream, and possibly even make the current role of utilities obsolete. Up to now, no single universal regulatory or business model solution has emerged to accommodate and support these changes. What is currently available are diverse, local specific proposals.

New technologies may result in two consequences that business and regulatory models cannot ignore. Firstly, local considerations would become increasingly important at the expense of national policies. Secondly, calls would increase for further unbundling of activities, products and services, which include reliability (MW), energy (MWh), system savings (NWh) and environmental benefits (CO2 emission reductions).

Distributed technologies have shown that it is no longer possible to lump costs and cross subsidize activities. Thus, successful future utility business models will be those that are able to create new products, establish more efficient pricing mechanisms and monetize services, that customers could no longer receive free-of-charge.

Regulation will need to adapt to the technological innovations. In the past, with fewer players in the sector, governments were in greater "control" and could enforce regulations more effectively. The challenge now for policymakers is to come up with frameworks that allow an increasing number of agents to interact and produce socially optimal outcomes. There is, however, a danger that regulation could promote one particular innovation to the detriment of future technologies. Another risk is that a technological solution may end up leaving vulnerable people without a safety net.

Longer term developments could include peer-to-peer transactions, effectively transforming households into energy companies.

Distributed Energy Resources

Distributed energy resources (DER) are smaller power sources, typically in the range of 3kW to 50 MW, which can be aggregated to provide electricity for regular demand. DER's are usually located close to where electricity is consumed, e.g., a home or business. They are parallel to the electric utility or stand-alone units. Power can be sold back to the grid where feasible or permitted by regulation.

Examples of DER are technologies that produce power outside the utility grid including fuel cells, micro turbines, biomass, wind turbines and photovoltaics. Also, distributed power and any technology that produces or stores power such as batteries. Further examples are demand response, demand-side measures and, on some occasions, electric vehicles.

Source: https://www.wbdg.org/resources/der.php

Background to the Workshop

On March 29, 2016, KAPSARC hosted a one-day Energy Series Workshop – New Business and Regulatory Models for Utilities of the Future – in New York, attended by experts from international agencies, research organizations and laboratories, industry, governments and academia. Participants explored how technological innovations in the electric power sector can reshape the business and regulatory framework. Future roles for utilities in a power sector with high DER penetration and how to adapt regulatory frameworks in this new environment were discussed. Options for the creation of products, services and markets within the electric power sector were also considered.

Attendants noted that while the U.S., U.K. and EU have been facing similar challenges, their responses have been dissimilar. Could a generic and transferable business and regulatory model emerge to deal with these challenges? Or can bottom up, indigenous solutions prevail instead? Based on the discussions in the workshop, the conclusions seem to be leaning toward the latter. Regardless of the location of the markets, new technologies could result in two consequences that business and regulators cannot ignore. The first is that local considerations would be increasingly important. This could lead toward more "local" components in energy policies to the detriment of policies conceived at national level.

The second is growing calls for further unbundling of activities, products and services. This could be seen as part of a larger evolution of the power sector, where initial electricity reforms focused on the unbundling of the value chain – i.e., generation, transmission, distribution and retail – and now moved on to the unbundling of services and creation of new products such as energy, risk coverage and emissions.

Successful business models will be those that are able to solve this puzzle of how to create new products, establish more efficient pricing mechanisms and monetize services that customers would no longer receive for free. Distributed technologies have made it very evident that it is no longer possible to lump costs and cross subsidize activities.

Turmoil in the Electricity Sector

The new power sector paradigm is based on higher levels of locally produced electricity from many small scale installations, which are often customer or third-party owned. Traditional utilities, as a result, have the prospect of getting into alternative businesses that may give them attractive returns. It could reduce reliance on the central grid, which may ultimately change the way electricity is purchased, transported and consumed.

Boundaries between transmission-distribution and distribution-commercialization and generation may become blurred as these activities could occur in the same location, i.e., the household. The system would become more complex, though, since households are geographically dispersed. Thus, the need to reassess markets, remuneration, and roles and responsibilities.

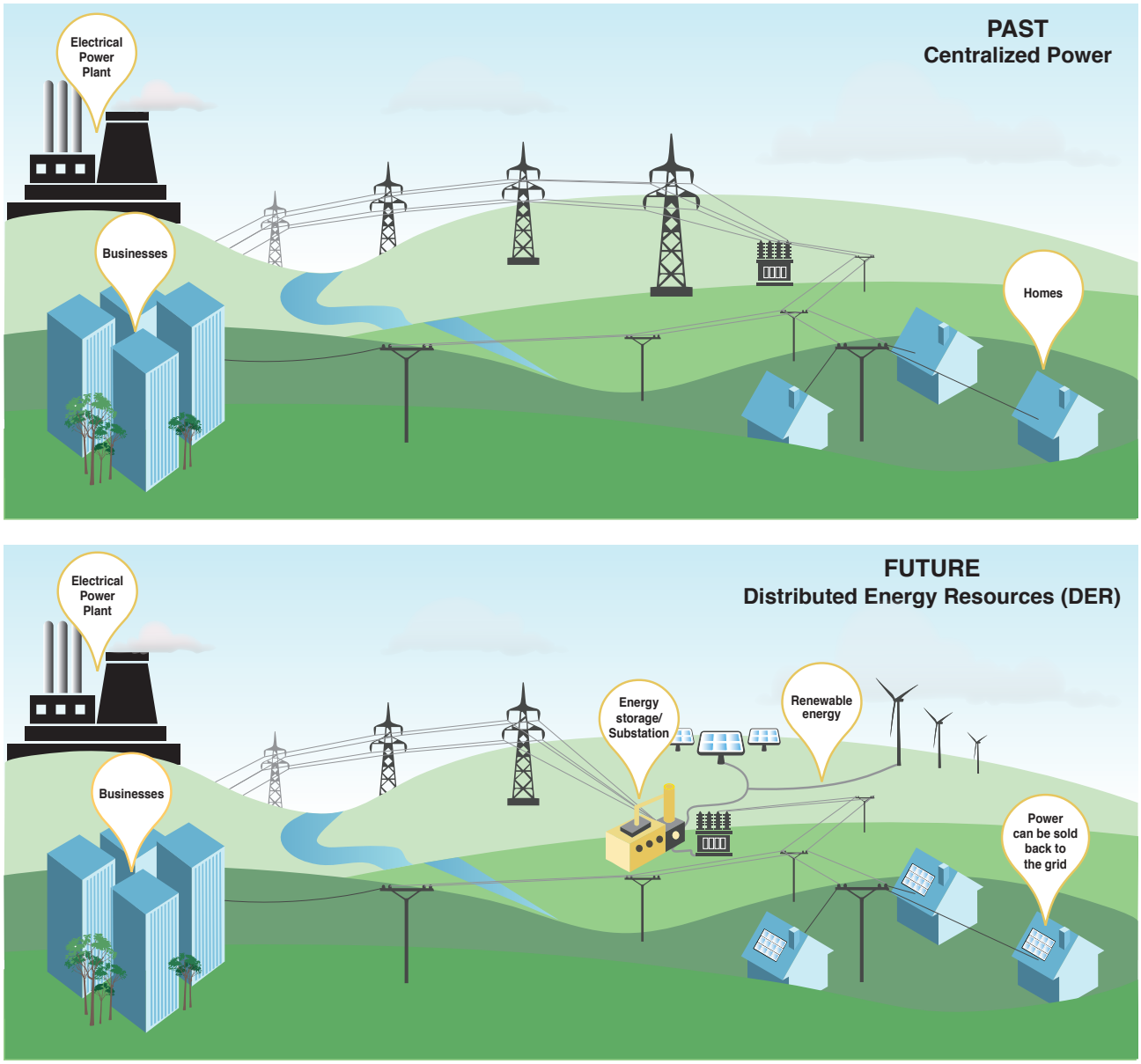

Figure 1. How the electricity sector could look in the future.

Source: KAPSARC analysis.

The rise in adoption of distributed solar PV and other DERs could jeopardize the traditional utility model and market architecture of the electricity sector. In the U.S., third-party solar developers view themselves as competing directly with utilities. This model makes residential solar affordable for the host, despite being more expensive than that provided by the utility, as it removes upfront capital expenses and takes advantage of tariff structures.

Consequently, technological innovations have raised concerns that utilities face imminent death spirals following the high penetration of DERs as the traditional utilities' finance model aims to cover fixed costs through charges based on the amount consumed. And thus any reduction in sales due to distributed power could lead to the remaining customers being charged higher rates, which in turn could lead to more customers installing DERs.

Consensus from the workshop was that this fear was premature, at least for distribution utilities. Nonetheless, even if the threat is not imminent, it is fair to say utilities are not enjoying the benefits of the growing segments of the business. Moreover, they face challenges such as the deployment of large-scale grid investments, which would be difficult to achieve in a context where technological trends are leaning toward greater decentralization and digitalization at the point of consumption.

Implication 1: Small is Beautiful, Maybe

Traditional electricity markets were designed to run at the national, wholesale level, not at local or retail level. Since in the future the center stage would belong to distribution it is likely that local considerations would override national policies. Moreover, distribution utilities are numerous and heterogeneous, while transmission operators are few and national.

> **"Energiewende in Germany is driven by individuals. It is a bottom up revolution."**

Generally, people prefer to enhance their local development if they have the ability to do so. For example, in Germany a lot of emphasis was put into energy cooperatives as a means to strengthen local value creation and enhance investment opportunities. Germany's Energiewende, its energy transition, is a bottom up revolution, driven by individuals who see value in being independent from suppliers and also as an investment opportunity to take advantage of subsidized government support. Private individuals own 35 percent of total installed renewable energy capacity, while the share of the big four energy suppliers is only 5 percent. Another key stakeholder group is farmers who own 11 percent of total German renewable capacity.

Although various developed countries appear to be fundamentally facing the same challenges, their responses have been different, and none of the existing solutions are likely to emerge as the triumphant policy recipe that could be the role model for universal use. Local specificities override attempts to generalize the challenges of the industry. Thus, each location would probably use their own approach. The examples of Germany and New York, which were discussed in the workshop, illustrate this point.

Since the 1990s, Germany has been promoting the deployment of renewable energy. Currently, about 30 percent of its electricity is derived from these sources and the aim is to reach 80 percent by 2050. This radical change, mostly subsidy driven by feed-in-tariffs, have brought about new players that have subsequently disrupted the value chain. Feed-in tariffs have negatively impacted traditional generators and are resented by the incumbents. Germany has tried to pursue different strategies to ensure grid resiliency, which is under pressure due to the high penetration of intermittent power. Regulators have tackled the issue of supply security through capacity markets and infrastructure investment as well as incentivizing customers to be self-sufficient. The message is that the next transformation will be triggered not by regulation or subsidies but by new business models and digitalization.

New York, on the other hand, has taken a forward looking and non-confrontational stance. They see a new role for the utility, where it gets paid for providing a platform, optimizing the system and promoting competitive markets for DER. The state sees utilities as having new activities, in addition to operating a platform, which includes financing DER acquisition, billing services, operation and maintenance of DERs, and getting a share of power purchase agreement revenue.

A key part of the New York Reforming the Energy Vision (REV) process has been consultations with key stakeholders. They realized that traditional utilities can benefit from savings through reductions in costs including capacity payments, operations and maintenance (O&M) expenses, line losses, transmission and distribution (T&D) investments.

Implication 2: Unbundling Business Models

New business models in the electricity sector would be about the creation of new products and services that would be feasible on the back of innovations in DER technologies. This may have an effect on the way different products are priced and conceived, and how much one pays for them.

> **"From the unbundling of the value chain to the unbundling of services."**

Unbundling can take many forms. For example, the value chain can be unbundled further with the creation of a trading platform, where the aforementioned products and services (energy, power, reliability, security, etc) are traded. The new role of utilities could be as a system integrator and platform provider.

Another type of fragmentation discussed in the workshop was the decoupling of the electricity market: one for "on demand" generators (traditional producers) and one for "as available" generators (DER producers). Both markets would be managed through a system operator that coordinates and optimizes supply of electricity.

Existing players have responded in different ways to these changes. Some, for example, have split their companies to serve specific segments of the business such as renewables, decentralized markets and digital solutions, while keeping their traditional niche in foreign countries. Figure 2 shows how some European utilities have decided to separate their companies.

Figure 2. Strategies followed by some European energy utilities.

Source: Adapted from Burger and Weinmann (2016). European Utilities: Strategic Choices and Cultural Prerequisites for the Future. In Sioshansi, F. (Ed). Future of Utilities – Utilities of the Future (pp.303-322). Academic Press

Electricity has multiple attributes that are bundled into a single product and priced under the same umbrella. DER eliminates opportunities for implicit cross subsidy between these attributes and allows for the identification of a customer's preferences. Firms can sell separately services and products such as reliability (MW), energy (MWh), system savings (NWh) and environmental benefits (CO^2 emission reductions). Consumers may value each of these in a different way; they may, for example, have different thresholds for comfort or convenience, which are indirect services provided by electricity provision. New business models could find a way to monetize the value of each of these attributes based on consumer preferences, without increasing transaction costs.

One application: insurance/coverage

An example of downstream service unbundling could be a market for reliability in domestic supplies, as even in the case of high DER penetration there would be value for customers to stay connected to the grid. The utility would in this instance act as the provider of last resort. The product traded would be an "insurance policy" or packages of options for coverage.

In one version of this alternative, customers could pay a one-time access fee for a fixed amount of energy per year. This would allow consumers to reveal the value they give to reliability. Another option could bypass the consumer wherein price signals are sent in an administrative manner, mimicking calculations of the value of loss load (VOLL).

Lessons from the sharing economy

The experience of the ''sharing economy'' can shed light as some of its principles are applicable to the power sector. In the sharing economy, owners share or rent out an asset that they are not using. Emerging new business models have emphasized the value of bringing together people wishing to hire or rent idle capacity with low transaction costs. Current notable examples are Airbnb and UBER. In the electricity sector, underutilized assets are the norm rather than the exception. For example, capacity utilization in the New York electric grid is 54 percent compared with other capital intensive industries, which have seen usage rise to the mid-80 percent range. This is because grid investments are based on the need to meet peak load, which occurs only for very short periods over the course of a year. This underutilization raises questions on both payments for grid maintenance costs and options to finance expansion.

Future electricity business models can borrow elements from companies that operate on the sharing economy principle. An important question when adapting to this framework would be how much and how often these services will be traded. Also, how to recover the network's fixed costs. This would imply a redefinition of electricity tariffs. Among the options discussed at the workshop were levying a fixed charge akin to membership subscriptions, or contracts similar to mobile phone packages.

Implication 3: Regulation and Innovation

Regulations need to innovate hand-in-hand with technological innovations. A lack of proactive action will result in inefficiencies and hinder the evolution of the utility business model.

> **"There is a risk of technological lock-in unless regulators stay abreast of innovations."**

Thus far, regulators have prioritized security and focused on capacity and infrastructure, and to some extent left the downstream markets untouched. Consequently, in the new environment regulators face a number of challenges. Among these are:

- The need to prevent technological lock-in and path dependency that ends up restricting choices for consumers. There is also a risk that regulation could promote a particular innovation to the detriment of future technologies.
- Create frameworks that can cope with an increasing number of agents. With fewer players in the sector, governments could more easily design and enforce regulation. Since the fine-tuning of the value of services would be impossible, regulation needs to focus on how to design and enforce markets that don't yet exist.
- Prevent high transaction costs, which could annul the benefits of unbundling products and services. Have innovative rules that capture the unbundling. An option could be to move from regulation based on costs to regulation based on values.
- Protect vulnerable people who may not be able to bridge the technological divide.

What's the future?

It is obviously very difficult to predict the distant future. Discussions in the workshop showed that in the near term several fundamentals of the power sector are likely to change (See Table 1).

Depending on the deployment of new technologies and the level of interconnection, the future electricity sector could take the form of a decentralized light-grid system, with mini grids interconnected to a main line, or a bifurcated system between those who can access new technologies and those who can't. The latter scenario would probably open an energy divide between the rich and poor, or between individuals and the commercial sectors. A third possible scenario could see the emergence of a high-tech peer-to-peer power system, where electricity is self-consumed-produced-stored and trades on a platform. It is possible that all three scenarios could coexist. The outcome will depend on who and where you are.

Longer term developments could include peer-to-peer transactions that effectively transform households from prosumers into energy companies. This change will imply a transition from households exchanging their unused energy into households who compete in the new unbundled markets. The new roles of the future utility could be as an insurer and a platform provider, while the dispatch center could be transformed into a 'weather forecasting' unit that foresees the need for back-up from traditional power sources.

Another issue facing many countries is the transition from a situation where utilities are state-owned monopolies to the radical peer-to-peer scenario. An open question would be the impact that utilities of the future would have on the poor and vulnerable. Discussions from the workshop suggest that research should focus on developing methodologies, such as modelling or simulation, which would help decision makers advance their understanding of these key challenges.

Table 1. Possible changes to the power sector structure.

	Now	Future
Cost structure	Mainly marginal	Mainly capital
Pricing	per KWh	?
Planning and operation	Flexible supply to match demand.	Demand response to match supply.
Control and dispatch	From center	Throughout system (cf Internet)
Role of demand-side	Passive	Interactive
Role of grids	Neutral conduit	Smart player

Source: OIES.

About the Workshop

KAPSARC convened a workshop in March 2016 with some 35 international experts to discuss the future of the electricity sector. Attendees explored what regulatory framework could help achieve policy objectives in a power sector with high penetration of DER, the future roles open to incumbent utilities in this scenario and if they could profit from them, and options for the creation of new markets within the electric power sector. The workshop was held under Chatham House rules.

List of Participants:

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About the Project

The Utilities of the Future project focuses on how new technologies in distributed energy resources (DER) 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 services, 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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