

Future of the Electricity System in GCC Countries

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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

Global electricity markets are facing substantial changes from both the demand and supply side of the industry. These structural shifts are also affecting Gulf Cooperation Council (GCC) countries, which need to adapt by developing new electricity models. Moving to a new power system will require significant reforms in the Gulf states. These countries may have to transform: state-run companies to private entities, monopolies to competitive markets, fossil fuel generation to a diversified electricity mix and from regulated to liberalized prices.

Renewable energy can be an economical option to diversify a country's existing electricity mix. Recent tenders for solar photovoltaic (PV) suggest that renewable technology is competitive or, at least, they confirm that renewables can compete successfully under certain conditions.

As the current business model of pricing electricity, which is based on the marginal cost of production, is becoming obsolete, new models must emerge; and one example is the use of markets that value reliability and flexibility of electricity supply.

Electricity reform efforts in the GCC might incorporate three important characteristics. First, a credible economic plan with a rational time schedule to develop the regulations needed to achieve stated objectives. Second, price and subsidy reform to ensure long-term viability. Third, renewable energy to be added to the generation portfolio, while natural gas can act as the most effective back up to the system.

Summary for Policymakers

Global electricity markets are facing transformational changes driven by transformations to both the demand and supply side of the industry. On the supply side, energy stakeholders expect a substantial increase in renewable generation due to falling costs of solar photovoltaics (PV) power, climate change commitments, diversification of the energy mix and growing consumption. On the demand side, consumers are slowly changing their behavior as new smart technologies are introduced in lighting, heating, cooling, electrical appliances, among others that modify the way they use electricity. It is clear that future power systems will require a different model to manage a market with new demand and supply characteristics. In particular, policymakers will have to decide how markets are going to pay for the intermittency challenges posed by renewable technologies.

Gulf Cooperation Council (GCC) countries also need to adapt to the changing global power markets by developing new electricity models. In particular, these states may, as part of their reform programs, consider transforming their public companies to private entities, monopolies to competitive markets, fossil fuel generation to a diversified electricity mix and regulated prices to liberalized prices. Moving to a new power system will require substantial reforms and a balanced approach in order to meet these different and sometimes conflicting objectives.

The result of ongoing tenders for utility-scale PV plants in the GCC suggests that renewable technology can compete successfully with conventional sources under certain market

conditions. However, a higher degree of transparency is required in order to evaluate correctly the cost of alternative generation technologies bearing in mind that a tendered price may not be the same as the levelized cost of electricity (LCOE), even though it provides a cost signal.

Customers will probably re-evaluate their use of electricity as it shifts away from being considered as a 'commodity' toward being a 'service' with the desired characteristics of utilities. In other words, customers would pay for air conditioning or lighting when they chose to use it, rather than electricity. This implies that new business models will emerge based on consumer preferences for these services, rather than on the cost of producing electricity, as is the current standard. In this context, it is likely that the business models will develop faster than regulations, which will lag behind the commercial changes.

There are a few general policy recommendations gained from the experiences of other countries, which can assist GCC policymakers. First, they must define a credible economic plan, set a rational time schedule to carry out the policy and develop regulations needed to achieve these objectives. Second, price and subsidy reforms is a prerequisite to achieving economic viability for the different players in the electricity sector in the long term. This will require exploring the best way to engage relevant stakeholders in compensating the most vulnerable citizens. Third, integration of renewable energy into the electricity system will impose costs to the system; and, most likely, natural gas will be the most cost effective backup.

Background to the Workshop

KAPSARC's December 2016 workshop, The Future of the Electricity Sector in the GCC, was attended by utilities and energy transition policy experts from international agencies, research organizations and laboratories, industry, governments and academia. Participants discussed the future of the electricity sector in GCC countries by taking a closer look at the relationship between electricity markets and the integration of renewables.

The workshop addressed several challenges associated with attempts to reform the energy sector in the GCC. It builds on previous workshops: A Framework for Fuel and Technology Transitions in Energy: Evaluating Policy Effectiveness (November 2013), Policy Support for Energy Transitions: Where is Public Money Best Spent? (May 2014), Energy Transitions Policy: What Matters Most (October 2014), Renewable Energy in the GCC: Oasis or Mirage? (September 2015), Designing Electricity Markets to Integrate Renewable Energy and New Business and Regulatory Models for the Utilities of the Future (both in March 2016).

This workshop explored the impact of renewable energy on electricity markets and current business

models of traditional utilities. In particular, participants considered whether renewable energy deployment would require a reimagining of current market design and policy instruments, especially given the new economic reforms envisaged by GCC countries. The workshop centered on a number of key questions:

- How is renewable energy changing the electricity market structure and how does that affect traditional utilities?
- Is integration of renewables only an issue of price and volatility, or does it involve creating a new business model?
- Will traditional utilities be able to survive in a more deregulated market?
- How can GCC countries move forward with reforms in other economic sectors and simultaneously achieve targets of diversifying its energy mix, decrease carbon emissions and maintain a low price of electricity?
- What is the potential for 'smart' houses in the GCC?

Future Design of Electricity Markets in the GCC

Most energy stakeholders in the GCC expect a substantial increase in renewable generation in the coming years. Some experts forecast global investments of \$13.5 trillion in low carbon and efficient technologies by 2030. In the GCC, the expected deployment of renewable energy could reach 78 GW by 2030. This wave of spending in renewable generation in the region is driven by the recent decline in the costs of solar PV generation, climate change commitments agreed to at COP 21, the need to diversify energy mix and increase in power demand. However, current low prices of oil and natural gas could curb the surge in renewables. Additionally, these low fossil fuel prices have put pressure on Gulf states' public budgets and reduced the ability and appeal to finance renewable technologies.

At a global level, the increase in renewable energy has been accompanied by a change in electricity usage. Electricity consumers are slowly adjusting their behavior, including those from GCC countries. New smart technologies in lighting, heating, cooling, etc. will modify the way electricity is consumed. In addition, distributed generation will change the way electricity is supplied. Future electricity systems will require a different model to manage a market with new demand and supply characteristics. In particular, the new system will have to figure out how markets are going to pay for the flexibility and spare capacity that new technologies will require. In other words, policymakers have to redefine existing market rules.

“In the GCC, in relation to the integration of renewable energy sources into the grid, the solution will be between the current model and one that’s totally liberalized.”

In this new technological context, GCC countries are making efforts to adjust their electricity markets, which in general, are public monopolies with an almost 100 percent fossil fuel generation mix. GCC governments have started reforming their markets to increase liberalization and private participation, promote renewable technology deployment and align domestic prices of electricity with the true cost of generation.

“Competitive tenders to promote renewable deployment are not silver bullets.”

Achieving complete liberalization, decarbonization and removal of fossil fuel subsidies, while keeping electricity prices low, are contradictory objectives. Liberalized power markets have difficulty absorbing high levels of renewable generation, given the almost zero marginal costs of these technologies. Higher levels of renewable penetration usually lead to lower prices and greater volatility. In addition, a 100 percent penetration of renewables would lead to prices equaling zero in a liberalized market. This outcome is possible from a theoretical point of view, but not possible from a practical perspective. Liberalization and higher private sector involvement is difficult in an environment where prices are heavily subsidized. Heavy subsidies automatically imply a high level of public intervention. The removal of fossil fuel subsidies and an increase in renewable technologies would lead to an increase in the price of electricity to consumers. Policymakers need to make compromises among these policy contradictions in their objectives.

The main driver of renewable energy in the GCC region is economic, while environmental concerns or energy diversification are secondary movers. In this context, the results of the solar PV tenders that have taken place recently in the region suggest that renewable technology is competitive or, at least, they confirm that renewables can compete successfully under certain conditions. However, higher levels of transparency are needed in order to

evaluate correctly the cost of alternative generation technologies. The positive results seen in some GCC countries confirm that competitive tenders are the most popular tool among GCC governments to promote renewable technologies. Yet, they may not be the cheapest method. The cheapest tool for governments is probably direct investment subsidies, but the current situation of public finances in the GCC makes this option less attractive.

Customer of the Future: An Active Buyer of Energy

Electricity consumers are now willing to take greater control over their energy management as new distributed energy technologies emerge around the world. Utilities need to respond to the changes in the way households consume electricity or risk losing relevance. Radical changes will have to be made to the business and operating models due to imminent innovations and transformations. First, technological advances and a changing business landscape are leading the move away from electricity as a basic commodity, toward a concept of electricity as a value-added service with multiple attributes. In this paradigm, consumers pay for a particular benefit or a bundle of benefits that features attributes such as connectivity, reliability or flexibility. As such, new business models are important to the emerging concept of electricity as a value-added service. Utilities must find ways to adapt their operating and business models to remain relevant and provide the value-added services that consumers want. One key challenge for policymakers is to create regulations that keep up with such a fast-changing industry and help transition the sector toward the new paradigm.

Second, power prices will probably decline but the ‘cents per kWh’ standard metric used to pay for electricity consumption could be inconsistent with the new technologies. In the future, electricity prices may fail to signal operations and investments since they will no longer reflect the relevant scarce resource. In other words, the traditional measure of ‘cents per kWh’ may not reflect the consumer’s value of electricity. Even if a growing quantity of electricity has marginal costs close to zero, electricity will not be free as its real market value is the ability to have it when consumers need it. Prices should, therefore, reflect this and reward flexibility and opportunity. People will react to the prices, as long as the prices are ‘relevant’ economic variables to them. If these

relevant prices, do not exist, regulation needs to create them, either by assigning values in a top down fashion or by assigning property rights that allow holders to trade.

Third, the rapid increase in distributed energy resources (DER) and the decrease in the cost of renewable technologies are forcing a redefinition of the relationship between utility and consumers. The traditional relationship is the one where the utility provides readily available power – and makes all the investments necessary to do so – while the household buys the electricity it needs, when it needs it. Today, this traditional relationship is at risk due to the change in ‘how’ consumers get electricity, especially with households installing their own generation capacity while at the same time utilizing the grid provided by utilities. This raises the issue of free riding by households, and how and whether regulation is needed to enforce a complete disconnect from the grid in order for households to bear the full cost of individually installing renewables technologies and not just enjoy the benefits.

Fourth, as DERs continue to be deployed and meet a growing part of demand, the question of who is ‘entitled’ to the load is brought to light, meaning who owns the electricity and therefore can benefit from it. The utility could argue that they make investments based on observed loads and, therefore, households have to compensate them. Alternatively, households may argue that the demand forecasts does not represent a legal contract. This issue of load ownership raises two differing points of view, utility versus household, on the value of allowing access to the grid. This valuation could be different between utilities and households, and could explain why electricity companies are always more interested in deploying smart grids while consumers find little value in them.

Fifth, the customer of the future is characterized as a dynamic and active participant in the electricity markets. The benefit of the customer's participation is that it helps to reduce future capacity requirements. A more comprehensive approach to the consumer of the future is also to treat them as a generation resource, known as a 'prosumer.' This implies that they can pay for capacity provision, actively trade in the energy markets and provide ancillary services.

Finally, integrating wholesale markets with distribution or retail markets, where the prosumer participates, makes the electricity sector increasingly complex to coordinate. Two important questions emerge from this approach: first, who controls which

aspect of the power system? Second, who coordinates deployment and operations? Growing use of information technology also creates governance issues as more players are involved; from transmission system operator (TSO), distribution system operator (DSO), micro grid to households. Additionally, the growing adoption of information technologies has important implications on privacy and security concerns. Blockchain technologies (distributed platforms, initially appearing in financial services that allow transactions to be made securely and in an automatic way) can enable smart contracts, which could facilitate peer-to-peer transactions in a safe manner.

Beyond Smart Meters: Smart Houses in the GCC

Buildings in general consume around 70 percent of the electricity generated. In tackling this, policymakers have the chance to reduce energy consumption and emissions by using technologies to improve efficiency. It is important to analyze efficiency as forecasts suggest that by 2040 electricity consumption will increase substantially. For example, in Saudi Arabia electricity demand could increase from current 277 TWh per year to as much as 850 TWh per year. This rate of consumption would require 4.2 GW of additional generation capacity every year until 2040, creating an opportunity for new clean technologies. In the GCC there are a number of barriers that prevent buildings from adopting the best technologies available for energy efficiency;

among these are limited standards and codes, subsidized tariffs, shortage of expertise and simply a lack of awareness.

Aside from these limitations, the vast potential for renewable technologies in the GCC region also faces other obstacles. Some preliminary studies suggest that although rooftop PV can reduce electricity generation from fossil fuel, it can also increase the variability of net demand and might not help peak shaving. This is because in GCC countries there are two consumption peaks, the first at noon and the second in late evening. Solar PV can reduce the first peak, but not the second. This implies that fossil fuel installed capacity cannot be substantially reduced. However, batteries could ameliorate this problem in the foreseeable future.

Promoting Policy Reforms in the GCC

Policymakers in the GCC can take advantage of the experiences of countries that have already undertaken energy reforms. This does not necessarily imply that GCC policymakers must automatically copy a successful experience from abroad. Each country is different and a one-size-fits-all policy simply will not work. However, there are some general recommendations that could provide value. The first is that governments must show a commitment to the rollout of their policies. Policymakers must define a credible economic plan, set a rational time line to carry out the policy and develop regulations needed to achieve the stated objectives. Secondly, price and subsidy reform is required to ensure the long-term economic viability of utilities and it is also necessary to explore the best way of engaging relevant stakeholders in the reform process and produce compensation packages for the most vulnerable citizens. Thirdly, it is important to make an effort to integrate renewable energy into the electricity system and boost the role of natural gas, probably as the most cost efficient backup.

“In most occasions, policymakers cannot carry out the best theoretical reform. The world of ‘second bests’ is the real world.”

These recommendations may also include two additional elements. The first is that governments make an effort to contain the costs associated with the policy. The second, while fossil fuel technologies are easy to accommodate in the traditional competitive model or liberalized markets, renewables are a ‘different animal.’ Fossil fuel technologies have high marginal costs while renewables have high fixed costs. The different cost structures make traditional price competition difficult and raises the issue of capacity payments for spare fossil fuel generations.

Institutions will play a critical role in the transition toward a new energy model in the GCC. Clear roles and responsibilities as well as decision-making processes are necessary for successful reforms. This is more relevant as some GCC countries are planning to move from a vertically integrated electricity monopoly to a competitive environment with independent new players.

Policymakers normally do not try to implement ‘best policy’ for a pure theoretical point of view or ‘first best.’ These best theoretical policies are normally difficult to carry out due to economic, social or political constraints. Additionally, there is a classic trilemma in the world of energy between efficiency, reliability and security issues that complicates the identification of a ‘best policy.’ In reality, a world of second bests where policymakers try to strike the right balance among contradicting targets is the path forward for decision makers.

About the Workshop

KAPSARC convened its sixth Energy Transitions workshop in December 2016 with some 35 international experts to facilitate a dialogue on the progress of the framework we are developing at KAPSARC to understand fuel and technology transitions and future utilities. The workshop was held under a modified version of the Chatham House Rule under which participants consented to be listed below. However, none of the content in this briefing can be attributed to any individual attendee.

Iqbal Adjali – Senior Research Fellow, KAPSARC

Ghassan Alakwaa – Energy Analyst, Arab Petroleum Investments Corporation (Apicorp)

Saleh Alawaji – Deputy Minister for Electricity, Ministry of Water and Electricity

Mubarak AlKater – Executive Director, New Business Development, Saudi Electricity Company (SEC)

Omar Al-Madhi – Managing Director and Board Member, Abdul Latif Jameel Industrial Development Company

Hisham Faer Al-Sharif – Renewable Project Development and Support Division Head, Aramco

Muhammed Asif – Associate Professor, King Fahd University of Petroleum and Minerals (KFUPM)

Saleh Balamash – Director General of Technical Cooperation/Manager of Voltage Standardizing, Ministry of Water and Electricity

Wail Bamhair – Business Development Manager, TAQIA Energy

Leila Benali – Corporate Advisor, Saudi Aramco

Jorge Blazquez – Research Fellow, KAPSARC

Andrea Bollino – Professor, University of Perugia

David Broadstock – Associate Professor, Research Institute of Economics and Management, Southwestern University of Finance and Economics

Christoph Burger – Senior Lecturer and Senior Associate Dean of Executive Education

Amro Farid – Associate Professor, Dartmouth College

Rolando Fuentes – Research Fellow, KAPSARC

Marwan Khraisheh – Senior Research Director, Qatar Environment and Energy Research Institute

Grzegorz Onichimowski – Manager of Market Operations, GCC Interconnection Authority

Mark McGranaghan – Vice President, Electric Power Research Institute

Paul Mollet – Senior Advisor, World Energy Council

Mohammed Muaafa – Senior Research Associate, KAPSARC

Nora Nezamuddin – Senior Research Analyst, KAPSARC

David Robinson – Senior Research Fellow, Oxford Institute for Energy Studies (OIES)

Adnan Shihab-Eldin – Director General, Kuwait Foundation for the Advancement of Sciences (KFAS)

Bruce Smith – Advisor to the Managing Director, Abu Dhabi Water and Electricity Company (ADWEC)

Xiansheng Sun – Secretary General, International Energy Forum (IEF)

Dennis Volk – Independent Consultant

Matthew Wittenstein – Energy Analyst, International Energy Agency

About the Team



Iqbal Adjali

Iqbal is a senior research fellow specializing in complex systems and energy systems modeling. He holds a Ph.D. from Oxford University and an MBA from Cranfield University.



Jorge Blazquez

Jorge is a research fellow specializing in energy and economics. He holds a Ph.D. in Economics from Universidad Complutense de Madrid.



Rolando Fuentes

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



Mohammed Muaafa

Mohammed is a research associate focusing on smart grids, consumer behavior, renewable energy and energy modeling. He holds a Ph.D.



Nora Nezamuddin

Nora is a senior research analyst, focusing on transition policy. She holds a BSBA in Business Administration and International Studies from American University, Washington, DC.

About the Project

The goal of this project is to understand how policy can expedite renewable energy transitions in a cost-effective way, while allowing competitive national industries to develop. In line with this objective, a wide range of policy instruments, designed and implemented to promote renewable energy, are being assessed. Furthermore, the project takes a holistic approach by analyzing how the competitive dynamics between renewable technologies and incumbent technologies evolve.

In addition, the 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.

Notes



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