KAPSARC

مركز الملك عبدالله للدراسات والبحوث البترولية

King Abdullah Petroleum Studies and Research Center

Assessment of the Political Feasibility of Developing a GCC Power Market

Paul Mollet, Imtenan Al-Mubarak, Brian Efird, Saleh Al Muhanna and Omar Al-Ubaydli

September 2018

Doi: 10.30573/KS--2018-DP39

Acknowledgments

The authors would like to acknowledge the Gulf Cooperation Council Interconnection Authority (GCCIA) for their assistance throughout the process of producing this paper.

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.

Legal Notice

Key Points

Countries in the Cooperation Council for the Arab States of the Gulf, commonly known as the Gulf Cooperation Council (GCC), established a regional power grid to support member countries' high voltage networks in 2001, but to date the system has remained underutilized. The intended purpose of the grid was to provide backup electricity during emergencies caused by power system outages, especially during the summer, and to share spinning reserves, optimize capital investments in electricity and reduce fuel costs. The grid has been fully operational since 2011 and has satisfied its intended purpose. However, GCC member states have largely failed to take advantage of options associated with the grid to trade electricity. Many regional analysts and the GCC grid's system operator – the GCC Interconnection Authority – argue that there is a missed opportunity to utilize the GCC grid to support electricity trading among the member states, allowing power companies to realize significant economic benefits. This paper uses the KAPSARC Toolkit for Behavioral Analysis platform, a model of collective decision-making processes developed at KAPSARC, to examine the political feasibility of expanding the utilization of the GCC grid to include trading electricity. The key findings of this paper are as follows:

- There appears to be growing political feasibility for the expanded use of the GCC Interconnection Grid, including the potential for a GCC-wide electricity market. However, in the short term, an increase in bilateral trade appears more likely.

- The recent dispute between Qatar and Saudi Arabia, the United Arab Emirates (UAE) and Bahrain has dampened the opportunity for realizing the full potential of the interconnection grid. However, if this dispute is resolved, the long-term trend should revert to a more positive trajectory for the use of GCC-wide interconnection.

- Political feasibility for a GCC power trading market does not necessarily mean it will happen. Despite increasingly favorable views of trading electricity over the GCC grid, particularly in Saudi Arabia, the UAE and Qatar (the largest economies in the GCC), broad utilization of the GCC grid and electricity trade are not priorities currently for key stakeholders in these countries. Despite the current political impediments to an intra-regional power pool, there appears to be insufficient political momentum to move this concept forward in any case.

- Oman, Kuwait and Bahrain all place a higher priority on the expanded use of the GCC grid but have less regional clout to overcome remaining regulatory and fiscal barriers to broader usage.

Executive Summary

The existence of an interconnection grid linking members of the Gulf Cooperation Council (GCC) offers countries in the region a unique economic and financial opportunity to trade electricity as part of a regional power market, and not just in the case of emergency power outages. Studies by the Gulf Cooperation Council Interconnection Authority (GCCIA) and others have found that trading power among the GCC countries could save the member states about $5 billion in electricity sector investments and $1.8 billion in fuel costs between 2014 and 2038. There is clearly a strong economic case in favor of creating a GCC-wide power market, and yet there has been little, if any, progress beyond the execution of short-term bilateral power deals.

The KAPSARC Toolkit for Behavioral Analysis (KTAB) platform, a model of collective decision-making processes (CDMPs), is an excellent tool for trying to understand the impediments to increased trade and to assess the political will for the development of a regional power trading platform using the GCC grid. This study focuses on the political feasibility of the expanded use of the GCC Interconnection Grid, ranging from bilateral power contracts to the development of a fully functional regional power market for the GCC. This paper used KTAB to perform a systematic analysis of the expected support for, and reactions to, power trading over the GCC grid. It also explores why so little progress has been made to date. The feasibility of the expanded use of the GCC grid, using this methodological approach, is correlated to the anticipated reaction of constituents and interest groups that will benefit or be impacted by this increase in grid utilization. These constituents include governments, regulators, power companies and consumers.

The aim of this paper is to analyze the value proposition offered by the greater use of the GCC grid for each stakeholder group and their constituent actors, evaluate how they might interact based on their individual preferences regarding regional power trading in the GCC, and assess the potential for areas of agreement among decision-makers and their constituent supporters. The KTAB methodology allows the user to simulate interactions among decision-makers (such as bargaining or negotiations) regarding a modeled policy question or issue.

These interactions take into account an actor's exercised power (a factor of an actor's influence and the importance an actor places on the modeled issue). Actors react to other actors depending on their preferences or utility, as well as the perception of other actors' utilities regarding the modeled issue. Such a simulation facilitates the evaluation of the political feasibility of reaching a consensus, as well as the form of consensus that is possible. It also provides insights into the status quo.

This paper simulated a CDMP around the willingness for trading electricity among the GCC countries. Based on data collected from semi-structured interviews with subject matter experts in all six countries, it found that there is no strong disagreement among GCC members to the development of a power pool in the GCC. Table 1 presents a high level summary of results. The "current political will" column describes the aggregate expert opinion regarding the views of all relevant stakeholders and influencers for each country. In each case, the assessed political will for trading electricity over the GCC grid is positive, but with various levels of domestic disagreement. The "expected political will" column summarizes how this is likely to change over time, based on the results of the KTAB model simulations. This paper finds that there is growing political will, in each country and in the region as a whole, for the broader utilization of the GCC grid, and potentially for electricity trading.

The results range from moderately to strongly positive, which suggests a strong positive trend in political will. Consequently, this paper finds that political feasibility for the expanded use of the GCC Interconnection Grid is growing, increasing the likelihood of a GCC-wide electricity market. However, the dispute between Qatar and Saudi Arabia, the UAE and Bahrain would need to be resolved before region-wide trading is possible. In the short term, one-off bilateral trading appears more politically practical.

Despite the encouraging evidence suggesting that there is political will for expanded use of the GCC grid, the KTAB simulation results (and the clear economic and financial benefits) are no guarantee it will actually happen. Even before the deteriorating diplomatic situation in the region, there was insufficient political momentum to move a GCC electricity market forward. In particular, the KTAB methodology measures the 'salience' of the issue for each stakeholder, i.e., the degree of importance or urgency with which the issue is perceived. Salience levels for most actors regarding the issue of increased intra-regional power trade are low, especially in those GCC member states with the most regional clout to push forward this expanded use of the GCC grid, namely Saudi Arabia, the UAE and Qatar. GCC member states with less clout, such as Kuwait and Oman, place a higher priority on GCC power trading than their neighbors but are less strongly in favor of expanded utilization of the GCC grid.

Overall, no GCC state has any strong, motivated champions that could push forward the regulatory policy synchronization required to enable a GCC power market. In particular, reconciliation of domestic energy prices and reform of domestic electricity markets are two of the most important policy issues that each country must resolve before they can move forward with regional power trade. Despite the political feasibility for electricity trade over the GCC grid, without a strong domestic advocate that can reconcile domestic concerns and raise the priority of regional power trade, then little progress can be expected even with a politically feasible outcome.

Furthermore, the dispute between Qatar and other GCC countries dampens some of the positive momentum observed in the simulations. The experts consulted for this study generally argued that the economic benefit of a GCC grid can overcome diplomatic differences, especially in the long-term. Indeed, Qatar continues to use the Dolphin pipeline to transport natural gas to the UAE and remains a participating member of the GCCIA.

Table 1. Summary of consensus views on trading power in the GCC, current and expected.

Country	Current political will	Expected political will
Saudi Arabia	Mixed but positive	Moderately positive
United Arab Emirates	Mixed but positive	Moderately positive
Kuwait	Mixed but positive	Weakly positive
Oman	Mixed but positive	Weakly positive
Bahrain	Mixed but positive	Strongly positive
Qatar	Currently disrupted	Short-term: trend disrupted Long-term: moderately positive if dispute resolved

Source: KAPSARC analysis.

Introduction

The reliability of energy services is paramount for the Gulf Cooperation Council (GCC) states. Indeed, electric power is critical: temperatures in the region can soar to 50 degrees centigrade and most states are entirely dependent on water produced through desalination. Faced with growing populations, domestic energy policymakers have historically countered this risk by building in a high degree of surplus capacity in national power systems with generous spinning reserve margins.

By the 1980s, the GCC began considering interconnecting the grids of its member countries as an additional way to increase energy security. In 1990, a study commissioned by the GCC Secretariat recommended the interconnection of all six GCC states, noting that it was both technically and financially feasible. However, it was not until 2001 that GCC energy ministers agreed to the establishment of a jointly-owned entity known as the GCC Interconnection Authority (GCCIA) to implement a regional grid. Unusually, instead of linking each neighboring country's national grid through simple interconnectors, the GCC opted for a fully-owned grid with circuits running through each of the GCC states. The only circuit not owned and operated by the GCCIA links Oman through the United Arab Emirates (UAE).

The GCCIA completed the project in three phases. The first phase, the Northern System, completed in 2009, saw the interconnection of Kuwait, Saudi Arabia, Bahrain and Qatar. Working in tandem, but independently of the GCCIA, the UAE and Oman worked on the second phase of the project, known as the Southern System, to link their respective grids. Finally, in 2010 the Northern and Southern systems were linked with the completion of a Qatar-UAE circuit, and a second link was created between Oman and the UAE. Figure 1 shows the GCC-wide grid, with both the Northern and Southern systems.

By creating an independently-owned and operated power backbone linking Kuwait through to the UAE, the GCC achieved tangible success in regional cooperation. The regional interconnection system includes not only a 400 kilovolts circuit but also the necessary infrastructure and operations control center to ensure robust network operation. However, by failing to extend the GCCIA-owned backbone through the UAE all the way to Oman, and relying on a UAE-owned grid for power transfers, the GCC effectively created a weak link that could impede future attempts to use the grid commercially.

Since its completion, the GCC interconnector has been an unqualified success in terms of its original mandate to improve energy reliability. In 2015 alone, the system was used 185 times to provide emergency cross-border power supplies to overcome temporary production and transmission problems in individual GCCIA member countries. Trading within the GCCIA surpassed 1.3 million megawatt hours (MWh) in 2016. The availability of the network also allowed members to reduce their spinning reserves and to reduce installed capacity requirements, with significant economic benefits. The GCCIA estimates that in 2016 actual capital and fuel savings for the GCC countries totaled $400 million. By 2020, the capital outlays are expected to be $3 billion lower than they would have been without the regional ties.

However, the GCCIA's management quickly understood that there was scope for further commercial value beyond the original mandate to provide emergency backup and, in 2006, received a mandate from its board to work toward the commercial exploitation of the system. In practical terms, this involves the promotion of bilateral trades in power supplies between member states, eventually leading to the creation of a GCC power market. Indeed, the GCCIA's Board now regards

the establishment of a power market as the second phase of its mission and its primary goal. In 2015 the GCC Electricity and Water Ministerial Committee approved plans to waive interconnection fees to encourage GCCIA member states to use the grid for power trade deals.

Moreover, in 2009 the GCCIA completed the legal framework required to ensure cross-border trade. Two key documents were approved and signed by member states: the Power Exchange and Trading Agreement (PETA) and Interconnection Transmission Code (ITC) that regulate the commercial relationship between seller, off-takers and the transmission service operators (TSOs), as well as the GCCIA.

In 2016, GCCIA bilateral power trading exceeded 1.3 million MWh (value of $161 million) through the involvement of five of the six GCC member states, ultimately establishing over 15 contracts. By mid-2016, the GCCIA reported a number of one-off bilateral deals, including a 400 megawatt (MW) (interview 2017) between the Saudi Electricity Company (SEC) and the Abu Dhabi Water and Electricity Company (ADWEC).

In addition to the variation of load curves and differences in the cost of generation, fundamental changes in the region's energy mix are potentially major drivers of increased power trading. These include a growing deficit of local gas supplies, the introduction of nuclear power and the fast growth of renewable energy. Natural gas has been the cornerstone of the region's energy mix since the 1970s. Except for Saudi Arabia, the region has used indigenously-produced natural gas for most of its domestic power generation and water desalination.

Figure 1. The GCC electricity grid.

Source: GCC Interconnection Authority.

But domestic natural gas is increasingly in deficit: The UAE, Bahrain and Kuwait have been forced to start importing liquefied natural gas (LNG) for power generation, while Oman is struggling to produce enough gas. Only Qatar has abundant supplies of natural gas. So long as states such as the UAE, Bahrain and Kuwait continue to buy LNG at international market prices, there will be an incentive to look for cheaper alternatives, potentially within the region.

The construction of four nuclear power reactors in the UAE, with 5.6 gigawatts (GW) due on-stream in 2018, will provide a quarter of the UAE's anticipated electricity demand by 2020 (World Nuclear 2017). Nuclear power would provide base-load electricity for the entire system in most other countries, but the UAE's dependence on combined cycle gas-fired power plants for its water supplies to a large extent negates the base-load premise of nuclear power. The Emirates Nuclear Electricity Corporation might find itself, in effect, having to export its base-load at times of low seasonal demand. An additional driver for cross-border trade in electricity will come from the growth of renewable energy, notably solar photovoltaics (PV), whose intermittency will produce peaks and troughs in supply that can be more easily managed through cross-border flows.

Water desalination remains a critical element of the regional power equation, given the dependency of most GCC states on gas- and oil-fired plants for water desalination. GCC states have been slow to take up the opportunities offered by reverse osmosis technology which, while requiring energy, is not directly linked to gas-fired turbines. In 2015, the Kingdom of Saudi Arabia's Saline Water Conversion Corporation announced plans for a new unit named Jeddah 4 that will have a desalination capacity of 400,000 cubic meters per day and will incorporate reverse osmosis technology. The UAE and Saudi Arabia are pursuing solar desalination; Saudi Arabia will build the world's first commercial solar desalination plant in Al-Khafji.

Power generation capacity in the GCC as a whole currently totals 148 GW. The region will need to add as much as 76.8 GW over the next five years, at a cost of $50 billion (Ventures Onsite for Middle East Electricity 2016). Increased energy trade would be a way to optimize investments at a time when decreasing oil prices are placing national budgets under stress.

Despite a small number of bilateral commercial power sales agreements, a fully-fledged power market remains little more than an aspiration. Obstacles include political concerns about excessive dependence on neighboring countries for a strategic resource, differences in national energy policies, price distortions caused by subsidies, differences in the structure of national power systems, the low number of market participants, the emergence of a new class of players, and regulators with different priorities.

Furthermore, as this study will show, there is a fundamental mismatch between potential buyers and sellers that goes beyond the issue of price. While consumers are by their nature anxious to buy, producers appear to lack the urgency required to adjust their governance structure around the GCC grid in order to establish a market.

When and if the development of a fully-fledged power market in the GCC happens, it will inevitably be driven by key decision-makers across each of the six GCC member states, either acting individually or as a group. The analysis in this paper suggests that these decision-makers, while broadly supportive, have some way to go before they fully endorse the creation of a fully functioning power pool. An interim solution based on a series of bilateral trading relationships is much more likely.

This paper focuses on the political feasibility of allowing electricity transactions across borders in the GCC region. Stakeholders views on the issue of developing a GCC-wide electricity market informs expectations of what can realistically be agreed. This analysis applies a modeling framework developed at KAPSARC to assess collective decision-making processes (CDMPs), known as the KAPSARC Toolkit for Behavioral Analysis (KTAB). For a more detailed description of KTAB, CDMPs, and the specific model utilized in this paper, please refer to Wise, Lester and Efird (2015a and 2015b).

This paper aims to analyze the value proposition for each stakeholder group – in the terminology of the model, 'the actors.' It assesses how the actors might interact, based on their evaluation of the utility of power trading, in addition to investigating the potential for areas of agreement among the specified decision-makers and their constituent supporters

The KAPSARC Toolkit for Behavioral Analysis (KTAB)

KTAB is a platform that enables the modeling and analysis of CDMPs. CDMPs are different to other decision-making processes in that:

- They involve more than one actor (individuals, institutions, or identifiable groups or 'blocs').
- A single decision is arrived at as a result of coordinated interaction between a finite set of actors.

The form of this interaction is different to large group decision-making processes, such as the market-based derivation of a price, for example, which is the result of the uncoordinated actions of countless individuals.

This paper presents an analysis of plausible outcomes for the CDMPs that decision-makers and stakeholders in each of the GCC states are currently engaged in, regarding the potential to trade power over the GCC Interconnection Grid. It uses a specific instantiation of a model in KTAB, based on the Spatial Model of Politics (SMP), one of the most prominent and best established CDMP models. SMP analyzes collective choice or actions of societal actors with various preferences, behavior assumptions and information under pre-defined institutional rules. The theory assumes an individual has well-defined preferences over a given set of alternatives, and will choose an alternative based on no other alternative in the set being more preferred by the individual; that is, the social actor will choose a 'best' alternative. The SMP model examines the possibility that individual preferences are directly aggregated into a collective preference relation, which is then maximized to yield a set of best alternatives, where 'best' is the most preferred with respect to the collective preference relation (Austen-Smith and Banks 1998). While this paper uses one model for its simulations, KTAB is a toolkit that enables an almost limitless implementation of variant models, based on different assumptions as to how various CDMPs work. Any of the assumptions in this paper can be changed, and new models built in the KTAB framework.

This paper focuses on the logic of the analysis and presents a description of the results. It does not provide a detailed technical description of the underlying model and its calculations. The following two KAPSARC papers provide more details of the underlying model:

- "An Introduction to the KAPSARC Toolkit for Behavioral Analysis (KTAB) Using One-Dimensional Spatial Models" (Wise, Lester and Efird 2015a).
- "Multidimensional Bargaining using KTAB" (Wise, Lester and Efird 2015b).

Both papers are available from KAPSARC's website, specifically the KTAB portal, as is the program's source code and documentation. Please visit http://ktab.kapsarc.org for all related papers and http://kapsarc.github.io/KTAB/ for the latest version of the software. The analysis in this paper utilized KTAB version 1.0.

By separating the technical detail from this applied discussion in this way, the hope is to make the discussion more accessible for what is a relatively new field to most readers.

Approach and assumptions

When analyzing CDMPs, one way to show the preferences of, and differences of opinion

between the various actors is to represent them graphically, using a technique referred to as spatial preferences. In this approach, the distances between points on a line that captures possible advocacy reflect the spatial component (Wise, Lester and Efird 2015b; Efird, Lester and Wise 2016). This approach forms the basis for a model implemented in KTAB: the SMP. This paper applies the SMP to the question of the political feasibility of trading electricity over the GCC interconnection. Other work describes the SMP approach exemplified in KTAB in detail (Efird et al. 2016). For this study, the essential aspects of the SMP are that a set of actors is defined with differing positions on issues, the influence they can exert on each issue, and the salience (or concern) they have for each issue. Position, influence and salience are all captured numerically on a scale of 0 to 100 during semi-structured interviews with subject matter experts. It is the combination of influence and salience that gives a particular actor his, her or their ultimate power in making the particular outcome for an issue more or less likely. Appendix 1 provides further details on the KTAB SMP.

Model dynamics: turns in the KTAB SMP

KTAB's SMP provides a simulation of how actor positions change over time. It captures time in a series of iterations or 'turns.' The exact length of time a turn takes is an abstraction: a turn is any period during which all actors can exchange information and attempt to influence each other. The results of the simulation present the turn-by-turn changes to actors' positions. These shifts in position are based on several different factors in the model, all operating simultaneously. The behavior of individual actors can vary widely, based on the configuration of numeric values in a particular dataset. There is no such thing as a 'rule of thumb' regarding how the simulation unfolds. Sometimes actors will move only incrementally as the turns progress; sometimes they may make much larger moves in the simulation. Appendix 2 provides a brief, nontechnical, description of the logic behind the simulation. This paper focuses on the high-level outcomes calculated by the KTAB simulation and explains the numeric calculations that result in the most interesting shifts in actor positions.

Analysis of Support for a GCC Electricity Market

Defining the question

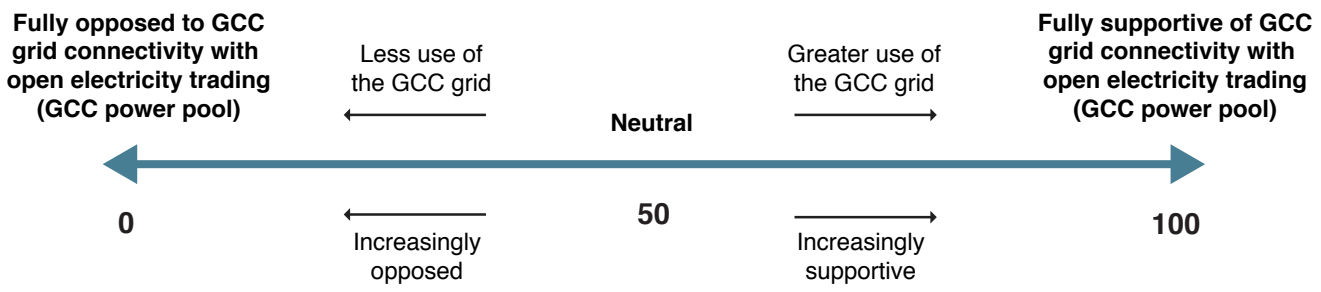
This KTAB study addresses the following question: What is the level of support for, and opposition against, a regional electricity market in the GCC? To analyze this question, the study begins by defining the spectrum of positions, as shown in Figure 2. The spectrum reflects the range of positions that actors in this simulation might take, capturing the degree of support for, or opposition to, a GCC power pool. The intent at this point is not to evaluate the specifics that might be included in establishing the market, but to assess the political environment and actors' views about whether there is any viable option for power trading.

As Figure 2 indicates, actors that take a position close to 50 are indifferent to the notion of power trading. Actors taking a position of 100, at the far right of the figure, fully support GCC grid connectivity with open electricity trading, and actors at position 0, at the far left of the figure, are extremely opposed to the idea. Positions ranging from 50 to 0 reflect increasing opposition, with an implied willingness to reduce the use of the GCC grid as the value approaches zero. Positions ranging from 50 to 100 reflect increasing support, with an implied willingness to increase use of the GCC grid as the value approaches 100.

The KTAB SMP data inputs

This study sourced data from interviews with 30 experts. The study team traveled to each of the six GCC countries to meet with the experts and interview them about the data required for their respective countries. The data collection was completed in the spring of 2017 but reconfirmed with a subset of experts more recently to account for the dispute with Qatar. The experts were knowledgeable about the stakeholders, or actors, for their particular country. That is, the experts provided input on the actors who had the ability to influence the decision to trade power with their neighbor states, for each country. The data collection phase of the study took place before the recent GCC diplomatic dispute between Qatar and Saudi Arabia, the UAE and Bahrain. For this reason, the data may no longer capture the current state of GCC relations on this topic. Nevertheless, the underlying dynamic and trends should still be applicable.

Figure 2. Spectrum of positions on the degree of support for, or opposition to, a GCC power market.



Source: Expert interviews conducted by KAPSARC.

As with any KTAB study, this study identifies a comprehensive list of actors, including policymakers and influencers, and has gathered data in semi-structured interviews with the aforementioned experts on three specific quantitative attributes for each actor. Specifically, this included the following attributes for each actor:

- Position: the location of an actor on the linear spectrum. In other words, what is the actor's advocacy concerning support for, or opposition to, a regional power market?
- Influence: the relative degree of political power for each actor. The most powerful actor is assigned a value of 100, and other actors are weighted relative to the most powerful actor.
- Salience: the relative priority each actor assigns to the idea of a regional power market compared with other issues over which the actor must exert influence.

The following experts were interviewed:

- A consultant in the Ministry of Electricity in Kuwait.
- A senior executive at the Kuwait Foundation for the Advancement of Science.
- The head of research at an Abu Dhabi-based research center.
- A consultant to the Abu Dhabi Water and Electricity Authority.
- The managing director at an international energy trade company based in the UAE.
- A leading consultant in sustainability based in the UAE.
- A senior advisor based in Qatar.
- A director at the Abdullah Bin Hamad Al-Attiyah Foundation for Energy and Sustainable Development.
- A manager at the Qatar Electricity & Water Company.
- A researcher at Nibras Power, based in Qatar.
- An advisor to the Qatari energy minister.
- A senior executive at the Public Authority for Electricity & Water.
- A professor at the Sultan Qaboos University.
- An expert on Oman oil.
- The Oman Electricity Transmission Company.
- A renewable energy consultant based in Oman.
- A senior director at the Saudi Ministry of Economy and Planning.
- An advisor at the Saudi Ministry of Economy and Planning.
- A senior executive at the GCC Interconnection Authority.
- A professor at the University of Bahrain.

The study aggregates the data into a single dataset, termed the baseline dataset. Differences of opinion regarding the assignment of values, particularly for key stakeholders, are noted in order to perform a sensitivity analysis. One baseline data set was created for each of the six GCC countries. Given the large quantity of data collected, spanning six countries, all data is in Tables A2-A7, in Appendix 3. The study uses the collective knowledge of the actors from the 30 interview subjects to assign values

for position, influence and salience. These last two properties were used to calculate exercised power.

These data were then used to simulate the collective decision-making process between and among the actors in this study, for each country separately, and then for all actors simultaneously. That is, the simulation covered how the actors in each country interact with, and influence, each other over time to arrive at an 'outcome' for an issue. This reflects a model-based view of the expected outcome for actors' collective support for – or opposition to – a regional power market.

The KTAB module used in this paper is the SMP. More information about the SMP can be found in Appendix 2 as well as in Wise, Lester and Efird (2015a, 2015b).

Simulation Results

After sourcing and handling the data, a KTAB SMP simulation was performed for each of the six countries individually, in addition to a GCC-wide simulation. The results of the simulations show the actors' movements within the CDMP through turns (the model's measure of time). These results enable inferences to be drawn about the political feasibility of a regional electricity grid among the actors modeled. Here, two types of visualizations are included to facilitate the interpretation of the model output. First, bar charts (Figures 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18, 19, 21, 22) show the distribution of the actors' positions and exercised power (the product of influence multiplied by salience) over the position spectrum. The first figure in each pair provides a visualization of turn 0 (reflecting the data collected from the group of experts before any model calculations), and the second figure in each pair provides a visualization of the final turn (depicting the final position of each actor, after KTAB has calculated the CDMP over each turn). Second, line graphs (Figures 5, 8, 11, 14, 17, 20, 23) present the changing positions of each stakeholder over all turns. Together these different figures help to tell a story of the evolving views for actors in each country on this question, based on the data collection process and simulation results.

In the bar charts, each actor is represented as a segment of a bar. The location of the bars on the horizontal axis indicates the position they take. For simplicity, when actors take roughly the same position, they are stacked on top of one another and rounded to the nearest interval. The height of the bars represents exercised power, which is calculated by multiplying influence and salience. The overall height of the bar demonstrates the power in support of that position among the collection of actors. Actors are color-coded to reflect groups of similar actors. For example, government members are colored dark green, while an energy-consuming company is orange. The color-coding in the bar chart, according to this schema, is purely to assist the reader in identifying actor groups. The grouping and color-coding do not have any effect on the SMP calculations.

Saudi Arabia

Saudi Arabia is not only the GCC's largest economy but is also home to its largest electricity market, with peak demand in 2015 recorded at 62.26 GW and total capacity at 80.5 GW. Power demand in Saudi Arabia is projected to increase to about 75 GW by 2020 and 120 GW by 2032. Power generation is entirely dependent on fossil fuels: mostly oil in addition to natural gas.

Despite possessing the world's fifth largest natural gas reserves, the country does not export gas as it uses the entire production to meet domestic consumption mainly from two sectors, petrochemicals and electricity generation. The country is planning on doubling its production of natural gas in the coming years, in an initiative toward cleaner energy. Saudi Arabia is planning on producing 3.5 GW of renewables by 2020 and 9.5 GW by 2023, primarily through solar and wind power generation.

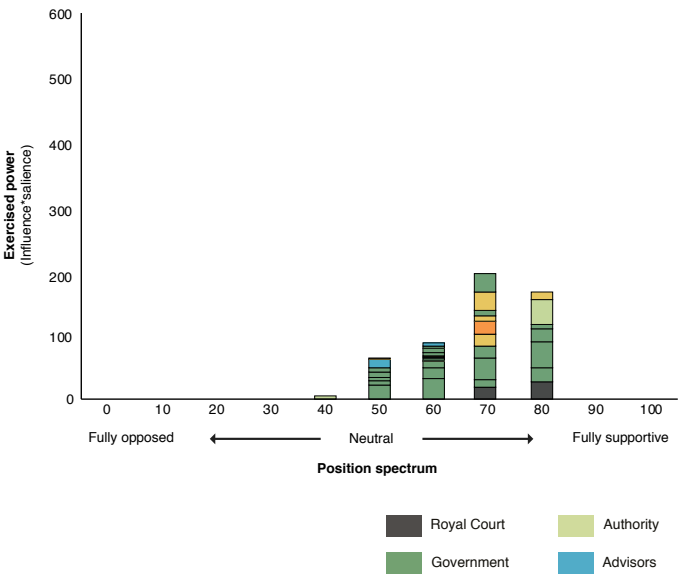
Plans to set up grid connections with Egypt and Jordan might provide GCC countries the opportunity to ultimately access European grids. This could allow the GCC countries to trade excess power with European countries during winters and summers. This trade will be mutually advantageous because off-peak demand in the GCC region occurs during the winter, while off-peak demand in Europe occurs during the summer. The abundance of natural resources in Saudi Arabia allows for cheaper inputs into power generation. The Kingdom's vast technical expertise and spare power capacity illustrate its

potential to become a major net power exporter through the GCC Interconnection Grid, and a leader of an inter-GCC, as well as an intercontinental, power market.

The results of the KTAB simulation for Saudi Arabia suggest growing political feasibility, meaning that decision-makers in the Kingdom are increasingly open to a fully functioning power market through the GCC grid. The following three visualizations show the results: Figures 3 and 4 depict the model data and final output as bar charts which display the distribution of actors' positions over the spectrum of positions ranging from opposition, neutral, to supportive of GCC electricity trading over a range of 0 to 100, as defined in Figure 2. Table A2 in Appendix 3 shows the initial expert-based data regarding the position, influence and salience of the actors.

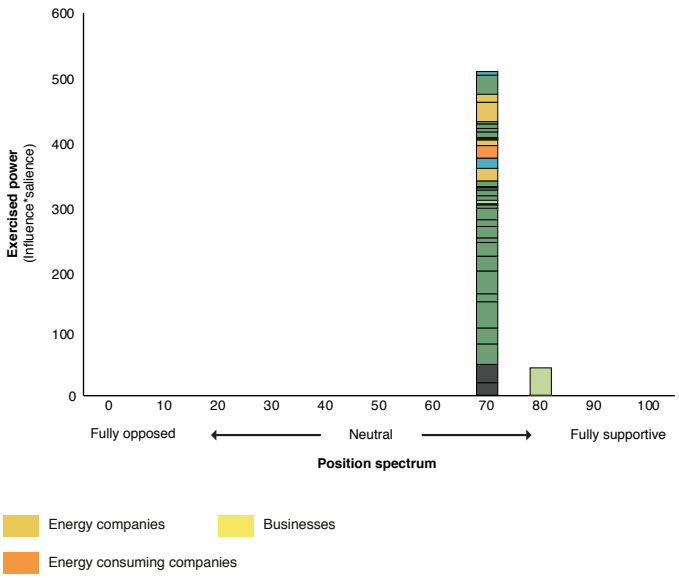
Figure 3 visualizes the various actors' initial positions before running the KTAB simulation (i.e., turn 0). These positions are based on the weighted average of expert-generated data, collected in structured interviews, as seen in Table A2, Appendix 3. Initially, there is a range of views regarding power trading, mostly ranging from a neutral to a positive disposition, except for the Saudi Arabian General Investment Authority (SAGIA) adopting a slightly negative position. The positions are distributed through four primary clusters of actors. The two largest clusters are anchored by Royal Court actors at positions 70 and 80; while advisors at the Ministry of Energy, Industry and Mineral Resources (MEIM), and the SEC are among the more powerful actors at position 70. The second cluster also includes the governor of the Electricity and Co-Generation Regulatory Authority (ECRA) at position 80. These actors are quite favorable to the idea of a fully functioning power market through the GCC grid, given the expert input. The other cluster is anchored by the MEIM minister, deputy minister of MEIM for electricity affairs, the Renewable Energy Project Development Office and the Aramco CEO at position 60. These actors are only moderately favorable to the idea of a fully functioning power market through the GCC grid, given the expert input. The third cluster is anchored by the ministers of foreign affairs and finance at position 50, a neutral view.

Figure 3. Turn 0 distribution of positions and exercised power for actors in Saudi Arabia.



Source: KAPSARC analysis.

Figure 4. Turn 16 distribution of positions and exercised power for actors in in Saudi Arabia.



Source: KAPSARC analysis.

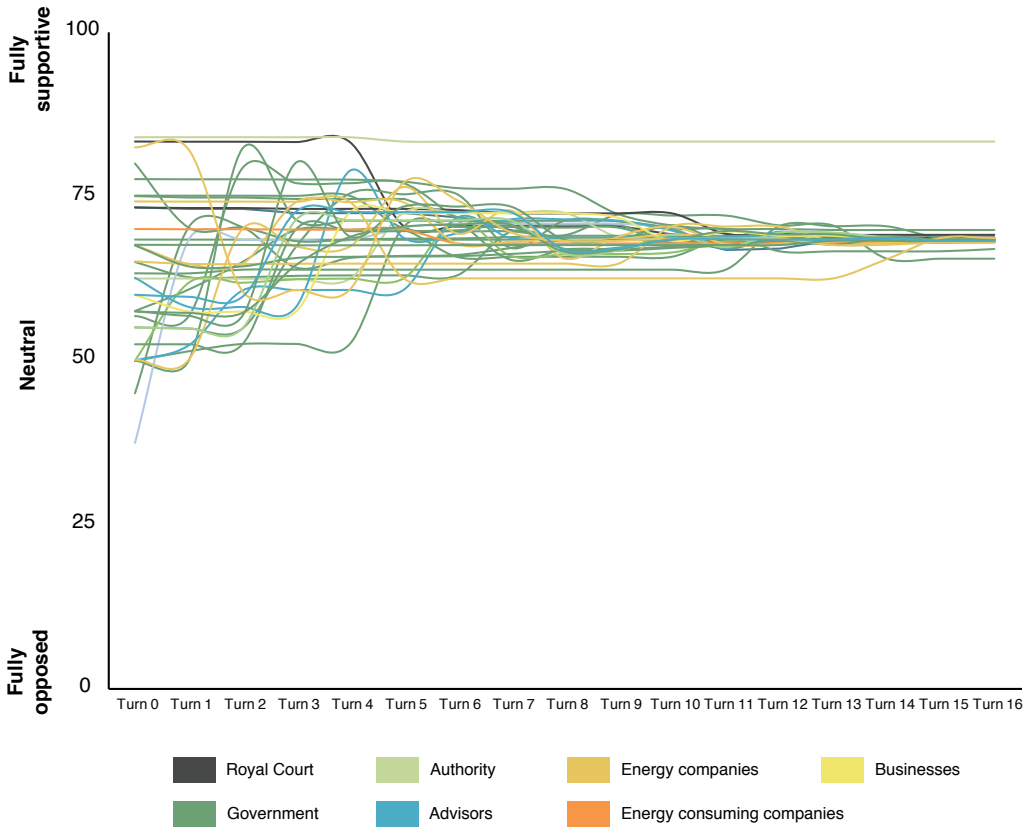
While the Saudi Arabian simulation ran for 16 turns, as indicated in Figure 4, the makings of the final consensus between points 60-80 are apparent as early as the fifth turn (shown in Figure 5). Four turns later, during the ninth turn, that consensus begins to stabilize between points 65 and 70. There were very minimal changes in position in the remaining seven turns, ultimately reaching a consensus around a position of 70, suggesting a favorable Saudi opinion regarding inter-GCC energy trading. This indicates that power trading over the GCC regional grid is expected to be politically feasible from a Saudi perspective.

ECRA was unwavering near its initial position of about 80 during the entire length of the simulation. With a very high salience score (strong commitment to its position), as well as growing consensus near its position, there is no reason for ECRA to compromise on its position.

Figure 5 provides a visualization also generated by the KTAB simulation. While Figures 3 and 4 display static pictures before the simulation and the last turn of the simulation, Figure 5 provides a turn-by-turn illustration of the results of negotiations. This line graph shows the simulation results of all Saudi actors in the dataset as they shift their positions from one turn to the next. Turn 0 reflects the initial state (data collected from experts) as detailed in Table A2. The remaining turns are the results from the KTAB SMP simulation. In each turn, actors apply political pressure to influence other actors to adjust their positions. At the same time, actors may apply counter pressure that might result in a position that splits the difference and thereby shifts positions from one turn to the next. Actors are balancing their desire to achieve their preferred outcome against building a consensus for an outcome – a position on the spectrum – that is close to their preferred outcome. As such, simulated changes in position capture the give-and-take that happens during a political bargaining process. The vertical axis shows the range of positions from 0 to 100. The horizontal axis shows turns of this simulation. Individual actors are color-coded according to the key on the right-hand side of the figure, consistent with the groups of actors listed in Table A2. This simulation leads to a narrowed range of positions, though there is nothing in the model that requires a consensus to emerge. The “approach and assumptions” section earlier in this paper provides more detail on the intuition of the progression of turns in the SMP simulation.

As Figure 5 shows, there are noticeable fluctuations in actor positions during the first five turns. However, a majority of these actors have a low exercised power; because either their influence is low or because of a low salience, they are not willing to use much of their influence. The two weakest actors with an initially unfavorable opinion in turn 0 immediately joined different yet supportive clusters after the first turn. Between the fourth and fifth turn, the MEIM advisor, a member of the Royal Court and the SEC shifted their positions, applying political pressure for a compromise from the minister of foreign affairs (MFA), with the MFA ultimately acceding to pressure from the Royal Court. The next significant shift in position occurs between the eighth and ninth turns, as the state minister for energy affairs shifts to the winning position, aligning with the MEIM advisor. The state minister for energy affairs aligns with the Aramco position, shifting the latter into the winning position as well. During later turns, the Royal Court’s advocacy consolidates support from the majority of actors around position 70 (the position initially occupied by the Royal Court before running the simulation).

Figure 5. Changing positions by turn for Saudi Arabia.



Source: KAPSARC analysis.

While the KTAB simulation result suggests a favorable view within the Saudi Arabian government for electricity trading in the GCC, there has been little progress in the creation of a fully functioning inter-GCC power market. This lack of progress may be attributed to Saudi actors' salience scores, where the average Saudi salience score was only 28. In other words, there is no clear champion for this issue inside the Saudi decision-making apparatus – no one assigns a high priority to the issue of pushing forward regional power trading. While the question of electricity trading is politically feasible, there are too many other issues of higher priority to Saudi decision-makers for meaningful progress to be observed in the real world, particularly given the number of crucial issues that Saudi policymakers in the energy space are now grappling with.

United Arab Emirates

Due to the federal structure of the UAE, its power sector comprises three distinct but interconnected systems: Abu Dhabi, Dubai and the Northern Emirates. In total, the three systems operate 28.63 GW of mainly gas-fired power stations with peak load recorded at around 20 GW in 2015. The fast pace of economic development and population growth means that annual demand growth is expected to rise by 9 percent annually, with plans to double capacity by 2030.

The region's gas deficit poses a major challenge for the UAE. Despite large reserves, most of the UAE's production is associated gas which is not enough to supply growing demand. As gas provides over 90 percent of its electricity generation, both Abu

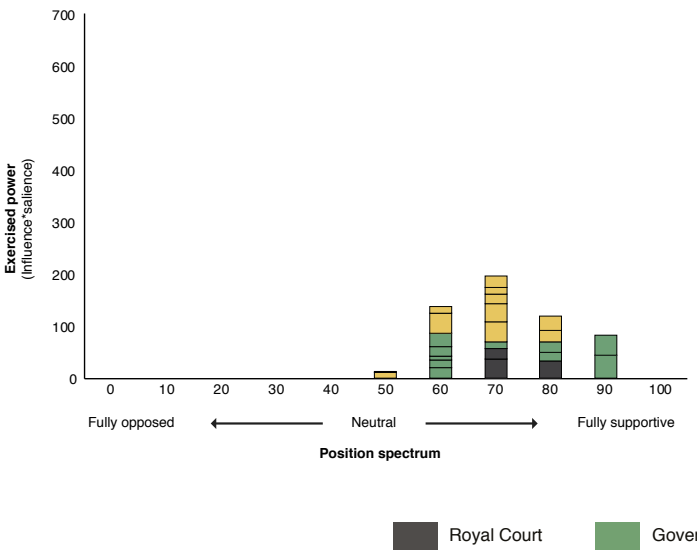
Dhabi and Dubai are already currently importing LNG. However, the UAE is taking steps to reduce its dependency on natural gas and plans to reduce the proportion of gas in the energy mix from 90 percent to 70 percent by 2021. Dubai is leading the way on the renewables front, with 25 percent of the electricity supply expected to come from solar plants by 2030. But not all of Dubai's energy plans are clean; the emirate is also planning 4.8 GW of coal-fired plants to offset the intermittency of renewable energy.

Abu Dhabi has set a target for solar generation to provide 7 percent of electricity capacity by 2020. Its solution to natural gas dependency is nuclear energy, with an expected capacity of 5.6 GW by 2020. However, the nuclear industry's ability to provide base load energy is constrained by Abu Dhabi's continued dependency on combined cycle gas-fired plants to produce desalinated water for the emirate. Exporting power, therefore, becomes an attractive proposition.

Given this background, the KTAB simulation results among the UAE actors for trading power through the GCC grid suggest a politically favorable environment. The data collected consider the establishment of a GCC-wide power market among a variety of actors in the UAE. Figures 6 and 7 are constructed in the same way as Figures 3 and 4. Table A3 shows the actors' initial expert-based position, influence and salience.

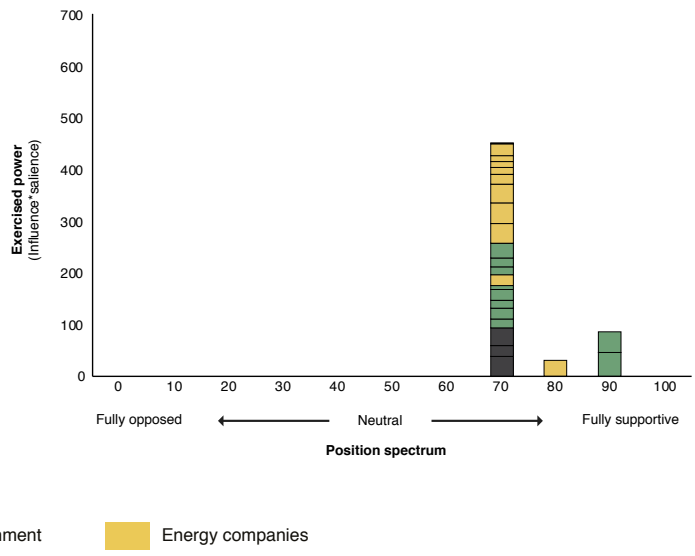
Figure 6 shows the input data for turn 0 for the UAE. As the figure shows, there is initially a range of positive support for trading power with neighbor countries through the GCC Interconnection Grid. Virtually every actor takes a positive view of the issue. Three large clusters dominate the distribution of actor positions. The Royal Court and the UAE national security advisor lead the largest cluster at position 70. The second cluster is anchored by Abu Dhabi Water and Electricity Authority, the Regulation and Supervisory Bureau, and other ministries at position 60; and the third cluster is anchored by the prime minister at position 80, with a spread of other, much smaller clusters or coalitions of actors – distributed from positions ranging from 50 to 90. Two weak actors, Taqah and the Supreme Petroleum Council (SPC), start with a neutral position.

Figure 6. Turn 0 distribution of positions and exercised power for actors in the UAE.



Source: KAPSARC analysis.

Figure 7. Turn 17 distribution of positions and exercised power for actors in the UAE.



Source: KAPSARC analysis.

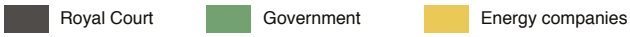
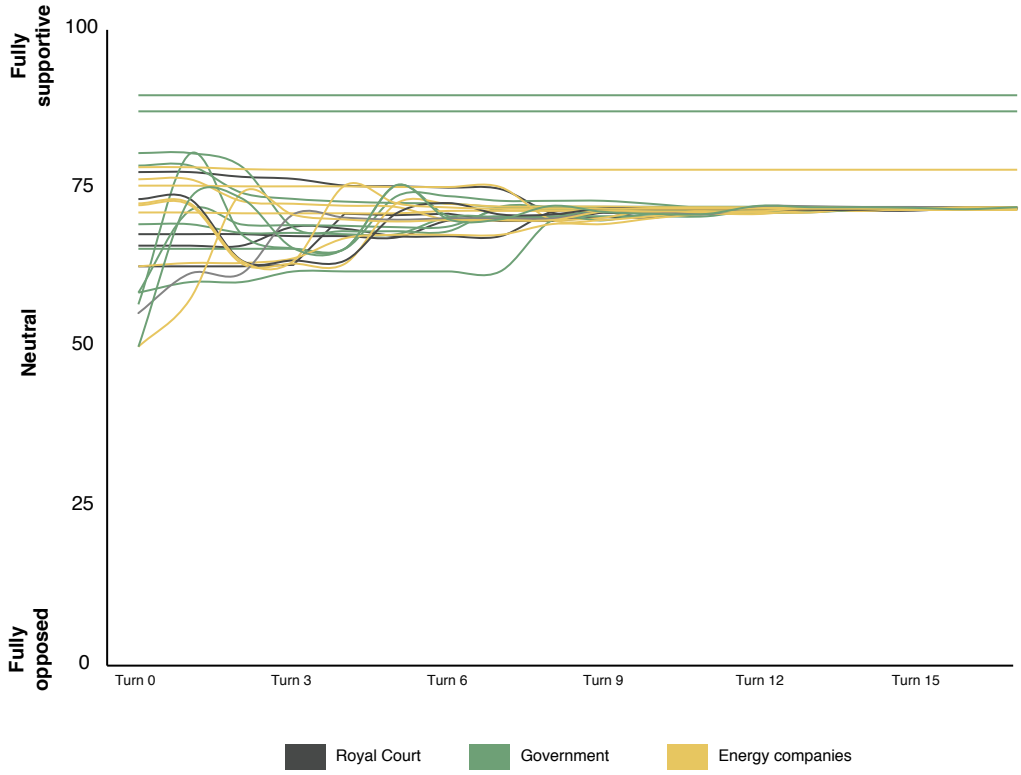


Figure 8. Changing positions by turn for actors in the UAE.



Source: KAPSARC analysis.

The simulation ends at turn 17, as shown in Figure 7. However, a rough consensus was achieved earlier by turn 8, with only small shifts in position taking place in later turns. The largest number of actors, with the greatest collective exercised power, end the simulation at a position of 70. The minister of energy and the deputy minister of energy in the UAE (the green bars at a position of 90) and the ADWEC advisor (the light orange bar at a position of 80) are the strongest advocates for regional trading and remain so throughout the simulation. Thus, there is moderately strong support for trading electricity over the GCC grid, and this result suggests that expanded use of the grid is politically feasible from the UAE perspective.

Figure 8 is constructed in the same way as Figure 5. It provides a line graph demonstrating the results of all actors as they shift positions during negotiations from one turn to the next. Figure 8 shows a number of actors fluctuating in their positions throughout the first seven turns of the simulation, seeking a common view on the GCC electricity grid over these turns. The largest set of changes in the graph represents the shift of the minister of interior (MOI), who moved from position 60 to 80 from turn 0 to turn 1, and then adjusted their position to 70 in turn 2. After turn 4, this actor changed their position to nearly 75. The MOI finishes the simulation at position 70. Taqah and the SPC initially adopted a neutral position but shifted their positions to 60 and 70, respectively, early in the simulation.

Three actors appeared to be the drivers for building consensus around moderately strong support (position 70): the two Royal Court actors and the national security advisor. After a few turns, actors less supportive of trading over the GCC grid appear to understand aligning with the ‘winning coalition’ (the two Royal Court actors and the national security advisor) is in their interests. Thus, Figure 8 suggests that the political will in support of trading electricity over the GCC grid is growing over time among UAE actors.

Qatar

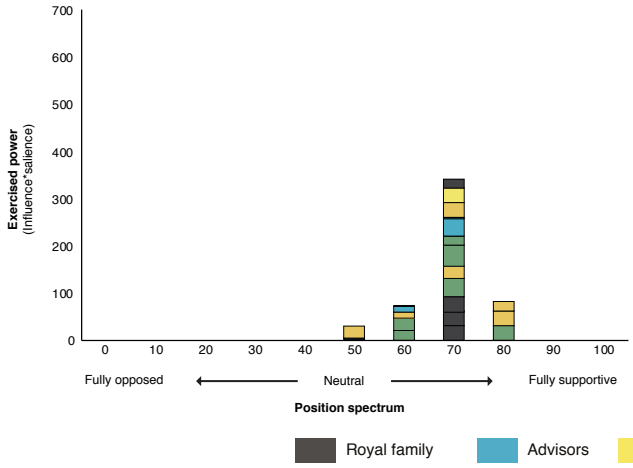
Endowed with plentiful natural gas resources and surplus electricity generating capacity, Qatar is a potential exporter of power. The power sector is partially unbundled with a single buyer, Qatar Water and Electricity Corporation, known as Kahramaa, and a dominant producer, Qatar Electricity and Water Company (QEWC), which owns or has equity stakes in all the country's power plants, including several independent power producers (IPPs).

Qatar's current power generating capacity stands at 8.6 GW and demand in 2015 peaked at a record 6.7 GW. The country has plans to increase solar energy capacity to 1.8 GW by 2020, and 10 GW by 2030. In October 2016, Qatar Petroleum (QP) signed a new long-term sale and purchase agreement with Dolphin Energy for gas exports to the UAE via a pipeline owned by Dolphin Energy. After the UAE (along with Saudi Arabia and Bahrain) severed diplomatic ties with Qatar in June 2017, the Dolphin agreement appears to have continued without interruption. There has been no indication of any plan to shut the gas flow to the UAE and Oman, due to the continuing energy demand from both countries. Furthermore, Qatari participation in the GCCIA has not changed. They remain engaged on a practical level with the physical interconnection.

Selling gas by wire could be an attractive option if the spark spread warranted it. QP is the sole arbiter of gas allocations in Qatar. If QP were to supply incremental gas for power exports, it would demand a higher price. However, with the UAE and Kuwait already using gas bought as LNG on the international market, Qatar should be able to achieve an attractive price for its gas sold as power to neighboring countries. Beyond QP and QEWC, many of Qatar's key decision-makers would be involved in the decision to export power since Qatar would effectively be exporting its sole natural resource.

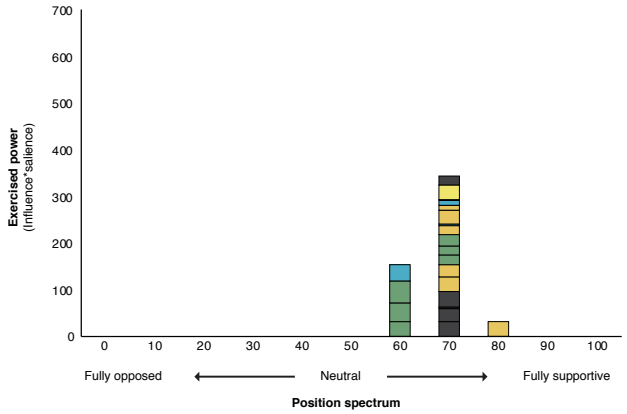
Turning to the KTAB analysis, there is initially a range of views in Qatar regarding the creation of a GCC-wide electricity market, as shown in Figure 9. Table A4 shows the actors' initial expert-based position, influence and salience. Similar to other GCC countries, all actors take neutral or supportive positions, ranging from 50 to 80. The most critical actors are moderately in favor of trading power over the GCC grid. The advocacy of the Royal Court actors (the black bars at a position of 60) represents a critical mass in the center of positive views among Qatari actors. The most supportive actors are the minister of energy, QEWC, and a QP board member, at position 80. Some government actors and advisors take a less positive position at 60, while QP takes a neutral position on the issue of power trading.

Figure 9. Turn 0 distribution of positions and exercised power for actors in Qatar.



Source: KAPSARC analysis.

Figure 10. Turn 12 distribution of positions and exercised power for actors in Qatar.

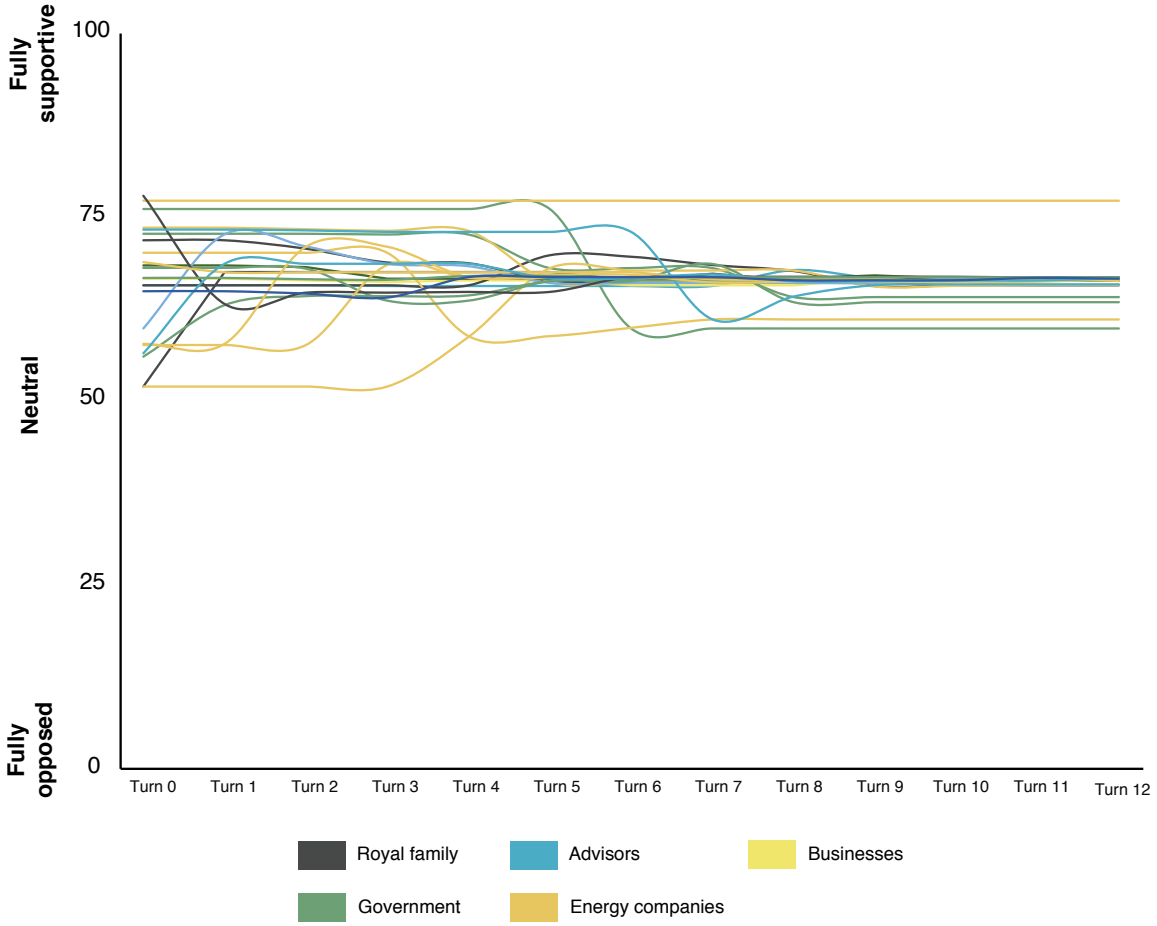


Source: KAPSARC analysis.

As shown in Figure 10, a rough consensus emerges in support of a moderately positive view on trading by turn 12. QEWC remains more supportive than most actors at position 80 throughout the simulation. QP becomes more supportive, shifting to position 70, over the course of the simulation. No actors appear to take a neutral or negative view of trading over the GCC grid by turn 12, suggesting that greater utilization of the grid is politically feasible from a Qatari perspective.

Figure 11 is constructed in the same way as Figure 5. As Figure 11 shows, the attempt to find a common position regarding the GCC electricity market appears to continue for around eight turns in the simulation, though a rough consensus is mostly achieved before the simulation terminates. This supports the conclusion drawn from the prior figures that there is growing consensus in support of developing an inter-GCC power market. It is important to note that the data on Qatari actors' political will to trade electricity over the GCC grid with the other GCC countries were based on interviews conducted before Saudi Arabia, the UAE and Bahrain severed diplomatic relations with Qatar. However, as described later in the paper, these data probably still capture the long-term view of these actors.

Figure 11. Changing positions by turn for actors in Qatar.



Source: KAPSARC analysis.

Kuwait

Kuwait operates a traditional centralized power model: The Ministry of Electricity and Water (MEW) has near-total control of the nation's power generation and distribution. However, the government is now mulling plans to partially privatize and unbundle the sector. Generating capacity stood at 18.3 GW at the end of 2015, with peak demand reaching 12.81 GW. Several new projects, totaling 6.13 MW, mean that the country's total generating capacity will rise to 21.69 GW. With demand anticipated to increase to between 22.5 GW and 25.4 GW by 2020, total capacity is ultimately projected to increase to 25 GW by 2020. Even though more than half of Kuwait's existing plants can burn either fuel oil or gas, most of them continue to depend on fuel. All the new plants planned by MEW are mainly gas, with solar and wind units expected to produce 15 percent of Kuwaiti generation by 2030.

As new gas-fired power plants come on stream, the flexibility and scheduling of Kuwait's LNG imports will be critical. Power exports, including seasonal power swaps to other GCC countries, could become an attractive option, paving the way for improved gas contract terms as well as providing an additional source of revenue. In 2015 Kuwait agreed to a power swap with Bahrain under which it made available 100 MWh during a period of peak summer demand. The power swap gave Bahrain security of supply, while Kuwait was able to sell excess power during the commissioning phase.

However, Kuwait's political system creates uncertainty. Unlike other GCC states, Kuwait has an active and vocal parliament that is empowered to analyze and discuss a wide range of issues, especially energy. Any systematic attempt to export power could come under scrutiny and could potentially be blocked.

The results of the KTAB simulation for Kuwait yielded a moderately positive result, implying that decision-makers in Kuwait are likely to be open to a fully functioning power market through the GCC grid. Table A5 details the actors' data. Initially, most Kuwaiti actors range from a slightly negative, to neutral, to a generally positive position (Figure 12). In the initial set of positions shown in Figure 12, Kuwaiti actors are in one of four clusters. The cluster with the highest aggregate exercised power takes a neutral view at position 50, anchored by the National Control Center, the National Assembly (Kuwaiti parliament), the speaker, and business-interested members of the National Assembly. The second largest cluster is positioned at 70 with a favorable view, including representatives of the Ministry of Electricity and Water (the minister and the undersecretary), the finance minister (also acting oil minister), as well as members of the Kuwaiti media. The remaining clusters have similar aggregate exercised power. One is anchored by the Kuwaiti emir, the Royal Court, and the assistant undersecretary for planning, at the slightly favorable position of 60. The other is anchored by the Kuwait Institute for Scientific Research, the Kuwait Petroleum Corporation and the Secretary-General of the Supreme Council for Planning and Development at the highly favorable position of 80. Only two actors held a slightly unfavorable view at position 40; the stronger of the two is the Chamber of Commerce/merchant class, and the other is the relevant committee in the National Assembly.

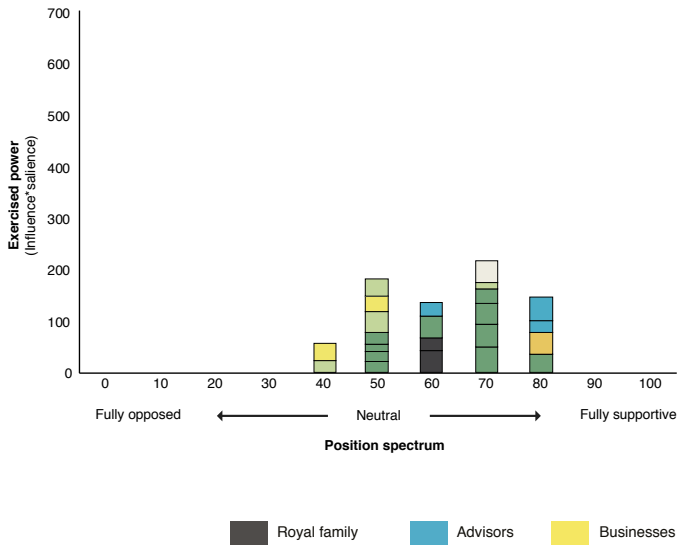
The Kuwaiti simulation ran for 13 turns, as shown in Figure 13. However, a strong consensus develops around position 60 by the seventh turn, with only minor changes in positions for the remaining six turns until the end of the simulation, as shown in the line graph (Figure 14). As with Figures 8 and 11, Figure 14 is constructed in the same way as Figure 5. The two actors with a slightly unfavorable view (position 40)

remain negative for the first four to five turns of the simulation, before shifting to a favorable view at point 70, finally settling with the majority position of 60.

The Kuwait Institute for Scientific Research (KISR), the Kuwait Petroleum Corporation, and the minister for electricity and water remain outliers until the end of the simulation. They appear to view the issue more favorably than the remainder of actors for the duration of the simulation, perhaps because of their high exercised power. By maintaining a more positive position than other actors, KISR played a key role in consolidating the support of more actors at position 60.

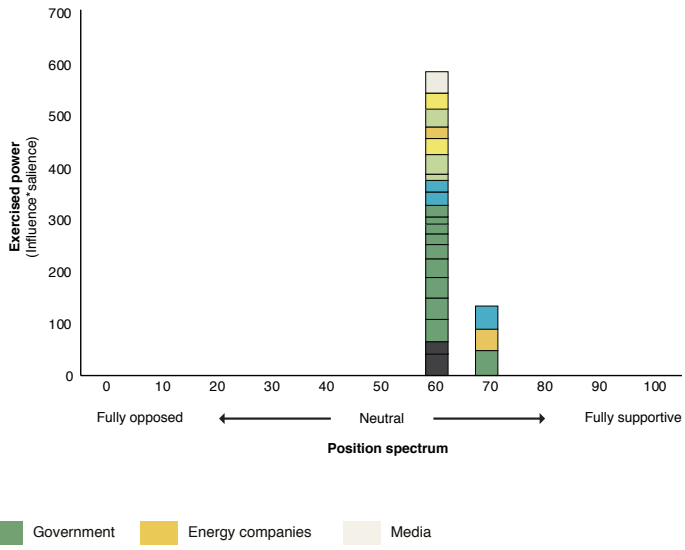
By the end of the simulation, position 60 is the most supported position, a marginally positive view of expanding electricity trade over the GCC grid. This is not a large shift from turn 0. The emir and the Royal Court favored position 60, and half of the Kuwaiti actors occupied positions between 50 and 60. Despite a powerful cluster of actors at the neutral position of 50, the cluster of actors anchored by the emir was the more powerful of the two, with an average exercised power of 33.5 compared to 26. This lead the neutral actors to join the more powerful, and more positive, group of actors. From this, Kuwaiti decision-makers seem open to the idea of an inter-GCC power market, though not strongly in favor of it. Despite their more cautious view of the GCC grid, Kuwaiti actors, on average, regard this issue as more important than other GCC member states, with a relatively high average salience score of 55.

Figure 12. Turn 0 distribution of positions and exercised power for actors in Kuwait.



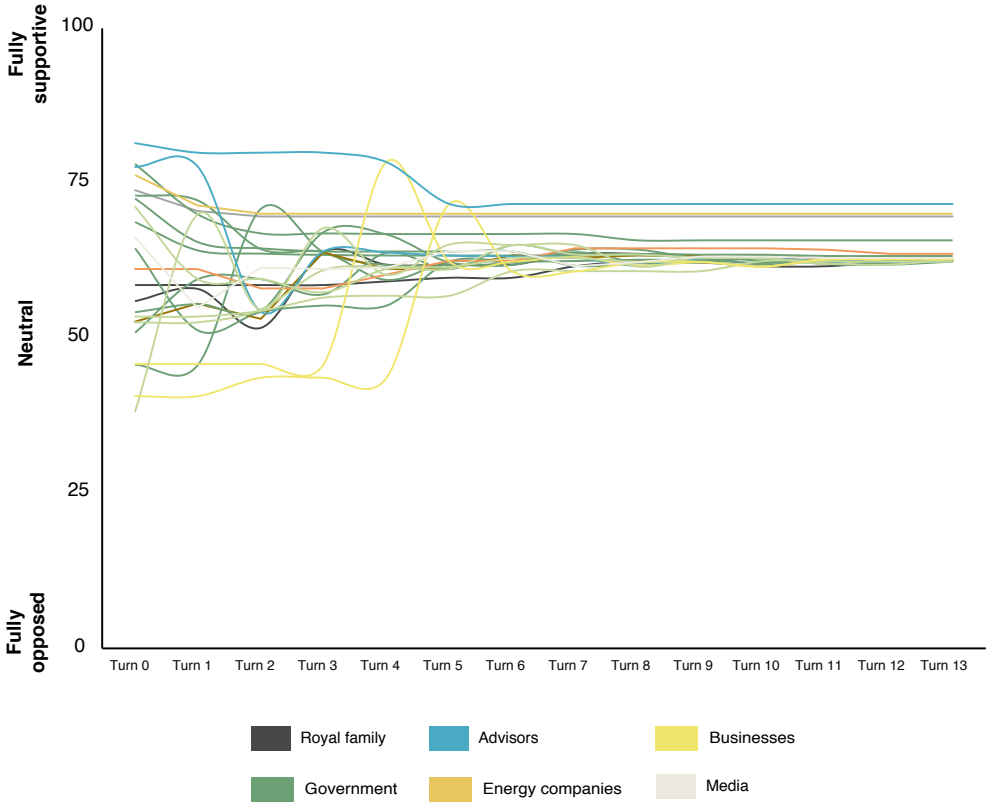
Source: KAPSARC analysis.

Figure 13. Turn 13 distribution of positions and exercised power for actors in Kuwait.



Source: KAPSARC analysis.

Figure 14. Changing positions by turn for actors in Kuwait.



Source: KAPSARC analysis.

Oman

For the last decade, Oman's power sector has been operating in textbook fashion. The industry became fully unbundled following a restructuring between 2004 and 2006. This included the Ministry of Electricity ceding authority to the Public Authority for Electricity and Water (PAEW), the creation of an independent regulator, the appointment of a single buyer, the establishment of transmission and distribution companies, in addition to multiple independent power generating companies. With a 2015 peak demand of 6.1 GW, and a total generating capacity of 7.8 GW, mainly gas-fired, Oman is facing the challenge of growing demand at a time when the sultanate's domestic supplies are constrained. Oman's Ministry of Oil and Gas has stated that future gas supplies are limited. Aside from a recently announced 1 GW PV project in Duqm, no renewable energy projects are planned for the near future.

It is estimated that Oman's energy demand will grow by 8 percent per year. To meet this anticipated growth in demand, it has planned 4.8 GW of new capacity. Starting in 2018-19, the Oman Power and Water Procurement Company (OPWP) aims to trial a power spot market, with the aim of full implementation in 2021-22.

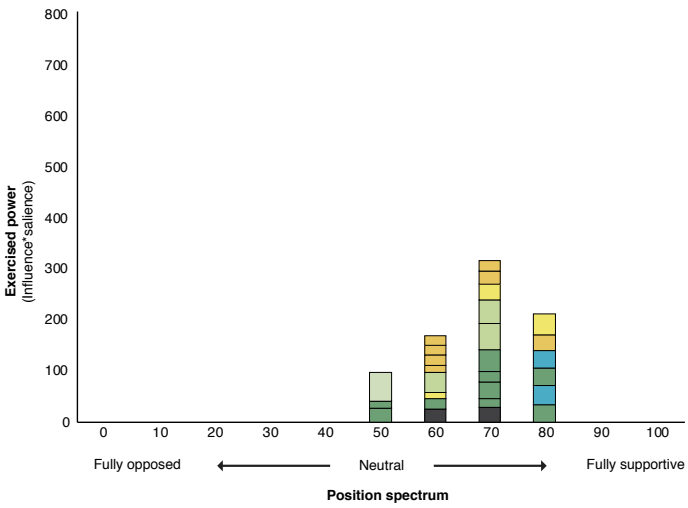
Oman was the last country to join the GCCIA, in December 2014, and is now connected to the GCCIA grid via the UAE grid. The complex structure of the Omani power sector and the focus by the regulator on securing a well-functioning domestic system could potentially hinder cross-border trade. Political tensions between Oman and the UAE could be a further complicating factor.

The following three visualizations show the KTAB simulation results for Oman. Figure 15 (based on expert-based data shown in Table A6) and Figure 16 display the final distribution of actors' positions. Figure 17 is the line graph of all turns in the simulation.

At first, there is a range of views among Omani stakeholders, ranging from 50 to 80, regarding trading power over the GCC Interconnection Grid. Nevertheless, every actor takes either a neutral or a positive view of the issue. Actors' positions can be grouped into three large clusters, in terms of exercised power. The largest cluster is led by the sultan at position 70 (who is also the prime minister, or PM), along with other actors such as the PAEW, the Supreme Council for Planning, Petroleum Development Oman (PDO) and Oman Gas. The second cluster includes the OPWP, the minister of oil and gas (MOOG), the minister of finance (MOF), and Oman Electricity Transmission Company (OETC) at position 80. The third cluster includes the deputy prime minister, Authority for Electricity Regulation, IPPs and other energy companies at position 60. Finally, another smaller cluster consists of internal intelligence and the minister of defense at position 50.

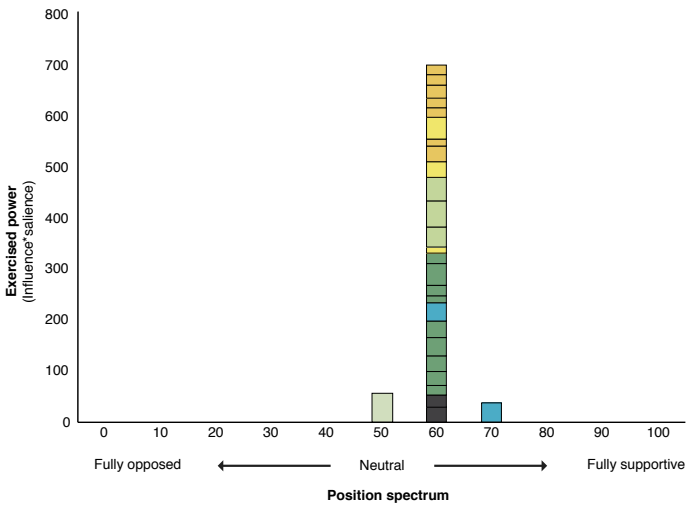
The simulation of Omani actors ran for a shorter number of turns compared to the other GCC member states. Figure 16 presents the final results. A consensus emerges around turns 7 and 8 that slightly favors trading power through the GCC grid (position 60). The position of the PM-anchored group of actors turns out to be the winning position, with all but two actors aligning behind this position by the end of the simulation. The two outliers include internal intelligence and the MOF undersecretary. Internal intelligence, with the highest exercised power among all Omani actors (57), remains in its neutral position throughout the simulation.

Figure 15. Turn 0 distribution of positions and exercised power for actors in Oman.



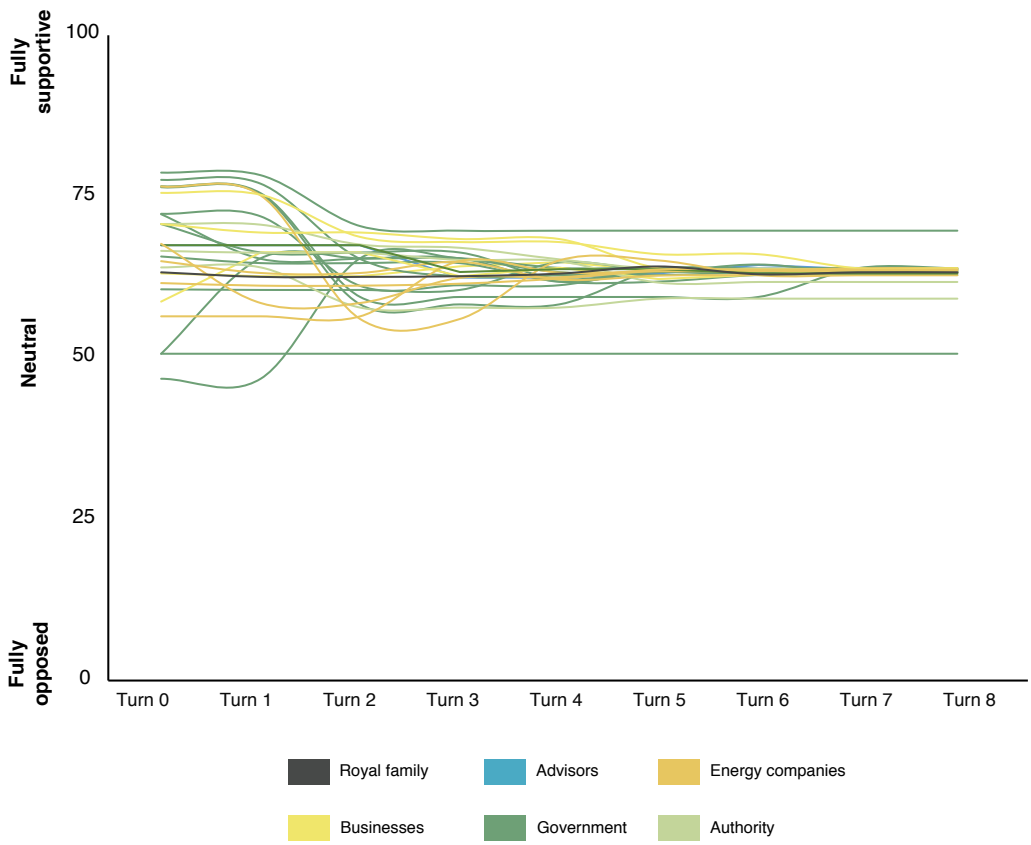
Source: KAPSARC analysis.

Figure 16. Turn 8 distribution of positions and exercised power for actors in Oman.



Source: KAPSARC analysis.

Figure 17. Changing positions by turn for actors in Oman.



Source: KAPSARC analysis.

Figure 17 shows more turn-by-turn detail of actors' changing positions, constructed in the same way as Figure 5. The MOF undersecretary moved from 80 to 70 after turn 1 and kept that position until the end of the simulation. The strongest supporters of electricity trading, the MOOG and MOF undersecretaries, settled on a less favorable position between turns 1 and 2. The final actor to join the winning coalition is OPWP, moving down after the sixth turn from a more supportive position of 70. OPWP has a high exercised power of 42, which made it more resistant to pressure from other actors. Thus, by the end of the simulation, Omani actors' collective view on the issue of trading is slightly favorable. Expanded use of the GCC grid appears politically feasible from an Omani perspective, but without a strong support base.

Bahrain

The Electricity and Water Authority (EWA) is responsible for generation, transmission and distribution of electricity in Bahrain. The country is planning to shift to a single-buyer model and has privatized the Al-Hidd, Al-Ezzel and Aldur power plants.

Bahrain has about 0.1 billion barrels of proven reserves of crude oil and 92 billion cubic meters of natural gas reserves. The country has nearly 4 GW of installed generating capacity. Natural gas is considered the primary fuel source for electricity generation. Electricity demand in the country is growing rapidly, fueled by population growth and expansion of the industrial sector. Peak demand

growth for electricity in Bahrain reached 8.1 percent in 2014 and was recorded at 3.5 percent in 2015. Peak demand was recorded at around 3.1 GW in 2015. The state's Electricity and Water Authority (EWA) is predicting consumption will continue to increase by an annual average of up to 6.4 percent until 2020, when required capacity is expected to reach close to 5.5 GW. To meet these needs, Bahrain is investing in several new power projects and has set a target for renewable sources to meet 5 percent of electricity generation by 2025 and 10 percent by 2035.

The results of the KTAB simulation for Bahrain yielded a strong consensus among actors in Bahrain, implying that decision-makers in Bahrain are likely to be supportive of a fully functioning power market through the GCC grid. Table A7 shows expert-based data.

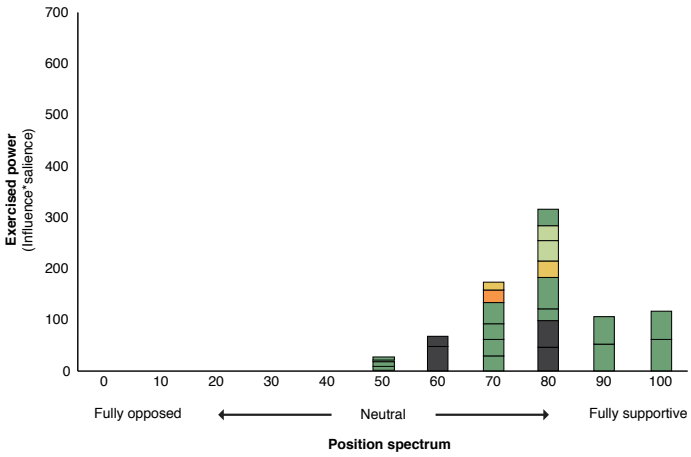
Initially, all Bahraini actors are either neutral or in favor of regional power trading (Figure 18). Before running the simulation, decision-makers in Bahrain fall within two major clusters (in terms of aggregate exercised power), along with a number of smaller ones. The largest cluster of actors takes a very supportive position of 80, anchored by Bahrain's most powerful actors on this issue: the chief of state, the crown prince, the Electricity and Water Authority, Advisory and Regulatory Committee and the Bahrain Petroleum Company (Bapco). The second largest cluster of actors is positioned at 70, a favorable view, including the deputy chief executive for electricity and water production and transmission, as well as representatives of the Ministry of Finance. The remaining groups of actors include one anchored by the prime minister and the deputy prime minister at the slightly favorable position of 60, one anchored by the minister of oil and the minister of electricity and water at the very favorable position of 90, and another anchored by the Sustainable Energy Unit and Bahrain Economic Board at an extremely supportive position of 100.

The Bahrain simulation ran for 16 turns, as shown in Figure 19. However, a general consensus finally develops near a favorable view around position 80 by the end of the eighth turn, with generally small movements until the end of the simulation, as shown in the line graph demonstrating the movements of actors, turn-by-turn (Figure 20).

The two most supportive actors end the simulation with a more favorable view of power trading compared with other Bahraini actors. The Sustainable Energy Unit remains at its position of 100 throughout the simulation, while the Bahrain Economic Board moves to a slightly less favorable position of 90.

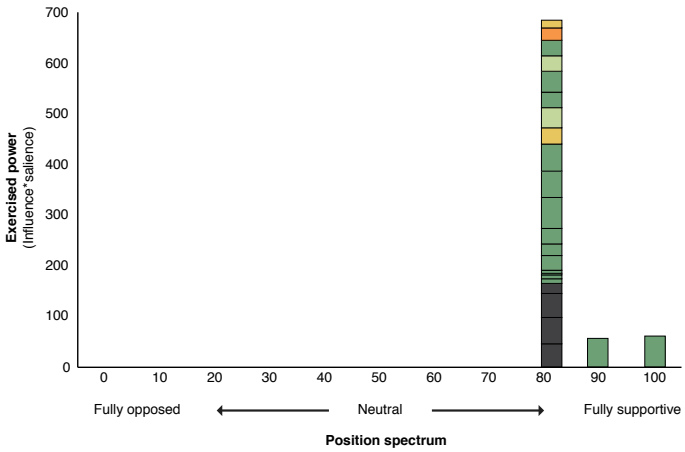
By the end of the simulation, the position held by the majority of actors appears to be strongly positive at 80, which implies that Bahraini actors are open and supportive of an inter-GCC power market. Similar to Kuwait, Bahraini actors possess a relatively high average salience score of 50. It appears from these results that not only is expanded use of the GCC grid politically feasible from the Bahraini perspective but the issue of trading is of higher importance to Bahrain than most other GCC member states. As Bahrain is the least energy independent country in the GCC, this is not a surprising result.

Figure 18. Turn 0 distribution of positions and exercised power for actors in Bahrain.



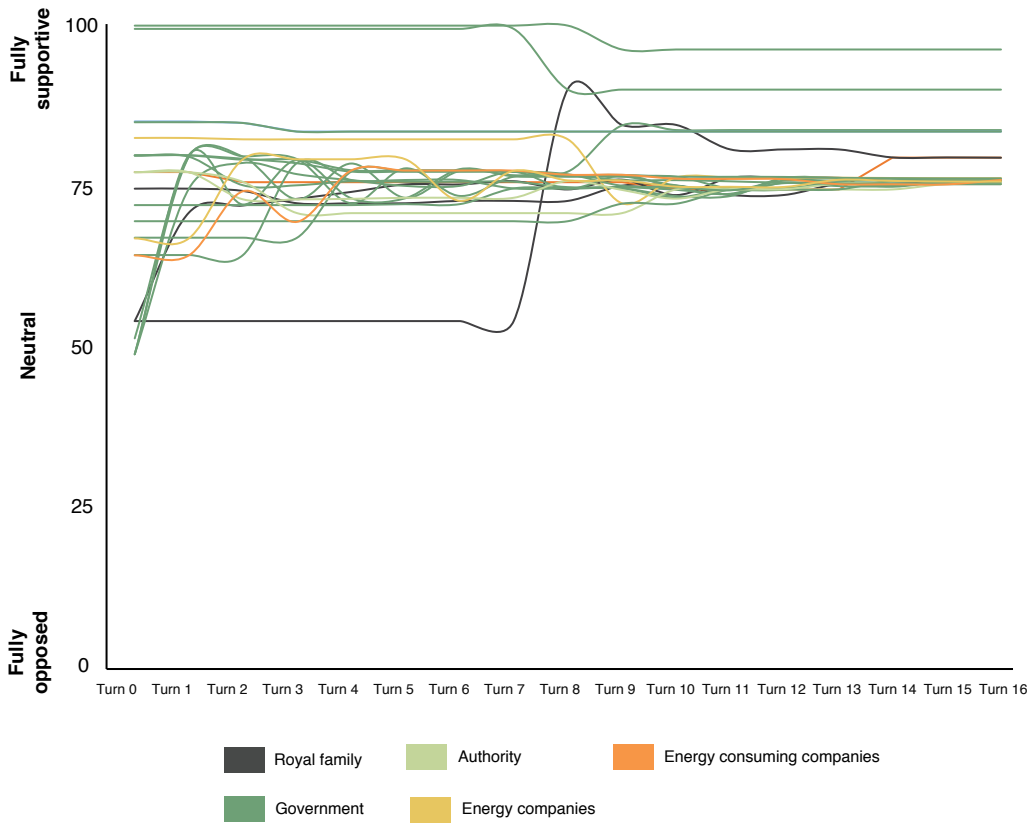
Source: KAPSARC analysis.

Figure 19. Turn 16 distribution of positions and exercised power for actors in Bahrain.



Source: KAPSARC analysis.

Figure 20. Changing positions by turn for actors in Bahrain.



Source: KAPSARC analysis.

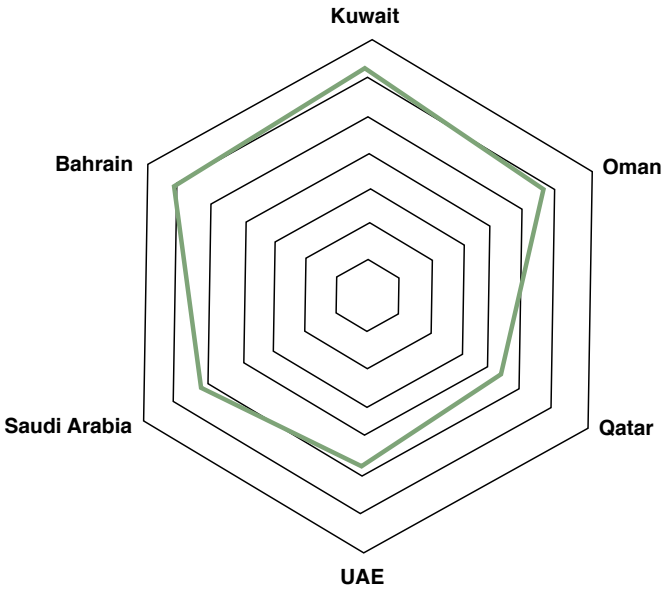
Conclusion

The GCC states agreed to establish the GCC Interconnection Grid over a decade ago, with the aim of increasing energy security in the region. The grid continues to be used mainly for emergencies, even though the economic and financial benefits from commercializing national power production across national borders using the grid were quickly identified. However, in recent years there have been some bilateral sales and purchase agreements. If, as suggested by the KTAB analysis, most countries harbor a favorable view toward power trading, the question remains as to why has power trading not happened?

KTAB is a unique tool that can help answer this key question. This study ran KTAB simulations for each of the GCC member states individually and for the region as a whole. The results of the simulations indicate that all of the GCC countries are growing in their support of regional power trading, but political inertia has stymied the system's ability to achieve its full economic potential. The current diplomatic dispute with Qatar might disrupt this trend in the short-term as the authors expect to witness more bilateral trading; perhaps a subset of the six states could initiate a sub-market to trade power among themselves. If the issue with Qatar is resolved, the long-term trend looks more positive, as reflected in this analysis.

Observed progress to expand utilization of the GCC grid is slow, as described in the earlier sections of this paper. Figure 21 provides a perspective on why this might be the case. This radar chart shows the average salience for actors in each country toward this issue (i.e., the importance assigned to the expanded use of the GCC grid by each country). As the figure shows, Kuwaiti actors assign the highest priority to the GCC grid, yet are the least supportive of expanding the use of the grid (Figure 13). The strongest advocates, in terms of position, in Saudi Arabia, the UAE and Qatar, do not assign high priority to the expanded use of the GCC grid. Thus, while electricity trading may be politically feasible, it is not a political priority.

Figure 21. Radar chart of salience comparison for each country in the GCC – support for a GCC power market.



Source: KAPSARC analysis.

The GCC countries are facing many challenges, including energy price reform, structural economic reform, the transformation to renewable energy, the implications of the Paris Agreement for long-term economic growth, among a host of other issues. The economies of scale and economic benefit of regional power trading are unlikely to be achieved without assigning a credible policy advocate within each country to ensure progress. Otherwise, it seems likely the other issues outlined above will continue to take precedence and supplant the focus that could be applied to this issue.

The observed lack of progress is attributable to the lack of urgency within the GCC's most influential countries, as measured by low salience levels. Simply put, there is no real drive by any of the main actors to put in place a power trading system, despite the willingness of the GCCIA to provide the logistical backbone required. Part of this lack of policy priority may be due to the perception among GCC countries that they already enjoy a high degree of energy security. As Table 2 shows, the most influential GCC countries also happen to be the region's most energy secure (according to the World Energy Council's Energy Trilemma Index Tool). Saudi Arabia, the most influential GCC member state according to expert data, has the second highest energy security in the GCC (39th worldwide). The other two influential GCC countries, the UAE and Qatar, are both ranked very highly in terms of energy security, which explains the low average salience scores displayed by these countries' actors.

The remainder of the GCC member states are in the opposite situation: their relatively low energy security rankings correspond with higher average saliences when compared with the more energy secure countries. Kuwait, Oman and Bahrain all have relatively high salience values. While Kuwait enjoys more energy security than Oman and Bahrain, its higher salience is most likely due to its usual role as the GCC proponent for unity. Unfortunately for Kuwait, Oman and Bahrain, they are far less influential than the remaining member states. Thus, despite general approval, there is insufficient political drive to generate the momentum required to create a fully-fledged inter-GCC power market.

Table 2. IGCC member states' influence, average salience and energy security rankings.

Country	GCC influence	Average salience	Worldwide energy security ranking (GCC ranking)
Saudi Arabia	100	28	39 (2)
United Arab Emirates	69.5	39	42 (3)
Qatar	51	39	25 (1)
Kuwait	25	55	75 (4)
Oman	18	45	109 (6)
Bahrain	9	50	80 (5)

Source: KAPSARC analysis.

Moreover, the issue in focus is not establishing the grid but rather utilizing it for commercial transactions. The question of trading is not currently at the top of any stakeholders' agendas (nor even near the top), especially following the Qatar trade embargo. The more obstacles or arguments that dampen enthusiasm for GCC power trade, the higher the bar for sufficient political will to get started. Additionally, even if implementing this system makes sense economically (and is technically feasible), stakeholders do not perceive the financial gain to be high enough to motivate action, as reflected in the KTAB data and simulation results.

In short, there appears no pressing economic or technical reason that would bring this issue to the top of the principal stakeholders' agendas. This is likely to remain the case as long as local power companies have as their primary mandate the delivery of secure and stable supplies of electrical power to domestic customers, rather than a wider commercial function to also provide profits for their shareholders. In the meantime, an increase in bilateral trading can be expected in response to purely technical requirements, namely the need to secure power supplies during times of peak summer demand. However, as individual GCC nations embark on unbundling and liberalizing their power markets, the emergence of new players focused on the creation of value for their shareholders could increase the priority assigned to regional power trading. This process could be supported by the establishment of more active regulatory bodies who would play a necessary role in establishing the ground rules for increased power trade. When GCC power companies are free to trade without governmental constraint and decide to explore new economic opportunities afforded by the GCC grid, they are unlikely to face any major barriers to the creation of a fully-fledged power market in the GCC in terms of political feasibility.

References

Al-Enezi, Meshaal, and A. Saleh. 2016. "New Electricity Consumption Record at 12,900 Megawatts – Ministry Reduces Fuel Budget Allocations." Kuwait Times. http://news.kuwaittimes.net/website/new-electricity-consumption-record-12900-megawatts-ministry-reduces-fuel-budget-allocations/

Al-Mubarak, Imtenan. 2016. "How to Pave the Way for Greater Energy Cooperation in the GCC." Middle East Centre. http://blogs.lse.ac.uk/mec/2016/12/07/how-to-pave-the-way-for-greater-energy-cooperation-in-the-gcc/

Anonymous expert in discussion with the authors, January 2017.

Arab Petroleum Investments Corporation. 2016. "MENA Power Investment: Finance and Reform Challenges."

Brownson, Karl. "400kV GCC Interconnector : Overview and Comparison with Clean Energy Corridor Enablers." Presentation, IRENA Initiative for a Clean Energy Corridor Executive Strategy Workshop, United Arab Emirates, Abu Dhabi, 2013.

Climate Action. 2017. "Qatar's Largest Solar Project to Begin Construction in 2017." http://www.climateactionprogramme.org/news/qatars_largest_solar_project_to_begin_construction_in_2017

Dinan, Desmond. 1999. Ever Closer Union: An Introduction to European Integration. Basingstoke, Hampshire: Lynne Rienner.

Dubai Carbon Centre of Excellence. 2015. "UAE State of Energy Report 2015." http://dcce.ae/state-of-energy-report/

Gulf Cooperation Council Secretariat General. 2016. The Gulf Single Market: Facts and Figures (Eighth edition). http://apicorp-arabia.com/Research/EnergyReseach/2016/APICORP%20Energy%20Research%20-%20Vol.1%20No.7%20May.pdf

James, A. E. 2017. "Oman Signs Pact to Build $94mln Solar Panel Project." Zawya. https://www.zawya.com/mena/en/story/Oman_signs_pact_to_build_94mln_solar_panel_project-ZAWYA20170502050749/.

Jeddah Chamber of Commerce and Industry. 2016. "Public Utilities Report February 2016."

Jones, Ronald and Peter Neary.1984. "The positive theory of international trade." In Handbook of International Economics, edited by Ronald Jones and Peter B. Kenen, edition 1, volume 1, 1-62. New York: Elsevier.

King Abdullah City for Atomic and Renewable Energy. 2017. https://doi.org/10.1016/S1573-4404(84)01004-2

Kingdom of Bahrain Central Informatics Organization. 2017. http://www.data.gov.bh/

Kingdom of Bahrain National Oil and Gas Authority (NOGA). 2015. "Annual Report." https://www.noga.gov.bh/Publication/Annual_report_2015_EN.pdf

Middle East Business Intelligence. 2016. Roscoe, Andrew. "Kuwait Considers Privatising Electricity Sector." https://www.meed.com/kuwait-considers-privatising-electricity-sector/

Middle East Economic Survey. 2015. "Saudi Desal Awards Take Capacity Under Development To 1.1Mn CMD." http://archives.mees.com/issues/1569/articles/52425

Middle East Economic Survey. 2015. "Qatar Awards Umm Al Haul Power/Water Plant As Part Of Major Capacity Hike." http://archives.mees.com/issues/1584/articles/52788

Middle East Economic Survey. 2015. "Qatari LNG Faces Up To Uncertain Global Climate." http://archives.mees.com/issues/1578/articles/52638

Middle East Economic Survey. 2015. "Saudi Arabia, UAE Seek Pioneering Role in Solar Desalination." http://archives.mees.com/issues/1567/articles/52379

Middle East Economic Survey. 2016. "Dubai Plans Gas-Fired Expansion as UAE Pursues Powergen Diversity." http://archives.mees.com/issues/1651/articles/54158

References

Middle East Economic Survey. 2016. "Kuwait Bullish on Contract Award, but Quietly Shelves Production Target." http://archives.mees.com/issues/1632/articles/53782

Middle East Economic Survey. 2016. "Kuwait to Hike Gas-Fired Capacity after Bagging More LNG." http://archives.mees.com/issues/1642/articles/53997

Middle East Economic Survey. 2016. "Oman Plans Big Solar Project." http://archives.mees.com/issues/1666/articles/54329

Middle East Economic Survey. 2016. "Oman Power: Foot off The Gas despite Khazzan Progress." http://archives.mees.com/issues/1669/articles/54375

Middle East Economic Survey. 2016. "Oman to Add 4.8GW to Grid by 2022 as Electricity Demand Forecast to Rise 74%." http://archives.mees.com/issues/1646/articles/54068

Middle East Economic Survey. 2016. "Qatar Finally Agrees To Boost Dolphin Gas Deliveries To UAE." http://archives.mees.com/issues/1663/articles/54282

Middle East Economic Survey. 2016. "UAE Moors 2nd FSRU as It Looks to Take Advantage of Cheap LNG." http://archives.mees.com/issues/1650/articles/54138

Oman Authority for Electricity Regulation. 2015. "Annual Report." http://www.aer-oman.org/pdfs/aer442.pdf

Oman Power and Water Procurement Co. (SAOC). 2016. "OPWP's 7-Year Statement (2016-2022)." http://www.omanpwp.com/PDF/7YS%202016-2022%20Final%20.pdf

Qatar Tourism Authority. 2015. "Annual Tourism Performance Report 2015." https://www.visitqatar.qa/binaries/content/assets/corporate/statistics/en/2015/annual-tourism-performance-report_2015.pdf

Saudi Arabia Electricity & Cogeneration Regulatory Authority. 2014. "Activities and Achievements of the Authority Report." http://www.ecra.gov.sa/en-us/MediaCenter/DocLib2/Pages/SubCategoryList.aspx?categoryID=4

Saudi Arabia Electricity & Cogeneration Regulatory Authority. 2015. "Annual Statistical Booklet for Electricity and Seawater Desalination Industries." http://www.ecra.gov.sa/en-us/MediaCenter/DocLib2/Lists/SubCategory_Library/ecra%20sat_book_15.pdf

Saudi Electricity Company. 2016. "Annual Report." https://www.se.com.sa/en-us/Pages/AnnualReports.aspx

Saudi Government Open Data Portal. 2017. http://www.data.gov.sa

The Emirates Nuclear Energy Corporation. https://www.enec.gov.ae/

The GCC Interconnection Authority. 2006. "GCCIA Annual Report 2006." http://www.gccia.com.sa/Data/Downloads/Reports/FILE_9.pdf

The GCC Interconnection Authority. 2009. "Annual Report 2009." http://www.gccia.com.sa/Data/Downloads/Reports/FILE_13.pdf

The GCC Interconnection Authority. 2015. "Annual Report 2015." http://www.gccia.com.sa/Data/Downloads/Reports/FILE_20.pdf

The GCC Interconnection Authority. 2016. "Annual Report 2016." http://www.gccia.com.sa/Data/Downloads/Reports/FILE_21.pdf

The Observatory of Economic Complexity. 2015. "United Arab Emirates." Accessed September 27. http://atlas.media.mit.edu/en/profile/country/are/#Imports

The Observatory of Economic Complexity. 2015. “What does Saudi Arabia export to Qatar?” Accessed September 27. http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/sau/qat/show/2015/

The Regional Center for Renewable Energy and Energy Efficiency. 2017. “Kuwait.” http://www.rcreee.org/content/kuwait

U.S. Energy Information Administration. 2014. “Saudi Arabia uses largest amount of crude oil for power generation since 2010.” https://www.eia.gov/todayinenergy/detail.php?id=18111#

U.S. Energy Information Administration. 2016. “Country Analysis Brief: Kuwait.” http://www.marcon.com/library/country_briefs/Kuwait/kuwait.pdf

Ventures Onsite. 2016. “GCC Power Market Overview”. Middle East Electricity. http://www.transformers-magazine.com/images/News/PDF/GCC-Power-Market-2016.pdf

Wise, Ben, Leo Lester and Brian Efird. 2015a. “An Introduction to the KAPSARC Toolkit for Behavioral Analysis (KTAB) Using One-Dimensional Spatial Models”. KAPSARC Discussion Paper. May. KS-1517-DP011A.

Wise, Ben, Leo Lester and Brian Efird. 2015b. “Multidimensional Bargaining Using KTAB”. KAPSARC Discussion Paper. November. KS-1524-DP018A.

World Energy Council. 2016. “Energy Trilemma Index.” https://trilemma.worldenergy.org/

World Nuclear Association. 2017". Nuclear Power in the United Arab Emirates." http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/united-arab-emirates.aspx

Appendix 1. The Spatial Model of Politics

The Spatial Model of Politics (SMP) is one of the most widely applied and accepted models of collective decision-making processes (CDMPs), both technically and informally (Bueno de Mesquita 1997; Abdollahian et al. 2006; Jesse 2011; Efird, Lester and Wise 2016). Even outside the field of political science, everyday language is imbued with the implicit assumptions of this model. Political parties may be described as right or left wing. Less spatially explicit, there is also a tendency to imply a linear spectrum when describing individuals – or groups, such as political parties – as conservative or liberal, aggressive or passive. Commentators and analysts will often try to uncover the positions held by politicians or other highly placed officials.

For more information on the SMP see the two technical papers cited earlier: Wise, Lester and Efird (2015a, 2015b). A brief description of the logic of the SMP follows here.

The SMP uses the following terms:

The set of actors

This comprises all the actors, or stakeholders, that contribute to the resolution of the CDMP in some way. They can be individuals or aggregates of individuals. Aggregates can be formal, such as a corporation, or informal, such as loose affiliations based on interests. The latter could include young men sharing a love of fast cars, for example. The constraint is that it must be possible to reasonably assume that each actor is a unitary entity, speaking with a single voice.

The following framework can be used to understand the range of viable outcomes rather than to narrow them down to a single 'most likely' or expected outcome.

A spectrum of positions

This is a way of mapping out the range of responses and positions actors could give/take to a given question in the form of a linear continuum of possible positions. The extreme ends of the spectrum are associated with extreme positions. In response to the question of private participation, one end could be 'extremely limited private sector participation,' the other 'a policy environment that is open and conducive to private participation.' These extremes are then labeled as 0 and 100, converting a qualitative spectrum into a numeric one where each position is given its own score.

The spectrum is a scale where distance measures the change in consequences for the actors: the gap between positions corresponds to the difference in the outcome. An implicit assumption is that all actors roughly agree on the order of potential costs implied by the spectrum. The potential political difficulty of moving from position 25 to position 50 would be of roughly the same magnitude as that involved in moving from 50 to 75. In other words, the spectrum requires reasonable calibration.

The set of positions

With identified actors and a defined spectrum of positions, the position (i.e., the advocacy) of each actor can then be mapped to the spectrum with a number between 0 and 100.

Measures of influence

Not all actors are equally powerful. Influence measures how easily the actor can shape the outcome of the CDMP, if fully motivated. It does not describe how likely the actor's preferred position is to win, nor is it a measure of the actor's motivation to win. It is the actor's clout, or political power, as applied to the question, assuming that each actor will bring its full resources to winning the negotiation and taking account of all its formal and informal powers.

Influence scores are relative: an influence score of 60 means that an actor is twice as influential as one with a score of 30. Influence scores are also additive: two actors in coalition, each with influence

30, could block an actor with influence 60. The combination of relativity and additivity can make influence the most cumbersome score to collect. Each actor's score needs to be calibrated against that of all the other actors.

Again, influence is scored against a range of 0 to 100. Strictly speaking, if an actor is assigned an influence score of 0, then it would have no power and would not be counted as an actor.

Measures of salience

Regardless of an actor's position and level of influence, different actors will have different levels of interest in the question. Salience quantifies how much an actor cares about the issue in general. How motivated are actors to exert influence to produce their preferred outcome, if and when the issue arises? One way to answer this question is based on the observation that each actor has a portfolio of issues to which it devotes its attention. Salience identifies the importance of the specific issue in that portfolio, recognizing that people have an implicit budget constraint on exerting their influence across their whole portfolio.

The salience scores are defined in Table A1 and range from 0 to 100.

The salience score is not the amount of time that an actor will devote to the negotiations but rather its willingness to use whatever influence it has to convince others of the merits of its preferred position. The salience score does not represent an actor's influence, merely its motivation when the issue arises.

Once again, salience scores are relative among actors. As with influence, a salience score of 0 would indicate that the actor does not care about the issue and that it should not be counted as an actor.

The calculation of exercised power

This is a derived value, calculated in the model. As previously stated, influence is an indication of the actor's political clout on the particular issue, if fully motivated, while salience indicates how much the actor cares about the issue. Exercised power is the product of these two values and reveals the amount of power the actor will bring to bear on the issue being modeled.

Table A1. Definition of salience scores.

Score	Definition
0	The stakeholder is not an actor.
5 – 10	**Barely cares –** the actor hardly cares and may not be aware of the issue.
10 – 20	**Minor issue –** the issue is minor, but the actor is aware of it.
20 – 40	**One of many –** the issue is one of many issues for this actor.
40	**Actively monitoring –** the actor actively pays attention to progress on the issue.
40 – 60	**Cares but not a priority –** the issue is something the actor cares about but competes with many other agenda items.
60 – 70	**Important but not critical –** this is an important issue for the actor, but one of several important issues and not a critical issue.
70 – 90	**One of the top issues –** the issue is the most important for this actor but there are still a limited number of other issues that need attention.
90 – 100	**Top priority –** the issue is that actor's absolute top priority.

Source: KAPSARC analysis.

Appendix 2. KTAB Model Dynamics

There are two stages within each turn of the KTAB model simulation, explained in further detail in Wise, Lester and Efird (2015a, 2015b).

> The simulation begins at the end of turn 0. At the end of each turn, actors generate a series of proposals and counterproposals, 'voting' – i.e., lending their influence in support, not actually casting a vote – on each until a winning outcome is reached, where winning is a probabilistic comparative assessment of outcomes. Actors produce proposals that improve the likelihood of achieving an outcome closest to their preferred outcome, while also trying to appeal to others until a 'winning' position emerges. The final outcome of the CDMP is not necessarily one with which all actors agree; strong actors might overrule weak ones. The probable winning position for each turn can be shown through a probability curve.

> Actors can seek to persuade others to shift their position during the proposal and counterproposal process between each turn, with the inducement that this may improve the chances of achieving a generally accepted position that is closer to their preferred outcome. These shifts may change the likely outcome of the CDMP. These attempts at persuasion may or may not succeed: the weaker actors may simply concede, counter with an offer to make limited concessions, or even make their own attempt at persuasion. The changes which are calculated by the SMP to be selected by each actor create a new set of actor positions. The proposal process described in the first stage restarts from this new set of positions. While the initial input data define the positions in turn 0, remaining turns are calculated strictly based on the SMP's assessment of actor interactions.

This second stage contains two distinct phases:

> In the first phase, each actor tries to find another actor to be a counterparty for effective persuasion. If they identify any suitable counterparties – there may be more than one, just one or none at all, for any potential initiator – then the initiator will focus its efforts to exert influence on the target most attractive to it. Weaker actors may be targeted by multiple initiators; stronger actors may not be targeted at all. The actual shift in position made by a counterparty is determined by a calculation that considers the interactions among the entire set of actors.

> In the second phase, the assessment of how the counterparty responds may vary slightly as it is based on its perceptions and evaluation of alternative outcomes. The combination of what the initiator chooses to do, and how the counterparty will respond, results in an 'objective' calculation of the reaction. Consequently, the objective results of the second phase can differ from the subjective estimates of the first phase. These calculations can differ based on the way risk, calculated endogenously in the model, or other factors might distort perception.

The high degree of complexity in the set of potential results that can emerge from each turn results from many calculated interactions. For example, what drives an actor to compromise is not only its view of the options available but also its assessment of the likelihood of various options 'winning.' It is possible to imagine an actor might compromise to lend support to a position that is not its most-favored outcome in order to defeat what it considers an even less desirable option. However, using this model, a detailed narrative can emerge for an individual actor's behavior in each simulation, itself a source of potential insight generated by the SMP.

Appendix 3. Country Datasets

Table A2. Saudi expert-based.

Actor	Legend	Group	Position	Influence	Salience	Exercised power
Royal Court	SaRoyalCourt	Royal Court	73	100	26	26
Minister of Energy, Industry and Mineral Resources	SaMEIM	Government	63	80	42	33
State Minister of Energy Affairs	SaMinEn	Government	78	70	35	25
MEIM Advisor	SaMEIMAdv	Government	75	86	50	43
Deputy Minister, Ministry of Energy	SaDepMEIM	Government	65	48	25	12
Deputy Minister for Electricity Affairs, Ministry of Energy	SaMOFA	Government	68	55	67	37
Minister of Foreign Affairs	SaMFA	Government	50	75	30	23
Minister of Economy and Planning	SaMEP	Government	75	73	30	22
Minister of State	SaMofState	Government	45	50	16	8
Minister of Finance	SaMinFin	Government	58	63	30	19
Minister of Commerce and Investment	SaMinComm	Government	57	52	20	11
Deputy Minister, Ministry of Planning and Economy	SaDepMEP	Government	73	43	45	19
Minister of Communications and Information Technology	SaMinCommIT	Government	50	48	11	5
President of King Abdullah City for Atomic and Renewable Energy (K.A.CARE)	SaKACARE	Government	80	23	33	7
Central Bank Governor	SaCentBank	Government	50	30	30	9
Governor of Saline Water Conversion Corp (SWCC)	SaSWCC	Government	55	23	16	3
President of King Abdulaziz City for Science and Technology (KACST)	SaKACST	Government	53	50	16	8
Ministry of Transportation	SaMinTran	Government	58	40	11	4
General Director, Saudi Energy Effeciency Council	SaSEEC	Government	68	40	23	9
Saudi Indusrial Development Fund	SaSIDF	Government	55	40	13	5
Ministry of Agriculture	SaMinAg	Government	58	50	13	7
Renewable Energy Development Office	SaREDO	Government	68	55	55	30
Supreme Economic Council Secretary General/Advisor to the Royal Court	SaSecGenSEC	Advisor	63	13	18	2
Former Minister of Economy and Planning/Advisor to the Royal Court	SaFmrMinEcon	Advisor	50	59	25	15

Center for Strategic Development Director General/Former MEP Advisor	SaCSD	Advisor	60	25	20	5
Governor of Standards Organization (SASO)	SaSASO	Authority	63	40	5	2
Governor of Saudi Arabian General Investment Authority (SAGIA)	SaSAGIA	Authority	38	40	13	5
Governor of Electricity & Co-Generation Regulatory Authority (ECRA)	SaECRA	Authority	84	65	65	42
Aramco CEO	SaAramco	Energy company	65	70	31	21
Independent power producers (IPPs)	SaIPPs	Energy company	68	30	28	8
Saudi Electricity Company	SaSEC	Energy company	74	63	50	32
ACWA Power Chairman	SaACWA	Energy company	83	48	25	12
Energy intensive industrials	SaEII	Energy consuming company	70	48	45	22
Chambers of Commerce	SaChamber	Business	50	13	13	2
National Industrial Committee	SaNatInd	Business	60	18	13	2

Source: Expert interviews conducted by KAPSARC.

Table A3. UAE expert-based data regarding support for or opposition to applying a regional power market.

Actor	Legend	Group	Position	Influence	Salience	Exercised power
Abu Dhabi Crown Prince	UAERuler	Royal Court	70	100	36	36
Prime Minister	UAEPM	Royal Court	80	92	35	32
National Security Advisor	UAENSA	Royal Court	70	80	25	20
Minister of Energy	UAEMOE	Government	90	71	60	43
Deputy Minister of Energy	UAEDM	Government	90	54	74	40
Minister of Climate Change	UAEMCC	Government	80	45	37	17
Minister of State/Abu Dhabi National Oil Company (ADNOC) CEO	UAEMStat	Government	60	64	32	20
Minister of Finance	UAEMOF	Government	60	61	24	15
Minister of Foreign Affairs	UAEMFA	Government	80	66	31	21

Minister of Interior	UAEMOI	Government	60	57	13	8
Abu Dhabi Executive Council	UAEADEC	Government	70	63	22	14
Energy Authority	UAEEA	Government	60	44	39	17
Regulation and Supervisory Bureau	UAERSB	Government	60	47	57	27
Supreme Petroleum Council	UAESPC	Government	50	20	10	2
Adwec Advisor	UAEAdwecAdv	Advisor	80	44	65	28
Mubadala	UAEMubadalh	Energy company	80	73	28	21
Abu Dhabi Water and Electricity Authority (ADWEA)	UAEAdwea	Energy company	60	63	61	38
Dubai Electricity and Water Authority (DEWA)	UAEDEWA	Energy company	70	63	35	22
Abu Dhabi Water and Electricity Company (Adwec) CEO	UAEAdwec	Energy company	70	58	65	37
Abu Dhabi Transmission and Despatch Company (TRANSCO) CEO	UAETransco	Energy company	70	54	66	36
Emirates Nuclear Energy Corporation (ENEC) CEO	UAEENEC	Energy company	70	49	36	18
TAQA CEO	UAETaqa	Energy company	50	30	35	11
Masdar CEO	UAEMasdar	Energy company	70	48	26	12
Distribution companies	UAEDC	Energy company	60	36	34	12

Source: Expert interviews conducted by KAPSARC.

Table A4. Qatar expert-based data regarding support for or opposition to applying a regional power market.

Actor	Legend	Group	Position	Influence	Salience	Exercised power
Emir	QrEmir	Royal Court	66	100	31	31
Father Emir	QrFEmir	Royal Court	67	83	34	28
Deputy Emir	QrDEmir	Royal Court	72	63	31	20
Prime Minister	QrPM	Royal Court	66	79	42	33
Qatar Foundation Chairperson	QrQF	Royal Court	53	53	8	4
Minister of Energy	QrMOE	Government	76	54	58	31
Minister of Finance	QrMOF	Government	73	72	57	41

Minister of Economy	QrMOEC	Government	68	48	43	21
Minister of Defense	QrMOD	Government	60	67	29	19
Minister of Interior	QrMOI	Government	56	68	33	23
Minister of Foreign Affairs	QrMOFA	Government	68	72	50	36
Majlis A'Shura	QrMajlis	Government	67	58	52	30
Father Emir Advisor	QrFEmirAdv	Advisor	78	48	41	20
Former Energy Minister	QrFEM	Advisor	73	55	55	30
Qatar University Chancellor	QrQatarUni	Advisor	57	20	12	2
Qatar Petroleum (QP)	QrQP	Energy company	53	70	44	31
Qatar Petroleum Board Member	QrQPBM	Energy company	69	28	11	3
Qatar Electricity & Water Co (QEWC) CEO	QrQEWC	Energy company	77	48	67	32
Kahramaa CEO	QrKaramaa	Energy company	73	54	49	27
Kahramaa GCCIA Board Member	QrGCCIABM	Energy company	70	65	70	46
Qatargas CEO	QrQatargas	Energy company	58	45	23	10
Rasgas CEO	QrRasgas	Energy company	58	42	23	10
Chamber of Commerce/Merchant Class	QrCOC	Business	65	44	25	11

Source: Expert interviews conducted by KAPSARC.

Table A5. Kuwait expert-based data regarding support for or opposition to applying a regional power market.

Actor	Legend	Group	Position	Influence	Salience	Exercised power
Emir	KuEmir	Royal Court	60	100	41	41
Prime Minister	KuPMJ	Royal Court	60	69	35	24
Minister of Electricity and Water	KuMEW	Government	70	71	68	48
Undersecretary – Ministry of Electricity and Water	KuUMEW	Government	70	63	69	43
Assistant Undersecretary – Planning, Ministry of Electricity and Water	KuAUP	Government	60	57	75	43
Minister of Finance (Acting Minister of Oil)	KuMOF	Government	70	65	61	40
Supreme Planning Council – Secretary General	KuSPC	Government	80	58	60	35

Minister of State (supervises Supreme Planning Council)	KuMOS	Government	70	55	50	28
Minister of Defense	KuMOD	Government	50	52	42	22
Minister of Interior	KuMOI	Government	50	48	38	19
Minister of State for Cabinet Affairs	KuMSC	Government	50	40	35	14
Deputy Prime Minister for Foreign Affairs	KuDPMFA	Government	50	52	43	22
Kuwait Foundation for the Advancement of Sciences (KFAS)	KuKFAS	Advisor	80	34	65	22
Former Oil Minister, Board of KFAS Directors	KuFOM	Advisor	60	40	65	26
Kuwait Institute for Scientific Research (KISR)	KuKISR	Advisor	80	65	70	46
Environment Public Authority (EPA)	KuEPA	Authority	70	27	45	12
National Control Center	KuNCC	Authority	50	63	63	39
National Assembly (Parliament) – Relevant Committee/Populists	KuNARC	Authority	40	56	41	23
National Assembly Speaker	KuNAS	Authority	50	58	57	33
Kuwait Petroleum Corporation – CEO	KuKPC	Energy company	80	64	65	41
National Assembly (Parliament) – Business Interested	KuNABI	Business	50	55	55	30
Chamber of Commerce/Merchant Class	KuCOC	Business	40	54	60	32
Media	KuMedia	Media	70	75	55	41

Source: Expert interviews conducted by KAPSARC.

Table A6. Oman expert-based data regarding support for or opposition to applying a regional power market.

Actor	Legend	Group	Position	Influence	Salience	Exercised power
Sultan/Prime Minister	OmSultan	Royal Court	70	100	28	28
Deputy Prime Minister	OmDeputyPM	Royal Court	60	88	28	25
Minister of Diwan	OmMD	Government	70	78	24	18
Minister of Defence	OmMOD	Government	50	86	31	27
Minister of Foreign Affairs	OmMFA	Government	70	89	36	32

Minister of Finance	OmMOF	Government	80	74	47	35
Minister of Oil and Gas	OmMOG	Government	80	69	48	33
Ministry of Legal Affairs	OmMLA	Government	50	47	30	14
Minister of Environment	OmMOE	Government	70	50	42	21
Supreme Council for Planning	OmSCP	Government	70	80	52	42
Majlis	OmMajlis	Government	60	55	38	21
Internal intelligence	OmII	Government	50	95	60	57
Minister of Finance – Undersecretary	OmMOFU	Advisor	80	69	54	37
Ministry of Oil and Gas – Undersecretary	OmMOGU	Advisor	80	65	54	35
Authority for Electricity Regulation	OmAER	Authority	60	65	60	39
Public Authority for Electricity and Water (PAEW) – Board of Directors	OmPAEWBoDC	Authority	70	70	75	53
Public Authority for Electricity and Water (PAEW) – Chairman	OmPAEWChair	Authority	70	71	63	45
Oman Oil	OmO	Energy company	60	46	41	19
Petroleum Development Oman (PDO)	OmPDO	Energy company	70	54	46	25
Oman Gas Company	OmG	Energy company	70	52	39	20
Shell	OmShell	Energy company	60	53	38	20
Oman Electricity Transmission Company (OETC)	OmOETC	Energy company	80	55	54	30
Distribution companies	OmDC	Energy company	60	38	38	14
Independent power producers (IPPs)	OmIPPs	Energy company	60	39	53	20
State General Reserve Fund (SGRF) – CEO	OmSGRF	Business	60	43	29	12
Nama Group (Electricity Holding Company)	OmNama	Business	70	65	49	32
Oman Power and Water Procurement Company (OPWP) – Chair (Single Buyer)	OmOPWP	Business	80	67	63	42

Source: Expert interviews conducted by KAPSARC.

Table A7. Bahrain expert-based data regarding support for or opposition to applying a regional power market.

Actor	Legend	Group	Position	Influence	Salience	Exercised power
King	BhKing	Royal Court	80	100	45	45
Crown Prince	BhSbH	Royal Court	80	95	55	52
Prime Minister	BhPM	Royal Court	60	95	50	48
Deputy Prime Minister	BhDPM	Royal Court	60	65	30	20
Minister for the Crown Court	BhCC	Government	50	55	15	8
Minister of Defense	BhMOD	Government	50	50	18	9
Chief of the National Guard	BhNguard	Government	50	21	13	3
Minister of Interior	BhMOI	Government	50	50	13	6
Minister of Finance	BhMOF	Government	70	65	45	29
Ministry of Finance – Director of Projects	BhGCCIA	Government	70	50	63	31
Minister of Foreign Affairs	BhMOFA	Government	80	55	40	22
Governor of the Central Bank	BhCentBank	Government	70	65	48	31
Minster of Oil – National Oil & Gas Authority (NOGA) – Banagas	BhNOGA	Government	90	80	65	52
Minster of Electricity and Water	BhMEW	Government	90	80	65	52
Electricity & Water Authority	BhEWA	Government	80	90	68	61
Deputy Chief Executive for Electricity & Water Production & Transmission	BhDCE	Government	70	65	63	41
Sustainable Energy Unit	BhSEI	Government	100	60	100	60
Bahrain Economic Board	BhEB	Government	100	80	70	56
Supreme Council for Environment	BhSCE	Government	80	65	48	31
Advisory And Regulatory Committee	BhARC	Authority	80	55	70	39
Parliament	BhParliament	Authority	80	75	40	30
Bahrain Petroleum Company (Bapco) – CEO	BhBapco	Energy company	80	55	60	33
Independent power producers (IPPs)	BhIPPs	Energy company	70	25	60	15
Energy intensive industries	BhEII	Energy consuming company	70	40	60	24

Source: Expert interviews conducted by KAPSARC.

About the Authors

Paul Mollet

Paul Mollet is a research fellow at KAPSARC. His primary field of interest is the energy policy of the Gulf Cooperation Council (GCC) countries and how the region is responding to the domestic and international challenges posed by the energy transition.

Imtenan Al-Mubarak

Imtenan is a research associate in the Policy and Decision Science program at KAPSARC, focusing on energy and economic policy research with an emphasis on Saudi Arabia, the GCC countries and Northeast Asia. Her current research interests include game theory, decision-making processes and big data machine learning.

Brian Efird

Brian is the Program director for Policy and Decision Science at KAPSARC. This program encompasses a multi-disciplinary, multi-national team of researchers who focus on collective decision-making processes, demography and energy, and energy policy studies of countries in the GCC region.

Saleh Al Muhanna

Saleh is a senior research analyst in the Policy and Decision Science program. His interests lie in geopolitical research, international agreements and international trade. He holds a master's degree in international commerce and policy from George Mason University and a B.S. degree in economics from Pennsylvania State University.

Omar Al-Ubaydli

Omar is the program director of Economics and Energy Studies.at the Bahrain Center for Strategic, International and Energy Studies (Derasat). He is additionally an affiliated associate professor of economics at George Mason University, a non-resident fellow at the Arab Gulf States Institute in Washington and an affiliated senior research fellow at the Mercatus Center.

About the Project

KAPSARC has developed the KAPSARC Toolkit for Behavioral Analysis (KTAB), an open source software platform, to support modeling and analysis of collective decision-making processes (CDMPs). KTAB is intended to be the standard platform for analyzing bargaining problems, generalized voting models and policy decision-making. It is our intent to use KTAB to assemble the building blocks for a broad class of CDMPs. Typical models in KTAB will draw on the insights of subject matter experts regarding decision makers and influencers in a methodical, consistent manner; and then assist researchers to identify feasible outcomes that are the result of CDMPs.

KAPSARC

مركز الملك عبدالله للدراسات والبحوث البترولية

King Abdullah Petroleum Studies and Research Center

www.kapsarc.org