Interlinking the Arab Gulf:

Opportunities and Challenges of GCC Electricity Market Cooperation

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Introduction

One of the key challenges faced today by the countries of the Gulf Cooperation Council (GCC)[1] is without doubt their rapidly growing domestic demand for energy, in which electricity plays a critical role as the driver of both residential and commercial life, and industrial expansion.[2] The tremendous economic growth experienced by Gulf countries since the oil price boom of the early 1970s, and in consequence the accumulation of oil and natural gas revenues in the region, has been a key driver of this demand growth for electricity. With GCC electricity consumption growing tenfold between 1980 and 2008,[3] one of the main challenges has been to provide the necessary infrastructure to secure supplies of electricity, both at times of peak demand and in the long term, for the region's fast growing industries and commercial sectors which are forecast to continue to grow at rates mostly above 5 per cent annually in the coming years.[4] Recurring peak electricity shortages that are experienced throughout large parts of the region during the summer months are merely the most visible reminder of the GCC countries' overall problem of electricity shortages that concern all parts of their economies.

In this context, the GCC has only recently launched the first two phases of its largest and most comprehensive joint project in the area of energy security to date, a GCC-wide electricity grid that will eventually interlink the national power grids of all six GCC countries. At the time of writing, only Oman's interconnection to the grid, planned for 2013, remains to be completed. The interconnection of the GCC countries' national power grids is intended to become the backbone for systematic regional electricity market cooperation that will enable the sharing of reserve and generation capacity between the GCC countries. First and foremost, this cooperation is aimed at providing greater security for the national power systems, through a peer emergency supply mechanism. The GCC grid could, however, one day also become a tool for the creation of a genuine regional market within the GCC, allowing for commercial trading of electricity along the lines of European and North American regional power markets. Successful regional trade in electricity may ultimately also enable the GCC countries to link their power system with other regional grids, such as the North African grid and the Mediterranean Ring.

Nevertheless, the road ahead for GCC electricity market cooperation is long, and it is argued in this paper that the policy choices made in the coming years by all six GCC members will be critical to raising the level of security the grid can provide, and for the development of a fully integrated, commercial regional electricity market. Some of the most immediate challenges ahead include current domestic market conditions within the GCC countries. In particular (i) the level of spare capacity available amongst countries facing essentially similar demand patterns and peak shortages; (ii) the lack of system diversity between the GCC countries, most importantly the lack of diversity of fuels used for power generation, a key condition for commercially viable electricity trade; and (iii) incomplete domestic market liberalization that involves both ownership models and pricing regulation. Secondly, regional electricity market cooperation, most importantly in the area of commercial trade, still lacks a

[1] The GCC includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE)
[2] The IEA lists the Middle East region, which includes also the Levant and Egypt, as the second largest growth market for primary energy consumption after Asia. IEA (2010b), 84–5.
[3] EIA (2011)
[4] Real GDP at IMF projections. IMF (2011), 188

complete and detailed legal framework at GCC level. Even in the case that enough of these preconditions are fulfilled, the effective creation of a regional electricity market within the GCC will be a long term endeavour – following regional electricity market development experience elsewhere. It is hence argued that regional cooperation between the GCC countries in electricity will require many more years to evolve fully, but its beginnings come at the right time.

Section 1 of this paper sets out the background for GCC regional cooperation – the domestic challenges faced by all six GCC countries, caused primarily by the rapid growth in their domestic electricity consumption. Section 2 discusses the arguments that support regional cooperation efforts in the area of electricity supply, based on (i) the security aspect, and (ii) the economic aspect relating to commercial trade. In Section 3, the paper takes a brief look at the history of the idea of GCC electricity trading, including the reasons why the GCC countries now have an almost complete grid that acts as an emergency mechanism, but not as a tool for electricity trade. Section 4 analyses the current state of GCC electricity cooperation through the interconnection grid, and the challenges ahead for further cooperation. The conclusion summarizes and returns to the original question: how beneficial is the GCC electricity grid for the region?

1. GCC Electricity Markets and the Challenge of Demand

Following years of relatively high global oil prices, the rapidly growing economies of the GCC have come to face a formidable paradox: one of the world's richest regions in hydrocarbon reserves[5] has been facing power shortages along the Gulf coast, as a result of a lack of reserve generation capacity and a lack of fuel for existing power generation capacity. While the resulting power outages have been relatively short, and limited to extreme demand peaks, they have demonstrated the vulnerability of even a large scale energy-exporting region, such as the GCC, in relation to domestic energy security. Ongoing investment programmes intended to create large new power generation capacity throughout the GCC have been the result of a race between domestic power demand and the ability of the utility sector to deliver sufficient generation capacity. The following provides a brief overview of GCC domestic demand, the origin of policy responses such as investment in new capacity, and the regionalization of the market.

1.1. GCC Electricity Consumption: A Brief Overview

The GCC economies have for many decades been an electricity growth market, with the region's total electricity consumption rising nearly tenfold since 1980. Growth during the 1980s was particularly high – consumption tripled within one decade, and since then has nearly doubled in each subsequent decade. By the beginning of the second decade of the twenty-first century, the GCC countries had become relatively large electricity consumers, given their comparatively small populations. In 2008, the region as a whole consumed some 330TWh of electricity, slightly less than the consumption of the UK, with a total installed capacity of some 78,600MW (see Tables 1 and 2 below). Saudi Arabia is by far the largest consumer, accounting for around half of the GCC's total consumption, followed by the UAE and Kuwait. Oman, Bahrain, and Qatar are the region's smallest consumers.

[5] The GCC countries hold around 37% of the world's proven crude oil reserves, and over 22% of its natural gas reserves. Its largest crude oil producer, Saudi Arabia, alone produces some 12% of world crude oil supplies, and controls, with neighbours Kuwait, the UAE, and Iran more than a third of those supplies. The GCC's natural gas giant Qatar comes third only to Russia and Iran in terms of total gas reserves, and has turned itself in to the world's largest exporter or Liquefied Natural Gas (LNG). BP (2010), 22, 24, 32

Table 1: Comparative Economic Indicators for the GCC

	GDP per capita, PPP (constant 2005 international dollars), 2008	Population, 2008	Electricity Production (TWh), 2008	Electricity Consumption (TWh), 2008	Electricity Consumption p.c. (KWh), 2008	Average Annual Electricity Consumption Growth, 1999–2009 (%)
Bahrain	32,233	1,106,509	11.217	10.48	10,390	7.8
Kuwait*	45,539	2,495,851	48.644	42.58	13,373	5.5
Oman	23,333	2,867,428	15.334	13.25	4,619	7.6
Qatar	84,043	1,448,479	20.319	18.79	12,694	10.3
Saudi Arabia	21,692	24,807,273	191.948	174.48	7,563	4.9
UAE	54,143	4,765,000	81.084	70.58	16,500	9.2
Total GCC	**-**	**37,490,540**	**368.546**	**330.15**	**-**	7.6
OECD	**30,801**	**1,216,298,865**	**1080.8635**	**839.86**	**8,399**	**1.62**

* Figure for 2007

Source: World Bank (2011); Arab Monetary Fund (2010); Arab Union of Electricity Producers (2009); EIA (2011)

Table 2: GCC Electricity Consumption and Installed Capacity 1980–2008

	Annual Consumption (TWh)				Installed Capacity (MW)
	1980	1990	2000	2008	2008
Bahrain	1.45	3.04	5.36	10.48	2,777
Kuwait	8.10	18.13	27.33	42.58	10,944
Oman	0.80	3.70	7.03	13.25	3,991
Qatar	2.03	4.28	7.95	18.79	3,164
Saudi Arabia	19.10	60.91	109.49	174.48	39,242
UAE	5.46	14.52	36.20	70.58	18,474
Total GCC	**36.93**	**104.57**	**193.35**	**330.15**	**78592.00**
Average Growth per Decade	-	183.2%	84.9%	70.7%	-

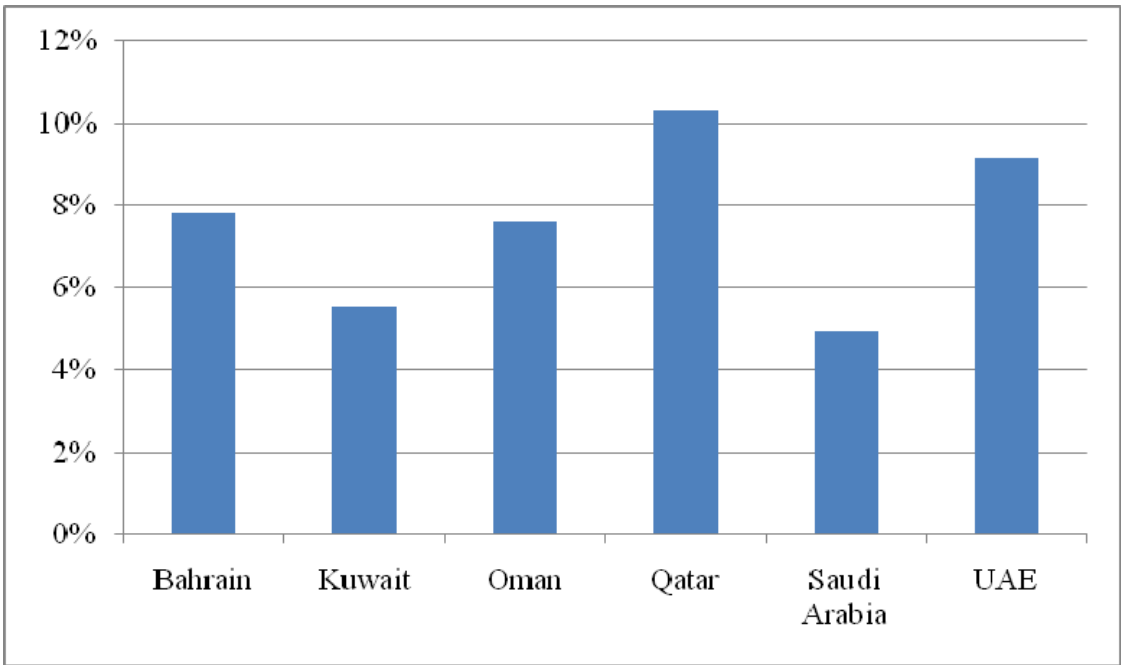
Source: EIA (2011)

In the early 1980s, GCC consumption growth was driven by the UAE and Oman, followed by Saudi Arabia. The fastest growing markets are, at the time of writing, those of the UAE and Qatar. Both countries witnessed average annual consumption growth rates of above 9 per cent over the first decade of the twenty-first century, compared with close to 8 per cent in Bahrain and Oman, and between 5 and 6 per cent in Saudi Arabia and Kuwait (see Figure 1). Economic boom years such as 2005/2006 resulted, for brief periods, in even higher growth rates of 18 per cent in Qatar and 14 per cent in the UAE in only one year. Peak demand has risen even faster: Kuwait experienced a 13 per cent increase between 2009 and 2010 to a total of 10,823MW in June 2010; Qatar 17 per cent; and the UAE in total 7 per cent (2009–10) – with Dubai emirate growing 10 per cent and Abu Dhabi 11 per cent in the same year.[6] Along

[6] 'Kuwait's Power Consumption Hits Record as Heat Rises', *Bloomberg*, 13 June 2010; 'Kuwait faces power crisis as it prepares to launch first IWPP', *MEES*, 53:25, 21 January 2010, 16; 'MEW cuts "water pressure" as

with the emerging economies of Asia, the GCC region hence faces among the world's fastest growth in electricity demand.

Figure 1: Simple Average Annual Electricity Consumption Growth Rates in the GCC, 1999–2009



Source: Author's own calculations based on EIA (2011)

1.2. Explanations for the Rapid Demand Growth

1.2.1. Economic Growth

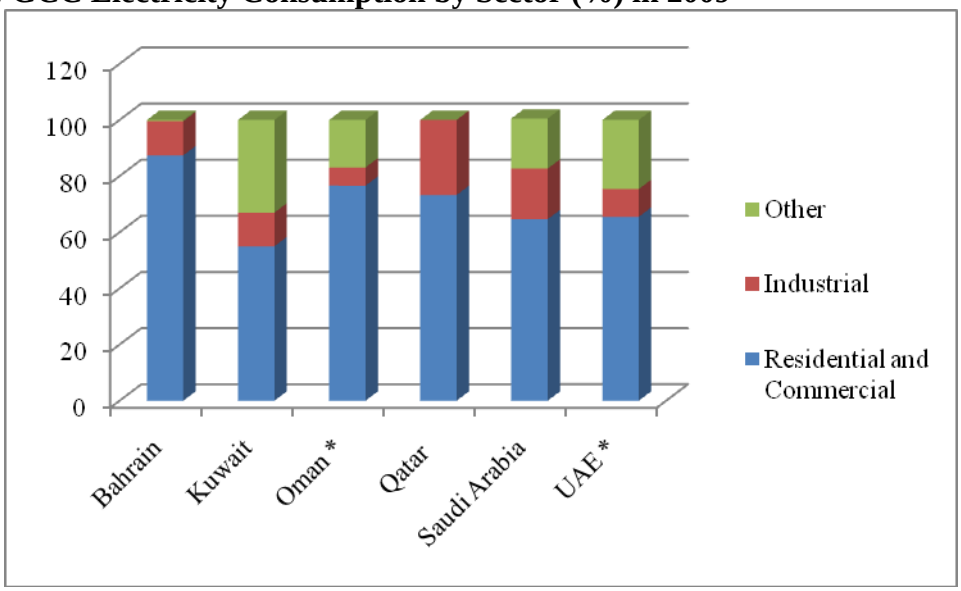
A key explanation for the GCC's rapid demand growth in electricity is the region's rapid economic growth. Large scale infrastructural development experienced since the 1950s (when many Gulf rulers began investing the accruing rent from oil, and later from natural gas) and heavy industrialization programmes into manufacturing, steel, aluminium, fertilizers, and petrochemicals all required increasing quantities of electricity. Rapid population growth in all Gulf states – as a result of labour migration and high birth rates, coupled with rapidly improving living standards – led to the rise in residential and commercial consumption. The bulk of demand for electricity now comes from within the residential and commercial sectors (see Figure 2), air conditioning being the single most important driver of electricity demand.[7] This factor explains the summer peak of GCC electricity consumption in contrast to, for instance, the European winter peak due to heating.[8]

consumption increases', *Arab Times Kuwait*, 12 November 2010; 'Qatar power boost will end era of blackouts – official', *ArabianBusiness.com*, 23 September 2009; 'Dubai peak demand for power rises', *The National*, 8 August 2010; 'Demand for electricity soars in Abu Dhabi', *MEED*, 28 March 2010

[7] For instance, see Al-Shareef and Abbod (2011), 21

[8] For a model and detailed discussion of Saudi Arabian load patterns, as an example, see Al-Shareef and Abbod (2011).

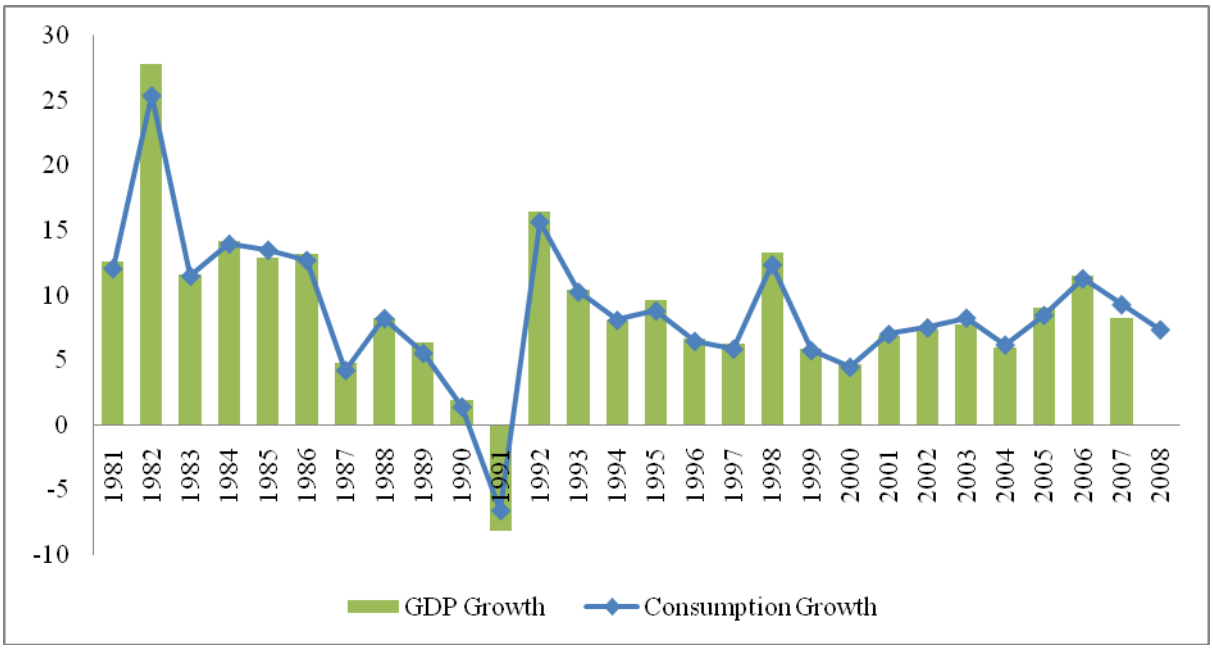
Figure 2: GCC Electricity Consumption by Sector (%) in 2009



* 2008 Figures
Source: Arab Union of Electricity Producers (2009)

Figure 3 below shows the strong link between economic growth and electricity consumption growth in GCC countries. Times of high rates of economic growth, such as in the early 1980s and the mid-2000s, are also characterized by an upsurge in electricity consumption. The only time of negative consumption in the GCC, over the given time period, is the year 1991. This is attributable to Kuwait's rapidly falling electricity generation, in consequence of the destruction of much of its domestic infrastructure resulting from the Iraqi invasion of Kuwait. The reconstruction period following the Gulf War subsequently accounts for the sudden rise in electricity consumption economic activity.

Figure 3: Electricity Consumption Growth vs. GDP Growth for the GCC (%), 1981–2008



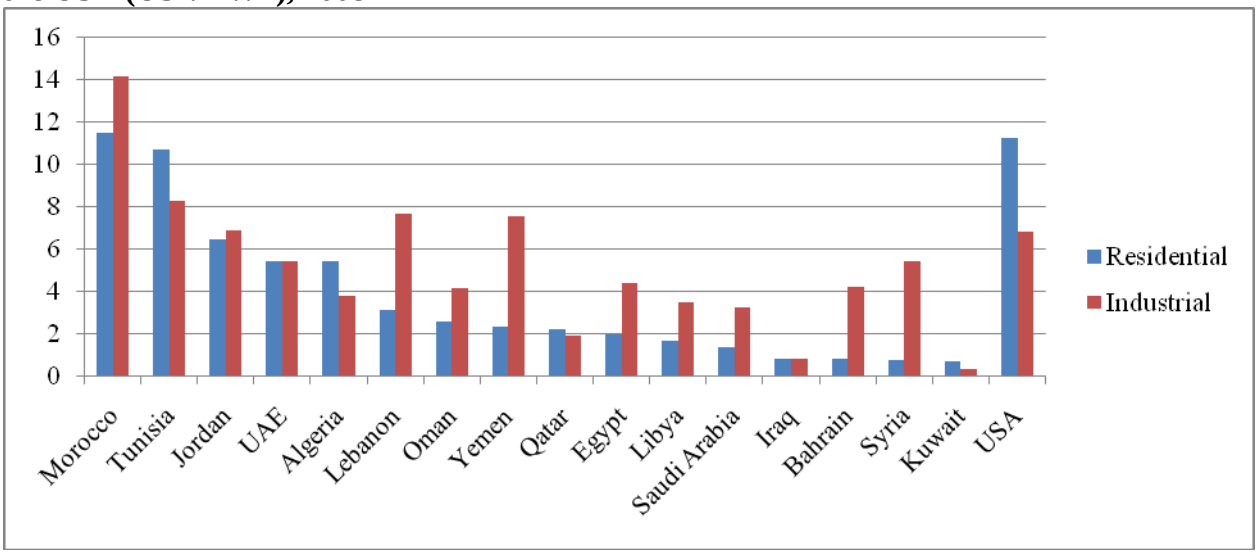
Source: Author's own calculations based on EIA (2011)

1.2.2. Pricing

In addition to economic growth, the pricing of electricity in the GCC countries plays an important role in rapidly increasing demand. Pricing in the GCC has reflected the role the state has historically played in the provision of energy in these countries: the utility sector has historically been dominated by state-owned power companies supplied with low-priced oil and natural gas by mostly government-owned oil and gas companies. The power companies then supply electricity to final consumers, both residential users and industries, sometimes at additionally subsidized prices.[9] The ongoing liberalization of GCC utility markets that allows for the increasing participation of private power projects[10] has not fundamentally changed the basic truism of pricing in the region: electricity is typically sold below cost, with the result that the region's electricity tariffs are among the lowest in the world (see Figure 4).[11]

Poor payment enforcement adds to this situation, as do occasional household cheques distributed by the Kuwaiti government (such as Amiri Grants) and, more recently, the Bahraini government to each national, equating to a sort of ad hoc cash subsidy of a range of goods and services including utility provision.[12] Such instances reinforce a sense among many nationals that electricity is essentially a free gift from the state. The result has been a lack of incentive for citizens over many decades to economize on their use of electricity.[13] Waste due to inefficient buildings and equipment, and the constant use of air conditioning, are an important contributor towards GCC electricity demand levels. Several GCC economies now rank among the highest electricity consumers per capita in the world (see Figure 5).

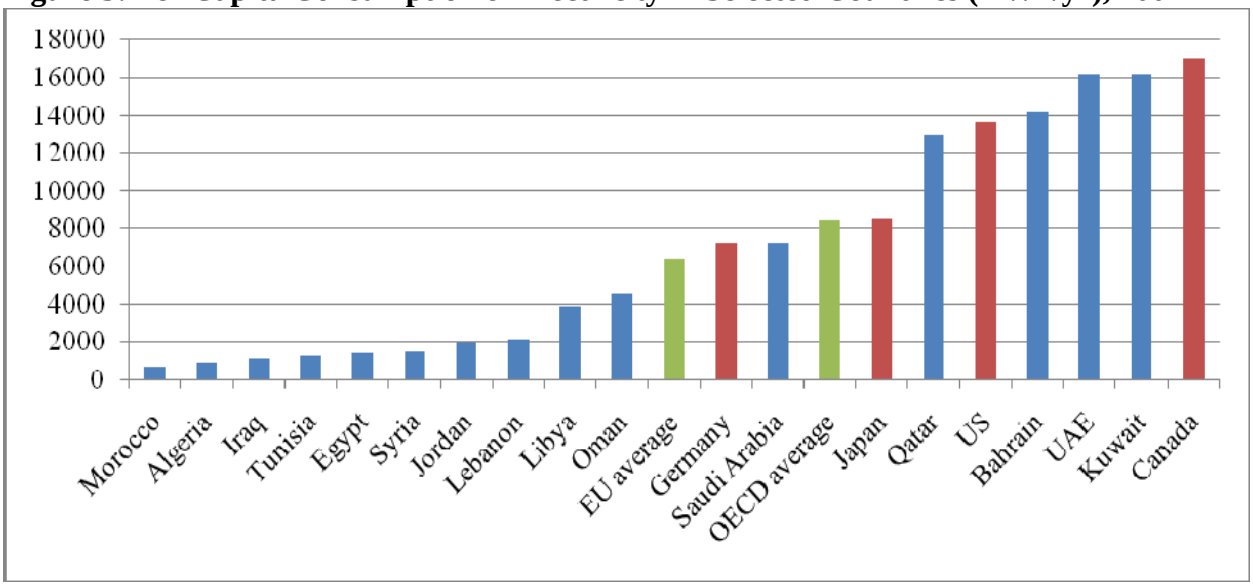
Figure 4: Residential and Industrial Electricity Prices in Selected Arab Countries and the USA (US¢/KWh), 2008



Source: Arab Union of Electricity Producers (2009); Kuwait Ministry of Electricity and Water website; EIA (2011)

[9] See, for instance, in the case of Kuwait, El-Katiri et al (2011).
[10] Emirates Centre for Strategic Studies and Research (1999)
[11] In Qatar, electricity tariffs apply to nationals only once consumption reaches a certain ceiling, rendering basic electricity supplies free of charge. 'Qatar's Energy Base', *APS Review Downstream Trends*, Vol.73 Issue 9, 31 August 2009
[12] For instance, see 'Kuwait's Power Consumption Hits Record as Heat Rises', *Bloomberg*, 13 June 2010; BMI (2010b), 18; 'Amiri Grant, free food to cost 7.5% of state budget', *Kuwait Times*, 19 January 2011; 'King Hamad gifts over $2650 to Bahraini families', *Trade Arabia*, 12 February 2011
[13] See El-Katiri et al. (2011) for the case of Kuwait.

Figure 5: Per Capita Consumption of Electricity in Selected Countries (KWh/yr), 2007



Source: World Bank (2011)

Tentative tariff changes in 2010 for residential users in several GCC countries such as Saudi Arabia and the UAE, reflect not only the realization by governments that previous practices have contributed to inefficient usage – and hence unnecessarily high consumption rates – but also that government subsidies on the price of electricity constitute an increasingly heavy burden on state budgets.[14] Oman was the first GCC member country to initiate a review of tariff structures that included the calculation of an electricity price based on generation costs at different natural gas prices (the main fuel for power generation in Oman).[15] In summer 2010, Saudi Arabia reviewed its pricing system and raised electricity tariffs for residential, commercial and industrial users.[16] Pricing signals of this kind are important policy tools for demand management, as they should guide customers' consumption behaviour in the long run, but their impact has yet to be felt.[17]

[14] At the end of 2010 both Dubai and Abu Dhabi introduced a dynamic tariff structure that also included slightly raised prices but still retained a large subsidy. Abu Dhabi's customers now pay between 3–15fils/KWh (between US$0.00817 and 0.04084/KWh), while Dubai's users pay between 20 and 38fils/KWh (between US$0.0544 and 0.1035/KWh). Abu Dhabi Regulation and Supervision Bureau, Information Tariffs, www.rsb.gov.ae; 'Electricity bill in Abu Dhabi set to increase', *Emirates 24/7*, 25 October 2010; 'Dubai approves electricity and water tariff revision', *Gulf News*, 9 December 2010; DEWA, Electricity Tariff Calculator, available online at www.dewa.gov.ae/tariff/tariffdetails.aspx.

[15] Omani Authority for Electricity Regulation, available online at: www.aer-oman.org/index.php?option=com_content&view=article&id=116&Itemid=176. See also Oman Electricity and Water Company (2009).

[16] According to the July 2010 tariff changes, residential users are now charged an average of SAR0.137/KWh (US$0.0365/KWh), up from the previous SAR0.125 (US$0.0333), and industrial users between SAR0.0125 and 0.02 (SAR0.02 equating to US$0.0053). The Saudi-quoted cost price is SAR0.372/KWh (US$0.0992), implying a subsidy of between SAR0.359 and SAR0.352/KWh for industrial users, and an average subsidy of SAR0.235/KWh for residential consumption. At Saudi Arabia's tariff prior to July 2010, all users were subsidized at SAR0.0867/KWh. Saudi Arabia was identified by the EIA as being one of the largest subsidizers of energy, with a total of $35bn worth of energy subsidies paid on oil, gas, and electricity in 2009. IEA (2010a), 580; 'Saudi Arabia to implement new power tariff', *Saudi Gazette*, 1 July 2010.

[17] See also a detailed discussion of the impact of energy subsidies on consumption, IEA (2010b), 569–92.

1.3. Implications

Unlike natural gas markets, electricity markets do not immediately provide an indication of a gap between supply and demand, owing to the technical nature of electricity as a non-storable commodity. In consequence, demand always equals supply, leaving engineers to work out frequency and voltage deviations over fractions of seconds as an indicator of a momentous over-demand or supply. For the casual observer, the need for GCC markets to upgrade their generation capacity is apparent from two indicators: the recurrent summer power shortages experienced across all consumer sectors throughout the region; and the struggle of most Gulf states to obtain sufficient amounts of natural gas, the main fuel used for power generation in the GCC.

1.3.1. Electricity Shortages

Capacity shortages are particularly visible during the summer, when consumption throughout the GCC peaks due to high levels of air conditioning. At peak times, usually during the afternoon hours, demand in some of the GCC countries can be as much as twice off-peak summer rates, and three times winter rates.[18] Sustained high load and inadequate capacity at peak times have caused recurring electricity outages along the Western Gulf coast.[19] Load shedding – which involves cutting off parts of cities and entire villages, often for several consecutive days – has also become more frequent, particularly in Kuwait, the Northern Emirates, and Bahrain. Low water pressure and, in some cases, water shortages, have been related problems, given that most of the region's supplies are dependent on desalination plants.[20]

Power outages and load shedding experienced along the Gulf have not only affected the residential sector, but are an increasingly serious concern for businesses and industries, which often have no other option than to shut down production and close offices during power cuts. Bahrain and the Northern Emirates' steel and aluminium industries have suffered particularly in recent years, having had to deal with several, often consecutive, days of total closure or reduced operation.[21] The economic loss due to power cuts in Sharjah in 2009 alone was estimated at more than AED70mn (US$19mn).[22] Saudi Arabia suffered a similar fate in October 2010 when a power failure shut down PetroRabigh, one of the Kingdom's most important petrochemicals complexes.[23] In the previous year, the Saudi Electricity Company had to shut down parts of the industrial zone in south Jeddah in the afternoon hours in order to avoid larger power outages.[24]

After several consecutive summers of power cuts, many businesses have resorted to installing diesel generators to supply electricity – either during times of shortages or while waiting for

[18] For instance, for Saudi Arabia and Abu Dhabi/UAE see Al-Shareef and Abbod (2011), 21; Miller (2005).
[19] For instance, see some more recent reports: 'Sharjah hit with yet more blackouts', *Business Maktoub*, 26 May 2010; 'Blackouts loom in Kuwait as summer sets in', *The National*, 12 May 2010; 'Bahrain: Power cuts force people to sleep in cars', *Business Maktoub*, 26 August 2009; 'Jeddah suffers seven-hour blackout', *Business Maktoub*, 8 March 2010; 'Qatar aims to cut summer power blackouts', *Business Arabia*, 5 August 2009.
[20] Saudi Arabia's Jeddah region, for instance, experienced water shortages several summers in a row. In Kuwait, lack of electricity led to reduced water pressure in summer 2010. 'Gulf Power/Water Privatization Continues, as Saudi Arabia Conducts Review', *MEES*, 52:28, 13 July 2009, 8–9; 'MEW cuts "water pressure" as consumption increases', *Arab Times Kuwait*, 12 November 2010; 'Kuwait to produce 17,500 MW power by 2014 – paper', *Reuters*, 25 October 2010.
[21] For instance, see Oxford Business Group (2010), 99
[22] Oxford Business Group (2008b), 63
[23] 'Power failure shuts down PetroRabigh', *The Saudi Gazette*, 25 October 2010
[24] Bains, E. 'Utility Plans for Growing Demand', *MEED*, 26 June 2009

the connection of new businesses to the national power grids.[25] Waiting times for new connections can be several months, and adequate supplies are often not guaranteed even after connection.[26] The result has been numerous project delays across the Gulf, as well as relocation or cancellation of planned projects. Ajman-based Crown Paper Mill, for example, decided to relocate its new 23,000 t/yr tissue paper machine to Abu Dhabi in search of more secure power supplies,[27] while Abu Dhabi Basic Industries Corporation (ADBIC) appears to have scrapped a project to build a $5bn aluminium smelter in Ruwais due to concerns over adequate power supplies.[28] Bahrain's Financial Harbour and the new Khalifah bin Salman Port faced long delays for the same reason.[29]

One of the responses of national governments has been to invest substantially in new generating capacity, with the aim of eliminating power cuts in future years. A 2010 statement by the GCC Energy Working Group set out plans for up to $272bn of new energy investments in the GCC by 2015, $53bn of which will be dedicated entirely to the water and power sectors.[30] The UAE, Kuwait, and Bahrain all plan to double their generation capacities over the next decade, with the UAE proposing ambitious nuclear generation plans.[31] Projects under way in Saudi Arabia will add an extra 50 per cent of total capacity by 2013, and an additional 8,800MW of capacity by 2019.[32] Oman and Qatar plan additions of between 1,000 and 5,000MW of new capacity over the next decade.[33] Gas giant Qatar, on the other hand, opened its new 1,000MW Messaieed power plant in late 2009, and announced that the era of power cuts in Qatar was over and that the state was prepared to become a regional electricity exporter.[34]

Investment into the power sector has also been encouraged through the promotion of private ownership over parts of the sectors, through Independent (Water and) Power Projects (IPPs and IWPPs respectively). Oman became the first GCC country to embark upon the privatization of its utility sectors in the mid-1990s, a policy since adopted in most GCC countries, Kuwait being the last country to have begun planning its first private power plant, at Al-Zour North.[35] The partial or complete privatization of power production/procurement in

[25] 'Fuel shortage cuts electricity supply', *MEED*, 4 December 2009

[26] An exemplary case is the opening of Ras Al-Khaimah's Safeer Mall in December 2008, more than one year after it had been completed. After waiting more than a year for a connection to the emirate's power grid, the shopping mall finally opened, powered with an electric diesel generator. Other emirates – Kuwait, Bahrain, and Oman – face similarly lengthy connection times, with many businesses resorting to emergency generators. Oxford Business Group (2009), 91; Oxford Business Group (2008b), 63; 'Oman Electricity gears up to meet increasing demand', *Times of Oman*, 8 February 2010.

[27] Oxford Business Group (2010), 99.

[28] 'Fuel shortage cuts electricity supply', *MEED*, 4 December 2009; Oxford Business Group (2009), 94.

[29] Oxford Business Group (2008a), 128.

[30] 'GCC countries to invest $272b in energy by 2015', *The Saudi Gazette*, 9 November 2010.

[31] Oxford Business Group (2008a), 128; 'Bahrain investment in power to reduce blackouts', *ArabianBusiness.com*, 27 June 2010; BMI (2010b), 26; 'UAE nuke energy push may start deal bonanza', *Zawya Dow Jones*, 26 July 2009.

[32] 'Saudi power production capacity up 31.4%', *Saudi Arabian Company News Bites*, 20 September 2010; 'Power has to rise to meet demand', *MEED*, 5 March 2010.

[33] 'Oman Electricity to invest $520m through 2013', *MENAFN*, 9 February 2010; 'Oman – The Power Sector', *APS Review Downstream Trends*, 1 February 2010; 'Oman to invest more than $6bn on power generation', *Reuters News*, 24 January 2010.

[34] 'Qatar power boost will end era of blackouts – official', *ArabianBusiness.com*, 23 September 2009.

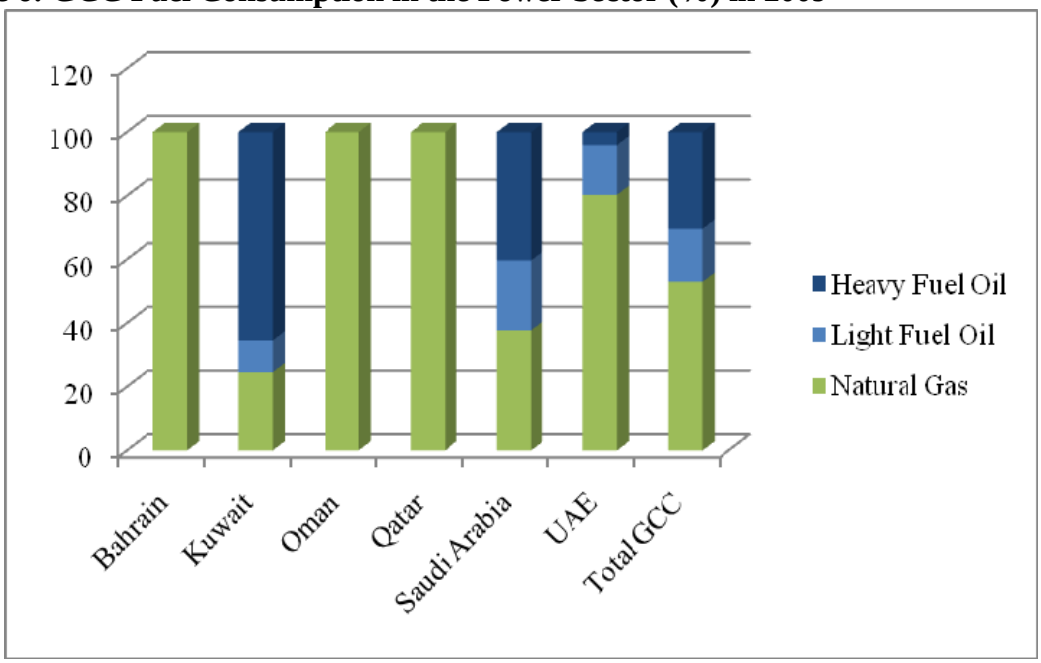
[35] In recent years, the GCC saw a proliferation of IPPs, including Bahrain's two IWPPs – Ezzel and Hidd – which provide most of Bahrain's power and water supplies, Abu Dhabi's planned Shuweihat S3 1,500MW IPP which follows eight successful IWPPs, Qatar's planned Ras Laffan 2,700MW IWPP, and Oman's Barak3 and Sohar 2 IPPs. Economist Intelligence Unit (2010); GDF Suez Press Release, 'Financing for Barka 3 and Sohar 2

several GCC countries raises the probability of more cost-reflective tariff structures in the longer term, because of the requirement of private sector companies for a significant return on their investments.

1.3.2. Natural Gas Shortages

High demand growth has also had an impact on the availability of fuel for power generation. The GCC electricity sectors are dominated by oil- and natural gas-fuelled power plants. Bahrain, Oman, and Qatar rely entirely on natural gas for power generation, although both Bahrain and Oman occasionally burn oil at times of natural gas shortages. Saudi Arabia and Kuwait are the region's two remaining countries still heavily reliant on both crude oil and oil products for power generation, a situation that both states wish to change in the coming decades, owing to the high opportunity costs associated with burning oil.[36] Forecasts by the EIA suggest that as a result, over 90 per cent of new power generation capacity added in the GCC area up to 2030 will be gas fired.[37]

Figure 6: GCC Fuel Consumption in the Power Sector (%) in 2009



Source: Arab Union of Electricity (2009)

independent power projects in Oman completed', 20 September 2010; Oxford Business Group (2008a), 128; 'Shuweihat S3 Power Plant Attracts Bids From Five Consortia', *MEES*, 53:31, 2 August 2010, 20–22; 'Shuweihat S3 To Send Out RFP To Developers', *MEES*, 53:10, 8 March 2010, 25–6; BMI (2010d), 17; 'Qatar's Record 2010–11 Budget Targets Infrastructure Growth', *MEES*, 53:15, 12 April 2010, 4–6; 'Kuwait sets bid deadline for Al Zour North IWPP', *Utilities ME*, 4 November 2010.

[36] This fact is based on the high global prices at which oil has been traded over the past decade – every barrel burnt domestically, loses the difference between the domestic price (a fraction of the value on international markets) and international prices. Saudi Aramco's CEO Khaled Al-Falih publically expressed his worries in 2010 about the levels of domestically consumed oil in Saudi Arabia. The kingdom currently burns as much as 1mn b/d in summer in power plants, out of a total production of some 8–8.5mn b/d in 2010. Al-Falih expressed worries that by 2028, exports could hence fall by as much as 3mn b/d. Kuwait has faced similar worries. 'Saudi oil chief fears domestic risk to exports', *Financial Times*, 26 April 2010; 'Saudi Arabia, Kuwait Seek Gas to Supplant Use of Oil for Power', *Bloomberg*, 30 November 2010; 'Gulf shifts focus to domestic energy', *Financial Times*, 17 January 2011.

[37] 'GCC Gas Shortage Worsening To 2015, Says Booz & Co', *MEES*, 53:25, 21 June 2010, 17.

The rapid increase in electricity demand has also caused a corresponding increase in demand for natural gas in the power sector. GCC gas consumption has consequently grown at nearly 6 per cent per annum over the past decade, with individual countries' demand more than doubling over this period.[38] Over the same period, domestic gas production in all cases but Qatar and Saudi Arabia has grown at substantially lower rates, owing to a combination of limited reserves in Bahrain and Oman, and lack of progress in development of new non-associated gas reserves, such as in Abu Dhabi and Kuwait.[39] Demand from the power sector competes with industries, many of which use natural gas as feedstock, for instance in petrochemicals production. Abu Dhabi, Oman, and Qatar are, moreover, natural gas exporters with long-term contract obligations. Of the three, only Qatar can realistically both export and supply its domestic industries and the power sector with cheap gas; since 2007, both Oman and Abu Dhabi have imported additional gas from Qatar.[40]

Capacity shortages are therefore not only a problem of physical availability, but of the availability of gas as fuel for power generation. Some of the 2010 summer outages of electricity resulted from a short term lack of sufficient gas supplies. Sharjah, despite having had sufficient installed capacity, was one of the worst hit by electricity shortages in the summers of 2008 and 2009, precisely because of this problem.[41] Oman, where question marks had long been placed over new power plant projects owing to limited gas supplies, decided in 2010 to prioritize all new production of natural gas to be allocated to the country's electricity sector. [42] Meanwhile, many GCC countries are pondering different mid- to long-term options to diversify energy sources used for power generation, including coal, renewables, and nuclear energy.[43] The UAE's nuclear programme is the most advanced programme for large scale generation capacity in the medium term, with a time horizon of 2017 for the completion of the first reactor, and 2020 for three others.[44]

[38] Gas demand of the UAE and Oman stands out as substantially higher than in the rest of the GCC. EIA (2011).
[39] Bahrain is the GCC's smallest reserve holder of natural gas, with an R/P ratio of less than a decade, while Oman can expect to produce for another 30 years at current rates, but is importing small quantities (some 1.5bcm/yr) from Qatar. The UAE and Kuwait have larger reserves (6.43tcm and 1.78tcm at the end of 2009) but have yet to develop their ultra-sour non-associated gas fields, which have experienced significant delays. BP 2010, 22, 30; See also 'Acid test for Abu Dhabi', *International Gas Report*, Issue 655, 16 August 2010; 'ConocoPhillips Makes Second Mega-Project U-Turn By Quitting Shah-Gas Development', *MEES*, 53:18, 3 May 2010, 23.
[40] Qatar's natural gas reserves are the largest in the GCC, the world's third largest, after Russia and Iran. Qatar's North Field, the world's single largest natural gas fields, holds more than 25tcm (at end of 2009), with an R/P ratio of more than 100 years. Qatar also exports natural gas to the UAE and Oman through the Dolphin pipeline, and is the world's largest producer of LNG. BP (2010), 22, 30.
[41] 'Demand for electricity soars in Abu Dhabi', *MEED*, 28 March 2010; Oxford Business Group (2008b), 63.
[42] Economist Intelligence Unit (2010).
[43] 'S Koreans win $20bn UAE nuclear power contract', *Financial Times*, 27 December 2009; 'UAE's first nuclear power station scheduled to start in 2017', *Gulf News*, 22 December 2010; 'Ajman in $2bn power plant deal', *Emirates 24/7*, 18 July 2008; 'Ras Al Khaimah to invest $1.5bn in Indonesia coal transportation', *Emirates 24/7*, 3 March 2009; Government of Dubai, 'DEWA Gets Tenders for a Techno Economic Study on the Application of Coal based Electricity Generation in Dubai', press release, 9 January 2011
[44] 'S. Koreans win $20bn UAE nuclear power contract', *Financial Times*, 27 December 2009; 'UAE's first nuclear power station scheduled to start in 2017', *Gulf News*, 22 December 2010.

2. Incentives for Regional Trading Schemes in the GCC

The challenges faced by the GCC countries collectively as a region of emerging markets raise the question of the extent to which greater regional cooperation could contribute towards more secure and more economic supplies of electricity to domestic consumers. Indeed, regional approaches to share and trade[45] electricity between different countries can provide major benefits for all participants. Two main sets of benefits can be distinguished in this context: firstly, benefits relating to security in cases of emergency; and secondly, economic benefits from regional electricity trading schemes that take advantage of differences in production costs and more efficient allocation of electricity supplies in the region. Whether or not these potential benefits materialize will be dependent on whether the GCC countries decide to make use of the different options provided by the grid, and also on whether their own countries have the appropriate institutional structures.

2.1. Security

The most immediate benefit likely to be provided by GCC regional trading schemes is the grid's contribution towards regional security of supply. This was the key function for which the grid was designed, throughout the various studies and planning processes which preceded its construction.[46] The principle function of a regional electricity grid is simple: it links the power systems of different countries, allowing both their generation capacities and national reserve capacities to be shared.[47] The result is a 'pooling' of regional capacity, such that individual systems can draw from neighbouring countries' capacity, for instance in cases of acute electricity shortages in one country, or at times when power plants need to be taken off the national grid for upgrading or maintenance. The pooling of capacity may also result in economic gains, through lower total investment requirements compared with isolated networks. The result is a more stable and secure grid, at potentially lower cost for all participants.[48]

There are three types of capacity-sharing:[49]

i. *Emergency supply* of electricity for a limited period of time: Based on real-time (RT) transactions, a country experiencing an immediate power shortage can request electricity from the regional grid, for a limited period of time (typically a few hours).
ii. *Scheduled outages* to be covered from the regional grid: these transactions involve forward trading[50] of electricity to cover known shortages due to short term capacity

[45] In popular use by newspapers and some commentators, the term 'trading' is widely used in the context of electricity as denoting all forms of electricity transfers, whether for emergency supplies or more commercial forms of trade. In this paper, the term 'trade' is mainly used hereafter to denote *commercial* transfers of electricity for payment in cash.
[46] The background for this is discussed in more detail below in Section 3.
[47] Reserve capacity is here defined as *the extra capacity required to be maintained in addition to the demand at any point of time, to tide over generation plant outages, errors in demand forecasting, and other errors and faults*. Installed generation capacity is *the maximum electricity production by a given power system.* These definitions are based on Bhattacharyya (2011), 233 and the EIA's Glossary.
[48] For instance, see World Bank (2005); Murray (2009).
[49] This list is based on World Bank (2005).
[50] In electricity trade, a number of parallel markets exist: (1) the forward market which includes (i) standard (futures) or (ii) non-standard (forward) contracts (iii) the day-ahead market, which trades electricity for up to 24 hours ahead, and (iv) the hour-ahead market; (2) Real Time (RT), sometimes referred to as the spot market where all trades correspond to actual power flows. Stoft (2002), 203–4.

bottlenecks, for example for certain hours during a specified month, typically up to two years in advance.

iii. *Spinning reserve capacity supplies*: immediately available reserve capacity needed to cover short intervals at times when national generation capacity is sufficient but reserve capacity may be too low.

Payment for such forms of exchanges can involve *cash settlements* that require the existence of an exchange, typically overseen by a financial regulator, such as in the case of several European exchanges; or payment may be *in kind* over a specified settlement period. Settlement in kind can be a useful mechanism to settle pure emergency supplies of electricity, for it does not involve a potentially lengthy negotiation process over pricing prior to the emergency supply, nor does it require the existence of an organized central exchange for an RT auctioning process. In-kind payments can also be used to settle scheduled transfers of electricity, although in many cases, scheduled transactions can become part of effective electricity trade – i.e. the exchange of electricity for payment in cash. Settlements can then be negotiated bilaterally in advance, subject to the payment of a transmission fee to the grid operator.[51]

Conditions for the effective functioning of the emergency mechanism through a regional grid include both legal and institutional factors. On the legal side, capacity sharing through an existing grid requires (i) a multilateral legal framework for regional electricity trade and (ii) a harmonized set of commercial rules of practice. If commercial trade is supposed to ensue, i.e. electricity exchanges in return for a cash flow, the trading parties will also need to agree on an institutional mechanism for trade such as an exchange or a power pool, where bids and offers are cleared and settled.[52] The degree of emergency support which can be given to any country depends on the availability of spare electricity generation capacity in neighbouring countries at the time of capacity shortages. The possibility of coincident peak demand is therefore an important factor limiting the availability of emergency capacity, particularly in countries such as those in the GCC with relatively similar daily, monthly, and annual load patterns.[53] Universal security coverage cannot therefore be expected – potential benefits will rather involve *improvements* in regional system security, in the absence of a guarantee against power outages or load shedding.

2.2. Economy and Efficiency

Beyond providing greater system stability and security of supply, a regional grid can create the means for regional commercial electricity trade. Commercial trade differs from emergency electricity exchanges by not being primarily motivated by system security; rather, the aim is to capitalize on differences in system efficiency and cost advantages between different producers (countries or individual utility companies) by buying cheaper electricity from any available source. Trade can also entail the short-, medium- or long-term decision of a supplier or country to replace a share of base or peak load production with imports. The result is ideally a regional market that functions similarly to liberalized national electricity markets with several, competing utility providers: more efficient and lower-cost producers

[51] World Bank (2005), 6–7.

[52] In the short run and for small quantities of electricity, trade can be organized bilaterally between trading parties, but in the long run and for a large volumes of traded electricity, a more formal exchange or pool will be needed.

[53] For instance, see Millar (2005), Al-Shareef and Abbod (2011). This point has also been one of the main criticisms of the GCC Grid from the beginning of its planning process, and will later be discussed in more detail.

sell their spare electricity capacity through an auction process to higher-cost providers, which save costs by reducing their own, less efficient production.[54]

The following two trade options are possible:[55]

i. *Economy Energy Exchanges (EEEs)* are short term trades in electricity that take advantage of differences in the short run marginal cost (SRMC) incurred by two countries' utilities, allowing for transmission costs. Differences in utilities' SRMC can be due, for instance, to differences in generation plant efficiency, a temporary fuel cost advantage, or short run 'spare capacity' of secondary energy, such as hydropower generation. Electricity is then bought from where it is produced most cost-effectively, leading to a net saving for the importing national utility, and an increase in revenue for the exporting utility.

ii. *Firm Energy Supply (FES)* by contrast is a medium- or long-term solution for a country's generation capacity needs, based on a medium- or long-term contract between two utilities. A national utility commits to supply specific amounts of electricity on a 'take-or-pay' basis, which may contribute to the buying country's base or peak load supply. This option may be chosen if, for instance, a national utility cannot, or does not wish to, make additional investments in new plant, or requires capacity during the construction of new plant. The price of firm electricity is typically higher than that of economy energy exchanges, given that the selling utility is likely to be making additional investment in its own capacity, thereby implying a higher long term marginal cost, which is reflected in the sales price.

Cost and efficiency savings made by EEEs can be substantial, and markets such as the European power exchanges are mostly based on this form of trade.[56] For the GCC, there is an obvious potential long term benefit of using the grid to make investments in more efficient, alternative energy plants located at their most suitable location. This argument has particularly interesting aspects in the area of renewable energy; the argument brought forward by many proponents of the grid is that renewable energy projects can be planned and based at their most suitable location, in order thereafter to produce energy for a larger market. Wind parks could subsequently be placed at the most suitable coastal sites, and large solar projects could be constructed at a single location, adding the benefit of economies of scale in the construction and maintenance process as well.[57] This argument comes at a time of controversy about the compatibility of renewable energy with commercial electricity trade in a European context.[58] The GCC as a region that is in the process of building both a regional market, and a renewable energy base, may therefore be able to contribute an important future case study in this regard.

In a similar vein of thinking, the nuclear power projects currently planned in the UAE may benefit substantially from greater market size. Smaller GCC countries, whose power systems in isolation are too small to make nuclear stations commercially viable, could in the future

[54] World Bank (2005); Stoft (2002), 223.
[55] This list is based on World Bank (2005).
[56] See for instance, Murray (2009), 199–216.
[57] Al-Asaad and Ebrahim (2008), 5; Al-Asaad et al. (2006) 5; Al-Shahrani (2009). A full discussion of the GCC renewable energy plans goes beyond the scope of this paper. What is acknowledged at this stage is that the GCC countries have such plans but likewise the extent of their implementation, in the coming years is uncertain. See Luomi (2010).
[58] For instance, see EFET (2010); Copenhagen Economics (2010); EWEA (2010).

diversify their energy mix by importing nuclear power from the wider region.[59] Larger conventional power plants could likewise benefit from economies of scale. Individual countries' progress in adding urgently needed new capacity could in the future also be helped through medium term contracts, which can cover the time needed to build new plants.[60]

Nevertheless, the concept of regional trade must be seen as a long term endeavour: experience from other regions such as Europe and North America suggests that creating regional electricity markets is a complex, time- and capital-intensive task which is unlikely to be completed within a few years.[61] Similar to capacity exchanges, trading requires the existence of a clear legal and regulatory framework, but with far greater detail and complexity, including pricing and the organization of trade through exchanges or power pools.[62] In order to function well, trading also requires the existence of significant spare capacity and a sufficient number of trading partners, as well as full market transparency. All these conditions imply that participating electricity markets will need to reform and liberalize national utility sectors before large scale trading can take place.[63] However, the interdependence of different parties bound by firm supply contracts would be considerable, rendering this form of trade more politically sensitive.

[59] Most of the cost advantages of nuclear energy are associated with economies of scale, which are difficult to realize in small, isolated power systems such as the smaller Gulf states. Abaoud and Veziroglu (2002); El-Genk (2008). See also the UAE's policy towards cooperation with the GCC in the field of nuclear power in its white paper on nuclear power in the UAE of April 2008. Government of the UAE (2008), 13.
[60] For instance, see Al-Shahrani (2009).
[61] See, for instance in the case of the European markets, Vandezande et al. (2008); Haas et al. (2008); Jamasb and Pollitt (2008). The evolution of the European legal framework around electricity trade is well documented on the EU's website on energy trade at http://ec.europa.eu/energy/gas_electricity/legislation/legislation_en.htm.
[62] See Stoft (2002), 223 for a discussion of the two types of markets.
[63] Murray (2009), 137; World Bank (2005), 6.

3. A Historical Perspective on GCC Electricity Trading

The combined immediate and potential long term benefits of sharing GCC capacity and trading electricity makes it perhaps surprising that the idea took almost three decades to materialize. The original idea, which was already contemplated in the late 1970s, had to surmount a number of political and financial obstacles that to some extent reflect the GCC's history of highly politicized economic decision making. One of the most explicit consequences of this history has been the design of the GCC Interconnection Grid first and foremost as an emergency mechanism rather than a tool for trade. The GCC countries discussed the possibility of trading, but only planned for the grid to be utilized in cases of supply emergencies. Only when the project gained momentum during the 2000s, did the idea of creating a common market for electricity, and the aim of trading commercially rather than exchanging energy only during times of emergency, receive greater emphasis from political decision makers.

3.1. Initial Plans in the Early 1980s

The first plans for regional cooperation in the area of utility markets go back to the late 1970s, a few years after the withdrawal of the British from the region. The GCC economies had just experienced the first oil price boom, with oil revenues filling government coffers to unprecedented levels. Expansionist fiscal and investment policies induced more than a decade of record economic growth throughout most of the region, and the rapidly growing influx of migrant labour precipitated an unparalleled level of population growth. For the first time, the need to invest substantially in the region's electricity sectors to keep up with economic growth became evident. The creation of the Gulf Cooperation Council in 1981 provided a forum in which to discuss, between heads of states and ministers, potential ways in which the region's economies could cooperate and react to their fast growth, in ways that would enhance regional economic security. Joint regional infrastructure projects soon came to be seen as a major area promising both economic and security gains for all Gulf states.

The idea of building a cross-regional power grid began to be put forward in the late 1970s at the same time as alternative forms of energy, in particular the issue of nuclear energy, first started to be discussed in the GCC. The generation capacity needs of many smaller Gulf states were too small to allow for the economies of scale needed to make nuclear power commercially viable. A GCC-wide power grid removed a critical hurdle to diversifying the regional power generation mix – an important point which had already been recognized.[64] Initial thoughts about nuclear energy did not materialize into projects, but the regional grid concept resurfaced relatively soon. In 1982, a year after the creation of the GCC, a team of professors from King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia proposed a study to link the power systems of Saudi Arabia and its neighbour Bahrain, for the purpose of power sharing. The project attracted great interest at GCC-level, which commissioned a working group to study the viability of sharing electricity between all six GCC members.[65]

A 1986 study confirmed, in technical and economic terms, the feasibility of a GCC-wide power grid.[66] The core idea and conceptualization have essentially remained the same until today: the national grids of Saudi Arabia, Kuwait, Bahrain, Qatar, the UAE, and Oman

[64] Personal Interviews, January 2011.
[65] Personal Interviews, January 2011.
[66] Personal Interviews, January 2011.

should be interlinked through a large high voltage AC grid along the Gulf coast, aimed at allowing regular electricity exchanges between the member states. Already at that stage, the security aspect of the grid was highlighted, and the grid's feasibility was primarily established on the basis of benefits expected from electricity exchanges, while more systematic trade was deemed possible, but was not part of the core concept.[67] The estimated total project costs, then estimated at US$1.6bn, would soon be recovered by expected savings of more than $2bn as a result of a reduction in generation margins. The implementation of the project was proposed in three phases:

- *Phase I* linking the so-called Northern Gulf Systems, Kuwait, Saudi Arabia's Eastern system,[68] Bahrain, and Qatar.
- *Phase II* linking the Southern Gulf Systems of the UAE and Oman, following the completion of unified national grids.[69]
- In *Phase III*, the two Gulf systems are interconnected with each other, resulting in completely integrated grid.

The original plan received wide support, but did not materialize into anything concrete in the following decade. The reasons were a combination of economic, political, and diplomatic developments, which gradually shifted priorities away from regional electricity trading.

3.2. Priorities Shift in the 1980s and 1990s

The shift in priorities in the 1980s and 1990s was not in principal a decision against a GCC grid; it was a reflection of changed circumstances. The GCC as a young organization, created in 1981, faced many parallel challenges, but was also the principal forum to drive ahead cross-regional infrastructure projects such as the GCC Grid. The second half of the 1980s started off with a decline in oil revenues for GCC exporters following the fall in oil prices after the second oil price boom earlier in the decade. Economic growth decelerated, removing some of the immediate pressure on the region's domestic energy/electricity providers to expand rapidly. In the light of the necessary cutbacks in public expenditure, previous support for costly projects such as a GCC-wide electricity grid began to fade. On the political side, the intensifying Iran–Iraq war between 1980 and 1988 drew much attention away from potential high-cost regional utility sector adventures. Defence and domestic security became sectors of greater importance.[70]

In the area of energy, a new development in the region changed the priorities for national and regional energy provision: the growing role of natural gas. The realization that commercial quantities of gas associated with many of the GCC countries' oil reserves – as well as non-associated reserves – could be used both domestically and for export triggered a wave of gas exploration and development programmes.[71] Qatar's large-scale investment decisions during the 1980s – to develop its vast natural gas reserves in its North Field – were subsequently

[67] The original document is not in the public domain but the author was kindly provided with a summary.
[68] Saudi Arabia until today has two separate main power systems, one which connects the eastern provinces, the here-mentioned system, and the Western coast system around Jeddah, Mecca, and Medinah. Saudi Arabia is in the process of linking the two systems at the time of writing.
[69] The UAE's electricity grid has historically consisted of emirate-level grids not interconnected with one another. In parts as preparation for the GCC grid connection, the UAE completed their national grid interconnection in 2008, creating the Emirates National Grid (ENG). Oman continues to run two separate grid systems, the Main Interconnected System (MIS) and the Salalah System at the time of writing.
[70] Personal interviews with a number of GCC and Gulf Cooperation Council Interconnection Authority (GCCIA) officials, November 2010 and January 2011.
[71] See, for instance, Flower (2011), Dargin and Flower (2011), and Fattouh (2011).

rewarded with the first, lucrative export contracts for liquefied gas (LNG).[72] A similar programme had already started in Abu Dhabi a decade earlier, and Saudi Arabia, today the region's second largest gas producer, also began investing in exploration. The revolution in GCC natural gas markets during the 1980s implied an, at least temporary, shift of focus away from regional electricity trade, as well as the potential regionalization of natural gas trade.[73]

The idea of building a regional gas grid, which began to be discussed in the late 1980s and early 1990s, temporarily became a rival to the electricity grid. A variety of scenarios involving all (or a number of) GCC countries importing gas mainly from newly-emerging gas giant Qatar had been discussed since 1988, when the latter first suggested the building of a regional gas grid.[74] The project was abandoned during the early 1990s due to a combination of pricing disputes, shifts in the main potential customer Saudi Arabia's domestic gas exploration priorities, and a series of diplomatic rows between the GCC countries – mainly over borders, – which resulted in Saudi Arabia's decision to refuse permission for any pipeline to cross Saudi waters from Qatar to Bahrain and Kuwait.[75]

The canny planning and design of the GCC electricity grid, by contrast, avoided a number of pitfalls that the gas grid had experienced, which explains why the electricity grid succeeded where the gas grid failed. Perhaps most critically, the GCC electricity grid interconnection was, from the start, planned and promoted first and foremost as a security mechanism for ad hoc emergency supplies – it hence did not imply the permanent interdependence of GCC countries upon one another which trade in natural gas entailed. A second study from 1990 stated that, 'the interconnection is justified on the basis of reserve sharing' and proposed, 'several possible interconnection schemes to provide for reserve sharing and generally more economic and flexible operation of the networks.'[76] The obviously vague formulation of these possible uses of the grid may have indeed been quite deliberate.[77] Pricing, as the second potentially contentious area, could subsequently be dropped from the planning agenda of the electricity grid, since the primary use of the GCC power grid was intended to be capacity sharing rather than trade, implying repayment in kind rather than cash.[78] Any subsequent

[72] Flower (2011), 345–54.
[73] See Flower (2011); Dargin and Flower (2011); Hashimoto et al (2004).
[74] Hashimoto et al. (2004), 31; See also Dargin (2008); 'Qatar's Gas Dilemma', *The Oil and Gas Journal*, 11 December 1989; 'GCC to debate natural gas grid in Qatar next month', *Reuters News*, 20 November 1989.
[75] These diplomatic rows originated in unsolved border issues between several GCC countries. Saudi-Qatari relations suffered particularly during the 1990s, owing to disputed territory along the Saudi-Qatari border. Clashes between Bedouins at the border in 1992, 1993, and 1994 resulted in fatalities, and triggered a series of diplomatic stand-offs between the two states, including a Qatari boycott of the GCC summit in November 1994, a public dispute about GCC leadership in 1995, and the withdrawal of the Saudi ambassador to Qatar in October 2002 following Saudi accusations that the Qatari government had allowed its TV channel Al-Jazeera to slander the Saudi royal family. Dargin (2008); Hashimoto et al (2004), 23, 33, 36; International talks on GCC Gas Grid continue', *Platt's Oilgram News*, 8 December 1989; 'Qatar: Gas Export Proposals', *APS Review Downstream Trends*, Vol. 38, No. 25, 29 June 1992.
[76] Al-Alawi et al (1991), 38; See also various GCCIA publications, e.g. Al-Asaad and Ebrahim (2008); Al-Asaad (2008); Janahi (2009) Presentation at the Arab Energy Conference, November 2009.
[77] The phrasing in the 1991 report about the 1990 study reads as follows: 'The principal benefits due to the interconnection arise from the sharing of reserves between the systems and a consequential reduction in the installed generating capacity and associated operation and maintenance costs in the GCC countries … A preliminary assessment of other benefits such as spinning reserve benefits, the potential savings due to economy interchange between the systems, and benefits associated with transmission reduction and/or postponement within the GCC countries indicated that such benefits would be of an order of magnitude less than those due to reserve sharing.' Al-Alawi et al (1991), 42; Personal Interviews, November 2010.
[78] See legal provisions for the grid, discussed in more detail in Section 4.1. below.

bilateral trade would require separate commercial agreements, but their absence did not stand in the way of the power grid's progress.

The grid's limited use for occasional emergency supplies, however, also slowed down the project by the 1990s. The decade began with the invasion of Kuwait by neighbouring Iraq, and the subsequent Gulf War in 1990/91 detracted from a new study, completed in late 1990 (updating the 1986 study) which proposed concrete steps for the implementation of the GCC electricity grid. Moreover, financing the enormous initial capital costs of constructing the grid became unsolvable during a decade of declining oil prices and empty government coffers. The question of who should pay for the regional electricity grid – governments, utility companies (which in most cases were still publically owned), or private investors/bank equity owners – had until the 1990s remained largely unanswered. A financing scheme involving a 35:65 government equity/debt ratio was being proposed, but bank lenders proved reluctant to finance the scheme in the absence of government guarantees.[79] Many private investors began to see the grid as an expensive venture, given the limited form of usage intended in its proposals.[80]

3.3. The Acceleration of the Project during the 2000s

The end of the 1990s proved to be a more fruitful time for the implementation of the GCC grid. Unabated growth in the region's utility sectors, and improvements in public revenues following a slight recovery of oil prices, contributed towards greater determinism to proceed. Fast-track growth in many regional economies – envisioned in various economic plans and supported by intensifying economic diversification efforts – furthermore provided an important argument to systematically strengthen the GCC utility sectors. In spring 1998 the decision was reached by GCC leaders that the common power grid would move ahead, under the proposed 35:65 equity/debt scheme, with or without secured debt financing.[81] The creation of a central committee that would oversee the implementation of the grid, and later on function as the grid's System Operator (SO) was announced, and in May 2001, the GCC Interconnection Authority (GCCIA) was formally established, with its headquarters in Dammam, Saudi Arabia.

In May 2004, the Grid overcame yet another major hurdle: GCC energy ministers approved 100 per cent government funding for the now $3bn project.[82] This decision can be seen as mainly the result of the far better fiscal status the GCC governments enjoyed by 2004, following the oil price recovery post 2002. The costs for the grid were divided between the countries participating by phase, according to the expected national share of the Grid's capacity. Phase II, the interconnection between Oman and the UAE, is not yet completed and is also not currently included in the project's assets, as it is funded separately by the governments of the UAE and Oman as a bilateral matter.[83] The ownership structure of the grid is therefore derived from individual state's contributions to Phases I and III, as shown in Table 3:

[79] Al-Asaad (2008); 'GCC grid gets final go-ahead', *MEED*, 14 May 2004.
[80] Personal Interviews, January 2011,
[81] 'GCC grid board to be appointed before 1999, *MEED*, 13 April 1998; 'Wiring up for Arab unity', *MEED*, 18 May 1998; Al-Asaad (2008).
[82] 'GCC grid gets final go-ahead', *MEED*, 14 May 2004.
[83] GCCIA website.

Table 3: Ownership Structure of the GCC Interconnection Grid (Phases I and III)

	Phase I (%)	Phases I & III (%)
Kuwait	33.8	26.7
Saudi Arabia	40	31.6
Bahrain	11.4	9
Qatar	14.8	11.7
UAE	-	15.4
Oman	-	5.6
Total	**100**	**100**

Source: Al-Asaad and Ebrahim (2008)

With the project's financing complete, construction contracts were signed in late 2005 and 2006 for Phase I, with construction starting thereafter.[84] Ownership rights have, since April 2011, shifted with the completion of Phase III (in public reports often referred to as Phase II for reasons of sequence) towards all six participating countries.

3.3.1. Grid Design

Since the creation of the GCCIA, many voices started actively calling for the greater use of the grid for commercial trade in addition to a mechanism for emergency supplies. The GCCIA has positioned itself as one of the most important advocates of regional power trading.[85] The opening of the UAE's link to the grid in April 2011 witnessed statements by energy ministers and regional heads describing the grid as both an emergency tool and a backbone for future trade.[86] Currently, such statements have not gone beyond public declarations of intent. All the functioning parts of the grid, i.e. Phases I and III, are operating as instruments for capacity sharing – with no commercial trade yet taking place.[87]

Technically, the GCC Interconnection Grid is based on original plans from the 1980s: a double-circuit 400KV, 50Hz AV line connects the six GCC countries along the Western Gulf shore; the most northern and most southern points being Al-Zour in Kuwait and Al-Waseet in Oman respectively (see Figure 7). Ghunan in Saudi Arabia serves as the Grid's control station. 400KV lines connect the North and South grid countries to the interconnection, and a 220KV line is planned to interlink the UAE and Oman. Saudi Arabia is linked via a separate back-to-back HVDC interconnection to the grid via a 380KV line owing to a difference in frequency of the Saudi Eastern System, implying that the Saudi system runs asynchronous to the rest of the system.[88] Bahrain is linked via a 400KV subsea cable. The total installed size

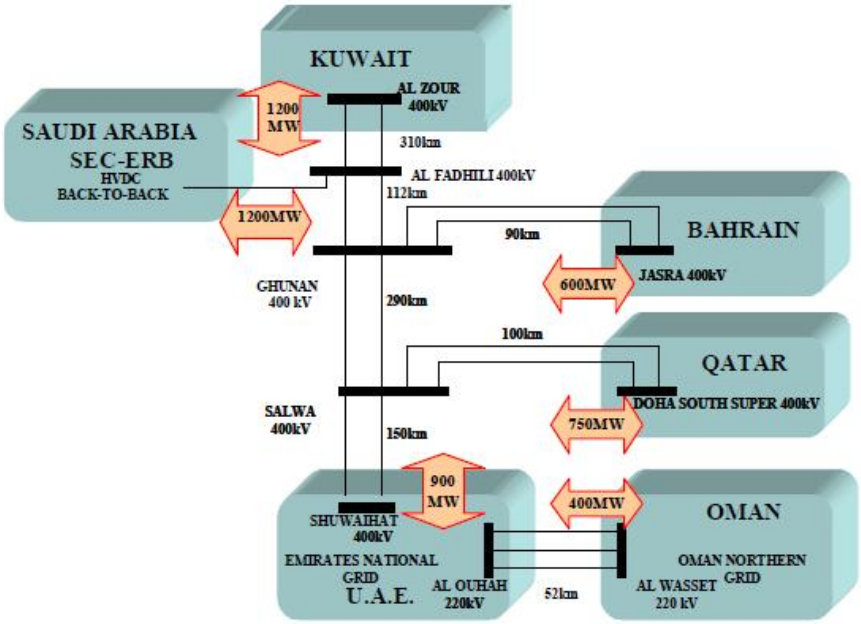
[84] 'Starting grid', *Power Engineering International*, Volume 14, Issue 3, 1 March 2006.
[85] Al-Asaad (2008); Al-Asaad and Ebrahim (2008); Al-Shahrani (2009).
[86] 'GCC electricity grid likely to save Dh18.4b in costs', *Gulf News*, 21 April 2011
[87] Section 4 discusses some of the prerequisites for electricity trade through the grid further.
[88] GCC Interconnection Authority, October 2010. The operation of two asynchronous grids in one regional power interconnection is technically not uncomplicated, as has been evident even in national systems where two systems with different frequencies exist, such as in the case of Japan. Possible complications in the presence of Saudi Arabia's convertor station include additional losses –the extent of which has yet to be revealed (assuming such numbers are ever to be made public) – which might be a problem particularly if Saudi Arabia wanted one day to engage in high-volume trade; technical faults that could temporarily cut off the main interconnection grid are also a possibility although with low probability, especially given the currently very low volume of electricity transfers. Hattori et al (2009).

of the system is 2 × 1,200MW, based on a 1990 approximation of the potential demand of each country from the grid (compare with Figure 8).[89]

Figure 7: The GCC Interconnection Grid in 2011

Source: GCCIA

Figure 8: Technical Scheme of the GCCIA Interconnection Grid, 2011



Source: GCCIA

[89] The 1990 design provided for each state to be able to import half of the capacity of the single largest power generation plant in operation at the time of the study, but no more than 30% of the peak load in 2010. This meant a total potential load capacity option of initially 1,800MW for Saudi Arabia (later reduced to 1,200MW), 1,200MW for Kuwait, 900MW for the UAE, 750MW for Qatar, 600MW for Bahrain, and 400MW for Oman. The design of the grid is such that in the event of an emergency in a GCC country, each country could import up to the capacity of the interconnection. Al-Alawi at al (1991), 39–40.

3.3.2. Completion of Phases I, II and III

Phase I of the Grid went online in July 2009; in April 2011, the UAE became the fifth country to join the Grid as part of Phase III, which was originally planned to also include Oman. Phase II, which interlinks Oman through the UAE to the main grid, is expected to be completed by 2013. Oman's original plans to be linked via the UAE were briefly reconsidered, when in March 2011 Omani officials announced that a direct link to Saudi Arabia was being studied (the background for which was not made public). In the following month, however, the government of Oman issued a statement saying the country would return to the original plan of linking its grid to the interconnector via the UAE.[90]

[90] 'Rabt Oman bi-kahraba' al-Khalij fi A3amain', *Al-Jazeera online*, 21 April 2011.

4. The GCC Interconnection Grid in 2011: First Benefits, Remaining Challenges

The first two years of operation of the GCC grid have raised some important questions regarding the extent of benefits for the GCC countries and the potential for them to extend the use of the grid to commercial trade. This section identifies three main aspects that deserve further discussion in view of the potential long term benefits of the grid. If the GCC countries want to benefit from the greater use of the grid in the future, these aspects will need to be addressed: (i) the legal framework surrounding the grid and its remaining challenges; (ii) current market structures, specific areas of which still require substantial investment and reform in order for the GCC countries to benefit from the grid; and (iii) options of expanding the grid beyond the GCC countries.

4.1. Legal Framework

The development of the GCC's legal framework for electricity transfers and trade is, without doubt, in its infancy, requiring both further refinement and, critically, greater public dissemination. Currently, only outlines of the main features of signed agreements are public. The two main agreements signed so far are:

- The *General Agreement* of 23 April 2009 sets out the principles of electricity cooperation via the GCC interconnection grid. For the participating GCC countries it sets out: rights of interconnection, connection fees, interconnection performance, defaults, termination of membership and, most broadly, the interconnection's governing law.
- The *Power Exchange and Trade Agreement (PETA)*, signed on 7 July 2009, is a commercial agreement between the GCC's power providers, which sets out the legal terms for commercial trade. PETA provides for technical and financial details of the Grid project, outlining cost and contribution structures, emergency support mechanisms, and other responsibilities. PETA is made up of three separate sub-agreements: (i) The Trading Agreement, which includes common legal terms and conditions, (ii) the Interconnection and Use of System Agreement, and (iii) the Interconnector Transmission Code. The parties to PETA are the national utilities, specifically one representative party for each member country's procurement companies and T&D companies respectively.[91]

The GCCIA functions as the Transmission System Operator (TSO). Since the start of operation, a Regulatory and Advisory Committee had developed and recommended additional articles and bylaws to be added to the General Agreement, while amendments to PETA fall under utility-level responsibility. What is vaguely termed 'trade' in the GCC interconnection agreements includes two types of electricity transfer:[92]

i. *Unscheduled Exchanges of Energy*: this form of trade involves transfers of electricity at real-time (RT) level, thus a form of reserve or emergency generation capacity supply.

[91] Al-Asaad (2008), 6; Al-Asaad and Ebrahim (2008), 6; Janahi (2009); Vast parts of legal descriptions in this section are also based on personal interviews with GCCIA officials in November 2010 and January 2011, which were essential in the absence of detailed public literature about this subject.
[92] Al-Asaad and Ebrahim (2008), 6; Janahi (2009).

ii. *Scheduled Exchanges of Energy*: scheduled transactions can fall under a variety of categories, including scheduled reserve generation capacity supplies, and possible future trade under commercial terms.[93]

The current legal framework provides for two methods of settlement for regional electricity transfers; unscheduled, or emergency exchanges, are principally settled *in kind*, i.e. the receiving party pays back the dispatching party on a quantity-for-quantity basis later on, with no transmission charge made by the GCCIA. The specific terms of exchange, including settlement periods, and contract enforcement (i.e. penalties in case of non-repayment) are not currently public, but the GCCIA supposedly uses similar models operating in Europe and the USA as a reference.[94]

The legal terms of trade for unscheduled transfers of electricity, under the current framework are rather vague, and subject to ongoing drafting at GCC level. Current provisions place the responsibility for deciding on ways of settlement for unscheduled transfers on the participating parties. With matters such as quantities, duration, and – importantly – pricing currently being bilateral issues, the GCCIA's role in unscheduled transfers would entail (i) the provision of necessary interconnector capacity, subject to RT changes owing to unscheduled emergency transfers (which always take precedence over scheduled ones), and (ii) setting a 'wheeling charge', to pay the GCCIA for use of capacity. It is intended that wheeling charges should eventually fund 100 per cent of the GCCIA's revenues, in place of the current annual contributions paid by interconnected countries to maintain the authority.[95]

The currently discussed pricing model for scheduled capacity transfers of electricity is based on a formula that includes a fixed or variable percentage of total volumes traded, as a wheeling charge payable to the TSO (the GCCIA), plus a variable indexed shadow fuel price reflecting the actual generation costs in the exporting country, rather than the price charged to domestic electricity customers in that country.[96] This point is of paramount importance in making GCC electricity trade (beyond emergency exchanges) economic. Currently, all GCC governments subsidize their utility sectors – both retail prices to consumers, and wholesale prices for fuel supplied to generators – through below-international market prices for oil and natural gas as fuel.[97] The extent of these subsidies is not easily quantifiable but is extremely large, and makes the export of electricity priced at levels based on subsidized fuel prices uneconomic – the result would be cross subsidies among GCC countries.[98] Hence, any price for regionally exported electricity must and will be based on actual costs incurred by exporting countries, including the opportunity cost of not having exported the fuel used for power generation to international markets. In the case of agreements on long term supplies of electricity, particularly under firm contracts in the future, the pricing formula will most likely include an additional capacity charge paid to the exporting country/utility for the medium to long term provision of additional capacity (and its resulting higher long run marginal cost). This latter form of trade, however, is likely to be a longer term feature of GCC trade.

The provision of a centralized market mechanism such as an exchange or power pool, on which both RT and forward market transactions can be settled, also needs to be fully

[93] Refer to Section 2 which discusses these different types of transfers in more detail.
[94] Personal interviews with GCCIA officials, November 2010; See also Al-Asaad and Ebrahim (2008), 6.
[95] Personal interviews with GCCIA officials, November 2010 and January 2011.
[96] Personal interviews with GCCIA officials, November 2010 and January 2011.
[97] See Section 1.2.2. above on electricity pricing for more details.
[98] e.g. see Millar (2005).

addressed.[99] The commercial parties to electricity trade would then be called upon to organize such an exchange, the design of which will require far more detailed work in the coming years if any decision was reached to create such an exchange. In all cases, however, the prerequisite for future effective trade will be the creation of a thoroughly transparent market, which includes public availability of the complete regulatory framework governing GCC power trade, as well as mechanisms for price discovery for market participants. Currently, the lack of publicly available legal and commercial information, including pricing, imply that the GCC market for electricity is still a long way from fully enabling all benefits that the market in principle can deliver. The further development of this legal framework will hence play a pivotal role in the further expansion of GCC electricity trade.

4.2. Market Structure

Market structures that are conductive to electricity trade – such as market liquidity, a competitive trading environment, and transparency – are a pre-condition of any form of regional market development. The GCC countries still lack many of these structures, which makes policy reform crucial for maximizing the benefits of GCC power trading benefits. The creation of a market conducive to electricity trading will probably be the biggest challenge for the GCC countries, since policy reform takes time and can be politically unpopular. Three areas of policy reform are now discussed: firstly, investment in overall power generation capacity GCC-wide, including through private sector participation; secondly, the diversification of the GCC's fuel base for electricity generation, as a prerequisite for the creation of cost-based advantages for trading; and thirdly, the continuation of ongoing structural reforms, particularly in the area of domestic electricity pricing.

4.2.1. Investment in Capacity

With virtually Gulf-wide summer electricity outages continuing to occur regularly, critics have raised doubts as to whether or not the GCC grid will, in the near term, even be able to deal with the limited emergency power transfers that are currently the only form of electricity exchange, not to speak of systematic commercial trade.[100] Summer 2010 reports that Kuwaiti pleas for emergency power had been rejected by its neighbours due to a lack of spare capacity in their own power sectors seem to suggest that, to a certain extent, criticisms of the current system may be correct.[101] Indeed, the GCC countries continue to suffer from what can be termed 'peak load collectivism', the coincidence of peak demand over similar hours during the day and seasonally in summer.[102] However, those exchanges that have taken place have

[99] For simplicity, only two forms of market are distinguished in this paper: an exchange market and a power pool. Their definitions follow Stoft (2002), 223. An exchange market is hence defined as a centralized market that does not use side payments, under an auction/bidding scheme that is typically based on a two-part bid (one supply side and one demand side bid a quantity and price directly with one another). A power pool is also a centralized market that involves multi-party bids (a seller sells to an intermediary, which sells electricity to the final buyer) and possible side payments between contracting buyers and sellers.

[100] The author has been provided with preliminary data by the GCCIA for the grid's usage in 2010, which is not in the public domain. Substantial doubts as to the reliability of the data exist, particularly with respect to a very large, unexplained discrepancy of imports and exports exceeding 30%, which is not explicable by technical losses. In the absence of daily and hourly data, no conclusions can be made about the features of emergency transfers, e.g. whether they tend to occur typically during the expected afternoon peak time. These and other reservations limit the viability of drawing factual conclusions from the data. If the data is roughly correct, electricity transfers (imports plus exports) as a share of total domestic consumption of all four Phase I countries is less than 1% which is very small. This would be expected, given the current functioning of the grid as an emergency mechanism, but obviously implies that the grid is currently highly underutilized.

[101] 'Kuwait power plea "rebuffed" ', *Kuwait Times*, 16 June 2010.

[102] See Section 1 for discussion.

benefited the countries so far included in the grid – and hence the emergency mechanism seems to some extent to have worked.[103]

In the medium to long term, one necessary remedy for periods during which all GCC countries experience peak load is investment in power generation capacity GCC-wide. New capacity will not change these countries' load patterns, but it will help raise available spare capacity, including during peak times. Substantial investment in the generation capacity of all GCC countries' power sectors will therefore be one of the most important conditions for the creation of a future regional commercial electricity market, which relies on sufficient supplies and transfers to meet demand for electricity at all times. Plans and ongoing projects aimed at raising the level of domestic generation capacity substantially in the coming years exist throughout the region.[104]

Long term investment in new capacity will also be conditional on continued policy support for the greater participation of private sector investors, whose capital and commercial orientation is likely to also remove part of the investment burden from GCC governments. Attracting more private investment will require the continuation of the ongoing reform process in the areas of government regulation, restructuring, and the possible privatization of further parts of the GCC countries' utilities sectors.[105] Many GCC countries have begun reforming their utility sectors, by allowing and promoting in an increasing number of cases the creation of private power and water projects, particularly in Oman, Bahrain, and Saudi Arabia.[106] Qatar has, moreover, begun privatizing its national power provider Kahramaa.[107] One of the potentially most competitive elements along the value chain – T&D infrastructure – remains entirely in state hands. In the case of regional electricity trade, a number of different trading parties, over and above the single buyer and seller model, will, moreover, constitute a key condition for commercial trade, by fostering competition and – critically in the GCC context – transparency.

On the technical side, large-scale capacity additions, and the possibly resulting trade volume, will most likely also necessitate the upgrading of GCC interconnector capacity to allow greater flows than are currently possible. The interconnector is relatively small in comparison to the volumes of trade that systematic commercial trade would entail: 2 × 1,200MW

[103] Encouraging in this regard is a leaked piece of information which was also confirmed to the author in interviews with GCC officials. According to press reports in September 2010, Bahrain imported electricity from Qatar for a scheduled period of time (a few hours each day for about a month). The details of the agreement behind these scheduled transfers is not public, but the case is interesting in so far as it provides evidence for the practical benefits of the grid. 'Firm rapped for violating terms', *Gulf Daily News*, 9 September 2010; 'States benefit from the unified grid', *Middle East Economic Digest*, 9 July 2010; 'Bahrain commends GCCIA backup to EWA', *Kuwait News Agency*, 1 September 2010.

[104] For instance, the UAE, Kuwait, and Bahrain all plan to double their generation capacities over the next decade, while it is hoped that Qatar's latest power plant, opened in 2009, will provide not only more capacity for the domestic market but also, according to the financing power company, GCC electricity exports. 'GCC countries to invest $272b in energy by 2015', *The Saudi Gazette*, 9 November 2010; Oxford Business Group: The Report: Bahrain 2008. 128; 'Bahrain investment in power to reduce blackouts', *ArabianBusiness.com*, 27 June 2010; BMI, Kuwait Power Report Q4 2010, 26; 'UAE nuke energy push may start deal bonanza', *Zawya Dow Jones*, 26 July 2009; 'Qatar power boost will end era of blackouts – official', *ArabianBusiness.com*, 23 September 2009

[105] For an example of how such reform processes were conducted in the Indian states, see Sen and Jamasb (2010).

[106] For instance, see Kingdom of Saudi Arabia, Ministry of Water and Electricity (2008); Oman Electricity and Water Company (2010). See also 'Special Report Power: Power in Private Hands', *MEED* Special Report, 6 August 2004.

[107] Kahramaa website.

(through a double current), i.e. 2,400MW maximum, based on forecasts of probable use of the grid made in 1990.[108] This projected maximum size of traded volumes is low already by today's standards; for example the UAE's connection size, is currently 900MW, which is about one tenth of the peak supply capacity of Abu Dhabi alone to UAE customers in 2010 (8,563MW) – this excludes the production of other emirates. More than 3,000MW of this capacity was exported from Abu Dhabi to the Northern emirates via the Emirates National Grid, which links different emirate-level networks.[109] Moving towards large scale commercial trade, and creating incentives for countries to import and export, will hence also depend on sufficient capacity within the grid. The upgrading of the interconnector itself is unlikely to be technically challenging, but will obviously entail additional costs.

4.2.2. Diversification of the Fuel Mix

The diversification of the fuels used for power generation in GCC countries will be a second long-term challenge that will need to be tackled before regular and systematic commercial trade can be introduced. In contrast to electricity exchanges as part of an emergency mechanism – where the value of electricity transfers lies in the security of supply and the avoidance of potential electricity shortages – commercial trade is based on an economic cost calculation that favours foreign over domestic production due to cost advantages. A diversified fuel mix for power generation is critical for such advantages, since these costs are one of the most important determinants of final electricity prices.

The GCC fuel base for electricity today is far from being diverse: oil and natural gas dominate, with very few, small-scale renewable projects such as solar power.[110] Assuming that the pricing of traded electricity will reflect international prices of input energy sources, it is unrealistic to expect that export of electricity from oil-fired power plants can be profitable. In practice, the resulting electricity price would be far above prices for electricity generated from natural gas. The opportunity cost of not charging an electricity price based on oil-related prices, would imply the de facto cross subsidization of neighbouring countries, and would make no economic sense. Oil will hence almost certainly always be more profitable to export directly rather than being used for electricity export.

In the case of natural gas, a case can be made for gas–electricity arbitrage by power producers, similar to what already happens in European countries: at times of relatively low gas export prices for LNG exporters within the GCC (this applies only to Qatar), and relatively high regional prices for electricity, a country both exporting electricity and gas may decide to export electricity. At times of reverse price developments, a country or utility will be better off exporting the natural gas rather than producing more electricity and exporting it at proportionally lower prices.[111] In the long run, the diversification of fuels used for GCC electricity generation, towards more widespread use of renewable energies and nuclear

[108] See Figure 8 above.
[109] Millar et al (2010).
[110] One such endeavour is the UAE's Masdar city, which bases its entire energy needs on renewable energy. See the city's website at www.masdar.ae/.
[111] The difference in price between the two types of products is called 'spark spread' and forms part of gas and electricity exporters' cost calculations, such as in the case of the Netherlands. The fact that the Netherlands has experienced among the highest trade flow to consumption ratio in electricity on the central European market is telling of the ability of dual exporters to engage in both regional natural gas and electricity trade. See Murray (2009), 150, 202.

power, is likely to add to the economic attractiveness of trading.[112] That said, an additional cost advantage that already exists today is the difference in efficiency between different power plants in the GCC. The building of more efficient plants in the future is hence also likely to benefit plans for regional trade.

4.2.3. Reform of Electricity Tariffs

In addition to the above mentioned reforms, it will also be crucial to reform the domestic pricing mechanisms which characterize current electricity markets in the GCC. Subsidies placed on electricity in the region not only artificially inflate domestic consumption due to the lack of any incentive for efficient use; they also render any imported electricity – charges for which are based on actual cost – more expensive vis-à-vis domestically produced and subsidized electricity.[113] This need not be a hurdle for trade per se, since lack of domestic capacity can still be a high enough incentive for an economy to import electricity; but it will substantially reduce the possibility of trading, i.e. the import of electricity that is more efficiently produced than domestic electricity, as imports of electricity will always be more expensive. Traded electricity will hence not be able to compete with supply at subsidized prices. Reducing subsidies and hence making wasteful consumption, particularly by residential consumers, more costly, may also serve as an important tool to cut peak demand – the resulting freed capacity can then either be saved or exported.

4.3. Options for Grid Expansions beyond the GCC

Proponents of GCC electricity trading have for many years also highlighted the possibility of a future extension of the grid to neighbouring regions, principally the Levant and North Africa.[114] The incentive to think about such extensions lies clearly in the high expected benefits, particularly for commercial trade: different regions add extra capacity, potentially associated with greater variance of pricing, and fundamentally different load patterns compared with the GCC countries, the critical factor for successful security arrangements. Cost/pricing differences may result from other regions' more diversified generation fuel mix, and possibly in the future more developed, large-scale solar and hydropower developments. Diversifying regional participation in electricity trade can help solve one of the remaining problems in intra-GCC trade: the region's relatively uniform load pattern, i.e. the typical summer peak and daytime peak demand in the afternoon hours. The Levant and North Africa, by contrast, have their seasonal peaks in winter, due to a greater heating load, and diurnal peaks in the morning and evening, which provide considerable opportunities for inter-regional trade. Nevertheless, such extensions must be seen as long term options that will be conditional, particularly where commercial trade is involved, on the creation of a functioning regional trading market within the GCC.

4.3.1. Egypt

The most likely neighbour for trade beyond the GCC is Egypt, which has been exporting electricity to Jordan for more than a decade. Egypt has, moreover, repeatedly declared its intention to extend electricity exports to other countries, and has had plans to increase its generation capacity substantially in the coming years.[115] Enthusiasts within the GCC even

[112] For instance, see 'Kingdom investing in solar power', *Saudi Gazette*, 20 April; 'UAE capital seeks 1,500MW of renewable power', *Emirates 24/7*, 9 June 2010; 'UAE's first nuclear power station scheduled to start in 2017', *Gulf News*, 22 December 2010.

[113] In the case of domestically produced electricity, the cost of input fuel such as crude oil is in many cases a fraction of its cost at international markets, which is reflected in the final electricity price; in contrast, electricity prices based on export prices of oil or natural gas would be much higher.

[114] Al-Shahrani, 41; Al-Asaad et al (2006), 5.

[115] 'Kingdom, Egypt to enhance cooperation in energy sector', *Saudi Economic Survey*, 15 July 2010,

speak of a possible future link of the GCC Grid via Egypt to the Mediterranean Ring, and from there to European power grids. The link with Egypt has in fact already been explored, at first primarily as a Saudi-Egyptian undertaking that would link the Kingdom's western power grid to Egypt. Saudi Arabia's west coast has remained, until recently, de facto disconnected from the central and eastern power grids and, therefore, from the GCC Grid.[116] Once the interconnection of Eastern and Western Grids in Saudi Arabia is completed, however, Egypt could be joined to the GCC electricity grid via this link. Studies have been conducted in the past, confirming the technical feasibility and commercial viability of the interconnection, suggesting a 500KV DC link between Medina and New Cairo, via Tabuk in northwest Saudi Arabia, and with a total capacity of 3,000MW.[117] In July 2010, the Saudi Economic Survey reported that technical studies, land surveys, and design works had been completed and financing options for the project proposed.[118] In November of the same year, another report quoting Egypt's electricity minister Hassan Younes, stated that a marine survey was about to map a route for the proposed interconnection, with a tender for the $1.5bn project to be issued in 2011.[119]

There are, however, doubts as to whether these prospects are indeed realistic for the coming years. Financing options for the interlink have not been made public, and it is indeed likely that no final agreement has been reached over the contribution of each party to the initial capital expenditure. More critically, the potential pricing scheme for traded electricity has not yet been agreed.[120] Furthermore, electricity shortages in Egypt itself in recent years have raised questions with regards to Egypt's realistic ability to export substantial amounts of electricity to the Gulf states, at least in the coming years.[121] Even in the event that the project goes ahead, experience with the GCC Grid itself suggests that the lead time for negotiating agreements and completing the construction of the interconnector could be a considerable number of years. Some observers further suggest it is more likely that the GCC countries will wait and gain experience with the operation of their own main interconnection grid, once both the UAE and Oman are linked.[122]

4.3.2. Iraq, Syria, Turkey

Similar conclusions apply to a second, and even less likely, extension of the Grid through Iraq to Syria and Turkey, and potentially onwards to Europe.[123] In this scenario, Iraq would serve as a transit state for electricity trade between Syria, Turkey, and possibly some European countries on the one hand, and the GCC on the other.[124] The current political

[116] In addition to the Saudi system operating asynchronously to the rest of the GCC, Saudi Arabia's national electricity grid has also remained fragmented between a Western Grid and an Eastern Grid until very recently. While an interconnection between Eastern and Western grids is now understood to have been completed (with no electricity transfers yet occurring), until recently the Kingdom's west coast along with some of the Kingdom's most important ports, refineries, and industrial centres remained cut off from the potential benefits of the GCC Grid and east coast power generation.

[117] 'Riadh and Cairo consider plans to connect power grids', *MEED*, 2 May 2008; 'Linking grids is good first step', *MEED*, 20 March 2009; 'Kingdom, Egypt to enhance cooperation in energy sector', *Saudi Economic Survey*, 15 July 2010.

[118] 'Kingdom, Egypt to enhance cooperation in energy sector', *Saudi Economic Survey*, 15 July 2010.

[119] 'Egypt, Saudi To start Sea Survey For Power Grid Next Week – Official', *Dow Jones Newswire*, 21 November 2010

[120] 'Kingdom, Egypt to enhance cooperation in energy sector', *Saudi Economic Survey*, 15 July 2010

[121] Darbouche and Mabro (2011).

[122] This observation was confirmed through a number of interviews by the author with officials at country and GCCIA level, October and November 2010, and January 2011.

[123] Al-Asaad at al, 5.

[124] 'Gulf gears up for energy trading', *MEED*, 14 November 2008.

situation in Iraq, however, makes that country currently unsuitable for such a project; hence no substantial talks have been conducted between Syria, Turkey, and the GCC with respect to GCC Grid extension plans. The case would also bring up the thorny issue of transiting in general, something with the potential to halt negotiations in the future should political conflicts in the region persist.

4.3.3. Jordan and Morocco

The announcement by GCC leaders in May 2011 to invite the Kingdoms of Jordan and Morocco to join the GCC has led to a discussion whose outcomes were not yet decided at the time of writing this paper. Potential would, of course, exist for the interconnection of the GCC Grid with both states – Jordan via a direct link through Saudi Arabia, and Morocco indirectly, through the interconnection of the North African grid (which remains incomplete at present). As in the above cases, both countries have significantly different demand patterns from the GCC countries, in principle rendering both ideal electricity trading partners for the GCC countries. None of the two links will be a short or medium term option, however. With no infrastructure, and no formal plans or talks in place, any link between the three sides is unlikely to materialize in the coming years. In addition, both Jordan and Morocco are currently net importers of electricity which makes them, at least at present, unattractive for the energy-hungry Gulf. The large-scale Saharan Desertec project, of which Morocco forms part may eventually turn the Kingdom into a very viable trading partner for the GCC in the longer term, along with several of its neighbouring countries.[125] The outcome, however, needs to be seen in the coming years.

4.3.4. Other Options

Looking westwards overall, the potential extension strategy for the GCC Grid has so far excluded two other regional extension options: southwards to Yemen on the one hand, and eastwards to Iran on the other. Extending the GCC Grid to Yemen would most likely imply the net export of GCC electricity to Yemen, where generation capacity is failing to meet the rapid growth of demand.[126] From the point of view of the GCC, net exports of electricity to Yemen could generate revenue while also helping regional cooperation and supporting economic development of a southern neighbour. No such plans have been discussed, however, and it is unlikely that the GCC will adopt this option in the coming years. Iran, on the other hand, could be a logical potential exporter of electricity to the west coast of the Gulf, holding in principle enough capacity and natural gas as fuel for its electricity generation plants. Peak demand in Iran is generally in winter, ideal for power trade with the GCC. However, the potentially most practical extension option for the Grid also remains unlikely, given the current political difficulties that would surround any energy trade agreement between the two Gulf coasts.[127]

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[125] The project and all participating countries can be found at its website at www.desertec.org/en/news/.

[126] For instance, see 'Yemen Develops Strategy To Meet Growing Electricity Needs', *MEES*, 53:9, 1 March 2010, 5.

[127] In September 2010, a state-owned TV news channel reported that Iran was going to export electricity to the UAE, Qatar, Oman, Bahrain, and Kuwait in the near future. Such reports are unconfirmed, however, by any of the GCC countries, and are unlikely in light of an evident complete lack of interest shown by the GCC countries in looking in this direction regarding electricity supplies, and reservations in principle even against the politically less complicated Egypt option – expressed by a number of electricity sector representatives interviewed for this paper. 'Iran to export electricity to seven regional countries', *BBC Monitoring Caucasus*, 12 September 2010 (a translation of the original text broadcast at Islamic Republic of Iran News Network, Tehran on the same day).

Conclusion

Securing domestic energy supplies in the long term has been a priority which has been gaining increasing attention in the GCC in the past few years. The GCC Interconnection Grid in this context constitutes the Gulf states' most comprehensive approach towards regional energy security to date. Sharing reserve and generation capacity makes great sense from a security perspective, and may also in the longer run lead to economic savings – not least from the likely reduction in region-wide power outages that have become a frequent summertime occurrence in recent years. Exchange flows observed over the first 18 months of the grid's operation are further evidence that the mechanism works in principle, despite the limitations of regional spare capacity that result from the long observed peak load collectivism. The result may not be beneficial economically at present, given the high initial costs of the project and the permanent under-utilization of the interconnection, whose capacity is many times larger than what is required for occasional power exchanges; but the grid does provide a sense of added security in view of lingering electricity shortages in many parts of the region, despite this security of course being imperfect.

Perhaps more than economically, the GCC Grid under its current use may be seen as having far-reaching political significance for the wider region. The economic integration of the GCC countries has been one of the most fundamental aims of the organization ever since its creation in 1981. Cooperation through shared infrastructure projects, collective security efforts (including in the area of energy), and the creation of a common market for goods and services have been objectives carried through the decades, with at times strong criticisms from within the region regarding the lack of progress in many proposed areas of such cooperation, including the failed pan-GCC gas pipeline and the still unachieved currency union. In this context, the GCC Interconnection Grid marks one of the few bright spots in the GCC's more recent history: it is a tangible achievement made possible by collective efforts and political will, with enormous economic potential for the long term development of the region as a whole. Its symbolic value is thus high – perhaps reflecting what Qatar's Minister of Energy in 2005, Abdullah Al-Attiyah, summarized at the opening of the separate Dolphin pipeline between Qatar, the UAE, and Oman as 'the proper conditions that enhance economic and political ties … among the GCC countries.'[128]

The conceptualization of the grid as primarily an emergency mechanism rather than a tool for commercial electricity trade of course reflects the political realities of GCC policy making. Planning the interconnection of the GCC's national power grids without a trading market, was certainly a canny manoeuvre that helped the project's realization in the absence of historical agreement on such issues as pricing, and the politically unpopular prospect of mutual economic dependence. A shift in thinking seems to have happened in the past few years with regard to the prospects for the creation of a common market in electricity among the GCC countries. Given that the grid is now in place and is technically underutilized, the trade option is also in the economic interest of the GCC member countries. While the recovery of costs involved in the construction of the project must necessarily be seen as secondary to the intended primary goal of providing more system security, the GCC grid still remains at the current time an expensive endeavour, and one with many more options to offer.

[128] 'Dolphin Makes Headway But Economic Currents May Rock Further GCC Integration', *MEES*, XLVIII:23, 6 June 2005, 1–3.

The potential economic benefits of electricity trade are of course vast for the GCC: efficiency savings could be large, particularly if trade led to greater utilization of newer and more efficient power plants region-wide. For many Gulf states whose principal income remains hydrocarbon exports, the export of electricity also provides the opportunity to export a more value-added product, provided that the price is both (opportunity) cost reflective and regionally competitive. Currently, the region is still far from a common power market. Lack of a legal framework is perhaps more straightforward to resolve, although political agreement over such sensitive areas as pricing of traded electricity may yet prove to be the more significant obstacle. Most critically, success will be conditional on a much greater level of regulatory transparency and accountability than is currently the case, with the operations of the GCCIA leaving much to be desired in both these respects. In commercial terms, the market signal transparency required for trade in electricity is missing, due to an absence of significant numbers of market players and cost-related pricing. A long term challenge will be for the GCC countries to (i) invest in new capacity, including private sector participation to increase the number of power providers; (ii) diversify the fuel mix of GCC electricity generation to create comparative advantages between the GCC countries to trade; and (iii) reform the domestic utility market, most importantly through pricing, so as to allow imported power to be competitive on domestic markets.

This is not to say that a regional GCC electricity market is unlikely; the central European market, today perhaps considered one of the world's more mature regional electricity markets, evolved over more than 20 years, and is still in an ongoing reform progress. The GCC Grid, and the idea of a regional electricity market, must likewise be seen as a long-term project, whose potential benefits will evolve over decades, not years. Given the GCC countries' current engagement in the structural reformation of their utilities sectors, including through investment in new capacity, pricing and ownership regulatory changes, and the increasingly stated intent of all GCC countries to diversify their sources of energy for power generation, the GCC grid may very well be an example of a project being launched 'in the right place at the right time'.

One aspect of the GCC case, which may be particularly interesting for European observers, is the future interplay of regional development of renewables and the evolution of a common market for electricity. While in Europe, the debate is currently about whether such developments are possible in a largely privately owned, fully liberalized electricity market, the GCC case may yet give interesting insights into how the parallel development of both a renewable energy strategy and commercial electricity trading can be made mutually compatible and reinforcing – potentially under circumstance being very much the reverse of European-style sectoral structures, such as a greater degree of involvement of publically owned utility companies and potentially incomplete market liberalization. This point opens a window for much further research in the coming decades, rendering the region potentially a very interesting case study for regional electricity market development in the future.

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