What can GCC countries learn from well-established green power markets in other countries?

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2020

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1. Introduction

Renewable energy purchases are typically either part of a compliance-based (government-mandated) program or belong to one of the voluntary green power programs. The latter category includes: utility green pricing, utility renewable contracts, unbundled RECs, competitive suppliers, community choice aggregations, power purchase agreements, and community solar. Table 1 shows a description of each of the products and to which customer class(es) it is available. Voluntary green power by definition is the voluntary purchase of RE by retail electricity customers over and above what is required from utilities by the government.

Product	Description	Customer Classes
Utility green pricing	Utility customers procure green power on a month-to-month basis through an added fee on their utility bill	Residential, small commercial
Utility renewable contracts	Utility customers procure green power from their utility through a special tariff or bilateral contract, typically on a long-term basis sourced from a new renewable energy generator	Large C&I
Unbundled RECs	Retail customers buy RECs separated or "unbundled" from the underlying electricity. This category refers only to sales of unbundled RECs directly to retail customers, it excludes sales of unbundled RECs through other green power products (e.g., utility green pricing) to avoid double counting.	All, mostly C&I and institutional
Competitive suppliers	Customers in competitive electricity markets may select a green power option from an alternative retail electricity supplier	All
Community choice aggregations (CCA)	Communities aggregate their loads to collectively procure green power as a bulk purchaser through an alternative electricity supplier	All, mostly residential and small commercial
Power purchase agreements (PPA)	Customers procure green power through a long-term contract with an off-site renewable energy project	C&I, institutional*
Community solar	Customers buy a subscription in a shared solar project and accrue green power in proportion to their subscription	All, mostly residential and small commercial

Table 1: Voluntary green power programs

Source: NREL 2018

In terms of sales, the compliance-based market dominates the voluntary green power market in all countries. For example, in 2017 the voluntary market represented only about 26% of all U.S. renewable energy sales. As of 2018, 33 countries have a government-mandated RE requirement and at least 39 countries have some form of voluntary green power program (IRENA, 2018).

In the voluntary market, the largest two markets are typically the utility green pricing programs and the RECs. Green pricing programs were first offered in the 1990s in several countries where consumers can voluntarily pay a premium for each kWh consumed to cover additional cost of generating electricity from a renewable energy source (RES) (Dagher et al., 2017), while RECs are credits that represent environmental and other non-power attributes of renewable electricity and are measured in single MWh where the owner of the REC can legally claim to have purchased renewable energy. Within the U.S., the commercial and industrial sectors constitute most of the voluntary market for RECs, while the residential sector's REC purchases accounting for only 1% of all REC sales (NREL, 2018).

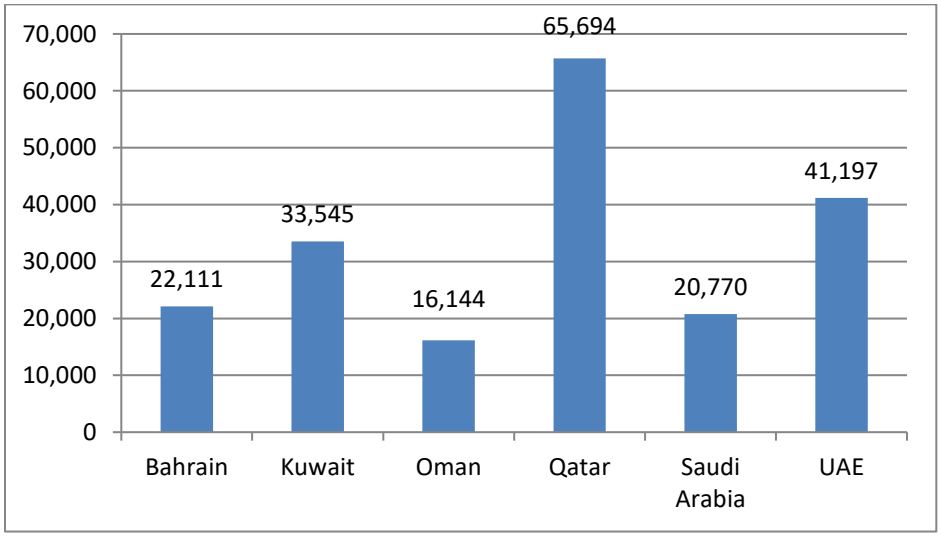
While the first unbundled retail REC product was sold in 1998, the first mention of "certificate trading" was in California in 1995 and some European countries had already introduced tradable attribute certificates in 1997 (EPA, 2019). The number of countries that have adopted RECs since then has increased to 16 in 2005 and by 2017 there were more than 30 countries that have adopted RECs (REN21, 2017). These countries include, among others, the United States, Canada, Australia and India.

2. GCC Background

With about 30% of proven crude oil reserves and about 22% of global gas reserves, the GCC states are the most important oil-producing region in the world (IRENA, 2019). Saudi Arabia is the world's second-largest oil producer after the United States; the UAE and Kuwait come in as the eighth- and tenth-largest. Qatar is the world's fourth-largest producer of gas (BP, 2018).

Today, despite being considered developing economies by the United Nations (2019), all six GCC countries are considered high-income, with GDP per capita of at least $16,000 (see Figure 1) (World Bank, 2019). Together, Saudi Arabia and the UAE account for about two-thirds of regional gross domestic product (GDP); in 2018, Saudi Arabia, accounted for 47% of the region's GDP, followed by the UAE at 26%, and Qatar and Kuwait at about 11% and 9%, respectively (First Abu Dhabi Bank, 2018).

Figure 1: GDP per Capita 2017 (Constant 2010 USD)

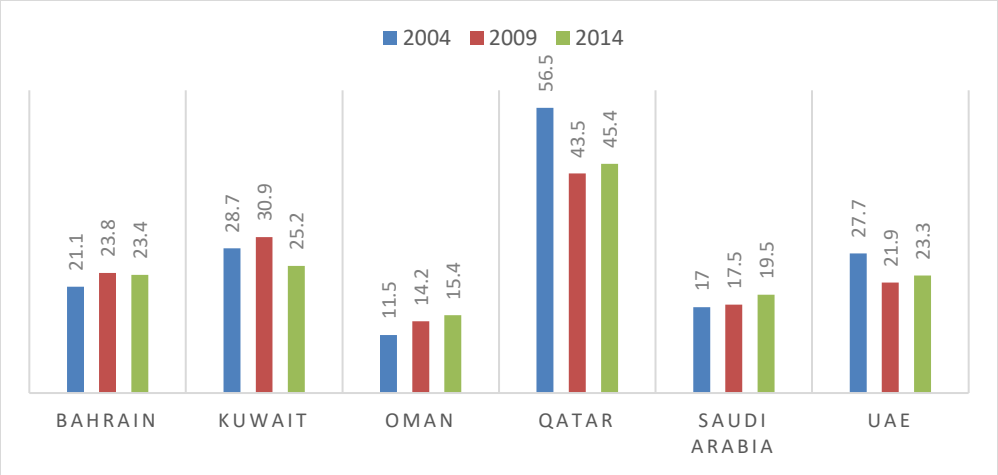


Data Source: World Bank, 2019

The GCC countries were used to be considered as relatively small consumers of energy compared with Europe, Asia, and North America. However, with rapid economic growth and increased population, these economies have substantially increased their energy consumption. Electricity demand in the region is expected to increase by around 62% in the next decade. All six countries have ambitious plans to invest in renewable energy and energy efficiency for several reasons. First, with lower oil prices oil exporters have seen a sharp decline in their revenues. Consequently, reducing domestic consumption of oil and gas would increase the exported share and lead to an increase in revenues. Second, renewable energy and especially

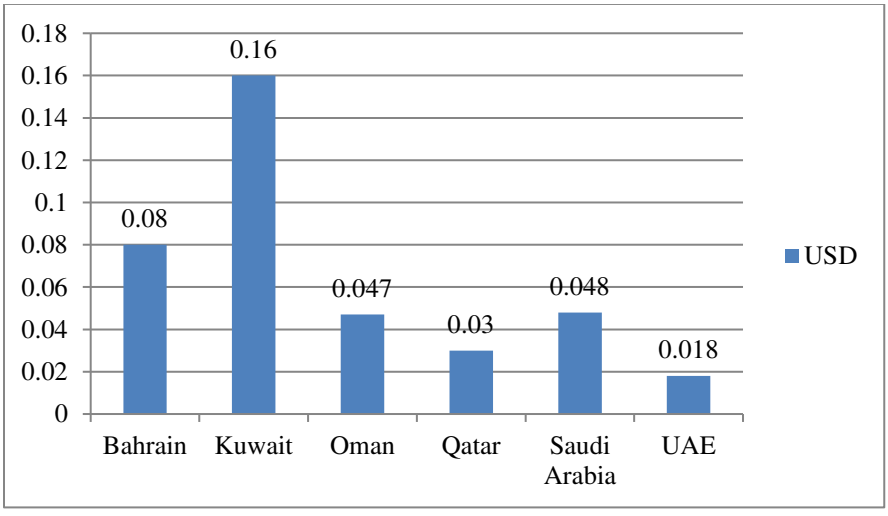
solar is abundant in the region and has become economically viable. Third, the GCC countries are all very high on the list on CO_2 emitters per capita and feel the urge to start curbing down on their emissions (see Figure 2). Fourth, the GCC states are also very high on the list of electricity–and in general energy–consumption per capita due to the generously subsidized energy prices that the consumers enjoy. Current rates are provided in Figure 3. Recently, all GCC countries have come up with plans, and some have started implementing, a gradual phasing-out of electricity subsidies.

Figure 2: CO_2 Emissions (metric tons per capita)



Data Source: World Bank

Figure 3: Electricity Rates for the Residential Sector (2018/19)



Data Source: GCC Ministries' Websites
Note: Local currency converted to USD

Current renewable energy capacity as a percentage of total capacity as well as the goals set in each of the GCC countries is shown in Table 1. Clearly, these countries have set ambitious goals. The next section presents the economic background, followed by a detailed exposition of the electricity sector in each of the six countries, including plans to reach the RE goals.

Table 1: Current and planned RE capacity

	Planned RE	RE Share 2018
UAE	27% in 2021 and 44% in 2050	2.03%
KSA	3.45GW in2020 9.5 in 2023 30% in 2030	0.18%
Qatar	200-500 MW of solar in 2020	0.42%
Oman	10% in 2025	0.12%
Kuwait	15% in 2030	0.41%
Bahrain	5% in 2025 and 10% in 2035	0.22%

Data Sources: IRENA, 2019

2.1 Bahrain

2.1.1 Current Economic Status

Bahrain, along with Oman are the only two countries bordering the Persian Gulf which are not members of the Organization of the Petroleum Exporting Countries (OPEC). The Kingdom of Bahrain, a high-income country with a GDP per capita of 47,526 USD (PPP current international $) in 2017 (World Bank, 2019) is the smallest oil producer among the Gulf Cooperation Council (GCC) nations (ESCWA, 2016). The country is a minor producer of crude oil, refined oil products and natural gas. The total primary energy supply of Bahrain in 2016 reached 2,216 ktoe of primary and secondary oil and 12,031 ktoe of natural gas (EIA, 2019a).

Bahrain's oil and natural gas resources are governed by the National Oil and Gas Authority (NOGA) which controls multiple subsidiary companies, including the Bahrain Petroleum Company (BAPCO), the Bahrain National Gas Company (BANAGAS), and the Tatweer Petroleum Company. The country receives revenues from two oil fields: the onshore Bahrain (Awali) field, and the offshore Abu Safah field, which is jointly shared with Saudi Arabia.

Due to the dependence of the energy sector completely on fossil fuel, the government aims at diversifying energy supply and reduces demand for cooling (University of Bahrain, 2018). In order to shift from dependence on oil to competing globally in including the private sector in the energy sector, Bahrain initiated its Economic Vision 2030. The "Vision" aims at attracting foreign direct investment and to increase reliance on the service sector, tourism, business services, and manufacturing and logistics.

2.1.2 Electricity Sector and Future Plans

With around 4 GW of installed generating capacity, the country is witnessing a similar trend to its neighboring countries; demand for electricity is growing rapidly to cope with the population growth and the expansion of the industrial sector. Currently, only 6 MW of the 4 GW (0.15%) stems from renewable sources (5 MW of solar PV and 1 MW of wind) (IRENA, 2019). Although the kingdom has initiated a number of power projects to meet the increased needs, so far only modest achievements have been reached in the renewable energy sector.

Two plans reflect the efforts to achieve the energy transition presented in the Economic Vision 2030. In early 2017 the Bahraini government adopted the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP). The NREAP highlights feasible renewable energy options for the country, and proposes targets, policies and initiatives for implementation. It sets a national target for the share of renewable energy in total energy generation to reach 5% by 2025 and 10% by 2035. The envisioned renewable energy mix comprises solar, wind and waste-to-energy technologies (Sustainable Energy Unit (SEU), 2019).

To reach 5% target by 2025, Bahrain needs to have at least 200 MW of renewable-based energy. One of the projects which is part of the NREAP and NEEAP is the 100 MW Bahrain PV Park which is being developed by BAPCO. The USD 360 million project will be a public-private partnership formed through competitive bidding. Another, and larger project is the Bahrain PV Park 1 (200 MW) that was announced by the Bahrain Electricity and Water Authority (EWA) in 2017 and costs USD 720 million. Smaller projects were announced later in early 2018 by EWA; Al Dur PV Plant and the Al Dur Wind Farm (USD 17.18 million), with installed capacities of 3 MW and 2 MW, respectively (IRENA, 2019). In addition to solar and wind, the Bahrain Waste-to-Energy Project (54 MW) started construction in 2018 as an integrated solid waste management and desalination plant.

In total, the planned projects (359 MW) with the existing 6 MW would add up to 365 MW of renewable energy and will amount to around 9% of total energy in the country. Although the announcement of projects seem promising, however there is previous experience of such plans being shelved. One project that was announced in 2014 but its construction is still pending is the 5 MW (USD 25 million) by BAPCO to supply electricity to the town of Awali, the University of Bahrain, and other location (IRENA, 2019).

2.2 Kuwait

2.2.1 Current Economic Status

Kuwait is the fifth-largest producer of crude oil among the 14 OPEC members and holds the world's sixth-largest oil reserves (OPEC, 2019). With a GDP per capita of USD 33,545, Kuwait is classified as a high-income country by the World Bank (2019) and as a developing economy by the United Nations (2019). In terms of oil production, the country was the 10th-largest producer of petroleum and other liquids in 2015 (IRENA, 2019). In 2016, Kuwait supplied 17,659 ktoe of oil and gas 18,176 of natural gas (IEA, 2019b). According to IRENA (2019) Kuwait is the GCC's third-largest market for electricity and is rich with solar resources.

According to EIA (2016c) Kuwait has been aiming to boost stagnant production rates by implementing oil enhanced oil recovery measures. Despite new discoveries made, Kuwait's regulated oil sector led to a slower exploration and production. In this regard, Project Kuwait was initiated to attract foreign investors in order boost production capacity to 4 million b/d by 2020 (EIA, 2016c) in a country where the state manages the gas, petroleum and other liquids sector through Kuwait Petroleum Corporation.

2.2.2 Electricity Sector and Future Plans

Similar to the other GCC countries, demand for energy and electricity has been rising sharply due to population growth and economic growth (Arab Union of Electricity, 2017). This increase in demand has raised the country's reliance on imports of natural gas. Consequently, Kuwait is trying to attract international investment for natural gas development to increase dry natural gas production to satisfy increasing domestic consumption and to reduce dependence on natural gas imports during hot climate

periods (EIA, 2016c). With an installed generating capacity of 15.7 GW in 2015 (EIA, 2016), Kuwait will need to reach an estimated capacity of 23 GW by 2021, requiring US$ 14 Bn. of investment (MEE, 2018).

Both the New Kuwait Development Plan and current Five-Year Development plan aim at diversifying the economy with particular focus on infrastructure investment, including transportation, a new port and the planned development of the "Silk City" business hub in Subiyah (EIA, 2016c). New Kuwait 2035 is expected to help in the creation of three new power companies with particular focus on renewable energy. The government has earmarked US$ 9.9 Bn. for infrastructure projects including power, and progress is being made on greenfield thermal and renewable projects (MEE, 2018).

In 2018 Kuwait had reached 79 MW of installed renewable-based capacity (IRENA, 2019) or 0.4% in terms of the share of renewables in total installed power generation capacity. The government has set a target of having renewable energy contribute 10% of the total energy mix by 2020 and15% by 2030, from an installed capacity of 5.7 GW CSP, 4.6 GW solar PV, and 0.7 GW wind (Kuwait News Agency (KUNA), 2018). According to KUNA (2018) renewable sources will cover no more than 3% of total energy demand by 2020. The largest of all solar projects in Kuwait is the 1.5 GW Al Dibdibah Solar PV plant/Shagaya Phase II. The construction cost pf the project is USD 1.2 billion and is expected to begin operation by 2022 and to generate 15% of the oil sector's electricity needs (IRENA, 2019). Kuwait has also had several small- to mid-scale demonstration solar projects in recent years. One of the most important showcases has been Shagaya, developed by the Kuwait Institute for Scientific Research (KISR) (IRENA, 2019). Shagaya consists of 10 MW of solar PV capacity, 10 MW of wind, and 50 MW of CSP.

Similar to the measures taken by other GCC countries, in May 2017 Kuwait increased the tariff in the commercial sector and Kuwait's electricity rates were changed to rationalize consumer consumption (MEE, 2018). Among the diversifying approach, the Kuwaiti government intends to encourage the use of renewable energy, hence benefiting from more oil exports and lowering gas emission. The use of renewable energy technologies could generate savings of up to USD 750 million through 2030 (Xinhua Net, 2018).

2.3 Oman

2.3.1 Current Economic Status

Oman is the largest oil and natural gas producer in the Middle East that is not a member of the Organization of the Petroleum Exporting Countries (OPEC) (ESCWA, 2016). Having the lowest GDP per capita among the GCC countries (USD 16,144), Oman is still considered as a high-income country (World Bank, 2019). In 2016 Oman produced 3,024 ktoe of primary and secondary oil and 21,087 of natural gas (IEA, 2019c).

Similar to its neighbors, Oman is highly dependent on its hydrocarbon sector which accounted for 30% of Oman's GDP in 2017 (Central Bank of Oman, 2017). In recent decades Oman has also witnessed the regional trend in fast-rising demand for energy. According to the Authority of Electricity Regulation (AER) (2008), Oman has one of the world's highest solar energy densities with excellent potential for renewables, which was the major reason to adopt renewables in the country. Oman's geography and socio-economic context have enabled renewable energy, such as solar-powered and small-scale, roof-mounted solar generation, to dominate in areas that have not yet been much explored in neighboring countries (BP, 2018).

Similar to other GCC countries that initiated plans for economic diversification, Oman set its Vision 2020 and the subsequent Five-Year Development Plan (2016–2020), aiming to set objectives, policies and mechanisms to raise non-oil revenue through increased private activity and human resource development (IRENA, 2019). Industries targeted for expansion include fertilizer, petrochemicals, aluminum, power generation and water desalination, and tourism.

2.3.2 Electricity Sector and Future Plans

With 8.2 GW of electricity generation capacity in 2017 (Oman National Center for Statistics and Information, 2019), Oman targets 10% national generation mix (or 2.6 GW) from renewable energy sources (mainly from onshore wind and solar) by 2020. In 2017, Oman reached only 17 MW of installed renewable-based capacity while the share of renewables in total installed power generation capacity reached 0.1% (IRENA, 2019).

Similar to the targets set in Oman's Vision 2020 and the subsequent 5-year Development Plan (2016-2020), in 2015 Oman's National Energy Strategy to 2040 was released in line with the ambitions to diversify the energy mix in the country (IRENA, 2019). In line with the large projects in Oman, the 500 MW Ibri Solar Project was announced in 2017 to be the first utility-scale solar project (Bellini, 2018). Al Amin solar PV plant (100 MW) that was constructed by Petroleum Development Oman in November 2018 (IRENA, 2019) is another example of the initiative to shift to renewables in Oman. Other smaller projects include the 50 MW wind park at Harweel and the 50 MW Dhofar I Wind Project.

In this regard, and to decrease dependence on natural gas, Petroleum Development Oman (PDO) (which is 60% owned by the state) is collaborating with the solar company Glasspoint to build a 1,021 MW large scale solar EOR project (Miraah) (RCREEE, 2018). According to PDO (2017) this project is expected to generate 6,000 tons of steam per day saving up to 80% or 5.6 trillion BTUs of natural gas and to save to save over 300,000 tons of CO2 emissions annually. PDO has also announced its interest to build other PV projects (PDO, 2018).

2.4 Qatar

2.4.1 Current Economic Status

Qatar holds the 9th largest reserves of crude oil in OPEC and the 13th largest in the world with proved reserves of crude oil estimated at 25.24 billion barrels (OPEC, 2017b). Although the country is classified as a developing economy by the United Nations (2019), Qatar has the second highest GDP per capita (USD 65,694) in the world and the highest among GCC countries (World Bank, 2019). In 2016, Qatar supplied 318 ktoe of primary and secondary oil and 41,797 ktoe of natural gas (IEA, 2019d).

Qatar's crude oil and lease condensate production ranks 17th in the world, with most of the country's production sent abroad as exports (OPEC 2017b). In terms of production, the country is the third lowest among the OPEC members, but with an increasing production of non-crude liquids–most of which are a byproduct of natural gas production. The Energy Information Administration (EIA, 2017b) estimates that Qatar earned $38 billion from net oil exports in 2014.

With 13.7% of the world's natural gas reserves, Qatar is the world's largest exporter of LNG (BP, 2018) with the largest proven natural gas reserves in the region (24.5 trillion cubic meters) and the largest producer of natural gas among the GCC countries (163.3 million tons of oil equivalent) (ESCWA, 2016). According to EIA (2017b), the country was the world's fourth-largest dry natural gas producer in 2013 (behind the United States, Russia, and Iran), and it has been the world's leading liquefied natural gas (LNG) exporter since 2006, with 31% of market share in 2014.

Given that a significant portion of the country's revenues come from its exports of LNG, crude oil, and petroleum products (IRENA, 2019) Qatar, like its neighbors, relies on its energy sector to support its

economy. According to the Qatar National Bank, Qatar's earnings from its hydrocarbon sector accounted for 49% of the country's total government revenues in 2014, a figure that has declined over the past four years (QNB, 2012).

The LNG expansion along with economic growth have also increased the demand for electricity which in turn made the country consider plans for significant growth in electricity generation capacity. Similar to other GCC countries, Qatar has acknowledged the need to shift for a more sustainable energy and diversifying the energy sources away from the natural resources. To this end, the country launched its Qatar's National Vision 2030 in 2008. The "Vision" aims to strike a balance between an oil-based and a diversified, knowledge-based economy (IRENA, 2019). The plan includes economic, social and environmental components, with emphasis on responsible exploitation of the country's oil and gas resources, and on the creation of a diverse set of economic subsectors capable of promoting innovation, technical specialization, and education.

Another initiative that the government took in this regard is Qatar's Second National Development Strategy 2018–2022 which comes as a continuation of the National Vision 2030 and aims at transforming Qatar into an advanced country by 2030, "capable of sustaining its own development and ensuring high living standards for its people for generations to come" (Ministry of Development Planning and Statistics, 2018).

2.4.2 Electricity Sector and Future Plans

Qatar's total electricity generating capacity in 2017 was 8.8 GW, with demand of around 8.2 GW (The Peninsula, 2017). Qatar's Second National Development Strategy 2018-2022 strategy sets out a plan for natural resource management that includes a call for an increase in the use of renewable energy. Specifically, it aims for 200–500 MW of solar-powered generating capacity by 2020 (MDPS, 2018). In addition, Ayre (2015) states that Qatar has expressed its intention to hold auctions for solar power projects on multiple occasions. At the end of 2018, Kahramaa initiated the prequalification of bidders for a 500 MW solar tender (Tsanova, 2018). The solar tender project, which is a joint venture between Qatar Petroleum and Qatar Electricity and Water Company is expected to start operating in December 2020 and is set to reach 1000 MW installed capacity (RCREEE, 2018). According to IRENA (2019), Qatar reached 43 MW of installed renewable-based capacity in 2017. The share of renewables in total installed power generation capacity reached 0.4% (IRENA, 2019).

Another solar power project that was initiated in 2016 is the 10 MW Al Duhail Solar PV Park was reported in 2016 to have the potential to expand from its pilot stage to 210 MW (IRENA, 2019). However, no recent activity has been reported for the project. Other separate projects of PV solar panels is the Qatar Convention Centre, a 0.7 MW solar PV Array (Alhaj, 2017).

Qatar had also previously announced plans to use solar power to cool the 2022 FIFA World Cup stadiums. The project, announced by Kahramaa (Qatar General Electricity and Water Corporation) was estimated to have a capacity of 3,500 MW (Kelly, 2015). However, in November 2018, Skysports (2018) reported that that the World Cup would be taking place in the winter months of November and December of 2022, which would reduce the tournament's cooling needs.

With regards to regulatory framework and policy instruments, IRENA (2019) reports that Qatar has made slow progress in deploying renewable energy with the notable exception of municipal waste. Biogas and municipal waste account for about 38 MW of power generation capacity in 2017. Qatar is also home to the largest waste-to-energy facility in the GCC region, the 30 MW Mesaieed plant, which also generates 8 MW of biogas-based power (IRENA, 2019).

2.5 Saudi Arabia

2.5.1 Current Economic Status

The Kingdom of Saudi Arabia (KSA) is a founding member of OPEC and has the second largest reserves of crude oil in the world (after Venezuela) with current reserves of some 266 billion barrels (16% of the world's proved oil reserves) and could produce at current rates for at least another 60 years (IRENA, 2019). Saudi Arabia also holds the world's sixth-largest natural gas reserves, the second-largest in the region behind Qatar (ESCWA, 2016). In 2016, Saudi Arabia supplied 136,525 ktoe of oil and 74,165 ktoe of natural gas (IEA, 2019e).

The Kingdom, a high-income country (World Bank, 2019) is the largest exporter of total petroleum liquids in the world, and maintains the world's largest crude oil production capacity at roughly 12 million barrels per day (EIA, 2017b). KSA is the second largest supplier of crude oil to the US (12% if total US crude oil imports) and the largest supplier to Japan (41% of total crude oil imports) (OAPEC, 2018).

KSA is the fastest-growing consumer of energy in the MENA region. Due to heavily subsidized domestic oil prices, the country relies on liquid petroleum for approximately 60% of its electricity generation (MEE, 2018). Petroleum exports are a crucial component of the Saudi economy as it accounted for nearly 75% of total Saudi export value in 2016 (EIA, 2017b). About 60% of Saudi government's revenues are oil-based, and the real GDP growth rate fell significantly in 2016, as a result of the slowdown in oil-driven growth that year (IMF, 2017). According to the EIA (2017b), Saudi Arabia's oil revenues have fallen dramatically as crude oil prices have decreased since mid-2014. Increasing domestic demand for energy is also negatively affecting Saudi revenues. Saudi Arabia is setting future plans to rely less on oil and more on renewable energy.

In addition, and in order to decreases the reliance of its economy on oil the Saudi government launched Vision 2030 in early 2016, as a comprehensive strategy for systematically restructuring the Saudi economy away from its reliance on oil (IRENA, 2019). According to the Government of Saudi Arabia (2018), Vision 2030 aims to diversify the economy, making it less dependent on oil, and to position Saudi Arabia among the first Arab countries to give prominence to renewable energy. Renewable technologies are also perceived as a new industry with the potential to create jobs and move the country into more service and knowledge based industries.

Saudi Arabia has also begun to reduce subsidies on fuel and electricity and to set tariffs closer to market prices in 2017 (IMF, 2017). As the government seeks to reform the power sector along with lifting tariffs, the state announced the liberalizing of electricity prices for both the residential and non-residential sectors. The new prices are expected to reflect the export value of feedstock fuels and higher generation costs (MEE, 2017). Moreover, Saudi Arabia and the UAE were the first countries in the GCC to introduce Value Added Tax (VAT) in January 2018 (IRENA, 2019).

Under the three themes of "A vibrant society", "A thriving economy" and "An ambitious nation", the plan targets the development of new industries and business sectors while boosting private enterprise. Among the national strategy's key components are so-called vision realization programs, which include the "Public Investment Fund program" aiming to invest in sectors that aspire to diversify the Saudi economy. The government indicated in 2016 that it seeks to attract between USD 30-50 billion of new investment in renewables in the period up to 2023, including from the private sector (Kerr, 2017).

Although the Vision 2030 was first launched in 2016 but Saudi Arabia's renewable energy plans date back to the 2000s, when several institutions were founded to support the development of renewables. However the initial target of 54 GW of renewable energy by 2030, later delayed to 2040, was eventually abandoned (IRENA, 2016).

2.5.2 Electricity Sector and Future Plans

According to EIA (2019), Saudi Arabia's total electricity installed capacity in 2017 was 83 GW. As part of Vision 2030, the National Renewable Energy Program was launched aiming for 3.45 GW of installed renewable capacity by 2020 and 9.5 GW by 2023 (10% of power generation capacity) (IRENA, 2019). Although the 2023 target of 9.5 GW seems to be more feasible than the earlier goal of 54 GW of zero-carbon technologies by 2040, however recent expectations suggest that Saudi Arabia's renewable energy capacity might exceed the target by the early 2020s (IRENA, 2019). Overall, Saudi Arabia plans to produce 70% of its power from natural gas and 30% from renewables and other sources (mainly nuclear power) by 2030 (Renewable Energy Project Development Office (REPDO Saudi Arabia), 2018).

One year after Vision 2030 was launched, the kingdom's renewable capacity in 2017 reached about 142 MW, mostly from solar PV projects (with some 2 MW of onshore wind), based on small-scale demonstrational projects, such as solar-powered buildings and parking lot installations (IRENA, 2019). The share of renewables in total installed power generation capacity reached 0.2% in 2018 (IRENA, 2019).

In March 2018, Saudi Arabia announced the construction of up to 200 GW of solar power generation capacity by 2030 together with the Japanese multinational conglomerate SoftBank (Cunningham and Nereim, 2018). In late 2018, reports surfaced indicating that the project was being shelved, though the Public Investment Fund (PIF), which had been involved in the initial (non-binding) agreement, has not confirmed this. The same year, a new city, known to be Neom as announced by Saudi Crown Prince in October 2018, powered entirely by renewable energy was declared (Government of Saudi Arabia, 2019).

2.6 United Arab Emirates

2.6.1 Current Economic Status

The United Arab Emirates (UAE) is among the world's 10 largest oil producers (BP, 2018) and is a member of the Organization of the Petroleum Exporting Countries (OPEC) and the Gas Exporting Countries Forum (GECF). The UAE is classified as a high-income country with USD 41,917 GDP per capita (World Bank, 2019). In 2016, the UAE supplied 11,762 ktoe of oil and 60,501 ktoe of natural gas.

In terms of oil production, in 2016 the UAE produced an average of nearly 3.7 million barrels per day of petroleum and other liquids (of which 2.9 million b/d are from crude oil), the seventh-highest total in the world (EIA, 2017b). The UAE was the fourth-largest producer of petroleum and other liquids among OPEC members in 2015 (ESCWA, 2018). According to EIA (2017b) the UAE aims at increasing crude oil production to 3.5 million b/d by 2020, despite lower oil prices.

With regards to liquefied natural gas (LNG), the UAE was the first country in the Middle East to export LNG and has exported more than 268 billion cubic feet of LNG annually (EIA, 2017b). The UAE has several ongoing projects that could bring additional natural gas supplies online to help satisfy rapidly growing demand. However, developing additional gas resources is costly. UAE has also begun to reduce

subsidies on fuel and electricity and to set tariffs closer to market prices (IMF, 2017). While necessary from a fiscal perspective, the spending reductions have further weakened non-oil growth (IMF, 2017).

Natural gas, mostly imported, has been utilized in meeting the rapid growth of domestic demand for electricity (IRENA, 2019). Like other GCC countries, the UAE and the governments of individual emirates have emphasized the need to reduce reliance on oil and gas by adopting new energy technologies that can also help generate jobs and contribute to the long-term goal of making the UAE a regional knowledge and technology hub.

The United Arab Emirates' Vision 2021, UAE Energy Strategy 2050, UAE Green Growth Strategy, UAE Future Strategy and UAE Centennial Plan (2071), all highlight economic diversification and technological innovation as pivotal to future development. The UAE's plans place high importance on tourism, aviation, advanced manufacturing and services as well as knowledge creation and technology in green energy (IRENA, 2019). The country is positioning itself as a regional hub for research, innovation and sustainable energy, with the latter recognized as a new growth sector with vast potential.

The UAE leads among the GCC countries in building of smart cities. In 2017 it launched the Energy Plan 2050 to increase the contribution of clean energy and cut dependence on natural gas to generate power in line with UAE Vision 2021. In March 2017, the UAE's Ministry of Energy signed a contract with Pricewaterhouse Coopers (PwC) to conduct a technical and economic study of its electricity sector. The deal is in line with the UAE's clean energy strategy. This includes plans to invest US$ 163.3 Billion to meet demand and aims to generate efficiency savings of around US$ 190 Bn.

The Government of UAE is also leading efforts to raise awareness and build capacity of the private sector through the Ministry of Climate Change and Environment (AFED, 2018). Such efforts are crucial in order to achieve the UAE Green Agenda 2030 and the National Climate Change Plan 2050. Green growth efforts are expected to result in 4 to 5.5 percent higher GDP growth and creating 160,000 new jobs by 2030, while accelerating the country's economic diversification efforts and mitigating a substantial portion of carbon emissions (AFED, 2018). With regards to environmental aspects of shifting to renewable energy, the UAE aims at reducing CO2 emission by 30% in 2030 (ESCWA, 2018).

2.6.2 Electricity Sector and Future Plans

The UAE had a 29 GW of total electricity generating capacity in 2016 (EIA, 2019). According to APICORP (2018), the UAE needs to invest US$ 35 Bn. to meet the 17 GW capacity addition needed over the medium term. APICORP estimates that 10.4 GW of capacity additions are already in execution. The UAE is expected to highly diversify its energy sources in the power mix; it is planning to add nuclear (6%), renewable (44%), and coal-fired electricity generating capacity to accommodate rising demand, while the country currently relies primarily on natural gas (IRENA, 2019). Among the GCC countries, the UAE has installed the most renewable capacity by 2018 with 589 MW (IRENA, 2019). According to IRENA (2019), UAE has 2% share of renewables in total installed power generation capacity.

In 2018, the Global Councils on SDGs were launched at the World Government Summit in Dubai, UAE, followed by the launch of the Sustainable Development Goals Center for the Arab Region. The country also has short- to medium-term targets. In line with Vision 2021, the UAE plans to generate 27% of its energy requirements from clean sources, including nuclear power. According to the UAE Government (2018), by 2050 the aim is to increase the share of clean energy in the country's electricity generation capacity to 50% and to expand renewable energy capacity to reach 44 GW.

The UAE is the largest and fastest growing solar market in the GCC (ESCWA, 2018). The country boasts an attractive investment landscape, and Dubai and Abu Dhabi have conducted auctions that awarded more

than 2 GW of solar projects in the last couple of years. Solar PV has been the leading technology, accounting for 83% of the 589 MW of installed renewable energy capacity and most of the project pipeline. CSP is the second largest technology by installed capacity (IRENA, 2019).

Each of Abu Dhabi and Dubai have their own targets. Abu Dhabi aims to install approximately 1.5 GW of renewable power by 2020, constituting 7% of its power generation capacity while the Integrated Energy Strategy of Dubai aims to install 5,000 MW of renewables by 2030, constituting approximately 25% of its power generation capacity (ESCWA, 2018).

According to AFED (2018), the UAE government is promoting public-private partnerships such that the private sector can benefit from participating in, or financing, various large scale projects. A good example is Dubai's Mohammed bin Rashid l Maktoum Solar Park. Developed in multiple phases, it will become the world's largest single plot solar park with a total capacity of 5,000 MW–enough to power 800,000 homes–when completed in 2030.

3. Lessons from Other Countries

To better understand the GCC countries' opportunities and challenges in introducing voluntary green power markets, it is important to examine the experiences of other countries who were early adopters of green power products. Several governments introduced compliance-based generation from renewable energy, in which electricity producers are required to generate a certain percentage of their electricity from renewable sources. In addition to government-mandated programs, several developed countries around the world started offering voluntary green power options since the 1990s. Most of these countries introduced an energy-based product in which consumers voluntarily pay a premium for each kWh consumed to cover the additional cost of generating renewable-based electricity (EPA, 2019). Although more than two decades have passed since the introduction of voluntary renewable energy, available data shows that penetration rates are still very low. In the United States, one of the first adopter of voluntary-based renewable energy, participation rates are still very low; around 4% in the top 10 programs average and around 2% for the remaining programs (NREL, 2018). In terms of sales, only 26% of all U.S. renewable energy sales are from the voluntary green power market. However, with the drop in RE prices, the development of RE sources is being driven by economics rather than dependent on policy. This might be a game changer for the voluntary green power markets.

3.1 Opportunities

Two closely related factors that have been found to impact the decision to join green power markets are: (1) existing knowledge about RE environmental attributes and (2) information and marketing campaigns. According to Bird et al. (2002), the success in the Netherlands can be due to the aggressive marketing campaigns. Similar evidence has been found for the United States; promoting the advantages of the green plan significantly increases green plan adoption, while promoting the disadvantages of the gray plan also significantly increases green plan adoption (Cardella et al., 2018). MacDonald and Eyre (2018) note that evidence from Australia shows the marketing campaigns done by the government provided valuable returns to green power investment. Information and knowledge of RE have also showed to be important factors in China (Xie and Zhao, 2018) and Japan (Nomura and Akai, 2004). Nowadays, the spread of information through social media is easy, fast, and relatively cheap. Thus, the GCC countries can take advantage of social media to raise awareness and share information with consumers.

The source of renewable energy can also have a significant effect on WTP for green power. Sundt and Rehtanz (2015) look at 10 countries and their consumers' WTP for renewable energy showing that WTP depends on the source of renewable energy, where hydropower is the least valued by households, while solar is positively viewed. In line with these results, a more recent study by Bae and Rishi (2018) considers both monetary and non-monetary incentives to study what influences the consumers' uptake in green pricing programs. Results also show that the green pricing program is linked with the type of green energy resources where sources that produce fewer externalities, more jobs, and monetary incentives had a positive effect on consumer uptake. WTP was highest in fuel cells, followed by solar and wind energy (Bae and Rishi, 2018). This again works in favor of GCC countries given that most of the planned projects are solar or fuel cells.

Another factor that positively affects participation in the voluntary green power market is the "warm glow" effect and the related public prestige (Harbaugh, 1998). The warm glow effect is when people feel better about themselves by contributing or taking part in something good, like benefiting the environment (Andreoni 1989, 1990). In Australia, most respondents select the minimum commitment possible when it comes to green products suggesting a buy-in warm glow for carbon mitigation (Ma and Burton, 2016). Social status is extremely important in the GCC states, which leads us to expect that prosocial behavior such as purchasing green power will abound.

Trust in the energy supplier or certification of the RE generation also seems to have a significant positive effect on customers' demand for green power (Dagher et al., 2017; and Xie and Zhao, 2018). Dagher et al. (2017) show that green accreditation has a positive and significant impact on green power consumption. Green accreditation is typically done by a third-party to guarantee that the energy supplier is indeed generating electricity from RES. For example, in Australia the GreenPower Accreditation Program provides verification of energy source (GreenPower, 2015), while most RE is certified by Green-e in the U.S. Therefore another recommendation for GCC countries is to make it compulsory for any RE supplier to obtain certification by one of the global leaders such as Green-e or DNV GL. Marketing and advertising campaigns for green power should highlight the use of an independent accreditation service.

With regards to the price of green energy, some researchers have argued that the demand for RESs is relatively price inelastic (Wiser et al., 2005; Mewton and Cacho, 2011; and Dagher et al., 2017). On the other hand, other studies argue that demand for RESs is affected by price. A report by Pollution Probe (2002) investigates the green power market in Canada and finds that effective ways to increase the residents' participation is by reducing the price of renewable electricity. The report argues that this can be done in Canada through increasing or broadening Wind Power Production Incentive. The different results between the strands of literature can be due to the different context and country effects (U.S. and Canada). For example, success in Sweden is believed to be due to the availability of large quantities of existing hydropower that can be sold at relatively low prices (Bird et al., 2002). In the U.S. the green power premium has continued to fall for several years now "owing to a combination of higher prices of conventional generation fuels and lower renewable resource costs" (Bird et al., 2007). In the United States, relatively low RECs prices are one contributing factor to ongoing increases in unbundled REC sales. From 2014 to 2017, REC prices fell by more than 50%, corresponding to a period of rapidly increasing unbundled REC sales.

In general, most RE in GCC nations is expected to come from solar PV whose price has dropped to below 3 cents per kilowatt-hour (kWh) (IRENA, 2019) and hence the premium is expected to be rather small. Recently, due to the declining RE prices many studies are investigating the vanishing premium of green power programs.

Large green pricing programs generally charge lower premiums than smaller programs possibly due to economies of scale (NREL, 2018). Given that electricity in GCC countries is monopolized by the public utility, it should be able to take advantage of the increasing returns to scale and offer relatively lower prices.

Other factors that have been found to increase WTP are income and education (Xie and Zhao, 2018; Bigerna and Polinori, 2014; and Liu et al., 2013). There is agreement across the different studies looking at individual characteristics that income and education are positively correlated with WTP. This correlation can explain the different responses between rural areas typically with low education and income levels and urban areas with higher income and education levels. Given that all six GCC countries are considered high-income countries, this should play in favor of any newly established green power market.

3.2 Challenges

McDonald and Eyre (2018) review all markets of green electricity tariffs only to find that high competition markets in energy markets is found to be a key driver of green tariff success. Countries where consumers switched easily between energy producers were more likely to have high enrolment in the green power market (McDonald and Eyre, 2018). As GCC's electricity sectors are mainly controlled by national utilities, this fact will work against newly introduced green power markets. However, in the long run it might be possible to privatize electricity (in the distribution sector at least) and hence introduce competition in the electricity market.

It is noteworthy to mention that the introduction of premium-based voluntary RE market in the GCC countries might be more challenging in a region where the energy sector has been historically subsidized by the government. Although all six countries have plans to reduce and ultimately get rid of these subsidies, this subsidization has delayed the development of RE projects. Lee and Heo (2015) argue that consumers' approval and WTP is essential for implementation of green energy development. Using a contingent valuation method (CV) to study the level of consumers' WTP in Korea, they show that public's disapproval can terminate such developmental projects. For example, the construction of transmission lines in Korea were suspended due to residents' opposition and protestors even resorting to self-immolation. If consumers oppose the reduction and removal of subsidies, this will potentially hurt green power markets.

4. Conclusion

In conclusion, the GCC countries are well positioned to introduce a successful voluntary green power market. To set the stage for a good uptake of green power products: (1) awareness and marketing campaigns should be launched early on, (2) certification by an international independent accreditation firm should be made compulsory, and (3) to maximize the public prestige factor customers could be given wall decals or car stickers to display. However, even the strongest voluntary markets around the world still suffer from low penetration rates. As noted above, this can soon change with the continuous decline in RE prices. However, in the meantime the GCC governments can start preparing the ground for a successful introduction of voluntary green power markets.

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