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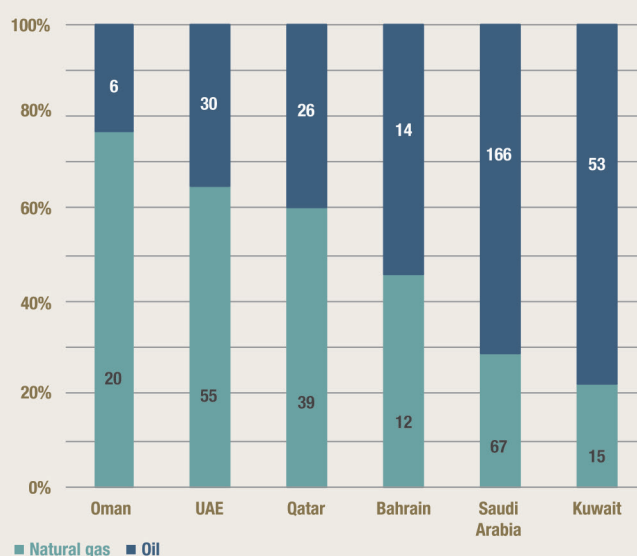
GCC renewable energy: towards a transition

GCC economies are at last beginning to exploit the economic potential of alternative energy, including renewables. Rapidly rising living standards and industrialisation, population growth, and extreme seasonal temperatures all underpin the rationale for the region's economies to be among the world's fastest-growing energy consumers between now and 2030. But these forces also mean it is now time to think hard about the GCC's energy supply, which has for the past 50 years been dominated by domestically produced fossil fuels. Oil and natural gas will continue to provide secure and cost-effective energy, but in the long term the region will also need to depend more on alternative sources of energy, especially solar power, which is particularly suited to the Gulf's climate and geography and is increasingly able to compete on cost with established sources of energy supply.

Greening the Gulf

Renewable energy is a relatively recent entrant to the GCC's energy sector. The availability of domestic fossil fuels produced at low relative costs has been a major hindrance, keeping renewables deployment marginal. But the potential for future expansion is vast, given fossil fuels' domination of the energy mix in most GCC countries. Oil, for example, accounts for between 20% of the total primary energy mix in Oman and over 70% in Kuwait and Saudi Arabia (see Figure 1), and natural gas accounts for the remainder. Gas — originally viewed as an inconvenient byproduct of oil production in the region — has been gradually replacing crude oil and fuel oil/diesel in GCC power sectors, where it provides a cleaner and more economic feedstock than liquids, which capture more value as exports. But the region's gas production, whether associated or free, has not kept pace with the rise in demand from power plants, desalination projects and value-added industries such as petrochemicals. Qatar is the exception — in the rest of the GCC, gas is in short supply. (see Figure 01).

FIGURE 01: **TOTAL PRIMARY ENERGY SUPPLY IN THE GCC BY SOURCE IN 2013 (SHARE IN % AND ABSOLUTE VALUES IN MILLION TONNES OF OIL EQUIVALENT)**



Source: IEA, 2015

FIGURE 02: RENEWABLE-ENERGY GENERATION CAPACITY IN THE GCC, 2011-14 (MW)

	2011	2012	2013	2014				
Countries/energy	Total RE	Total RE	Total RE	Total RE	PV	CSP	Wind	Biomass & waste
Bahrain	0.6	0.6	0.6	0.6	0.1	0	0.5	0
Kuwait	0.1	0.1	0.2	1	1	0	0	0
Oman	0	0	0	0.7	0.7	0	0	0
Qatar	25	28.2	28.2	28.2	3.2	0	0	25
Saudi Arabia	0	19	25	25	25	0	0	0
UAE	19.5	20	134.9	134.9	33	100	0.9	1
TOTAL	45.2	67.9	188.9	190.4	63	100	1.4	26

Source: IRENA (2016)

The UAE and Kuwait are net importers of natural gas, while Qatar remains the GCC's only large-scale gas exporter. Gas and oil are the only power feedstocks used in the Gulf at present, although the UAE and Saudi Arabia will introduce nuclear power in the medium term. Renewable energy, therefore, has become a key element in Gulf states' long-term strategy to diversify their domestic energy mix and reduce their overall dependence on fossil fuels. Of the renewable technologies available to the region, by far the most promising is solar power. Almost all the GCC's renewable-energy projects have been focused on solar power, either as photovoltaic (PV), such as Kuwait's Shagaya project, or as concentrated solar power (CSP), such as Abu Dhabi's Shams I project (see Figure 02).

The potential to expand the role of solar-based renewables in the GCC is vast, not least because of the region's dependably high hours of sunshine. New solar-energy deployment is also well suited to the Gulf's dense urban clusters with efficient, fuel and space-saving technologies; as much as it is to large-scale power-generation systems in more remote desert locations. The International Renewable Energy Agency (IRENA) estimates that the GCC economies as a whole could cumulatively save some 2.5bn barrels of oil equivalent — equivalent to \$55-87bn in discounted fuel savings — if current national renewable-energy targets were to be met over the 2015-30 period.

Renewable energy also offers significant potential for further value-creation in the economy, especially in terms of the potential for local research and development (R&D), and hence job creation for GCC nationals. IRENA estimates that achieving GCC renewable-energy targets and plans currently in place could create an average of 140,000 direct jobs every year, implying that by 2030, close to 2m people could be employed in the renewable sector. These are significant numbers, particularly when placed alongside the region's hydrocarbon sector, where job creation is more limited. Both from a policymaker's perspective, and from the perspective of private developers, the future for renewable energy looks positive in the Gulf.

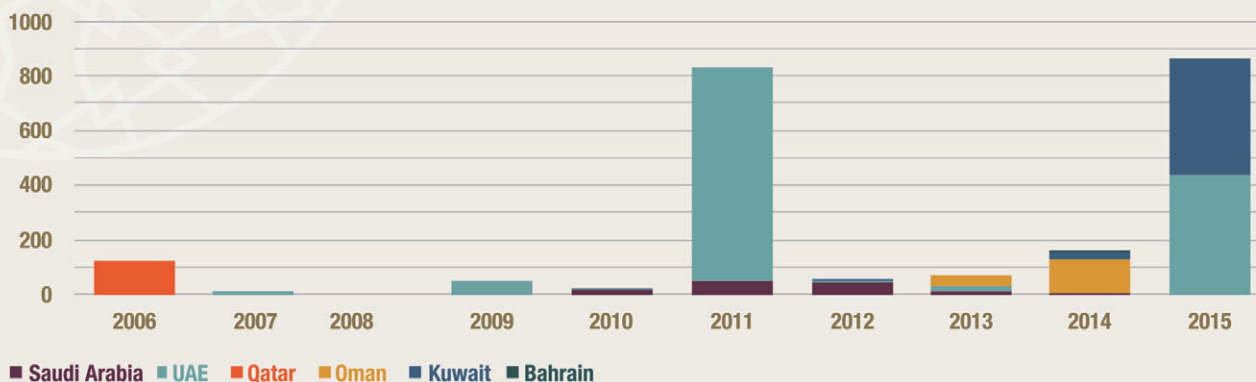
A range of policy frameworks

But national policy frameworks differ considerably across the region in terms of scope and access — a factor that is particularly important for the private investors that are expected to drive future deployment of renewable energy. The recent emergence of the sector means that, with some exceptions, few policy frameworks are in place. Investment codes, modes of financing for the private sector and third-party access to power grids are still a work in progress. Even so, several GCC countries have attracted an expanding volume of investment in renewable projects in recent years, highlighting the latent potential if the correct policy frameworks can be established. (see Figure 03).

Several successful small- and large-scale demonstration projects have shown the potential for renewable energy technologies in the Gulf, ranging from utility-style applications in electricity generation and desalination to rooftop heating and cooling and self-powered commercial buildings. The UAE and Qatar have so far attracted the largest solar-power investments, accounting for around three-quarters of renewables deployment in 2014 (a total of 189MW of renewables-based generation capacity). This success has been due to their advanced regulatory frameworks and implementation mechanisms targeting utility-style deployment of frontrunner technologies, primarily solar and hybrid wind power in the utility sector, and advanced cooling and energy storage. This also reflects the strong political will to back the sector in those two countries. The following core elements are proving to be essential to renewables growth:

- **A long-term vision and policy support.** Renewable energy is a new industrial sector in the Gulf — and its markets have yet to be properly established. Government support and endorsement of green-energy technologies are therefore critical to attracting investors and providing realistic financing options. The UAE's Vision 2021, launched in 2010, focuses on medium-term goals including the diversification of the economy and the positioning of the UAE as a regional hub for knowledge,

FIGURE 03: GCC RENEWABLE ENERGY INVESTMENT, 2004-15 (\$MN)



Source: IRENA (2016)

innovation and green development. Recent years have seen UAE officials reassert this goal, including Dubai's desire to become the world's green capital. To support this goal, the UAE has built Masdar City, a prototype of a sustainable, low-carbon city; and has emphasised its commitment to renewable energy by hosting IRENA in its capital, Abu Dhabi.

- Bringing in the private sector.** The private sector is a critical driving force behind renewable-energy deployment, not only because of its role in co-financing and implementing new large-scale projects, but also as a potential facilitator of a range of applications of renewables outside the established remit of state power utilities. These include rooftop self-generation schemes, water heating and cooling schemes, and electric mobility. Dubai's record-low prices for new solar PV utility-style technology, for instance, have been the result of competitive auctions that involved a flexible framework for bids by several bidders. A rigorous pre-qualification process helped ensure only capable companies with a solid track-record were short-listed to bid, reducing the risk of underbidding and subsequent project delays.
- Investing in R&D and human capital.** Qatar launched its Sustainable Water and Energy Utilization Initiative, based at Texas A&M University in Doha, with the aim of bringing together industrial sectors, research and educational institutions to jointly look at sustainable uses for water and energy. In the UAE, Masdar Institute of Science and Technology, located in Masdar City, is the world's first graduate-level university dedicated to scientific research and teaching of a wide range of science and technology subjects related to sustainable development. The Masdar Institute campus has been designed to consume 75% less cooling than conventional buildings, and 70% less electricity, which is supplied by its 10MW solar-PV plant. The idea behind concepts such as these is to help educate a new generation of Gulf nationals who will be able to contribute to their countries' long-term strategy of building a more sustainable economy from an energy perspective.

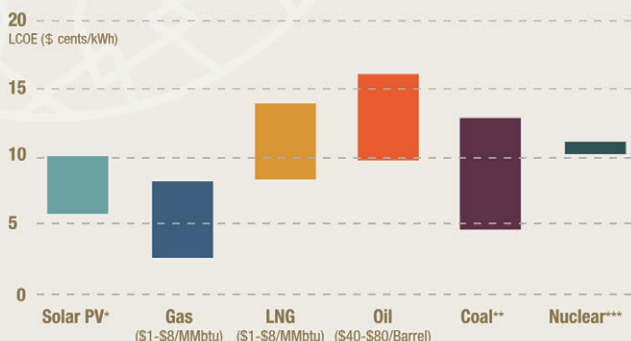
Other GCC countries maintain academic research capacity into renewable energy and energy efficiency, including the Kuwait Institute for Scientific Research and King Abdullah Petroleum Studies and Research Center. GCC countries have also started to welcome public-private partnerships in an effort to boost the deployment of solar technologies. In June 2016, Saudi Arabia's state utility, SEC, issued a tender for two 50MW solar-PV projects in a bid to ramp up the kingdom's renewable-energy capacity. Saudi Arabia has committed to producing around 14% of its current power-generation capacity from renewables by 2030. Investment in renewables worth more than \$100bn is expected over this period.

The changing economics of renewables

A key reason why renewable-energy technologies have become more attractive in the Gulf is their increasing cost-competitiveness. Solar PV's costs have declined sharply in recent years, a development that has been boosted by Dubai's competitive auctions — these have driven down costs for utility-size PV in the UAE to as low as \$0.03 per kilowatt hour, the world's lowest cost for PV, and a price that is competitive with local costs for all other energy technologies, including imported natural gas. Dubai is now maximising the use of renewables to reduce its dependency on fossil-fuel imports for its own utility sector, aiming for the sector to account for as much as 15% of its power-generation capacity by 2030. Qatar is aiming even higher, at 20% over the same period.

A look at the levelised cost of energy (LCOE) compiled by IRENA suggests that as of January 2016, solar PV is on average competitive in the GCC with LNG, oil, coal-fired power plants and nuclear power (see Figure 4), only failing to compete with domestically produced gas. As demand for energy in the GCC is growing rapidly and expected to continue to grow swiftly in the period to 2030, cost-competitive renewable energy will be an increasingly commercial alternative to fossil fuels. Given the regional shortage of gas for power and desalination across the GCC and the subsequent increase in LNG imports, renewables such as solar PV should not only help reduce the region's carbon footprint, but also lower the cost of power generation.

FIGURE 04: LCOE OF GCC POWER-GENERATION TECHNOLOGIES (CENTS/KWH)



Source: IRENA

* Low = price for second phase of the Mohammed Bin Rashid Al Maktoum Solar Park and High = a conservative (high) assumption based on project-level data and opinion of regional experts

** Low = price for Hassyan Clean Coal Power Plant (at May 2015 coal prices) and High = estimate for coal with CCS

*** Estimated range for nuclear power based on Mills (2012) and Scribner (2015)

Note: LCOE is one way to examine the cost-competitiveness in a static analysis. LCOE estimates are not a substitute for detailed nodal modelling and analysis of factors such as backup generation requirements or demand-side management.

The effect of lower oil prices

Lower oil prices have slowed renewable uptake as governments reduce budgets to reflect weaker export income. For many GCC governments, consolidating state finances takes legitimate priority over long-term capacity building. This is both a challenge and an opportunity for renewable-energy deployment. Challenges arise from the risk of state-side investment cuts in renewable-energy projects, as well as — potentially — in technology R&D. Lending costs for debt-financed projects are likely to rise as ratings agencies cut sovereign ratings for oil-exporting countries.

On the other hand, lower oil-price revenues also encourage GCC governments to focus on economic, cost-saving projects that can save government capital expenditure in the medium and long term. Figure 4 is based on an oil-price assumption of \$40-80 per barrel, suggesting that solar PV continues to be cost-competitive even at present oil prices. Mobilising the private sector will be critical to renewables growth and periods of tighter government spending might offer an additional incentive for regional governments to explore new means of attracting private investment into the sector.

Cross-border trade

The deployment of renewable energy would be encouraged by greater levels of cross-border power trading in the Gulf, which would reduce costs and thereby increase the attractiveness for investors. Since electricity generated from renewables is intermittent, multiple linked projects, possibly combining different technologies in a variety of locations, could also contribute to more stable power generation. Costs could also be reduced by sharing backup power-generation capacity from gas-fired power plants. In less mature technology areas such as solar desalination, geothermal power and electricity storage, cross-border collaboration in both R&D and eventual electricity trading could help accelerate learning curves, reinforce inter-regional integration and the creation of a regional knowledge economy with more skills-based employment opportunities for nationals.

But as it stands, the economic conditions necessary for cross-border electricity trade in the GCC are not in place, even if the infrastructure is. The GCC Interconnection Grid links the national grids of all six GCC members and functions as a back-up and emergency-supply network. For full-scale cross-border trading to take place, policymakers will need to institute a competitive pricing framework that allows national electricity suppliers to buy electricity from more than one producer. Except for the UAE, legal provisions enabling such trade have yet to evolve and will require further GCC-wide negotiation in the adaptation of their national regulatory codes for the utility sector. Challenges around subsidies, third-party access and pricing mechanisms also need to be addressed on a regional level if progress on an internal power market is to be made.

Conclusions

Renewable energy offers the GCC many benefits, combining the long-term contribution towards domestic energy supply with the potential to create highly skilled jobs and an industrial cluster along the renewable value chain that fits well with existing government targets to expand the region's knowledge economy. This alone should invite further policy innovation within the region to create the conditions to maximise the use of renewable energy. Moreover, renewable-energy technologies offer an advantage fossil fuels do not have: while costs for fossil fuels will continue to fluctuate and challenge budgetary planning across the GCC, costs for renewable energy technologies such as solar PV and CSP are expected to continue to fall.

This is good news for the GCC, which has been relying on fossil fuels for its energy longer than any other region in the world. Maximising the GCC's competitive advantage in renewable energy such as solar power promises to reap rewards for those able and willing to attract investment with a set of locally adapted policies aimed at paving the way for a GCC energy transition. Some 80 years after oil was first struck on the Arabian Peninsula, this may be the time to add another source of energy to the valuable natural resources that have underpinned the region's socio-economic development for so many decades.



The Foundation's mission is to provide robust and practical knowledge and insights on global energy and sustainable development topics and communicate these for the benefit.

WE THANK ALL OF OUR MEMBERS
FOR THEIR CONTINUED SUPPORT:





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