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'When large-scale oil reserves were first discovered in Saudi Arabia in 1938, who would have believed that growth in the Middle East and North Africa (MENA) would ever have been oil led?' This question comes up in one of our articles in this special issue of the *Oxford Energy Forum*. The question is very well timed; for while MENA continues to play a pivotal role as the world's supplier of oil and, to a lesser extent, gas the collapse in global oil prices since mid-2014 has refocused the debate on the region's ability to use oil revenues to build sustainable economies that can one day function without oil, or at least reduce their dependence on the export of only a single commodity. The Paris Climate Conference in December 2015 will provide an opportunity to the global community, including MENA countries, to contribute new vision and perspectives to the debate, and to engage proactively in leading regional green policy efforts. In this issue, we ask the question directly: can the MENA economies use this time to initiate the switch from fossil fuels to renewables, from wasteful energy consumption towards energy efficiency? Can the region re-invent itself? Can it 'grow green'?

In the editorial to this issue, *Laura El-Katiri* argues that sustainability is not actually an alien concept to the region, but is in fact in the interests of us all. Despite glaring differences in income and political stability across MENA countries, the author argues, the region as a whole faces some very tough, common challenges in the management of its natural capital – its energy and water resources. At a time when the pivot of global energy market growth is shifting away from traditional consumer markets in Europe and North America towards the Middle East and Asia, developments in energy demand and supply in the MENA region are critical factors influencing future balances on global energy markets. We are therefore turning all our attention to the *how* and *when* of the region's gradual energy transition.

Jonathan Walters looks more closely at an as yet underdeveloped natural resource that the MENA region has not made use of in its full potential: solar power. Walters looks at the range of potential counter-arguments; these range from political instability over price subsidies for conventional fuels to water stress, dust, and sand and he establishes that none of these factors actually explains the lack of past success of the technology in the region. Walters concludes: '*An increasingly integrated part of the global economy. And a solar resource that is the best in the world. And all of this sitting inside a market with very fast-growing electricity demand, and next to a rich market in Europe which pays a premium for solar energy*.'

Thani Al Zeyoudi traces the history of innovative energy policy planning in the United Arab Emirates (UAE), one of the MENA region's fastest developing markets for renewable energy technologies and green policy planning. He explains the

Green Growth in the Middle East and North Africa

UAE's motives in urging policy reform in the direction of more sustainable energy policy practice (including that for new resources such as natural gas inside the country), as energy demand has risen much faster than new resources can be exploited. Changing market conditions also play an important role in the UAE's choices: while prices for oil and natural gas on international markets are volatile, the cost of renewable energy technologies such as solar power has, in recent years, fallen by over 80 per cent. Dubai's recent success in bringing down the cost of new utility-size photovoltaic (PV) power underlines, on an economic basis, the future of renewables in the country – a development the UAE see as a strategic step in making their economy more resilient over the long term.

Robin Mills examines the competitive advantage of solar power in the Middle East more closely. Beginning with Dubai's success story in implementing utility-scale solar power that enjoys what are among the lowest costs in the world, Mills argues that we are seeing the beginning of a 'second age' of solar power in the region, one that is '*driven by economics, not by environmental concerns or government fiat*'. In addition to Dubai, he points to increasing deployment in energy-importing countries such as Egypt and Jordan. Mills also refutes the suggestion that consumer price subsidies for fossil fuels and electricity, per se, hinder the development of renewable energy projects in the region, for governments and utilities, considered holistically, '*should seek the lowest-cost generation mix, even if they continue to subsidize the end-consumer*'. Mills argues that with continuing expected falls in PV costs, residential rooftop solar in Dubai could be commercial without subsidies by the early 2020s.

Alissa Amico discusses the region's corporate and investment climate and its role in channelling green investment in the future. Amico suggests that a major reason for the region's scarcity of basic resources is underinvestment in utilities and network industries, which continue to be dominated by state-owned enterprises. The transition to low-carbon, greener economies in the region will require the mobilization of not only public, but also of private investment, the author argues; however, private capital is not currently encouraged by either existing investment frameworks or the overall geopolitical climate. In order to transition from ad hoc investments, the region will need to move to the mainstreaming of environmentally conscious investing, and fiscal frameworks containing guidance and mechanisms for environmental impact disclosure – a mechanism that has proven effective in encouraging green developments in the OECD.

Ernesto Somma and *Alessandro Rubino* look in more detail behind the question of how to attract more private investment into the MENA region's energy sector. Looking back at the relatively slow start of public–private partnerships in the region, Somma and Rubino highlight the enormous potential that green energy, in particular, offers in attracting new investors. Renewables have already drawn in considerable private investment (more than for any conventional forms of energy) in two of the region's most advanced renewable energy promoters, Morocco and Jordan. A further elaboration of investment codes and the creation of a favourable regulatory climate, including the liberalization of underlying utility sectors, are, in their analysis, key to making use of the opportunities provided by green energy.

'We all know that the oil dominance era will not end because we will run out of oil', argues *Osamah Alsayegh*. He points out the fact that economies such as that of Kuwait (highly dependent on oil exports and excessive energy intensity) *'will be significantly impacted if sustainable energy measures and economic diversification actions are not adopted'*. Kuwait still ranks among the world's largest consumers of energy and highest emitters of CO_2 on a per capita basis. Faced with an as yet growing energy footprint, the author urges pressing reforms for the country's domestic energy sector, matched up with the more strategic use of available domestic resources such as natural gas and solar power. The parallel lack of demand-side management policies is more of a threat to Kuwait's long-term economic future than the challenge of fossil fuel resource depletion – making proactive energy policies of pivotal importance for Kuwait's long-term growth and continued socio-economic development.

Rabia Ferroukhi and *Arslan Khalid* focus on another potentially beneficial side effect of adopting green energy technologies, the potential for indigenous job creation in the renewables sector. Looking at opportunities in the GCC region, Ferroukhi and Khalid argue that the job creation potential for renewables (particularly solar energy) in the region is significant. While construction and installation will undoubtedly lead job creation to start with, future growth in the market may also help create more employment options in the manufacturing and R&D segments of the sector. Key to using the green sector to drive employment opportunities in the GCC, however, will be the creation of a stable and predictable policy framework. The authors urge regional governments to further back up their policy commitment by ramping up future efforts into renewable energy and training – a new branch within local energy sector development.

Waleed Alsuraih asks whether the 2014/15 oil price collapse may actually prove to be an opportunity for the region not only to focus on 'green' economic thinking, but on maximizing energy productivity overall. Indeed, Alsuraih argues, given their large hydrocarbon resources the GCC countries in particular have a large stake in the global transition towards sustainable energy. Using clean energy as a tool to raise their energy productivity can support these economies' growth, providing them with opportunities to engage in R&D. Such opportunities are important both from a labour market and an industrial diversification perspective, as they provide the sort of 'home grown' industries that policymakers have been promising their young and increasingly educated populations.

Jason Bordoff and *Akos Losz* appeal for a different way of 'greening' the GCC economies by targeting their underlying market incentives – eliminating subsidies on fossil fuels. The GCC economies, alongside those of many other MENA oil and gas producers, have for decades engaged in the practice of supplying their valuable hydrocarbon resources to their domestic markets at a fraction of their international value. Not only do fossil fuel subsidies in the GCC result in the systematic encouragement of wasteful and inefficient energy consumption patterns, but they also create a structural market impediment to the diversification of the region's energy mix towards alternative sources of energy and away from oil and gas. Without subsidy reforms, the authors argue, '*Saudi Arabia and the other leading oil exporters in the GCC risk losing, both in the short and the long run*'.

Walid Matar leads on from this position to discuss the need for alternative fuel prices for more efficient allocation of resources. He argues that reforming the energy prices facing industries such as petrochemicals, cement, and the power sector can bring huge benefits in terms of reducing energy consumption and changing the energy mix towards renewables and nuclear, which will free more oil for exports. While such a transition would involve adjustment costs, the benefits overwhelm these costs. According to Matar, these benefits can be achieved without increasing prices sharply, reflecting the large inefficiencies that are associated with the current pricing policy.

Similar conclusions are reached by *Jim Krane*, who simulates the effect of a rise of all energy prices across sectors in the GCC to international levels. Krane finds that subsidized prices in the Gulf account for a significant share of energy consumption, and reforming end-user subsidies by raising prices '*would go a long way toward rationalizing demand*'. Looking at the large projected growth in regional energy demand over the next two decades, Krane thus offers us a demand-led rather than a supply-led model to reduce the region's carbon footprint while reducing wasteful energy consumption. Interestingly, the author also finds in his own country-based studies that a regional energy price revision might not actually be as controversial as has been widely thought; according to his work, a majority of Saudi citizens would '*agree to higher prices on electricity if compensated*'.

Mari Luomi looks ahead at how the GCC states have been, and at how they could be, participating in building the post-2015 development agenda, in particular in the area of sustainable energy. Luomi argues that the unfolding paradigm shift in the region's development thinking is already under way, for reasons that include the food price and global financial system crises, biodiversity loss, and climate change. Luomi explains how the Gulf Arab states have stepped up their participation in multilateral sustainable development forums, as shown, for example, by the UAE's active role in the process that led to the development of the UN Sustainable Development Goals (SDGs) that will guide international development through 2030. Luomi argues that the GCC states now have an important opportunity to translate their economic interdependence and participation in international cooperation in the area of sustainable energy into domestic policies and action, and to turn their 'brown' wealth into green growth.

Eckart Woertz takes the discussion away from a sole focus on energy, linking the green energy cluster to the wider nexus of water, energy, and food security. While MENA is the world's largest oil exporting region, it is also its largest importer of cereals, poultry, and sugar, and due to it high aridity and limited local agricultural production, it is a large importer of 'virtual water'. Woertz argues that water, food, energy, and climate change should very much be treated as interrelated issues that should be tackled with an integrated approach. This is even more important as the MENA region '*is not only the world's petrol station*' but has also become '*its own best customer*'. Woertz calls for overall better resource governance, and good stewardship of interrelated natural resources such as water, energy, and food, whose positive externalities have been for too long taken for granted.

Nivine Issa and *Phillipa Grant* explore climate-friendly policy choices in the context of the UAE. As the country has started to engage more proactively in climate adaptation, the authors explore the country's dual approach towards reducing its carbon footprint: demand-side policies focusing on reducing overall national energy demand and increasing energy efficiency, and supply-side policies aimed at diversifying the country's energy mix towards renewables and nuclear power. Part and parcel of the UAE's policy reform efforts have been regulatory changes such as green building codes, while the emirate of Dubai has moved ahead with the region's first energy policy planning document: Dubai's Integrated Energy Strategy 2030. While the UAE is realistically only standing at the beginning of a more structural energy transition, it is policy initiatives such as these that are likely to form the basis of the country's long-term resilience to global shocks and the stability of its economy.

In their article on 'solar aid', *Kishan Khoday* and *Stephen Gitonga* take a closer look at the big picture – the relationship between, on the one hand, the post-2015 development agenda and global policy commitment to the goal to ensure access to affordable, reliable, sustainable, and modern energy for all; and on the other, the MENA region's vast socio-economic challenges. With an estimated more than 20 million refugees inside the MENA region alone, the region's wealthy and stable nations are called to use international sustainable development objectives to help people throughout the region to create sustainable livelihoods. New sustainable energy partnerships that address the issue of today's refugee and migration crisis in the Middle East, Khoday and Gitonga argue, '*can help serve as a model for efforts to bring the benefits of green growth and innovation to the most needy in the world*'.

Sustainable energy is in all of our interests

Laura El-Katiri

The past few decades have witnessed a remarkable socio-economic development trajectory in the economies of the Middle East and North Africa (MENA). Despite glaring differences in income and political stability across MENA countries (including the proliferation of violence and political turmoil across parts of North Africa, the Levant, and Yemen over recent years) the region as a whole faces some very tough common challenges in the economic sphere, in the management of its natural capital: its energy and water resources. From the onset of the Middle East's oil and later on its gas exporters' stellar economic growth since the 1960s, fossil fuels have been intimately connected with the region's rising wealth and socio-economic development that has enabled virtually universal access to both modern energy and treated fresh water across the MENA, and turned the Arab Gulf monarchies in particular into some of the wealthiest states in the world.

However, many of the economic opportunities offered by oil and gas-based economies across the MENA region are now also turning into long-term liabilities. Rising living standards, coupled to some of the world's lowest domestic energy prices, increasing vehicle ownership, and universal access to electricity across the region have led to surging rates of energy, as well as water, consumption. Rapid urbanization and industrialization in many parts of the MENA have accelerated the fast-rising draw on the region's natural capital (oil and natural gas) which continues to supply almost all of the region's rapidly growing energy needs. The MENA, alongside the Asia–Pacific region, is already expected to account for the majority of global energy demand growth for the period up to 2030, according to various global forecasts such as those of the IEA and OPEC. This prospect warrants much closer consideration so that regional strategies can be formulated to respond to the growing natural capital needs of the region's economies, as well as to the way in which this new group of energy consumers will position itself in global forums that deal with issues such as water governance and climate change.

A new economic reality

This new economic reality faced by the MENA economies would not have been predicted several decades ago, when most Arab oil and gas producers' domestic energy demand was marginal in global terms, and growth markets were to be found elsewhere – in Europe, North America, and in parts of Asia. For many decades, fossil fuels both underpinned and formed an essential part of economic growth and industrial diversification strategies in the Gulf states and countries in North Africa. The legacy of this position today is the existence of economies that continue – in contrast to those in all other world regions – to grow in terms of their energy intensity. 'Green' technologies and ideas, and policies aimed at reducing waste while encouraging a more efficient, more sustainable use of energy and water resources have, in this context, been a recent addition to the MENA's economic policy arena. So has the idea that a focus on 'greener', more efficient, energy solutions and management practices could lead to a regionally more sustainable energy footprint, and ultimately towards sustained economic growth.

'Green growth' is more than a buzzword, a label we place on a few megawatts of experimental photovoltaic power cells or LED light bulbs. It will clearly require more than verbal commitment – as important a first step as this is – in many cases it will depend on a fundamental rethinking of the way economies utilize and allocate natural resources. Green growth, the World Bank suggests, is growth that is efficient in its use of natural resources; it is clean in that it minimizes pollution and environmental impacts. It is, the Bank argues, *'necessary, efficient, and affordable'*. And it is '*a vital tool for achieving sustainable development'*. Green growth hence follows in the footsteps of the Brundtland Commission's seminal report of 1987 – *Our Common Future* – which calls economies throughout the world to engage on a sustainable development path that '*meets the needs of current generations without compromising the ability of future generations to meet their own needs'*.

'GREEN GROWTH HELPS ECONOMIES *DO MORE WITH LESS*.'

But perhaps most relevant for the MENA region are views such as those of the Asian Development Bank, which argues that green growth strategies can help developing and developed economies to *'decouple resource use and waste generation from economic growth and human well-being'*. This is a fundamentally different approach from that followed by proponents of *prosperity without growth*; green growth becomes a concept that, rather than consuming additional resources, helps economies use their valuable natural capital more smartly in the service of long-term

growth. Green growth helps economies *do more with less*.

North Africa invests in green energy

Encouraging first steps have been seen in North Africa, parts of which have been pursuing clean energy projects for many years. Driven by the need to diversify the highly import-dependent energy mix of countries such as Morocco and Tunisia, these markets have already made progress in opening their domestic power sectors to national and international private investors over the last few years, with a number of (often under-reported) success stories.

Morocco has shown remarkable business sense by drawing in foreign investment to forge a series of solar power projects inside the country, including part of the Kingdom's efforts, over the last decade, to increase off-grid electricity access in rural Morocco through new hybrid solutions. Morocco's Solar Plan entails a total of 2,000 MW of future capacity, of which the implementation of the 500 MW Noor Solar Complex (consisting of 460 MW concentrated solar power (CSP) and 40 MW photovoltaic (PV) power) is already well under way and will start operation by end-2015. This project, particularly in the area of CSP, is well in advance of any other schemes in the region. Capitalizing on its own favourable geography, in its own quiet way Morocco has also been expanding its wind parks, with the result that the kingdom's several large-scale wind parks are now its lowest-cost source of electric power, at some of the world's most competitive prices.

Like Morocco, other North African countries such as Algeria, Libya, and Egypt hold plentiful potential for solar power, which could eventually be exported to Europe, and hence provide North Africa with an additional source of revenue. The opening of the European market for clean power from outside the European Union in the late 2000s, alongside the availability of Climate Investment Funds for countries such as those in North Africa, has helped in forging the position of renewables as an increasingly attractive additional energy source. The potential for green industrial growth is particularly high here because North Africa, in addition to its favourable geography, also offers labour-abundant markets which benefit from a young and comparably well-educated population who could realistically feed into both R&D and manufacturing activities around the sector.

Green leadership in the Gulf

It might surprise many casual observers of Middle East politics that regional green policy initiatives are no longer just the reserve of import-dependent economies. The past few years have seen an unprecedented proliferation of green energy plans, and new weight put on sustainable long-term energy strategies, from a country at the heart of the region's oil producers in the Arab Gulf. The United Arab Emirates (UAE) have, within a mere few years, taken a series of initiatives aimed at raising awareness and finding innovative ways of integrating greener technologies into their energy mix, while promoting parallel policies aimed at raising energy efficiency and establishing the green economy as a separate business sector. Abu Dhabi is home to Masdar City (designed as a regional centre of innovation and research dedicated to clean and alternative energy solutions that include low-carbon solutions for future city design) and, since 2009, to the International Renewable Energy Agency (IRENA). These initiatives clearly signal a shift in the UAE's commitments towards a more diversified long-term energy mix.

That fossil fuels and renewable energy mix very well in the Gulf is a reality that has also begun to be demonstrated in outright commercial terms; earlier this year Dubai's Mohamed Bin Rashid Al Maktoum photovoltaic park brought down the cost of solar to less than US¢6/kWh – among the world's lowest costs. This is a marked success few might have initially expected to come from a Middle Eastern oil producer, and one that also has a realistic chance of contributing to the gradual establishment of photovoltaic power in the markets of neighbouring countries.

'THAT FOSSIL FUELS AND RENEWABLE ENERGY MIX VERY WELL IN THE GULF IS A REALITY …'

Other Gulf oil and gas producers, such as Qatar, Oman, and Saudi Arabia, have followed with R&D initiatives that include the demonstration of niche technologies such as alternative vehicle fuels, solar-powered desalination, and enhanced oil recovery (EOR). While many of these initiatives are in their early stages, and far from being in a position to establish renewable technologies and energy-conserving measures as an integral part of their energy policies, they are steps in the right direction and lay out the potential of these markets in the future. And while world market prices for competing oil and natural gas have been falling since mid-2014, the parallel fall in technology costs for solar as well as for wind power have much potential to render these technologies cost-competitive with fossil fuels, even in traditional fossil fuel producers.

The motivation behind these recent but seemingly determined steps to gradually change the region's engagement both domestically and internationally, with concepts such as green growth and greater resource efficiency, is partly a response to the region's own changing circumstances

that are felt more in the Gulf than anywhere else. The GCC economies alone account for the bulk of Middle East energy consumption, while Saudi Arabia, alongside Iran, is not only a major producer but also a major consumer market for energy. The region's very high living standards have also taken their toll on cumulative energy consumption, more so as skyscrapers, which require constant access to air conditioning, have become an all too familiar sight in the region's desert-like climate. The conservation of energy at home, together with the reduction of waste, have become synonymous not only with medium-term natural resource management, but also with the preservation of long-term prosperity in the Gulf states – resting as this does on a continued ability to export, rather than consume domestically, the majority of their valuable hydrocarbon production.

But green growth needs many more steps

But as much as the past years' successes in areas such as technology demonstration, far-reaching government agendas with ambitious renewable energy targets, and acts of symbolism for the wider region form part and parcel of a process of a 'green awakening' in the MENA region, they are but the starting points for what is undoubtedly a long-term journey. Ultimately, green growth will be the consequence of policy choices made today in a region where resources such as energy and water remain within the political realm of the state–citizen relationship; this process will likely require a fundamental re-evaluation of how states, industries, and societies allocate resources, as we move beyond those times when an abundance of natural resources, relative to the needs of the peoples of the MENA region, could be assumed.

An important element in this puzzle will undoubtedly be the way in which markets price energy, including in those parts of the region where energy and water continue to be provided below cost. Granted, offering consumers (including industries) real incentives to conserve energy and rationalize consumption (while ensuring social safety nets provide continued universal access to water, electricity, and transport) will prove a far more complex undertaking, from an institutional perspective alone, than subsidizing prices and setting targets for industry performance. But these are the types of policies that integrate long-term planning in areas such as energy sector management and environmental planning, resource management, and socio-economic long-term development in one of the most rapidly changing regions in the world.

Providing the right framework for green growth will continue to be a government job. Green growth requires infrastructure planning and investment, in areas as diverse as power, utility and secondary industries, public transport, and rural–agricultural development. It will also entail a central role for the state in managing the increasing role of private investment into the sector, ensuring citizens and the economy as a whole derive a fair deal. Regulation, particularly in the area of resource efficiency inside industries, the commercial sector, and in private consumption, is perhaps one of the lowest hanging fruits on the market. Finally, awareness of environmental concerns, resource scarcity, and waste reduction alongside climate change will need to be encouraged across the region, far beyond current acts of symbolism and occasional advertising.

While regional differences in all of these areas are large, there is not one country in MENA for which the management of future natural capital is not, and should not be, a priority. There would hence also be significant potential for further regional cooperation in the area of resource management and preservation. Regionally unified regulatory frameworks for technical appliances such as air conditioning systems, for instance, could significantly reduce waste at minimal additional cost. Cross-regional investment opportunities, together with complementarities in areas such as alternative energy projects, green industrial development, and training of human resources, could have many positive spill-over effects, including the creation of more green jobs and the use of existing trade networks to foster greater socio-economic prosperity throughout the MENA region.

What happens in the MENA is important for all of us

The future evolution of energy and environmental planning in the MENA is important for all of us, inside and outside the region. At a time when the pivot of global energy market growth is shifting away from traditional consumer markets in Europe and North America towards the Middle East and Asia, developments in energy demand and supply in the MENA region are critical factors influencing future balances on global energy markets. MENA economies, particularly the wealthy oil producers in the Gulf with their growing financial power, will also set important signals with the direction of their investment in alternative energy and green technologies, as will their voice within global forums such as the UNFCCC framework, and inter-governmental commitments to reduce the human impact on climate change. The green economy offers the region many opportunities, although not all come with relative ease. Setting a regional example in green growth could, however, turn the MENA economies from being resource-rich to resourceful – knowing how to make use of all of their natural capital in the smartest possible ways.

Here comes the sun: solar-led green growth in MENA

Jonathan Walters

When large-scale oil reserves were first discovered in Saudi Arabia in 1938, who would have believed that growth in MENA would ever have been oil led? Saudi Arabia had been declared a nation state only six years before, had few people with formal education, little infrastructure, no modern legal system, and was largely isolated from the rest of the world. A long and difficult journey to transport oil to market. Not an attractive investment location, not obvious there would be a large market. And the rest is history as they say. A history which few would pay attention to now.

'… A SOLAR RESOURCE THAT IS THE BEST IN THE WORLD.'

Fast forward to solar energy today in MENA. A MENA with lots of educated people, sophisticated economies and legal systems, deep states in many countries, a well-developed infrastructure – including the means to transport energy to markets. An increasingly integrated part of the global economy. And a solar resource that is the best in the world. And all of this sitting inside a market with very fast-growing electricity demand, and next to a rich market in Europe which pays a premium for solar energy.

Why is this solar resource only in the early stages of exploitation compared to its enormous potential, and what would help realize that potential? Well, here are a few possible explanations and responses.

Don't fossil fuel subsidies crowd out solar energy in MENA?

Perhaps. In oil-importing countries fossil fuel subsidies certainly don't help solar energy development. And if electricity or LPG is underpriced in those countries as a result of fossil fuel subsidies, then the retail customers of energy are less likely to invest in rooftop solar PV or solar water heating. However, at the wholesale level it is not so clear that it makes much difference, particularly given the structure of electricity sectors in MENA. Typically – in fact almost without exception to date – all electricity is purchased at the 'wholesale' level by a state-owned 'single buyer' utility, and that single buyer can determine the prices paid to electricity generators (public or private) as a matter of policy. There is really not much to stop them from paying incentivizing prices for solar energy generation, even while fossil fuels are being subsidized. It may be more an issue of whether they want to promote solar energy than whether fossil fuel subsidies really get in the way.

In oil-exporting countries, the situation is even less clear. In addition to the considerations above, fossil fuels are often supplied to the power sector at an extremely low price (in order to keep final electricity tariffs very low for consumers), which can have a huge opportunity cost in terms of hydrocarbons export revenue foregone, or lost value added in other uses such as petrochemicals. We have seen, particularly in some Gulf countries such as the UAE or Saudi Arabia, that these considerations may be quite powerful drivers encouraging plans to replace some fossil fuel generation with solar energy, in order to liberate the fossil fuels for exports or other uses.

Would a different oil and electricity market structure in MENA help solar energy?

In the long run, probably yes. If subsidies were removed and markets were made more competitive, it may be easier for solar energy to compete on a level playing field in MENA, or for well-designed supportive policies to be implemented if needed. Overall, there would probably be more adoption of new technologies, and more innovation in applications, and that could certainly help solar energy. In the short run it is not so clear, for the reasons given above, particularly in the oil-exporting countries. This disjunction between short-run recommendations and those appropriate for the long run is challenging for MENA policy makers who wish to promote solar energy. It really depends on whether the promotion of solar energy is a very high priority for policy makers, or one priority among many others. More research is needed into how to overcome this transitional challenge.

Is the investment climate good enough? What about political stability?

This varies a lot from country to country in MENA. Obviously nobody will be investing in solar energy in Syria, Yemen, or Libya for some time to come. By contrast, Morocco, Jordan, Tunisia, and Egypt have generally attractive investment climates for solar energy, and a recent track record in political stability (although not without risks and challenges). In the Gulf, investment climates and political stability are even stronger. There are plenty of attractive destinations for investment in solar energy in MENA, particularly given that the solar energy resource is world-beating.

Do MENA governments have strong pro-solar policies?

Increasingly yes. For example, Morocco, Egypt, the UAE, and Jordan have moved forward recently with

tenders for solar energy, and in some cases with pro-solar legislation. Oman has concluded agreements for a large solar energy investment in enhanced oil recovery, which could be a forerunner of more widespread use of this technology.

'EUROPE BUYS PINEAPPLES AND COCOA FROM HOT AND SUNNY COUNTRIES, SO WHY NOT BUY SOLAR ENERGY?'

In the Gulf, there has been some recent movement in the direction of reverse osmosis desalination technology, away from thermal desalination, which makes it easier for large-scale photovoltaics, rather than just fossil fuel-fired thermal generation, to be connected to the grid. This is because reverse osmosis utilizes electricity, while thermal desalination requires a thermal power plant. In principle, thermal desalination could utilize concentrated solar thermal power, but this has not yet happened in MENA (and in any case, concentrated solar thermal power can obviously also provide electricity into the grid to be used for desalination using either type of technology). In short, reverse osmosis allows the decoupling of energy and water supply.

What about exporting solar energy to Europe? Will Europe let it happen?

It depends whether economic considerations are allowed to prevail. MENA has a clear comparative advantage over Europe – even southern Europe – in producing solar energy. The sunshine is more intense, with fewer interruptions, and land is much more plentiful, particularly in MENA deserts. Europe buys pineapples and cocoa from hot and sunny countries, so why not buy solar energy? In addition to the economic comparative advantage in MENA, solar energy in developing countries, including those in MENA, can be financed at concessional rates through climate financing schemes such as the Green Climate Fund or the Climate Investment Funds. Europe does not enjoy that financing advantage. Morocco has already availed itself of that advantage vigorously.

The politics of exports into Europe is of course less categorical than the economics. Europe has invested a lot in solar energy, even in suboptimal solar conditions, and that creates protectionist interests – sometimes quite strong ones. The protectionism manifests itself in Europe's solar energy subsidies, such as feed-in tariffs, not being made available for imports, but only for domestic production – thereby acting like an import tariff. Europe also tends to believe that energy self-sufficiency promotes energy security, even though it imports much of its energy anyway and can thus also create security through import diversification.

European countries have both their own renewable energy targets to achieve and also those mandated by the EU Renewable Energy Directive of 2009. The latter makes specific provision for imports from outside the EU in its famous Article 9. It is important to note that the Directive mandates targets only through 2020, and the fate of country targets is unclear after 2020, even though Europe remains rhetorically committed to long-term decarbonization. However, the European Commission has recently questioned whether a number of countries are on track to meet even those 2020 targets, which may create an opportunity for MENA exports to fill part of the gap.

Perhaps more importantly, Europe may have strong political drivers to promote growth in MENA through trade and to support MENA's climate change mitigation efforts. Solar energy trade would be an ideal candidate for meeting those objectives (particularly due to its unquestionable comparative advantage). See below for more on this important point.

Didn't the Desertec Industry Initiative (Dii) and the Mediterranean Solar Plan (MSP) try pushing exports and fail?

Well, it's hard to say they truly failed, because they didn't do very much to actually promote exports. The Mediterranean Solar Plan was a 'plan' without any instruments – it was mainly a political declaration – and never explicitly committed itself to Europe buying solar energy from MENA anyway. Dii was an association of mostly European companies, with diverse and often competing interests, which never decided unequivocally to advocate for MENA exports. Both Dii and the MSP announced big objectives in terms of investment in solar energy, but without any means to achieve those objectives. Probably they did not do much more than inadvertently discredit the idea of large-scale MENA solar energy, by creating an expectation that they could not themselves realize.

What have others been doing while Dii and the MSP were failing?

A lot has been happening. For example, Morocco has successfully tendered for 500 MW of concentrated solar power (CSP) under public–private partnership arrangements. The price achieved was about one half of the level of the equivalent feed-in tariff implemented in Spain. By end-2015, 160 MW will be operational, and the remaining 340 MW is about to start construction. Further tenders for CSP and photovoltaics (PV) are scheduled. Dubai has contracted for 200 MW of PV at one of the lowest prices in the world (less than US¢6/kWh), and is now embarking on another 2800 MW of PV. Jordan and Egypt have been moving ahead with solar tenders. Tunisia is

home to the TuNur project – a planned 250 MW CSP project in the deprived south of Tunisia (to be later expanded to 2000 MW), with exports to Europe under negotiation (through a planned transmission line to Malta and then an existing line to Italy).

Solar energy is beginning to be developed on a large scale in MENA, mainly with private sector investment, and some of that energy would in principle be available for export to Europe. Nobody waited for a top-down initiative from Europe to drive this forward. If exports were to open up, the investment opportunity in MENA would be massive.

Wouldn't transmission costs to Europe be too high for exports to be viable?

First, it is important to realize that MENA is already connected by transmission lines to Europe:

- At the western end by lines from Morocco to Spain, and thence to the entire European grid.
- At the eastern end, by lines to Turkey and beyond into the Europe Union.

Indeed, there are transmission lines continuously around the Mediterranean. This does not, of course, mean that all the grids can operate synchronously as one grid, because of voltage and frequency fluctuations in some MENA countries. However, the grids of Morocco, Algeria, and Tunisia do indeed operate synchronously with Europe thanks to the Morocco–Spain interconnections, and have done so for some years. Other countries could eventually achieve that with some investments and improvements in technical operating standards.

Solar energy exports to Europe could begin today as far as transmission availability is concerned, at least from the Maghreb and through Spain. Once those exports exceeded a few hundred megawatts of generation capacity, more transmission capacity would indeed be needed, and for Tunisia to export to Europe by the shortest route a new transmission line would be needed directly across the Mediterranean (at least as far as Malta). But such a scaling up of transmission into Europe would not necessarily be just for solar energy, so the costs would actually be shared. To give an indication of how much transmission would cost for solar exports, the figure of 1–2 euro cents/kWh is often cited (although obviously exact numbers would be case-specific). In short, this is not a major constraint given the degree of MENA's comparative advantage in solar energy.

'… SOLAR ENERGY OFFERS A SUSTAINABLE WAY OF ADDRESSING MENA'S NEED FOR WATER SUPPLIES, THROUGH DESALINATION.'

What about water stress in MENA? What about dust and sand?

Concentrated solar thermal power needs a cooling system, just as other thermal plants do. One type is wet cooling, which uses substantial amounts of water. Another is air cooling, which is slightly more expensive in terms of capital costs, but which uses no water. Solar photovoltaic requires no water to operate. Concentrated solar thermal generally uses mirrors, which require water for cleaning, but in minuscule amounts. Both CSP and PV require cleaning of dust and sand, but that does not present insurmountable technical challenges.

Dust and sand can lower plant efficiency through haze reducing the sunlight which actually reaches the plant, but that doesn't make solar prohibitively expensive (and the effect can be reduced through proper solar measurement from the ground when the project is being sited).

By contrast, and of greater importance, solar energy offers a sustainable way of addressing MENA's need for water supplies, through desalination. Desalination is currently responsible for a large and rapidly growing consumption of MENA's fossil fuels, particularly in the Gulf. The development of solar energy is a potentially important way of tackling that massive long-term sustainability issue.

Why would Europe want to create jobs, trade, and investment for MENA?

There are a number of global and regional reasons why Europe could decide to support the development of solar energy in MENA by overcoming its protectionism and opening its market to imports of solar energy from MENA. That would mean, in effect, making its feed-in tariffs and other subsidies available for imports from MENA, rather than only for domestic production as is currently the case – or at least to do so partially, so that MENA exports could start to compete in Europe on a reasonably level playing field.

Europe could do this because it cares about climate change mitigation, and believes in market-based subsidy minimization as a good way of achieving that mitigation. Why buy expensive domestic solar energy when you could get significantly more emissions reductions per euro of subsidy by buying cheaper MENA solar energy? On a more technological basis, why subsidize PV (which no longer really needs subsidies in order to achieve global manufacturing economies of scale) in northern Europe, when you could subsidize concentrated solar power that has not yet fully realized its economies of scale, in the south? Also, CSP has more

potential for providing the all-important energy storage on an economic basis than PV (heat storage being much cheaper than electricity storage in batteries). Shouldn't the developed world spend its climate change mitigation subsidies in the region with the best solar resource in the world? That should be the cheapest way of reducing the cost of solar energy for the world.

And Europe could do this because it cares about political stability and economic prosperity in MENA – close to home – and knows that job creation through market access, and the related trade and investment, will be cheapest and most effective for the product in which MENA has the most obvious global comparative advantage – solar energy.

Would solar energy megawatts actually create backward linkages into local manufacturing and employment?

A number of studies have shown positive results on the potential for a solar construction, manufacturing, and services industry in MENA if there is investment in sufficient megawatts to induce it. This is particularly the case for concentrated solar power, given that technology's very low level of intellectual property rights (typically less than ten per cent of the cost base being protected by IPR) and the existing industrial base in MENA (glass, cable, and steel manufacturers being present in some countries, together with engineers and a skilled construction sector, among other factors). It will be largely a question of the scale of megawatts in the region driving economies of scale in manufacturing in the region, possibly supplemented by government incentives or requirements for local content. Exports to Europe could drive those megawatts up fast, and with them substantial jobs in MENA could be created; this can only reinforce stability in the region. A stability that is clearly desirable from the point of view of Europe too.

Diversifying the energy mix in the heart of the oil world

Thani Al Zeyoudi*

The economy of the United Arab Emirates achieved great prominence through decades of economic development driven by hydrocarbon exploration, production, and exports. In the past decade, however, a pathway of diversification – of both its economy and its energy sector – together with the clear recognition of sustainable development goals, have become increasingly significant. This is apparent not only in the physical changes to infrastructure and the numerous policy and regulatory changes, but also in the increased academic attention and use of the UAE as a regional example for renewables, energy efficiency, and active participation in international efforts to tackle climate change.

But why change the fuel mix? Why diversify away from natural gas as the primary energy supplier and crude oil as the primary economic driver? Besides addressing these questions in the context of recent developments, this article will also attempt to go a step further, beyond the seemingly apparent responses relating to '**why**'. It will aim to provide insights into the '**how**' – how the UAE actually needs to be, and to some degree already is, looking at the issue concerned.

What constrains this ambition and how can 'optimization' be approached? The need for a more holistic policy appreciation of 'energy' will be highlighted – covering both demand and supply together with its various uses across electricity, water, heating, and cooling – as opposed to high level 'energy policy' alone.

This article will also point out the flaws inherent in one-off planning, target setting, and execution, due to the constant change being undergone in the UAE. Finally, it will provide a proposal of how optimization of the UAE energy mix can be accomplished, given these inherent constraints. Greatly simplified for the purposes of this article, this argument nevertheless aims to provide both practical guidance to future policy-makers and context for future research and academic engagement with the regional energy agenda.

Why does a gas-rich country seek to diversify the fuel mix?

The United Arab Emirates remains amongst the ten largest oil and natural gas producers in the world. From driving over 90 per cent of Gross Domestic Product (GDP) in the 1970s, crude oil today is providing for just under half of the UAE's economic output, with sectors such as real estate, financial services, and tourism taking larger and larger shares. This economic diversification has often centred on the concept of cheap, plentiful energy. However, for natural gas that is no longer the case. Demand has risen much faster than new reserves can be exploited. Furthermore, new reserves are higher

in sulphur ('sour') and therefore more expensive to produce; imports, in the form of liquefied natural gas (LNG), are thus likely to remain high.

This actually contradicts the overall image many international stakeholders have of the UAE as a 'major oil and gas nation'. While it is true that the UAE has plenty of domestic reserves and is also a viable exporter, it actually became a net gas importer in 2009 – meaning that more gas has been imported than exported since then.

This means that we need to assess new options such as nuclear, renewables, and energy efficiency – not against traditional gas production prices in the UAE, but against new domestic production cost and the price of LNG imports. By this metric, a number of gas alternatives are now highly competitive.

The power sector, dependent on gas for nearly 100 per cent of its electricity generation, is hence seeing stark structural change in relation to this trend. A nuclear programme is underway and ambitious solar developments continue to be deployed across the UAE following a first 'wave' of interest in Abu Dhabi through Masdar. By 2018, what was once a single-fuel system will have become a diversified mix with sizeable nuclear and solar components and a far reduced reliance on natural gas. By 2021, 24 per cent of energy will come from clean sources (defined as nuclear and renewables), a goal directly embedded in the highest federal 'Key Performance Indicators' (KPIs) through the UAE Federal Vision 2021, set by the prime minister and endorsed by federal ministries. In some Emirates, plans for renewable energy alone have been increased to as much as 15 per cent by 2030, up from a near-zero base in 2010. (Dubai's Integrated Energy Strategy 2030 was updated in January 2015, raising the targeted renewables share to 7 per cent by 2020 and to 15 per cent by 2030 – up from previous figures of 1 per cent in 2020 and 5 per cent in 2030 – following faster than expected decreases in solar costs.)

How can diversification be managed in a constantly changing world?

Affirming the feasibility of diversification is useful, but not sufficient for policymakers. The 'why' outlined above is reassuring in relation to current policy, and explanatory for those new to the subject – but it is not sufficient to provide an explanation that would enable UAE policymakers and international analysts to understand and address the actual energy policy challenge in the country. In an attempt to add to this understanding, this section seeks to broaden the discussion and to address the 'how' in UAE energy policy.

Firstly, 'energy' policy is, and should be, a broader issue than 'just' electricity. Energy fuels the economy in multiple applications and in many forms. Citizens and consumers don't want 'energy', they want such things as electricity, water, cooling, and transport; policy must hence recognize how such differentiated end uses are linked and the way in which they rely on interdependent policy choices. 'Energy', besides providing amenities such as those just listed, also fuels the economy in another way – it is an economic sector in its own right, generating added value towards the country's GDP, providing employment, requiring investment for infrastructure, and opening opportunities for research and development.

Secondly, the world of 'energy' is in a state of constant flux. Creating and maintaining resilience against adverse shocks and creating the flexibility to adapt and to exploit opportunities as they arise is more important than setting a target for the 'optimal' fuel at any one time. Technologies evolve and as a result prices change; geopolitics and global market dynamics also change constantly, which again affects resource prices, while demand itself continues to grow at an unprecedented pace. Natural gas, for example, was deemed a low-cost resource just five years ago, sometimes below US$2/MMBtu. Today it is being imported as LNG, which costs more than US$15/MMBtu at times.

Global crude oil prices fell 60 per cent between June 2014 and January 2015, recovered 34 per cent in February, and fallen 20 per cent again since then. This has a major link to UAE government revenue, as well as having an impact on transportation fuels and lubricants. Constant change, and often cyclical trends, are common in both oil and gas markets – yet energy policy needs to create a stable, predictable environment for economic planners, businesses, and customers.

'BY 2021, 24 PER CENT OF ENERGY WILL COME FROM CLEAN SOURCES (DEFINED AS NUCLEAR AND RENEWABLES) …'

Renewable energy prices, on the other hand, have only become dramatically cheaper. The cost of solar technology, and that of the resulting renewable electricity, has fallen over 80 per cent in the past few years. In other words, for the investment needed in 2007 for a 100 megawatt (MW) solar photovoltaic power plant, one can now get up to 500 MW, and the resulting cost of electricity is cheaper than gas-fired power in many cases. Energy policymakers observing this trend were delighted, but at the same time troubled, by the thought of how much further it might drop – should their policies target solar at scale now, or wait longer for even lower prices?

To be successful in the long run in light of constant change, UAE energy

policy needs to be holistic, bold, and strategic.

'Holistic' energy policy is needed to address the multifaceted use of energy

The recognition that 'energy' is obviously a much broader issue than just electricity (outlined above) introduces a level of complexity sometimes overlooked in energy policy, or conveniently ignored in discussions. But it is critically important to appreciate the complexity of the entire energy system: from primary sources (crude oil, natural gas, coal, renewable resources), through the many transformation methods (such as refining, electricity generation, and storage), to the varied forms of energy consumption (for example: transport, desalination, heating, cooling, and electrical devices). They are all linked – and linked to wider economic and trade policy. A policy that incentivizes cleaner transport, for example, through natural gas vehicles and highly efficient engines, has repercussions on gas export or imports and on refining sector demand. Equally, a policy which introduces new electricity generation sources (such as nuclear or renewables) has repercussions on water production planning as well as on storage, when added to the current system of water and power co-generation from gas. Equally, the question of whether to delay support policy for renewables or invest now can be easily answered – as soon as renewables are cheaper than another given option to be considered (such as LNG imports), scaling up investment already makes good economic sense – even if further cost reductions might be expected.

UAE energy policy hence should be, and is being, pursued in a holistic fashion at a system level – across sectors, use types, and jurisdictions:

- The various *consumer* types (including domestic, commercial, government, and industry segments) need to be addressed, together with their current and future needs. Both the individual demand profiles and growth trends of each group play a major role in holistic energy planning.
- The various *use types* (such as cooling, water generation, industrial heat, transportation, and general electricity), their technological evolution and interrelationships should be considered. In particular, where technology change introduces new requirements (water generation complementing nuclear generation) or presents new opportunities (efficient, electric reverse osmosis desalination), new planning approaches are needed.
- The varied set of *policy-relevant institutions* across the UAE's jurisdictions needs to be taken into account for holistic energy policy. This includes both the relationship between federal UAE-wide policymaking, and emirate-level plans, as well as the difference between each emirate in terms of resource endowments, investment climate, and consumption profiles.

Of course, such an integrated, holistic approach is easy to prescribe on paper or in academic theory, but is far more difficult to put into practice. While much remains to be done, the directional signals for policymaking in the UAE are clear. The need for a holistic approach has been recognized and is apparent in current policy. Examples include the UAE Green Growth Strategy, the 2030 energy policy taskforce from across the UAE's jurisdictions, and Dubai's Integrated Energy Strategy 2030.

'Bold' policy and investment decisions to meet fast-paced demand growth

This is dictated by the simple pace of development, with population (and hence demand) growing at unprecedented levels. 'Wait and see' is not a viable option, as within years the lights would go out, water resources would dwindle, and the economy would suffer – this is clearly recognized in current UAE policy. As is the case with general infrastructure investments in the UAE, the energy sector evolves quickly with bold steps aimed at bringing about change at the necessary scale and pace. Examples range from the UAE Policy on the Peaceful Use of Nuclear Energy, to tariff and subsidy reforms for water, electricity, and transport fuels, to the pioneering, early regional efforts into renewable energy which have triggered the scaling-up of renewables in parallel with expected cost reductions in the UAE (and beyond).

We are unable to shy away from bold infrastructure plans and technology investments; hence we are seeing drastic advances which are moving the energy system towards a holistic and fundamentally transformed outcome by 2030. This will include nuclear, renewables, district cooling, green efficient buildings, and integrated public transport, to name but a few aspects. Few observers, just ten years ago, would have foreseen such a wide-ranging scope of change in such a short period of time.

'Strategic' energy policy to enable flexibility to react to global change

Energy policy in the Middle East today is not about picking the right horse in a race with one winner – it is about picking the right set of choices with the broadest possible set of options in a diversified future. Flexibility and resilience are needed – and current policy choices aim to provide just that.

It is necessary to diversify the system to create resilience against future global oil and gas price fluctuations. The price of oil decreased by 65 per cent in 2014/15, while gas prices increased to US$6–10/MMBtu (at times US$15–18/MMBtu) compared to a price of US$1–3/MMBtu until recently. Prices

for electricity and water are far less variable and that creates an imbalance between global cyclical shifts and local economic factors.
A decreased reliance on oil and gas means an increased resilience against such shocks, and hence a more stable economic planning environment for sustainable development. While global oil price fluctuations will still have a major impact on the UAE's GDP and government revenues, their impact on the country's domestic energy system is less significant. Since electricity generation and desalination no longer use oil, oil prices only indirectly affect electricity costs, through their link to gas prices (which can be oil-indexed). Nevertheless, the link is not insignificant, and a diversified mix which includes non-fossil sources will further increase the UAE's resilience to global oil and gas price changes.

It is desirable to reduce the exposure of the UAE's power sector to fuel price fluctuations through the use of renewables. Besides the advantage of falling costs for renewables, the absence of cyclical fuel price movements is often overlooked as being a major advantage in long-term energy policy. The certainty of renewable energy costs is a vital advantage over the uncertainty of constantly changing resource prices – for fuels such as gas, oil, and coal.

Given that we know the current technology cost of solar, we can forecast the exact electricity costs from today's power plants up to 2035. Plants have a 20–25 year lifespan over which there is no exposure to fuel costs which could go up or down. The 200 MW solar PV plant awarded in Dubai this year will produce electricity beyond the year 2030 at a rate specified today, without indexed fuel prices that could change over time. And for the power plants the UAE will build in the future, something similarly promising applies. Given that solar technology costs are still changing, we cannot forecast the exact price of new solar power plants, or of the electricity they will produce in 2020 or 2030. But we do know with great certainty that costs:

- will not be higher than today's;
- will very likely be lower by 2020; and
- will likely be much lower still by 2030.

So instead of seeking to foresee the future in the current policy decisions, by 'betting' on a certain gas, oil, or coal price being feasible, a diversified mix using renewables greatly enhances the prospects for smarter more reliable planning.

Conclusion

A shift in mind-set is needed towards seeing energy resources as valuable and limited, however abundant our remaining reserves are. For natural gas specifically the UAE, as a net importing country with growing production costs, can no longer think of natural gas as a cheap resource. Demand for gas is rising much faster than new reserves can be exploited; new reserves are more expensive; and LNG import costs are even higher. So, as we assess new options (such as nuclear, renewables, and energy efficiency) with this new economic reality in mind, many are now highly attractive, as is a shift towards using reverse osmosis desalination, which uses much less energy.

This trend is one that will affect many countries in the region. The UAE is unusual in having spotted this trend early and made major investments early on to develop alternatives. In that sense, it is establishing a model that will inform changes across the region. We are being helped in making this transition by rapid improvements in critical technologies such as solar PV and reverse osmosis desalination, neither of which was attractive in the Gulf region five to ten years ago, but both of which are now technologies of choice. But above all, we have benefited from strategic, long-term thinking at the highest levels, which has allowed us to build the capacities to participate in innovation as well as to make appropriate investments. This strategic thinking has put the UAE in a good position to benefit from the dynamic changes taking place in the energy sector.

**The opinions expressed in this article are those of the author alone and do not necessarily represent the views of the Ministry of Foreign Affairs.*

The new viability of solar power in the Middle East

Robin Mills

As another blazing summer in the Middle East approaches its zenith, the region's solar power industry is hotting up too. As it enters its second age, solar has reached the ignition point where it competes on economic viability alone. The first age of Middle East solar deployment was driven by small-scale pilots and some heavily subsidized larger projects such as Abu Dhabi's 100 MW concentrated solar power (CSP) plant Shams 1. However, the emphasis was more on grand vistas than concrete projects. Saudi Aramco's K.A.CARE

(King Abdullah City for Atomic and Renewable Energy) sketched a grand vision, or mirage, for 54 GW of renewable generation by 2032, including 16 GW of photovoltaics (PV) and 25 GW of solar thermal. From 2009, the Desertec Foundation sought to advance its dream of North African renewables supplying Europe. As reported in the *MENA Renewables Status Report*, every Middle East North Africa (MENA) country has developed a renewable energy target (though many remain aspirational). Having established Masdar, its clean energy vehicle, in 2006, Abu Dhabi successfully secured the headquarters of the International Renewable Energy Agency (IRENA) in June 2009.

But a period of slow progress followed as the economics of solar power were unconvincing in a region of cheap gas and subsidized electricity. The technical performance of concentrated solar thermal power was disappointing in the Gulf's hazy climate; state utilities were conservative in mind-set and governments dithered, or pursued confused and conflicting objectives. The Saudi programme, which had enticed many solar companies to establish a presence in the region, was the biggest disappointment. It became mired in turf wars, with K.A.CARE lacking resources or a mandate to pursue its vision, while the Saudi Electricity Company (SEC) and state oil giant Saudi Aramco later advanced their own renewables plans.

The second age

By contrast, the second age is driven by economics, not by environmental concerns or government fiat. It was foreshadowed in 2012 (see the report *Sunrise in the Desert: Solar becomes commercially viable in MENA*, by the author of this article) when it became clear that the falling cost of solar PV, low financing costs, and high oil and LNG prices would make solar PV economically viable under conditions in the Middle East. Fast-rising domestic power demand raised growing concerns that some countries, particularly Saudi Arabia, would eventually run short of oil for export.

Solar's regional promise became reality when, following the 13 MW first phase, the second (100 MW) phase of Dubai's Sheikh Mohammed Bin Rashid Al Maktoum Solar Park attracted a low bid of US¢5.98 per kilowatt hour (kWh) from Saudi Arabia's ACWA Power in November 2014. The second-placed bid was only slightly higher. Falling panel costs and cheap financing were key in facilitating ACWA's bids. ACWA also offered to build the whole 1,000 MW planned for the park at US¢5.4/kWh, betting on economies of scale and learning. Concerns about desert dust reducing the panels' performance have been eased by operational experience gained at Masdar's 10 MW and Dubai's 13 MW installations, with regular cleaning.

According to the Access Power MEA document 'Dubai Energy Outlook 2020', Dubai subsequently raised its 2030 renewable target from 5 per cent to 15 per cent, with its solar park eventually intended to reach 3 GW capacity, and plans to power half of its Expo 2020 (around 50 MW) with rooftop and building-integrated PV. From 2014, solar water heating has been mandatory on all new buildings. Abu Dhabi and Dubai have both proposed rooftop solar schemes (Abu Dhabi's of 500 MW), with installation standards and net metering.

'DUBAI'S SUCCESS HAS CAPTURED HEADLINES AND SPURRED GREATER INTEREST ACROSS THE REGION.'

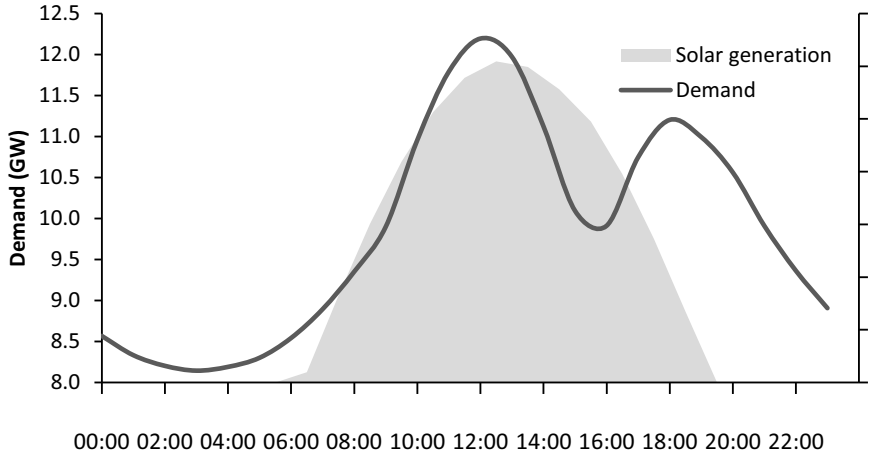
Dubai's success has captured headlines and spurred greater interest across the region. Some of its fuel-importing neighbours have already begun serious investments in solar power and other renewables such as wind.

In November 2014, Egypt announced plans for 2000 MW of utility-scale PV and 300 MW of rooftop PV, supported by a feed-in tariff scheme and concessionary bank financing. (The country has been struggling with gas and power shortages that have turned it into an LNG importer.) The second round of Jordan's solar power tender, totalling 200 MW, saw a low bid of US¢6.13/kWh, with a target of 600 MW by 2020. Morocco has been capitalizing on exceptional conditions for concentrated solar power, with a target of 2000 MW by 2020. Algeria has a feed-in tariff scheme and an 800 MW target by 2020, while Iran plans 5000 MW of solar and wind power by 2018. According to the MESIA (Middle East Solar Industry Association) website, Saudi Arabia is building two integrated combined-cycle gas-fired plants with supplementary solar power, and envisages around 6 GW of PV to 2025, while there are some small PV projects in Qatar, Kuwait, Oman, Lebanon, Mauritania, and Sudan.

Security concerns are also supplementing pure cost considerations, particularly in Jordan, which was plunged into an energy crisis by repeated bombings of the pipeline bringing gas from Egypt, following the 2011 revolution there. Residents and industries in countries plagued by power cuts, such as Egypt, Lebanon, and Iraq, might consider solar power for reliable supply.

New economic viability

This author has calculated that the power purchase price in ACWA's Dubai contract is equivalent to a combined-cycle gas turbine burning gas priced around US$2.7 per million British thermal units (MMBtu) or oil at



Typical summer demand versus solar generation for a Gulf market

around US$16/barrel. Though Dubai has access to low-priced gas from Abu Dhabi and Qatar, it has to supplement this with LNG, costing around US$8/MMBtu, even after recent price falls. Just as a fuel-saver, combined with gas-fired back-up, solar PV is therefore attractive. And at least at moderate penetration levels (up to 10–20 per cent of total capacity), insolation levels in the area match well with regional demand patterns, since air-conditioning represents some 65–70 per cent of total electricity demand during the Gulf summer months, as shown for an illustrative day in the figure above.

In the region, Kuwait, Jordan, and Egypt also import LNG; Bahrain, the UAE emirate of Fujairah, and Morocco may join them. Large quantities of oil are burnt by Kuwait, Saudi Arabia, Iran, and Iraq for power. Even those states which remain sizeable gas exporters – such as Abu Dhabi, Oman, and Algeria – are struggling to keep up with domestic demand, losing them exports at international-parity prices. According to research published by IHS ('Occidental Wins ConocoPhillips's Abandoned Shah Sour Gas Project in Abu Dhabi') on 20 January 2011, new domestic gas resources are more costly: sour gas in Abu Dhabi with production costs estimated at US$5–6/MMBtu; deep offshore and shale gas with top prices of US$5.65–5.88/MMBtu in Egypt; deep, tight, and sour gas in north Kuwait; tight gas in Oman; and tight and shale gas in Saudi Arabia and Algeria. Indeed, in the whole region, only Qatar continues to have access to abundant low-priced domestic gas. And though nuclear ought to provide reliable baseload power, this author concludes that likely generation costs for the UAE's new reactors are above US¢10 cents/kWh.

It may be argued that subsidized energy in the region makes solar power apparently unviable. This is true from the point of view of a residential consumer considering rooftop solar panels. But considered holistically, governments and utilities should seek the lowest-cost generation mix, even if they continue to subsidize the end-consumer.

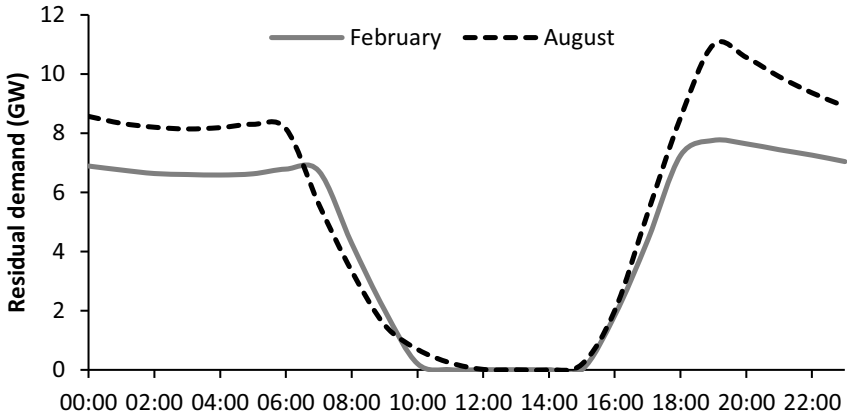
Abu Dhabi's and Dubai's rooftop solar PV schemes do not feature feed-in tariffs or similar support mechanisms. According to a *Gulf News* article ('Abu Dhabi revises water and electricity tariff') from 1 January 2015, Abu Dhabi's electricity prices remain heavily subsidized at around half of cost, while (as will be argued in a forthcoming issue of *Energy Strategy Reviews* by Steve Griffiths and Robin Mills) even in Dubai, rooftop solar PV would only be economically attractive for a heavy consumer such as an industrial site. However, with continuing falls in PV costs, residential rooftop solar in Dubai could be commercial without subsidies by the early 2020s.

Niche solar technologies may also play a role and, as can be seen on its website in an article from January 2013, 'Masdar Launches Renewable Energy Desalination Program', Masdar has a programme investigating solar desalination, with the goal of a commercial-scale plant by 2020. Storage of desalinated water can help match solar generation to demand through the seasons. Reliable and low-cost direct solar-driven cooling could represent a breakthrough for residential customers, given the heavy use of air-conditioning.

On a larger scale, GlassPoint has agreed to construct a 1021 MW equivalent solar thermal plant in Oman to provide steam for enhanced oil recovery (EOR) at the Amal heavy oil field, saving about 15 million cubic feet per day of gas. GlassPoint estimates its break-even at US$5–7/MMBtu, comparable to costs for more expensive Gulf gas fields (see the Rigzone article 'GlassPoint to Build Solar EOR Facility to Boost Oil Output at Oman Field' by Karen Boman dated 14 July 2015).

The falling oil price may have raised some questions as to whether solar power's new competitiveness would endure. Lower hydrocarbon prices are clearly an overall negative for Middle East solar power: less economic growth should calm the rampant advance of electricity demand, reduced oil revenues mean smaller budgets for pet projects, EOR projects are less attractive, while energy importers such as Dubai, Jordan, Egypt, and Morocco are enjoying more moderate bills.

On the other hand, slumping oil earnings are driving governments to look for savings, and to cut energy subsidies. As noted, solar PV is now sufficiently cheap to undercut oil, imported LNG, and higher-cost domestic gas, even at today's distressed prices. And, of course, lower oil prices naturally turn regional governments' attention to a future when their economies can no longer depend on hydrocarbon revenues alone.



Residual demand

Cautions and challenges

At the same time, it is important not to exaggerate the impact of Middle East solar power. The installed capacity today, and over the next few years, is still tiny in comparison to fossil-fuelled capacity, and even to Abu Dhabi's under-construction 5.6 GW of nuclear power.

'THE INSTALLED CAPACITY TODAY, AND OVER THE NEXT FEW YEARS, IS STILL TINY IN COMPARISON TO FOSSIL-FUELLED CAPACITY …'

Abu Dhabi and Dubai both have a target to have renewables, mostly solar, representing 7 per cent of electricity generation capacity by 2020, or around 2250 MW between them. But this would only save around 90 million cubic feet of gas per day, compared to total UAE consumption of 6.7 billion cubic feet daily in 2014. Meanwhile K.A.CARE's vast, and now unlikely, solar ambition for Saudi Arabia (in excess of Germany's entire current installed capacity) would have replaced about 2 Bcf/day of gas or 360,000 barrels/day of oil. This major contribution still has to be seen in the context of about 800,000 barrels/day of oil and 3.8 Bcf/day of gas burnt for power alone in 2012 (according to the International Energy Agency), and a demand for electricity expected to double by 2030 – from about 58 GW today to 120 GW (according to the 2014 annual reports of the Saudi Electricity Company and the Energy and Co-generation Regulatory Authority).

For solar power to take a dominant role in generation into the 2030s and beyond, it would need to address issues of its fit to demand patterns, and of integration with other generation sources. The figure above shows an illustration of residual electricity demand for a city with similar demand patterns and generation patterns to Dubai, with sufficient installed solar PV to cover peak demand in August (the highest-demand month). It can be seen that this would also cover daytime demand in February (the lowest-demand month) as lower insolation is more than compensated by the much lower demand, given reduced use of air-conditioning. But in both February and, particularly, August, there is a pronounced early evening residual peak, as the sun sets but demand rises as people return home from work.

Therefore even this extreme level of solar penetration would only cover about 40 per cent of annual demand. Increases beyond this level would require some combination of flexible generation, probably gas-fired; energy storage, whether by batteries or thermal methods; concentrated solar power with storage; electricity trading with other regions; and demand management.

So, for all the promise of solar power, truly heroic amounts will have to be installed to make an impression on the region's rampant hydrocarbon consumption. Solar will have to be part of a holistic energy policy which would include other renewables (waste, wind in the right locations, and perhaps geothermal), unconventional gas, nuclear power, and major improvements in energy efficiency, driven by the removal of subsidies.

These are questions for the next couple of decades. For now, given the new viability of solar photovoltaics, the laggards should awaken to its potential and make MENA one of the most attractive and fastest-growing markets globally, by driving costs down and building more large-scale projects. The region as a whole needs the white heat of solar technology for its energy and economic future.

The role of investors in greening MENA economies

Alissa Amico*

Although most economies in the Middle East and North Africa (MENA) region rely on natural resources – whether hydrocarbons, fisheries, or agriculture – which account for a considerable portion of their revenues, the interest in green growth has been a relative latecomer. In large part, this is due to the fact that economic growth in the region has traditionally relied on heavy industry and featured little contribution from innovative, high tech or service sectors. This corporate landscape remains dominated by state-owned enterprises and family-controlled firms, as the rate of new firm creation in the region remains the lowest globally, apart from sub Saharan Africa.

Over the past decades, the region's corporate fabric, both in terms of ownership landscape and sectoral orientation, has not been subject to notable shifts in most countries, despite efforts to develop high value-added activities and to diversify local economies, especially in the GCC countries. While the United Arab Emirates (UAE), and notably Dubai, have significantly reduced their dependence on hydrocarbons, they still account for over 90 per cent of government revenues in both Saudi Arabia and Kuwait. Cheap, subsidized energy in the Gulf has supported the development of value chains underpinned by environmentally unfriendly technologies or dependent on cheap fossil fuel inputs.

While the Arab world is heavily dependent on its natural habitat and resources, its environmental track record has generally been lacklustre in terms of carbon emissions, water pollution and depletion, and a number of other critical indicators. Yale's Environmental Performance Index (based on 20 indicators reflecting national-level environmental data for 178 countries), ranks a number of MENA countries, notably Libya, Lebanon, Morocco, and Jordan, quite poorly. Only the UAE, Saudi Arabia, Qatar, and Egypt rank among the top 50 countries, by order of performance, with the UAE ranking first in the region and at 25 globally.

'… THE MENA REGION ALREADY HAS THE WORLD'S HIGHEST LEVELS OF CARBON DIOXIDE (CO_2) EMISSIONS …'

According to the May 2013 article 'MENA Faces up to Carbon Challenge' by Justin Dargin in *Petroleum Economist*, the MENA region already has the world's highest levels of carbon dioxide (CO_2) emissions, both per capita and per dollar of manufacturing output, representing 5 per cent of global greenhouse gas emissions. This situation has a real impact on the economies of the region, not only in terms of their long-term sustainability, but also on the quality of life (relating to such factors as access to clean water and air). For example, according to the 2010 World Bank report entitled 'The Cost of Environmental Degradation: Case Studies from the Middle East and North Africa', it is estimated that environmental degradation costs Jordan 2.3 per cent of its GDP annually. Recent protests sparked by the government's failure to collect and treat waste in Lebanon serve as an illustration of how environmental degradation can spiral into political protest.

What is the urgency?

These examples highlight an urgent need in the region to scale up investment in low-carbon, more energy efficient, alternatives and to shift away from fossil fuel use. While these issues have already been touted in diversification objectives outlined by national governments (especially in the Gulf), investment in energy-efficient alternatives (such as renewable energy, environmentally friendly infrastructure, and sustainable transport systems) lags in most countries, especially in relation to the mounting threat of environmental degradation and the apparent prerogative of economic diversification. The reasons for this underinvestment reflect the diversity of the region's economies.

Increasing levels of urbanization and conflict-driven migration have put further pressure on the already overextended infrastructure, notably energy and water in countries such Jordan and Lebanon where resources are in shortage. Even prior to the Arab Spring uprisings that swept the area, it was estimated that just 3 per cent of the most densely populated areas in the region were home to 92 per cent of its population, while urbanization continued to proceeded at 3.3 per cent annually, according to the World Bank's 2011 book *Poor Places, Thriving People: How the Middle East and North Africa Can Rise Above Spatial Disparities*. Considering the significant migration flows currently being experienced across the region due to ongoing conflicts, population density is projected to grow – as is the demand for energy and water in these areas, resulting in shortages. In part responding to this, the Egyptian government has announced the establishment of a new administrative capital in proximity to Cairo; other countries in the region, such as Lebanon, are looking at this experiment quite closely.

A key reason for the scarcity of basic resources is underinvestment in utilities and network industries, which tend to be dominated by state-owned enterprises, operating either as monopolies or as oligopolies. One example of this is the water sector in Tunisia which, according to the October 2014 OECD report 'Water Governance in Tunisia: Overcoming the Challenges to Private Sector Participation', is faced with deteriorating infrastructure and declining service quality as the water supply and distribution company (SONEDE) and the national sanitation office (ONAS) are both in a tenuous financial situation. This situation is not unique to Tunisia, or to the water sector, and reveals the limits of public sector financing of infrastructure across the region.

The transition to low-carbon, greener economies in the region will require the mobilization not only of public, but also of private investment, which is not encouraged by the current geopolitical climate or existing investment frameworks, which provide few incentives for private capital. It will also require novel approaches to dealing with fossil fuel dependency fostered by subsidies. In recent years, several governments have started to build awareness around the real cost of subsidized energy and the UAE moved in August this year to remove subsidies entirely.

This step was taken by the UAE within the framework of a broader green growth approach established by its Ministry of Environment and Water and implemented through a detailed set of Green Economy Indicators, establishing measurable targets to 2021. While the UAE is the first, and for the moment the only, country in the region to establish a green growth strategy, other countries such as Saudi Arabia have announced less comprehensive, yet specific, goals. This, according to Jeffrey Ball's article 'Why the Saudis Are Going Solar' in *The Atlantic* in July/August 2015, includes the building of 41 GW of solar capacity by 2032, slightly more than that of Germany, today's world leader.

These ambitious plans have been slow to materialize, in large part due to the heavy reliance on government investment, which has been affected by lower than expected oil revenue receipts in GCC countries and fiscal instability in others. Current trends in the region point to the urgent need to scale up private investment in green investment projects, including in priority sectors such as infrastructure and utilities. However, the million dollar question is: what mechanisms can be used by governments to attract private investment in these projects and what kind of investors can be mobilized to support them?

Who are the investors?

Unlike the OECD countries, where pension funds, insurance companies, and mutual funds are the largest investors, the main sources of capital in the MENA region are sovereign investors and family offices. While their capital is mostly channelled into private companies, their investment in listed equity is also notable: according to the forthcoming OECD publication 'The Role of Institutional Investors in MENA Capital Markets' by Alissa Amico and Zeynep Ozcelik, sovereign investors account for approximately 41 per cent, and family offices for 26 per cent, of ownership of listed equity in the region. This is a reflection of the fact that the pensions and insurance industry is relatively underdeveloped in the region, but also a consequence of the history of MENA economies, where sovereign actors and large merchant families have historically acted as key motors of development.

'… THE MAIN SOURCES OF CAPITAL IN THE MENA REGION ARE SOVEREIGN INVESTORS AND FAMILY OFFICES.'

In OECD member countries, institutional investors – especially long-term investors such as pension funds – are increasingly expected to be behind the financing of green growth projects, including those involving infrastructure, although current levels of investment fall substantially short of expectations, according to the 2011 OECD working paper 'The Role of Pension Funds in Financing Green Growth Initiatives' by Raffaele Della Croce, Christopher Kaminker, and Fiona Stewart. In the Arab world, some institutional investors, notably sovereigns, have also invested in green assets and technologies. Examples of this range from Qatar Investment Authority's investment in Fisker Automotive to develop a hybrid sport car, to Taqnia's diverse investments in renewables (Taqnia being a technology arm of the Public Investment Fund, which is officially part of the Saudi Ministry of Finance). The best known illustration of large-scale investment of this kind, however, is Mubadala's subsidiary Masdar, a green city built close to the city of Abu Dhabi.

While sovereign investors have already experimented with 'green investing', these investments have been sporadic and not part of a wider strategy to channel assets to environmentally sustainable activities. An example of an investor which has embraced a more holistic approach is Norges, Norway's sovereign wealth fund (SWF), which is in the process of divesting its holdings from mining and power companies that generate in excess of 30 per cent of their output or revenue from coal. Although MENA SWFs are not major investors in hydrocarbons, considering that most oil and gas companies are held directly by governments or dedicated holding companies, this example is relevant for the region as equity markets are expected to deepen

and the role of sovereign investors is, at the minimum, expected to remain stable.

The example of Norges – which aims to mainstream environmental concerns in its investment approach – is all the more relevant given that motivating sovereign investors to channel funding towards strategic green or greener investments is potentially less challenging than asking the same of private investors. In order for private institutional investors to channel funding to green investments, greater corporate disclosure is necessary to evaluate the opportunities and risks of these investments. Environmental considerations should be integrated in the valuation methodologies since, according to the 2015 Mercer Report 'Investing in a Time of Climate Change', climate change is expected to affect not only the performance of renewable sectors but also other asset classes such as agriculture and real estate.

Integrating criteria that could capture the environmental impact of corporate behaviour in the investment strategies of institutional investors is, at least in principle, straightforward and can be rooted in a broader approach to responsible investing – often referred to as ESG (environmental, social and governance) investing. One example of a tool developed in the region that could support this approach is the S&P Hawkamah Pan Arab Index, which tracks the performance of 50 equities selected on the basis of ESG criteria.

What do investors need?

Disclosure of the environmental impact of corporate activity has developed at a slow pace in the Middle East, arguably rather slower than that of governance or social impact reporting. This is due to the fact that reporting on corporate governance is mandated by virtue of codes, which increasingly use a comply-or-explain approach whereby listed firms are asked to explain any deviations from recommended standards. Reporting on social initiatives is often fostered by firms' intrinsic interest in communicating news of such initiatives to their stakeholders as part their marketing efforts.

'DISCLOSURE OF THE ENVIRONMENTAL IMPACT OF CORPORATE ACTIVITY HAS DEVELOPED AT A SLOW PACE …'

On the other hand, no regulatory requirements on environmental disclosure are imposed by stock exchanges or securities regulators, and motivations for firms to report are less obvious. A number of blue chip firms such as Bank of Muscat, SABIC, and Agility have started to issue voluntary sustainability reports, generally inspired by the Global Reporting Initiative (GRI). These examples do not, however, represent the mainstream: a recent study from the Hawkamah Institute ('Environmental, Social and Corporate Governance Practices in the MENA Region 2007–2012') of the 150 largest listed companies from 11 MENA markets found that only about 10 per cent disclose their greenhouse gas emissions and only 7 per cent disclose water usage statistics.

Considering that most petrochemical and industrial companies in the region are unlisted, their levels of public disclosure are even lower than those in listed firms. In Saudi Arabia for example, environmental impact assessments of Saudi Aramco are required, but the results are not made public; a similar situation prevails in other countries such as Egypt. As a result, the Resource Governance Index, which measures the quality of governance in the oil, gas, and mining sector, ranks MENA countries quite low in terms of reporting practices: Saudi Arabia landing at 43, Tunisia at 47, and Qatar at 54, out of 59 countries examined.

This situation stands in contrast with international developments. Globally, practices around environmental disclosure have evolved, spurred by initiatives such as the GRI, which aims to provide a framework for sustainability reporting. A range of tools and standards on climate disclosure are now available under the Climate Disclosure Standards Board and the Climate Disclosure Project, among others. Some jurisdictions have taken a regulatory approach. For instance, the EU recently amended its Directive on Financial Reporting to require public companies with more than 500 employees to report on non-financial information, including on environmental matters.

What's next?

According to the OECD working paper 'The Role of Pension Funds in Financing Green Growth Initiatives' mentioned above, barriers to institutional investors' participation in green infrastructure may include: a weak business case, an unattractive regulatory framework, a lack of suitable financial instruments, or inadequate data for making an assessment of investments and risks. Although all of these may find an echo in the region, the business case for investing in solar power and in other types of renewable energy appears difficult to challenge in the MENA context, and suitable financial instruments to invest in these opportunities can be created.

In order to transition from ad hoc investments by large sovereign actors to mainstreaming environmentally conscious investing, frameworks for enhanced non-financial disclosure should contain guidance and mechanisms for environmental impact disclosure. Better environmental reporting can be encouraged by securities regulators and stock exchanges through regulatory and

voluntary initiatives. On the one hand, this would allow institutional investors – including foreign institutions which increasingly incorporate ESG in their decision-making processes – to create meaningful benchmarks for screening investment opportunities. On the other, it would help them understand the long-term risks associated with their investments.

As it often the case in the region, the private sector is waiting for the public sector to lead the tango. Given their natural alignment with national development targets and strategies, sovereign investors will need fewer incentives to invest in green growth. According to the 2012 report 'Procurement, Innovation and Green Growth' from the International Institute for Sustainable Development (IISD), not only do sovereign investors and state-owned enterprises have the capacity to influence local equity markets as investors, they are also able to influence firms in their value chain through procurement policies which can include 'green' considerations in the selection criteria.

Governments in the region should seek to attract private investment in green projects by promoting environmental disclosure by corporates as part of their non-financial disclosure. With better disclosure on firms' environmental impact, institutional investors such as pension and mutual funds – whose presence in MENA markets is expected to grow – will be in a better position to evaluate opportunities where green investments are competitive and, equally importantly, to engage with companies whose environmental risks they perceive as excessive. This will not only green MENA economies in the long term, but also help mitigate risks of black swan events – the dramatic consequences of which have already been seen elsewhere.

**The views expressed in this article are those of the author and do not reflect the official views of the OECD or its member countries.*

MENA countries have to bring in the private sector: a perspective from Europe

Ernesto Somma and Alessandro Rubino

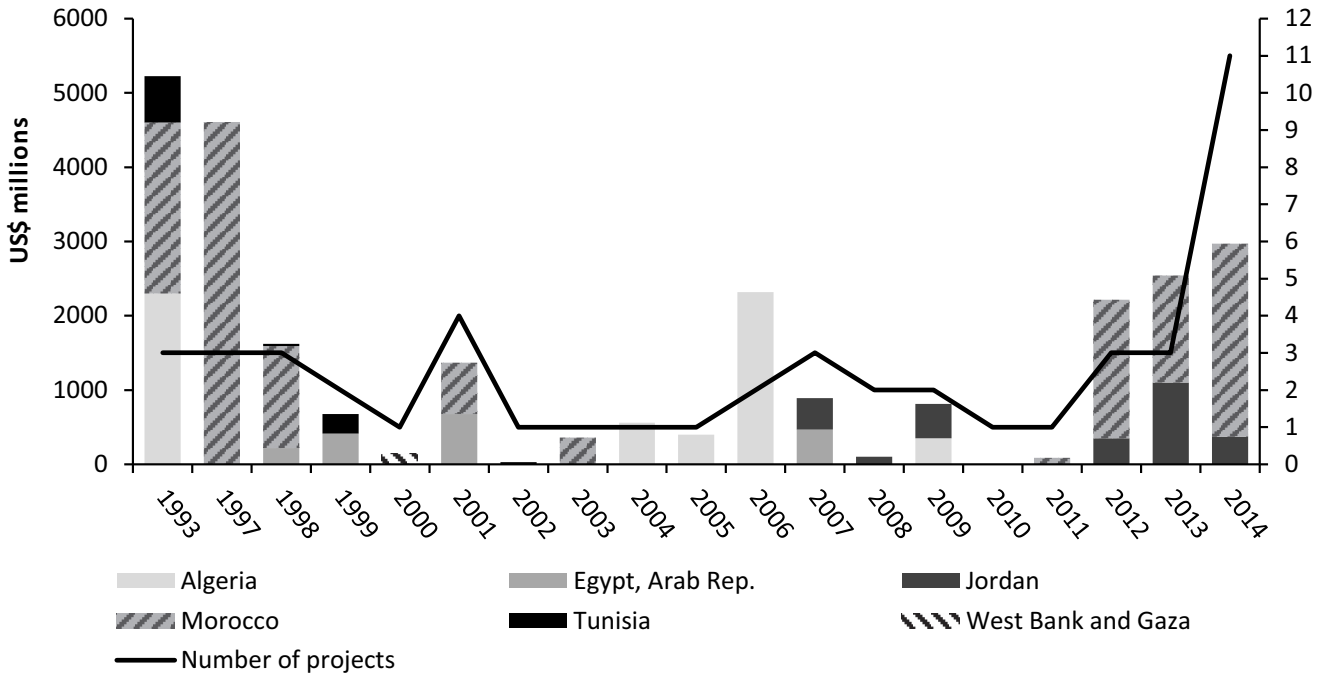
Middle East and North Africa (MENA) countries are expected to grow at twice the rate of the North Mediterranean Countries (NMCs) in the period to 2030, at which point they will make up approximately one-third of the total GDP of the Mediterranean region. According to a Observatoire Méditerranéen de l'Energie (OME) projection, over US$790 billion (700 billion euros) will be needed by 2030 to ensure the additional electricity generation capacity required. Although state-level energy policies are still dominant, it is indisputable that MENA countries will not be able to deliver investment of this variety and size solely via public budgets. Therefore new business models need to be introduced to achieve active private sector participation.

The MENA region has historically been poor in attracting private investment. Private Participation in Infrastructure

'THE MENA REGION HAS HISTORICALLY BEEN POOR IN ATTRACTING PRIVATE INVESTMENT.'

(PPI hereafter, PPP and PPI are used interchangeably) in MENA countries is lagging, both in relative and absolute terms. PPP only represented 3 per cent (around US$27.5 billion) of global investment in the region between 1990 and 2014, making this the lowest performing region globally. By contrast, the best performing region (Latin America and the Caribbean) has been able to attract more than a third of global PPP investment in energy infrastructure (US$303 billion). It is true that investment in infrastructure in North Africa and the Levant is currently recovering from the financial crisis in 2008 and the effect of the social unrest related to the 'Arab Spring' in 2011 (see the figure opposite, 'Total investment in energy in MENA'). But it is also useful to see the investment dynamic registered in different MENA countries and what interesting best practice can be picked up.

It is notable that private participation in energy infrastructure in the region experienced a 'double dip', both in 2008 (in the aftermath of the financial crisis) and in 2011 (following the outbreak of the 'Arab Spring'). The volume of investment now is just above the pre-2008 level; however, in the years since 2009 PPP investment in energy has only taken place in two countries, Morocco and Jordan. Eleven projects were closed in 2014 (ten in Jordan, one in Morocco) for a total of US$2.9 billion – an increase of 17 per cent on a year-on-year basis. This healthy performance has been achieved with the conclusion, since 2012, of a total of 17 new projects, 15 of which are in renewable generation.



Total investment in energy in MENA: PPP in energy (by year)

Source: Authors' elaboration based on World Bank and PPIAF, PPI Project Database (http://ppi.worldbank.org) 11 July 2015

Bringing in the private sector

The level of private sector investment depends on a number of factors. Within this long list, it is interesting for us to identify those that have played a significant role in the energy context for MENA countries. We can group these factors into three main categories:

- Factors that determine whether governments will engage in public–private partnerships (PPPs);
- The underlying context, in terms of the overall macroeconomic environment;
- Factors that affect the incentive and motivation of the private sector to enter into a PPP.

In relation to the first group, most MENA countries, in order to raise the expected level of investment for generation infrastructures over the next 15 years, are devoting increasing attention to developing an investor-friendly environment. Some of the most recent energy policies, including the establishment of national Renewable Energy Source (RES) targets and feed-in tariffs for newly added renewable generation, have been set up to encourage private participation in energy investment and to signal a gradual opening of internal markets. As of today, all countries in the region have announced targets for the deployment of renewable technologies in their energy systems.

'THE INSTABILITY OF THE REGION INHERENTLY CREATES UNCERTAINTY ABOUT THE FUTURE, MAKING LARGE UPFRONT COMMITMENTS DIFFICULT.'

The second group of factors depends on the general framework under which infrastructure investment takes place. In addition to the strong demographic growth that resulted in a bottom-heavy population pyramid, the IMF *World Economic Outlook* expects an average GDP growth of 5.1 per cent up to 2018. While these factors have typically led to an expansion of infrastructure needs, recent political developments have led to a contraction of fiscal space. The instability of the region inherently creates uncertainty about the future, making large upfront commitments difficult. The political stability score, as defined by the Worldwide Governance Indicators project (WGI) of the World Bank, is significantly lower, on average, for the MENA region, when compared to other regions in the database. According to the WGI project, within the MENA region Morocco and Jordan are relatively politically stable, with a score respectively of 2 and 1.88 (zero = weak; five = strong), against an average of 1.71 in the region. As a comparison, the score for Egypt in 2013 (last observation available) was 0.88.

Finally, the third group of factors takes into consideration all those aspects considered critical by private investors such as: an adequate regulatory framework, proper enforcement of laws, and the independence of the regulatory system. The Regulatory

Quality (RQ) score represents a synthetic indicator that can reflect those aspects. According to this indicator, Morocco and Jordan are above the regional average, with scores of 2.33 and 2.61 respectively (zero = weak; five = strong, again according to the WGI project). As a benchmark, for the same indicator, the score registered in Algeria is 1.31 and in Egypt is 1.8.

Morocco's gradual energy strategy

The seeds of this success, relative to the performance of the overall MENA region, is evident in cases such as Morocco and Jordan. The process of energy sector liberalization in Morocco dates back to 1995, when a first liberalization strategy (to liberalize power generation) was introduced. However, it was only at the end of the last decade that the government of Morocco considered a more far-reaching energy strategy, to respond to the challenges that this sector represents for the country. In 2009, the Moroccan government developed a national energy strategy that focused on achieving tangible results and attaining precise targets:

- Establish an optimized fuel mix;
- Increase deployment of renewable technologies;
- Promote private investments;
- Promote energy saving and use efficiency;
- Promote regional integration.

Accordingly, additional power capacities were scheduled to be added by the year 2020. In addition, Morocco launched its renewable energy programme, which consists of achieving overall installed capacities of 2000 MW wind energy and 2000 MW solar energy, and of increasing its hydropower capacity to 2000 MW, by 2020. To achieve the renewable energy targets a new institutional framework was set up which resulted in the creation of:

- The Moroccan Solar Energy Agency (MASEN) to pilot the solar programme (Plan Solaire),
- An energy investment firm to promote private investments in energy sector,
- An institute (IRESEN; L'Institut de Recherche en Energie Solaire et Energies Nouvelles) to promote research, innovation, and development in the energy sector.

Meanwhile, the government started to update, renew, or set new rules in the legal and administrative framework related to power generation, transmission, and distribution with special focus on renewables. Therefore, within the Moroccan context, a variety of stakeholders are concerned with renewables. The existence of this institutional stakeholders' arena demonstrates the high level of interest that Morocco has in renewable energy in particular, and in sustainable development in general. As a result Morocco was able to feature among the top six destination countries for energy investment between 2012 and 2014, attracting nearly US$6 billion of PPP (representing 5.6 per cent of the total investment in the period considered).

'… THE TREND FOR PUBLIC–PRIVATE PARTNERSHIPS IN THE ENERGY SECTOR IS ROBUST IN MOROCCO …'

Four large projects were financed. However, the lack of incentives and regulatory framework for distributed generation and small-scale projects (such as roof top PV), as well as the lack of any specific indication in relation to the type of technologies targeted by the Plan Solaire, prevented market expansion. For instance, a system of feed-in tariffs is still missing, while net-metering schemes have been under discussion for a very long time now with no concrete progress. Thus, the current legal and administrative frameworks do not yet enable an effective development of small and medium-scale renewable energy projects. Notwithstanding these possible downsides, the trend for public–private partnerships in the energy sector is robust in Morocco and is driving a slow, but steady transition toward a sustainable energy system.

Renewable energy in Jordan

The policy of the Government of Jordan in the field of energy was shaped through the adoption of the updated National Energy Strategy (NES) in Jordan for the period 2007–20. The main goals of the Energy Strategy are:

- The provision of a reliable energy supply by increasing the share of local energy resources in the energy mix;
- Reducing dependency on imported oil;
- Diversifying energy resources;
- Enhancing environmental protection.

These goals are to be achieved through maximizing the utilization of domestic resources such as oil shale and natural gas, expanding the development of renewable energy projects, and promoting energy conservation and awareness.

Jordan's government has underlined its commitment to reach these ambitious targets and issued the Renewable Energy and Energy Efficiency Law on 17 April 2012. With this law, for the first time, unsolicited or direct proposal submission is allowed, where investors have the opportunity to identify and develop renewable grid-connected electricity production projects on their own and propose them to the Ministry of Energy and Mineral Resources. The Tafila wind power project, with a capacity of 117 MW, was the first project to be undertaken through the direct proposal process.

Specifically, the government invited developers to submit expressions of interest for the development of renewable projects, indicating the maximum tariffs that the government would pay for different types of renewable power. In the developers' expression of interest, the land required for the project and the proposed size and type of facility had to be identified. Memoranda of understanding are issued for expressions of interest which are acceptable to the government; these provide developers with an exclusivity period of 24 months, during which time they are required to develop the project, sign project agreements with the government, and reach financial closure.

As a result of the introduction of this bottom-up approach, 13 PPP projects were developed between 2012 and 2014, amounting to an investment commitment of US$1.8 billion. The number of requests for the connection of renewable energy systems, according to the Net-Metering system, has reached 430 requests with 12,352 kW of capacity; of these, 291 (with 2554 kW of capacity) were connected and in operation during the year 2013.

Looking forward

Public–private partnerships are expected to play a growing role in infrastructure investment because they represent a shortcut to the modernization of the energy sector and the provision of much-needed infrastructure. Different strategies are possible to achieve the attraction of private stakeholders. The two most successful cases in the MENA region illustrate that both decentralized and centralized models can be viable.

'PUBLIC–PRIVATE PARTNERSHIPS ARE EXPECTED TO PLAY A GROWING ROLE IN INFRASTRUCTURE INVESTMENT …'

In the first case, positive results have emerged from Jordan following an attempt to promote widespread diffusion and social acceptance of RES, while promoting, at the same time, domestic and residential installations. Decentralized energy projects are also promoted as part of government's localism and rural development agenda, as citizens, rural communities, local authorities, and private organizations are now involved in energy projects and investments, thus developing solutions that meet local needs and involve local stakeholders.

In contrast, Morocco has promoted a centralized investment strategy, to attract a few flagship projects, in combination with a policy to develop, at the same time, green growth and a RES industrial sector. This main strength of the policy framework also represents the main limitation of the Moroccan renewable energy strategy – that it is focused solely on large-scale projects.

The evidence collected illustrates the fact that stabilization of the remuneration provided with the most common regulatory tool for RES technologies (in particular a RES quota and target) is essential to provide the necessary guarantees, and certainly represents a positive step toward RES penetration. However, while widely diffused, such measures need to be accompanied by a long-term strategy – one capable of generating an environment conducive to investment – in order to become effective. In such a framework, the strategies adopted in Morocco and Jordan, although different in their approach, have been able to provide these preconditions. These two approaches can well represent possible alternative models for the active participation of the private sector in energy investment. To this end, recent policy development, particularly in Egypt and Algeria, testifies for a move toward a more sustainable and investment-friendly environment in the region.

Kuwait needs to rethink its energy mix

Osamah Alsayegh

The Stone Age did not end because we ran out of stones; we transitioned to better solutions (Steven Chu and Arun Majumdar, Nature, August 2012).

We all know that the oil dominance era will not end because we will run out of oil; it will fade away because the world will have alternative options.

Countries with economies that are highly dependent on oil exports and excessive energy intensity (energy consumed per unit of GDP), such as Kuwait, will be significantly impacted if sustainable energy measures and economic diversification actions are not adopted.

The expected decline of oil demand in the long term is suggested by evidence already in existence. Each year, new policies are enacted toward the mitigation of greenhouse gas (GHG) emissions; these require the continuous development of energy efficiency measures and increased use

of clean energy sources (renewables, biofuel, and nuclear). The recent United Nations Framework Convention on Climate Change (UNFCCC) event that was held in Lima, Peru, in December 2014, issued a decision entitled 'Lima Call for Climate Action'. This suggests replacing the Kyoto Protocol with a commitment which would be binding on all countries (rich and poor alike, but with different responsibilities with respect to mitigation, adaptation, finance, technology development, and capacity building) to mitigate GHG. The Lima conference is to be followed by COP21, which will be held in Paris, France, in December 2015; this event is seeking a legally binding agreement on climate from all the nations of the world. The expected impact of the various policies involved has been taken into consideration and its effect on oil demand has been simulated. The 2013 IEA World Energy Outlook and the OPEC World Oil Outlook have projected that global oil demand will decline by 5 per cent and 6 per cent, respectively, from 2010 to 2035.

In addition to the impact of environmental concerns, technological advances have been pushing toward the discovery of new and unconventional energy sources (shale oil/gas) that have been competing with conventional sources and taking part of their market share. Moreover, new (East Africa) and resuming (Libya, Iran, Iraq) oil producers are expected to compete for market share with current oil producers. For a country such as Kuwait, that has about 95 per cent of its revenues coming from oil and oil product exports, this would mean gradually losing part of its market share which would, consequently, affect its economic development.

The State of Kuwait is aware of the impending challenges created by the dynamic changes affecting the world energy system, and of the considerable impact on its socio-economic development. A number of government, private, and civil society organizations have made sincere efforts to advance economic diversification and energy sustainability practices through energy efficiency and renewable energy programmes over more than three decades. Yet Kuwait is still considered as being among the highest energy consumers and carbon emitters per capita. Energy sustainability indicators, such as energy intensity (consumed energy unit per GDP unit), confirm the unsustainable nature of Kuwait's energy system. According to IEA statistics, Kuwait's energy intensity index shows that the cost of converting energy into GDP has an average annual growth rate of 2.0 per cent. These indicators call for serious investigation to identify the barriers to energy sustainability in Kuwait.

'ABOUT 60 TO 70 PER CENT OF GENERATED ELECTRIC ENERGY IS CONSUMED BY A/C SYSTEMS DURING PEAK HOURS IN THE SUMMER.'

Drivers towards unsustainable energy

The energy system of Kuwait, unlike that of most countries, is simple. Crude oil and natural gas are currently the only primary energy sources. Power plants (which are co-generation plants that produce electricity and potable water) and refineries are its main energy conversion systems, and energy end-use services are mainly driven by electricity, oil products, and petrochemical products. The main end-user sectors include transportation, industry, residential, and commercial.

The key natural forces that push toward unsustainable energy status are harsh weather and the lack of resources, such as fresh water, supporting life. The land area of the State of Kuwait is 17,818 km^2. Most of its mainland is a flat sandy desert. The weather is characterized by long, hot, and dry summers (from April to October) and short, warm, and sometimes rainy winters (December to February). Dust storms occur frequently, with a rise in humidity, during late summer. The typical extremes of ambient temperature, over winter and summer, range between 0 °C and above 50 °C. Air conditioning (A/C) use through the summer seasons is necessary for human health and the ability to work. A number of studies carried out by the Kuwait Institute for Scientific Research (KISR) show that about 60 to 70 per cent of generated electric energy is consumed by A/C systems during peak hours in the summer seasons. Moreover, and because of the lack of fresh water, more than 95 per cent of potable water in Kuwait comes from energy-intensive seawater desalination. It is estimated that about 30 per cent of the energy consumed in power plants goes to desalination units (which are mostly multi-stage flash technologies).

In addition to the environmental conditions (which are beyond human control), unsustainable consumption in Kuwait is also driven by a lack of energy demand-side management and by unexploited renewable energy sources. Currently, the average ratio of domestic energy consumption to total energy production is about 20 per cent, according to OPEC data from 2013. The dominant domestic consumer is the electricity and water sector that consumes about 11 per cent of total energy production. The industrial and transportation sectors receive about 5 per cent and 4 per cent of total produced energy, respectively. The annual average consumption growth rate has been about 5.0 per cent for the past 10 years, according to data from Kuwait's Ministry of Electricity and Water.

About 70 per cent of the power plants' input supplies are liquid fuels (oil

'… THE ENERGY DEMAND OF THE ELECTRICITY AND WATER SECTOR WILL INCREASE BY 65 PER CENT IN THE COMING 20 YEARS.'

and oil products). The remaining 30 per cent is natural gas. It should be mentioned that Kuwait imports about 15 per cent of its gas demand, while its domestic gas source is associated gas. The end-users of the electricity and water sector include residential, commercial, and government buildings, and others (light industries and agriculture). Annual per capita consumption has reached 16.6 MWh and, consequently, the annual per capita carbon dioxide (CO_2) emission is currently around 31.0 tons. Given the status quo (lack of demand-side management measures), it is expected that the energy demand of the electricity and water sector will increase by 65 per cent in the coming 20 years. It is challenging to keep up with such growth – it leads to an unsustainable growth in demand for energy which has, up to now, been met entirely by fossil fuels in Kuwait.

One can see that the challenges are not related to the issues of depletion or lack of energy sources. The challenge is that rapid growth of domestic energy demand is leading to the reduction of oil and oil products export revenues. Since Kuwait is an oil-based economy, the reduction of oil revenue would have a direct negative impact on the development of the country's socio-economic sectors (education, health, civil infrastructure, etc.). Furthermore, the oil market is not stable, and oil prices can fluctuate drastically. Evidence of such a fluctuation was witnessed in the recent oil price drop from about US$110/barrel in June 2014 to US$48/barrel in January 2015. Moreover, GHG emissions are another challenging consequence of oil consumption. The international community's concern about the increasing global temperature has led to the enactment of various policies to mitigate GHG emissions. Such policies might, in the future, constrain Kuwait's fossil energy use and exports, through penalty taxation and other economic sanctions.

Efforts toward energy sustainability

For the past three decades, the government and private sectors and civil society organizations in Kuwait have proposed, developed, and worked on measures toward energy sustainability. The key actions include:

Energy Efficiency Building Code. The building code was first issued and put in action in 1983 by the Ministry of Electricity & Water and has been frequently modified since then. However, enforcing the code effectively has been a major challenge so far.

Solar Energy Program. In the early 1980s, KISR established a Solar Energy Program that carried out research and development (R&D) activities focusing on exploitation of solar energy for electricity generation, steam production, cooling, agriculture, and water desalination applications. The program was disbanded in the late 1980s for economic reasons, when oil prices reached a record low.

Renewable Energy Program. Since the mid 2000s, KISR has revived R&D work in solar energy and tackled other renewable energy and related technologies including wind and energy storage. Renewable R&D activities have also been carried out by Kuwait University.

Meeting 15 per cent of the Demand Through Renewable Energy by 2030. His Highness, the Amir of the State of Kuwait, Sheikh Sabah Al-Ahmad Al-Sabah, announced in the opening ceremony of the United Nations 18th Conference for Climate Change on 4 December 2012 in Doha, Qatar, that Kuwait will meet 15 per cent of its energy demand from renewable sources by 2030. This announcement is considered to be a general policy towards the adoption of renewable energy systems in the country.

Shagaya Renewable Energy Park. Shagaya is a multiple renewable energy technologies (photovoltaic, concentrated solar power, and wind) utility-scale plant with total planned installed capacity of more than 2000 MW. Shagaya Phase-1 is currently being constructed and is expected to be commissioned by 2017. It has a total installed capacity of 70 MW. In Shagaya Phase-2, the installed capacity will reach 1,000 MW and it is expected to be commissioned by 2025. The total installed capacity in the third and last phase of Shagaya will extend to more than 2000 MW by 2030.

Building Integrated Photovoltaic (PV) Systems. In order to realize H. H. the Amir's call to exploit renewable energy to meet 15 per cent of demand, a number of government and private organizations have started to integrate PV systems with their buildings, making use of their roofs and car ports. An initiative is currently being led by the Kuwait Foundation for the Advancement of Sciences (KFAS) to install rooftop PV systems on 150 residential homes with an estimated total capacity of 1.5 MW.

Environmental Protection Law. The Kuwaiti parliament has recently approved the Environmental Protection Law Number 42 for the year 2014. This law aims to protect human health, the environment, and natural resources, and control pollution. A numbers of its articles address energy issues involving the enforcement of energy efficiency measures and the use of clean energy technologies.

Thus far, even with the aforementioned actions toward sustainability, Kuwait's energy intensity performance has not improved. Indeed, the latest IEA statistics show that its energy intensity increased from 0.49 kWh/US$ in 2005 to 0.56 kWh/US$ in 2012. There are numerous factors underlying the deficient behaviour of Kuwait's energy system; these are discussed in the following section.

Barriers toward sustainability

The main barriers to energy sustainability in Kuwait involve, but are not limited to:

Undefined goals with respect to energy efficiency and conservation in terms of:

- Quantity and quality, for example, an energy saving target that is based on total consumption, per capita, or GDP. In other words, how much do we want to save? Is the indicator based on per capita savings, energy intensity improvement, or some other measure?
- Time duration needed to achieve the energy saving goals.

Lack of an implementation roadmap strategy that has clear and achievable milestones. In 2012, KISR developed such a roadmap for the deployment of renewable energy systems to meet 10 per cent of the demand. However, it has not been utilized due to the absence of a mandated authority to implement it.

Lack of an authority that is empowered with legal framework to follow up and enforce energy sustainability in the country. So far, a number of fragmented efforts have been carried out by a range of public and private organizations. Such efforts need to be concentrated in order to reach the intended goals more effectively. A national authority is needed to coordinate the efforts of the energy stakeholders and to be responsible for the development and implementation of the energy roadmap strategy.

Political pressure. The continual political pressure to provide substantial energy subsidies has been the key barrier toward sustainability in Kuwait. In 2011, the total energy subsidy in Kuwait was US$11.1 billion, which represented 7 per cent of GDP (see Jim Krane's article in this issue). The government has advised in favour of, and has attempted to pass, a number of propositions to increase the energy tariff. However, all of these attempts have been vetoed by the parliament.

Necessary actions

These barriers can be addressed through short/medium and long-term actions. Within the short and medium terms (five to ten years), an energy consumption labelling system for appliances could be developed and applied, to encourage the use of energy-efficient systems. Moreover, the present building code may be revised to reduce energy consumption per building area unit further, and put restrictions on the building areas. In addition to appliance and building code development and improvement, legislation for energy efficiency and renewable energy must be developed and applied, in order to regulate related applications, deployments, pricing policies, and financial incentives, etc., to stimulate sustainability practices. Furthermore, there must be promotion of energy service companies, to advance energy efficiency practices and renewable energy deployment. A national entity – such as a National Energy Council – must be established to manage energy resources, impose energy efficiency measures, and sustain the deployment of renewable energy systems. Such a body would have a mandate to secure the energy supply and to enforce efficient energy use, in order to assure socio-economic development and environmental sustainability.

'… LEGISLATION FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY MUST BE DEVELOPED AND APPLIED …'

For a long-term strategy for action, the education system should be developed to embed a culture of responsibility toward sustainability. Additionally, such a strategy ought to embrace a communication plan to disseminate to the public the importance of, and need for, sustainability. Such a strategy would support investment in long-term R&D programmes that are adapted to the nature of Kuwait's energy challenges.

Renewable energy can drive job creation in the GCC

Rabia Ferroukhi and Arslan Khalid*

As global economies continue to struggle with remnants of the persistent economic crisis, unemployment and its associated social and economic impacts remains a key concern and an instrumental driver of public policy. Renewable energy offers considerable potential for gross job creation. In fact, according to estimates in the

document 'Renewable Energy and Jobs: Annual Review 2015' published by IRENA, the sector (excluding large hydro) supports around 7.7 million direct and indirect jobs globally. Project level data indicates that, on average, renewable energy technologies create more jobs than fossil fuel technologies. For instance, solar photovoltaic (PV) creates at least twice as many jobs per unit of electricity generation as either coal or natural gas. According to the UK Energy Research Centre document 'Low carbon jobs: The evidence for net job creation from policy support for energy efficiency and renewable energy' published on 5 November 2014, renewable energy deployment is also associated with net job creation throughout the economy, although the magnitude varies by country and with the mix of technologies and policies deployed. Therefore, countries in the GCC can expect significant job creation through renewable energy deployment in addition to other benefits such as emission reductions and fuel and water savings.

Growth driving jobs

Over the past 20 years, rapid economic growth has been the primary driver of job creation in the region, with the public sector as the leading employer. The career opportunities offered by the public sector, and the comparison with private sector wages, made these jobs more attractive to nationals. Public sector employment, however, has been growing at a slower pace than private sector. In addition, while governments have traditionally relied on the public sector to absorb the growing national workforce, budgetary concerns are driving efforts to implement employment strategies that can increase national participation in the private sector. According to the document 'Labor Market Reforms to Boost Employment and Productivity in the GCC: an Update' prepared by IMF

'… ON AVERAGE, RENEWABLE ENERGY TECHNOLOGIES CREATE MORE JOBS THAN FOSSIL FUEL TECHNOLOGIES.'

staff for the annual meeting of ministers of finance and central bank governors (on 25 October 2014 in Kuwait City), factors such as the saturation of the public sector, the unattractiveness of private sector opportunities, and the relative lack of required skills coupled with a rising population have resulted in a significant employment problem for the region's young people. (The document 'Rethinking Arab Employment: a Systemic Approach for Resource-Endowed Economies', part of the New Vision for Arab Employment Initiative of the World Economic Forum World Economic Forum, published in October 2014, indicates that youth unemployment rates are high: 28 per cent in Saudi Arabia and Bahrain, 21 per cent in Oman, 9.2 per cent in Kuwait, 11 per cent in the UAE, and 1.7 per cent in Qatar. In contrast, it notes that overall unemployment rates are lower than the global average: 5.6 per cent in Saudi Arabia, 7.4 per cent in Bahrain, 8.1 per cent in Oman, 1.5 per cent in Kuwait, 3.8 per cent in the UAE, and 0.6 per cent in Qatar.) The creation of employment opportunities in all sectors of the economy will be essential in addressing this issue in the future. It is in this context that renewable energy can contribute to the solution.

All the GCC countries have announced renewable energy targets and plans to define the long-term vision for energy sector diversification. Despite relatively slow progress over the past few years, decreasing technology costs (especially in solar PV) show promising signs. This is best illustrated by the recent 200 MW PV plant in Dubai, where the record-breaking bid of US¢5.84/kWh has set a new benchmark for solar PV projects. Several initiatives followed suit, reviving hopes that GCC aspirations for renewable energy can be met. These include the tripling of Dubai's target, the revival of plans for the 100 MW PV plant Nour 1 in Abu Dhabi, the announcement of a 50 MW solar PV plant in Saudi Arabia by Taqnia, and the announcement of a 1 GW solar thermal facility in Oman for enhanced oil recovery.

The completion of renewable energy plans in the GCC could result in the deployment of more than 70 GW by 2030 (in the absence of any national technology-specific targets we assume that the shares of the technologies are as follows: 60 per cent PV, 30 per cent concentrated solar power (CSP), 5 per cent wind, and 5 per cent waste-to-energy). Such a deployment would potentially create a significant number of jobs along the value chain (results are derived from IRENA estimates that use an employment-factor approach). This could generate an average of 137,000 direct jobs every year between now and 2030 (direct employment is generated by core activities, without taking into account the intermediate inputs necessary to manufacture equipment or to construct and operate facilities), with Saudi Arabia in the lead at 70 per cent.

Solar technology will lead job creation

Given the abundance of solar resources in the region, employment in the renewables sector will be led by solar technologies, with CSP and PV accounting for around 75 per cent of the jobs in 2030. Massive deployment of CSP in Saudi Arabia, and to some extent in the UAE, could result in around 71,000 jobs, making it the largest technology by numbers employed, followed by PV at 32 per cent of the jobs in 2030. According to the forthcoming IRENA paper 'Gulf Cooperation Council Regional Energy

Market Analysis', waste-to-energy and wind energy – important elements in the plans of some GCC countries – could support about 15 per cent and 12 per cent of the jobs in 2030.

Looking at the different segments of the value chain, *construction and installation* will undoubtedly create the largest number of jobs in the sector in the early stages of deployment. However, as markets mature and local manufacturing increases, the share of jobs in the *manufacturing* segment is likely to rise. Moreover, as greater capacity is installed, a larger workforce for the *operation and maintenance* (O&M) of existing plants will be required, resulting in an increase in its share.

'REGIONAL TRENDS INDICATE THAT THE CONSTRUCTION AND INSTALLATION SEGMENT IS INDEED LEADING JOB CREATION.'

Regional trends indicate that the construction and installation segment is indeed leading job creation. Developers have been involved in projects in the GCC and in the broader MENA region (in countries such as Jordan, Morocco, and Egypt). ACWA power, for instance, has been developing/running renewable energy projects in South Africa, Morocco, and Bulgaria since 2012, and is now developing the 200 MW PV plant in Dubai which is expected to create 1,000 jobs.

Although not comparable to mass manufacturing and low-wage markets such as China and south-east Asia, the GCC region has the potential to create jobs in the manufacturing segment of PV and CSP, given its relative advantage in lower energy prices. The case for equipment manufacturing for local use is further strengthened by the presence of synergistic domestic industries such as: glass and petrochemical industries for PV; and cement and metal industries for foundations and fixtures for PV, CSP, and wind farms.

Though solar equipment manufacturing in the region remains small, interest in localizing different segments of PV manufacturing is rising. According to Robert Kennedy's *Aljazeera* article 'Qatar Sheds Light on Its Solar-Power Future' from 8 June 2014, module production has been taken up by Qatar Solar Energy, which established a 300 MW facility in Doha, with a goal of producing 2.5 GW in the long run. The competitive advantages, together with the future market potential of the region, is attracting foreign investors such as SunEdison which, according to a statement released by the company on 4 February 2014 ('SunEdison, PIF, Sanabil Investments Take Steps To Advance Solar Energy Industry In The Kingdom Of Saudi Arabia') is conducting feasibility studies for a 3 GW panel production facility. Saudi Arabia has also announced plans (reported in a Gulf Research Center paper 'EU–GCC Renewable Energy Policy Cooperation: Exploring Opportunities' published in December 2013) for a 10,000 tons per annum polysilicon production facility in Yanbu Industrial City, which is expected to create 1,000 local jobs.

While the opportunity for renewable energy job creation across the segments of the value chain is clear, maximizing its potential will require appropriate policy and regulatory frameworks that encourage deployment, stimulate investment in local industries, strengthen firm-level capabilities, and promote education and training.

Stable and predictable policies will be key

It is important to highlight the fact that stable and predictable deployment policies and regulations will play a central role in creating a thriving renewable energy market; this is essential for attracting sizeable investment into the local value chain and creating jobs. In addition, capacity-building activities that develop the necessary skills, coupled with constructive labour policies, can facilitate the integration of labour resources into the renewable energy sector. However, in order to maximize job creation throughout the renewable energy value chain, GCC countries may need to adopt a range of industrial policies that encourage the development of the domestic industry from both the demand and the supply side.

On the demand side, incentives such as local content requirement (at least in the early stages of deployment) can be introduced to support a young domestic industry and generate demand for local equipment and services. On the supply side, governments can support the establishment of a domestic industry by providing guarantees and low-cost financing, promoting research and development, arranging technology transfer, and training human capital. Finally, governments can further promote the establishment of the renewable energy value chain through direct public investment in flagship projects and/or in public private partnerships.

Renewable energy education and training are of particular relevance in creating an enabling policy framework that can maximize job creation for the growing number of nationals entering the labour force. Opportunities for renewable energy employment will include a broad range of occupations and skill requirements. Skilled technical jobs (for those such as scientists, engineers, and designers) will continue to be filled by experienced international professionals, with increasing participation from nationals

supported by education and training. As the industry develops over time, the share of low-skilled technical jobs (such as PV panel cleaners and factory workers) is expected to decrease through process improvement and mechanization. Such low-skilled jobs should be replaced by opportunities for a smaller number of high-skilled workers, providing further chances for trained nationals. Finally, the sector could create other types of employment, including commercial, financial, legal, and policy-related opportunities.

Resilience through renewables

According to the paper 'Impact of the Global Financial Crisis on GCC–UAE's Banking Sector' by Hoda Jaber, published by the British University in Dubai on 1 February 2012, the economies of the GCC have been relatively more resilient in the aftermath of the global economic crisis. However, the recent collapse in oil and gas prices is prompting a rethinking of the region's development strategies. With an uncertain economic outlook and rising populations, any failure to address appropriately the needs of a large domestic population entering the labour market could pose certain challenges. Therefore, job creation is a central priority for the GCC governments.

Renewable energy offers considerable potential for job creation in the energy sector and in the broader economy. Successful implementation of renewable energy plans in the GCC could generate an average of 137,000 direct jobs every year along the value chain. While most of these jobs would initially be created by project developers in the construction and installation segment, employment in the other segments is likely to increase as the domestic industry matures. However, maximizing the job creation potential of renewable energy will require policies that encourage deployment, strengthen firm-level capabilities, enable investment and technology transfer, and promote education and training. The GCC countries have been blessed with hydrocarbon resources that have fuelled development over the past decades. Going forward, the abundant solar resources of the region can stimulate economic growth and provide employment for future generations.

**The opinions expressed in this article are those of the authors and do not necessarily represent the views of International Renewable Energy Agency's Secretariat or member countries.*

Energy productivity, the new frontier for GCC countries

Waleed Alsuraih

The recent decline in oil price – the largest in terms of annual average when compared to those of 1986 and 2009 – turned the 2014 budget surplus for Gulf Cooperation Council (GCC) countries into a deficit of about 8 per cent of combined GDP in 2015, according to the International Monetary Fund (IMF). Since 2014, natural gas prices have also shown a declining trend, although not as pronounced as oil. In response, governments have dug into their reserves and are tapping new sources of financing, particularly government bonds. Global estimates show the oil price may remain depressed for the foreseeable future, implying slow recovery in the short to medium term.

'THE DEMAND FOR DOMESTIC ENERGY IN GCC COUNTRIES HAS BEEN GROWING FASTER THAN THEIR GDP …'

The demand for domestic energy in GCC countries has been growing faster than their GDP (an average of 5 to 9 per cent a year from 1980 to 2014). This rate of growth is unsustainable, however, as GCC governments face significant difficulties in balancing their budgets, mostly due to the rising costs of fossil fuel subsidies relative to their GDP. For the GCC economies, the challenge of diversification remains, as their growth is still not of a type designed to reduce their reliance on oil revenues, let alone to increase private sector jobs for citizens, strengthen human capital, and promote more sustainable development.

Under the old social contract, oil revenues (which represented about 80 per cent of total revenues in the GCC in 2013) delivered economic development and substantive societal benefits for three and a half decades. This was done through the provision of highly subsidized fuels and other services on the domestic market, and the sale of oil at overseas international prices. This level of government spending is unlikely to be maintained, however, because a return to high oil revenues is uncertain in the short term. In GCC countries, the growth in total factor productivity – a measure of an economy's efficiency and technological sophistication – has

been consistently negative (although according to IMF figures from 2013 Saudi Arabia, which has recently showed modest positive growth in the non-oil sector, is an exception). This is not surprising, as economies with large energy subsidies tend to attract investment in energy-intensive industries that rely on low energy costs, often at the expense of labour-intensive sectors, manufacturing in particular.

In essence, fuel subsidies act as a tax on labour. A number of GCC governments have begun the gradual process of reducing energy subsidies, but this will take some time. Such a situation begs the question of whether there are other paths towards diversifying their economies to help generate jobs, reduce exposure to the vagaries of the global oil market, and sustain economic prosperity in the GCC.

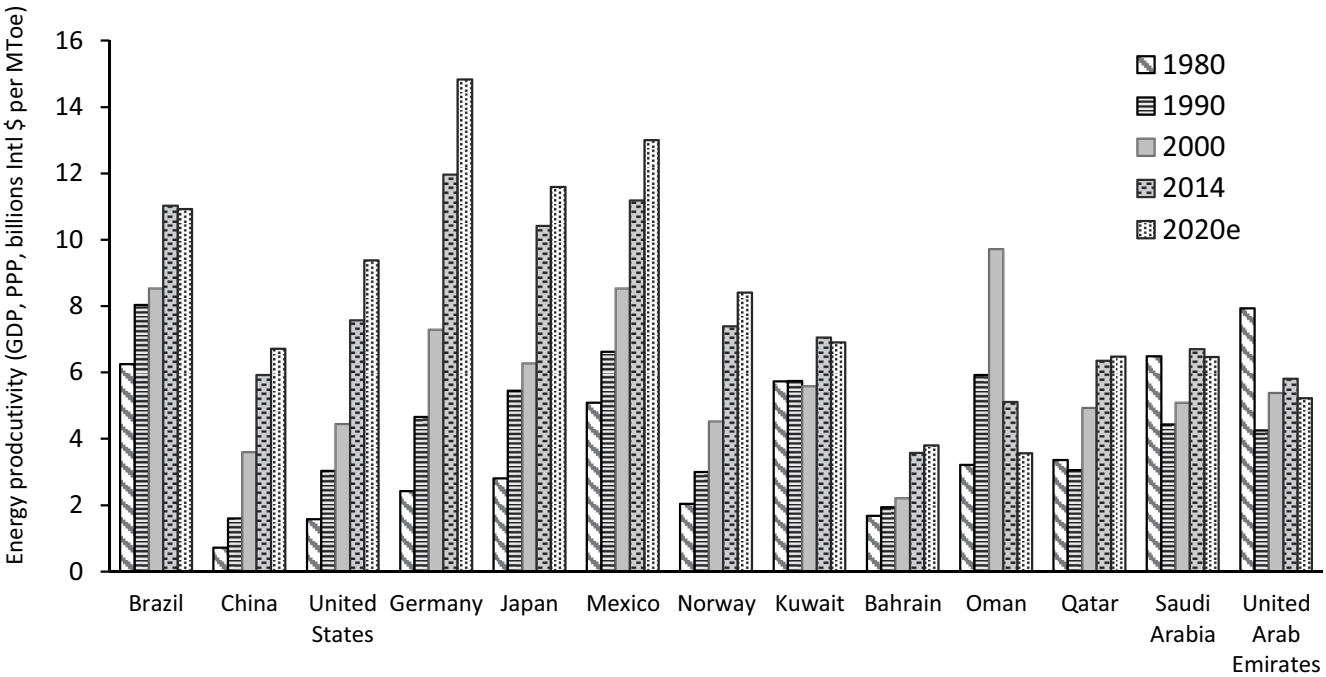
Evolution of energy productivity in the GCC

If there is a good time for the GCC countries to place energy productivity at the core of energy sector priorities and policies, it is now. Energy productivity is a measure of the economic output that can be created from a unit of consumed energy. An energy productivity target would enable GCC countries to generate more wealth per unit of energy consumed, and to go beyond a focus on energy efficiency, towards optimizing energy use. Increased energy productivity would enable the GCC countries to identify levers for maximizing growth and boosting the competitiveness of their economies.

'ENERGY PRODUCTIVITY IS A MEASURE OF THE ECONOMIC OUTPUT THAT CAN BE CREATED FROM A UNIT OF CONSUMED ENERGY.'

From 1980 to 2014, Bahrain led the GCC countries with 2.3 per cent annual growth in energy productivity, followed by Qatar (1.9 per cent), Oman (1.6 per cent), Kuwait (0.6 per cent), and Saudi Arabia (0.1 per cent), while the United Arab Emirates (UAE) had a declining trend of –0.9 per cent. Interestingly, Bahrain had the most diversified export structure and the highest energy intensity (albeit this has been declining). Saudi Arabia had the same level of energy productivity in 2014 as it did in 1980. In 2014, Kuwait, Saudi Arabia, and Qatar were the top three in energy productivity levels compared to other GCC countries (see the figure below) with values in GDP, PPP, billions Intl $ per Mtoe of 7.1, 6.7, and 6.5, respectively.

In comparison with both developing and developed economies the figure also shows that the GCC countries were lagging behind the trend toward improved energy productivity between 1980 and 2014. All other countries have shown an upward trend in maximizing their economic value per unit of energy consumed, with Germany, Japan, Brazil, and Mexico leading in energy productivity levels. In absolute terms, by the end of 2014, these countries – as well as the USA, China, and Norway



Energy productivity for the GCC and selected countries 1980–2020e

Source: Calculations of energy productivity is based on data from World Bank, IMF, IEA, and EIA

– had increased energy productivity with values in GDP, PPP, billions Intl $ per Mtoe in the range 5 to 10 compared to a range of –2 to 3 for the GCC countries.

From the perspective of developing countries, the economies of China (which still counts as a developing nation), Mexico, and Brazil all went through a significant shift towards diversifying their exports by developing and integrating their industries into the global supply chains. In contrast, in Germany, Japan, and Norway, economic transformation was largely driven by a focus on human capital together with an effective institutional and governance framework (see the chapter 'Natural Resource Endowment: A Mixed Blessing?' by Thorvaldur Gyfalson in the book *Beyond the Curse: Policies to Harness the Power of Natural Resources*, R. Arezki, T. Gylfason, and A. Sy (eds.), IMF, 2011). The USA, however, has moved away from its dependence on abundant natural capital towards being a widely diversified economy. It is, moreover, also important to recognize the role of energy savings in improving energy productivity. In this respect China, between 1990 and 2010, has saved the same energy as it consumed in 2010, while equivalent savings for Germany and the USA were in the range of 20–30 per cent (World Bank, SE4ALL initiative, Global Tracking Framework).

The slow annual increase in, as well as the level of, energy productivity in the GCC implies that a significant level of improvement still exists for their diversification policies and energy savings efforts. Energy is, however, a key factor in several of the economic sectors that drive diversification such as: the energy industry itself (upstream, transformational sectors such as the generation of electricity, oil refineries, and energy intensive industries); transportation, building construction, and suppliers; and manufacturers of energy products. The water sector would also be a key economic sector in the GCC countries, due to their heavy reliance on water desalination. The question then is how would improving energy productivity in these sectors strengthen the GCC's diversification efforts?

'FROM THE PERSPECTIVE OF ENERGY SUSTAINABILITY, THE GCC COUNTRIES HAVE COME A LONG WAY.'

GCC countries – importance of sustainable clean energy

From the perspective of energy sustainability, the GCC countries have come a long way. Given their rich endowments of hydrocarbon, the GCC countries have a large stake in the global transition towards sustainable energy. It is a transition in which they can play a pivotal role.

The lingering low oil price, together with new global energy technologies, offer an opportunity for the GCC countries to realign their energy policies with other sectors in order to broaden the range of their energy products by focusing on clean energy to strengthen industry competitiveness and, eventually, to increase energy productivity. The last decade has seen an impressive amount of development in clean energy, ranging from alternative energy technologies, diverse research and development (R&D) programmes, demand-side energy efficiency, the adoption of sustainable buildings, the beginnings of advanced public transport systems, and the proliferation of green growth strategies – all now part of everyday news in the GCC.

Investment policies in the GCC have been largely focused on meeting the fast-paced growth of domestic demand (for example in electricity, water, transport, and building). However, this approach has not kept up with the growing domestic demand in several sectors. For instance, the rising trend of using fossil fuels in the domestic market is now becoming a threat to the competitiveness of GCC economies, unless it is urgently addressed in a sustainable manner.

This situation has prompted policymakers at different levels in almost all the GCC countries to take a more serious look at demand-side energy efficiency, and to revisit the mix of their energy production. As a result, regulatory measures, and a few market incentives have been introduced by several GCC countries to enforce energy efficiency in buildings, industries, and transport. In addition, renewable energy targets were set, which – along with the realignment of the energy sector's framework – have started to emerge as a commitment by governments – mostly in Saudi Arabia, UAE, Kuwait, and Qatar – to support R&D and increase the penetration of renewable energy.

Yet, progress in the Gulf has been slow in terms of scaling up investments in renewable energy, and reaping the benefits of energy efficiency.

Complementing the support of energy efficiency with renewable energy investments is *prima facie* sensible for the GCC, because of its abundance of resources. More energy efficiency and more investment in renewable energy will enable the GCC to save fuel, reduce subsidies, and thus improve energy productivity. The GCC countries' ambition to exploit the full potential of energy efficiency and renewable energy in a sustainable and commercial way will not be met, however, in the current economic environment of high energy subsidies (implicit and explicit).

Momentum for subsidies reform is gradually emerging, for example in the

UAE and Kuwait, with policymakers focused on 'how' to implement price reforms, along with well-targeted subsidies, public engagement, and the garnering of political will. Political buy-in for such reforms, as well as leftover political credit, could be far easier during this time of low oil prices.

Clean energy technology and energy productivity

The size of the GCC economies (US$1.6 trillion in 2014, according to the IMF), and of their hydrocarbons reserves, illustrates the GCC's importance – both as a major economic and political bloc in the Middle East and North Africa (MENA) and globally. The global energy transition is reconfiguring the global energy market and bringing major breakthroughs in clean energy technologies. The GCC countries have a unique window of opportunity to break free of the confines of natural resource dependence by incentivizing industry to boost the production of clean energy technologies and to use clean energy.

This would require the GCC countries to make a major leap toward supporting labour-intensive clean energy industries, and accelerating the enforcement of energy efficiency and use of renewable energy. The aim of a new policy would be to create new sources of revenue, led by the private sector, to complement GCC government endeavours in the development of demand-side measures (such as energy efficiency standards and incentives, and gradual subsidy reform), and thus increase the overall levels of energy productivity.

The unique difference between clean energy industries and oil is that the latter has a market price with predictable revenues. Hence, one challenge would be to make the industries that manufacture clean energy technologies competitive. As well as incentivizing industries, this requires significant investment in R&D to reduce the GCC's reliance on importing complex technologies and skilled labour.

The GCC governments have launched a number of recognized initiatives to support R&D in alternative and clean energy technologies, but the private sector's role is still limited. A survey by the Economist Intelligence Unit in 2011 showed more than 50 per cent of participants acknowledged the role of government-led efforts in developing an R&D cluster in the Middle East, but said they also considered these efforts insufficient to drive real innovation.

Way forward for energy productivity improvements in the GCC

The GCC countries are facing one of the greatest challenges they have yet faced, in terms of ensuring secure energy supplies at affordable prices, to make sustained economic development possible and allow for the wellbeing of their people.

Improving energy productivity offers a compelling – perhaps imperative – case for the GCC countries to meet their domestic energy needs, generate private sector jobs, and widen the competitiveness of their energy-related manufacturing industries. This is a major initiative that involves creating a shared vision as well as bold, adaptive, and forward-looking policies that capture synergies among respective economic sectors in the improvement of energy productivity.

Other countries have set the example for doing this: Germany has set a target for improving energy productivity by 2.1 per cent a year up until 2020; the USA aims to double energy productivity by 2030; and in 2015 Australia announced a target of a 40 per cent improvement by 2030. These targets are based on diversifying and increasing the sources of revenue from economic sectors, and on reducing energy consumption.

'THE GCC COUNTRIES POSSESS THE KEY INGREDIENTS TO BECOME MORE ACTIVE IN THE GLOBAL CLEAN ENERGY ARENA …'

The GCC countries possess the key ingredients to become more active in the global clean energy arena and in the development of new, clean technologies. Their challenge is to keep up with the rapid pace of technological advance. Some results of disruptive technological improvements have already started to emerge such as: the decline in the cost, and improvement in performance, of renewable energy technologies (mainly wind and solar); the increased penetration of rooftop solar photovoltaic (PV) that has pushed distributed generation systems to the next level; growing demand for plug-in hybrid electric vehicles; and new energy storage technologies, particularly lithium ion, that will eventually change the supply chains of electricity and transportation.

In addition, the sudden rise of unconventional oil and gas sources, such as fracking, have started to change the global energy landscape, enabling the USA to double its oil production and become the largest gas producer over the last five years.

The GCC countries are now being presented with an opportunity to develop their home grown industries and be recognized as global role models for advancing the arguments of increased innovation and investment in clean energy technologies. An energy

productivity initiative can offer the GCC countries the means to achieve long-term growth, as well as showing solid commitment to green growth. Ambitious initiatives have already been seen in the GCC: what is needed now is the integration of sound policies to create a sustainable energy productivity ecosystem for higher economic value and lower energy demand per dollar output.

The potential for the GCC's industries to become major players in the developments of these technologies already exists. Beyond its domestic potential, MENA's renewable energy sources are abundant but very under-tapped, offering a promising market. The design of residential and commercial buildings in the GCC is largely flat and unutilized, offering much potential for rooftop solar (PV). As peak domestic demand for power coincides with maximum solar radiance, the GCC countries could give consumers incentives to install rooftop PV, and perhaps even transform their homes into sources of electricity supply to the grid. Done successfully and at a scale, this could offset significant investment in inefficient peaking thermal units, until now barely used, and help governments to lessen the impact of tariff reforms.

Similarly, GCC countries are leaders in water desalination, which has significant amount of brine as a byproduct. This brine could be a major revenue stream because of its richness in minerals which, once recovered, could serve several industries, including the potential production of lithium batteries – an area where global demand is envisaged to grow by 60 per cent in 2017 compared to 2014 (according to figures for 2014 from the US DOE).

'ENERGY PRODUCTIVITY COULD HELP THE GCC'S DIVERSIFICATION POLICIES TO EVOLVE AND TO MINIMIZE THEIR EXPOSURE TO THE NATURAL RESOURCE CURSE.'

In sum, energy productivity could help the GCC's diversification policies to evolve and to minimize their exposure to the natural resource curse. The GCC countries have sufficient financial buffers to be able to revamp their economies through making investments in clean technology innovation and manufacturing. Capitalizing on the strengths of each country could create collaboration and integrative supply chains that maximize economic resilience and shared prosperity.

Finally, in order to weave energy productivity into different economic sectors, a vision and a range of actions are needed. Some examples are: which members of the private sector should be in the driving seat; investing in human capital (beyond formal education) and local community partnerships; scaling up R&D investments; incentivizing industries to venture into clean energy technologies; realigning existing utilities models to deliver utility-driven energy efficiency and renewable energy programmes; incentivizing distributed generation; and investments in cross-cutting areas such as brine from desalination.

Eliminating fossil fuel subsidies is good for the planet – and more than ever for the GCC

Jason Bordoff and Akos Losz

Fossil fuel subsidy reforms are in fashion these days. The 2014 oil price collapse offers what has been called a 'golden opportunity' for cash-strapped governments around the world to phase out energy subsidies by taking advantage of lower fuel prices that reduce both the political cost of liberalizing energy prices and the risk of runaway inflation resulting from price reforms. More than two dozen governments have undertaken some form of fossil fuel subsidy reform since the beginning of 2014. The list includes India, Iran, and Indonesia, which are not only among the world's largest energy consumers, but also some of the largest subsidizers of fossil fuels. As our colleagues Johannes Urpelainen, Keit Benes, Andrew Cheon, and Joonseok Yang explain in a new briefing paper ('Low Oil Prices: An Opportunity for Fuel Subsidy Reform') for Columbia University's SIPA Center on Global Energy Policy, the three main barriers to fuel subsidy reform – popular opposition, vested interests, and low institutional capacity – are all reduced by low oil prices.

'SUBSIDIZING FOSSIL FUEL USE IS BAD ECONOMIC POLICY, BAD ENVIRONMENTAL POLICY, AND BAD SOCIAL POLICY.'

The rationale for subsidy reform is straightforward. Subsidizing fossil fuel use is bad economic policy, bad environmental policy, and bad social policy. Keeping fossil fuel prices at artificially low levels drains fiscal

resources – either directly in net importers of fossil energy, or indirectly in net exporters. Subsidies can create immense budgetary pressures in developing countries, where they can easily exceed 10 per cent of GDP – as in Iran, Venezuela, or Egypt. Fossil fuel subsidies are also harmful for the environment. They not only incentivize greater fossil fuel use, and thus carbon emissions and pollution, but also undermine renewable energy sources – including in locations with great renewable potential like the Middle East. Fossil fuel subsidies also perform poorly as a social policy tool. As the richest households tend to be the largest energy consumers, fossil fuel subsidies are naturally regressive. A 2013 IMF study estimated that the richest 20 per cent of households in low- and middle-income countries captured six times more of the total fuel subsidies than the poorest 20 per cent. However, poor households typically spend a greater portion of their income on energy, and thus may be more severely affected by the removal of fossil fuel subsidies. Targeted measures to help them cope with higher energy prices – such as direct cash transfers – have proven to be more effective according to a wide body of research by the IMF, the World Bank, and others.

Fiscal burden of subsidies

When countries embark on the path to subsidy reform, a key motivation is often the severe fiscal burdens imposed by subsidies, particularly when oil prices are high. The most prominent reform efforts in Egypt, India, and Iran were chiefly motivated by unsustainably growing subsidy bills and precarious fiscal balances. Egypt, for example, spent 25 per cent of the government budget on fossil fuel subsidies in 2013, seven times more than on health care, according to the IEA.

'WHEN COUNTRIES EMBARK ON . . . SUBSIDY REFORM, A KEY MOTIVATION IS OFTEN THE SEVERE FISCAL BURDENS IMPOSED BY SUBSIDIES …'

The arguments for reform, however, have often been more compelling for net importers of fossil energy than for exporters. Indeed, whereas 70 per cent of the US$550 billion spent on fossil subsidies in 2013 occurred in major energy producers, less than a third of the countries that have recently undertaken subsidy reforms were net exporters of energy.

Factors affecting exporters

Major oil exporters can be more reluctant to phase out fossil fuel subsidies for a number of reasons:

Benefits for citizen. Many resource-rich countries nationalize domestic natural resources, thus creating a sense of entitlement that there is a 'right of citizenship' to their own resources at low cost. Fossil fuel subsidies are considered part of an unwritten 'social contract' in Saudi Arabia (and indeed in other Gulf oil monarchies as well). Gulf citizens tend to regard cheap energy as their 'birthright' and view any efforts to raise energy prices as illegitimate. Saudi Arabia, for example, does not even acknowledge in the G20 that it subsidizes fossil fuels because its domestic fossil fuel 'prices reflect the country's comparative advantage in oil production and are above the production costs.'

Role of national oil companies. Producing countries are more likely to have national oil companies, which have also been a key mechanism perpetuating fossil fuel subsidies. Indeed, Gulf Cooperation Council (GCC) countries have often used national oil companies for broader social policy implementation. Energy subsidies are easier to administer through a company such as Saudi Aramco than via targeted redistribution schemes, such as direct cash transfers run by the government.

Direct and indirect nature of subsidies. There can be greater pressure to reform subsidies when the cost is a direct outlay from the government budget than when it manifests itself as an opportunity cost in the form of lost additional sales. This is especially true in today's oversupplied market, when there may be limited scope to sell additional oil abroad. In Saudi Arabia, the opportunity cost argument may not even hold, as production and export decisions have at times been based on non-market factors and thus reduced domestic consumption would not necessarily have led to increased oil export sales.

Effect of oil price collapse. A sudden oil price collapse has fundamentally different political consequences in major oil exporting and major oil importing countries. When international oil prices fall, oil importers have a unique opportunity to remove fuel subsidies without causing severe price increases for their consumers. Major oil exporters, on the other hand, are more likely to view lower oil prices as a threat to political stability and a potential source of social unrest. Ruling elites across the GCC, for example, have cautiously maintained – and in some cases even increased – public spending since the 2014 oil price collapse, with the Arab Spring uprisings still fresh in their minds. Energy subsidies are an important policy tool in the hands of many petrostates for the maintenance of social stability. As lower oil prices undermine economic growth in large exporters, therefore, they can hinder reform efforts even as they lower the cost to the consumer of paying market prices.

Effect of foreign currency reserves. Many oil exporters – including most GCC countries – have substantial foreign reserves, which can help them cover budget shortfalls in the medium term and ease the fiscal pressures at a time of low oil prices. On the eve of the 2014 price collapse, Saudi net foreign assets, for example, approached 100 per cent of the country's GDP and amounted to 2.5 times total government spending in 2014. Public debt levels are also comparatively low across the GCC, ranging between less than 2 per cent of GDP in Saudi Arabia to 43 per cent of GDP in Bahrain. This leaves some room for GCC governments to issue bonds to finance part of their looming fiscal deficits, as the Saudis recently did. In addition to tapping into foreign reserves and bond markets, GCC governments can also slow down infrastructure investments. In a recent report, Goldman Sachs identified more than US$600 billion worth of 'active' infrastructure projects in Saudi Arabia alone, noting that the pace of project awards appears to be slowing in the Kingdom since the beginning of 2015.

Ineffective use of resources – incentive for change

Even if the urgency of subsidy reform may appear greater in oil importing countries, there remains interest in eliminating inefficient fossil fuel subsidies in GCC countries. The halving of international oil prices since the middle of 2014 will likely push this year's budget deficits into the double digits in Saudi Arabia, Oman, and Bahrain, according to the IMF. The UAE has recently decided to deregulate motor fuel prices starting in August 2015 – although its fuel prices are already high by regional standards, representing twice the GCC average for petrol and three times the regional average for diesel. Kuwait enacted diesel and kerosene price increases in early 2015 (but had to backtrack due to the initial public outcry), and Bahrain has been cautiously planning to reform fuel and electricity pricing for some time. By contrast in Saudi Arabia (which has greater social inequality than other GCC countries and thus greater potential backlash against fuel price hikes) there has been less progress toward reforming subsidies.

Today's new world of oil, however, provides new and added incentives for GCC countries, particularly for Saudi Arabia, to reform domestic fossil subsidies. In November 2014, Saudi Arabia signalled to the global oil market that it intended to boost production (which rose to 10.6 million barrels/day), maintain market share, and keep limited supply in reserve as spare capacity. In an interview with the *Middle East Economic Survey*, Saudi Oil Minister Ali Naimi said that the low-cost producers in OPEC 'deserve market share'. Reminding long-time market observers of the Saudi experience in the 1980s, he explained: '*If I reduce [production], what happens to my market share? The price will go up and the Russians, the Brazilians, US shale oil producers will take my share.*' As Oxford University's Bassam Fattouh aptly notes: '*the ultimate nightmare for any exporter is a reduction in both its market share and its revenues*'.

'FOSSIL FUEL SUBSIDIES HAVE PROMOTED THE OVERCONSUMPTION OF OIL IN THE GCC AT AN ENORMOUS SCALE …'

The continuing use of fossil fuel subsidies that induce oil consumption growth are at odds with the key GCC producer's new market share strategy. Fossil fuel subsidies have promoted the overconsumption of oil in the GCC at an enormous scale – oil demand in Saudi Arabia, Kuwait, and the UAE increased by about seven times the world average in 2014 alone. Refined product demand in the three largest GCC producers increased by 9 per cent over the previous year and direct crude burning in power generation rose by 16 per cent in 2014, according to the JODI database. This rate of domestic consumption threatens the ability of the region's oil exporters to maintain exports at anywhere near the current elevated levels over the coming years. Thus, fossil fuel subsidies not only undermine the long-term sustainability of the oil export-dependent economic models of most GCC countries, but also the stated near-term oil market strategies of the low-cost Gulf producers – particularly of Saudi Arabia, Kuwait, and the UAE – to maximize market share in today's oversupplied global oil market.

With Iranian barrels returning to the market and Iraqi exports reaching new records in almost every month, rather than GCC producers striving to maintain market share through costly new drilling plans, it makes more sense to rein in domestic demand for crude oil used in electricity and refined products. Fossil fuel subsidy reforms offer the most effective tool to achieve this goal.

Benefits to be gained from limiting fossil fuel use

According to our preliminary estimates, based on IEA reports, eliminating fossil fuel subsidies can free up close to a million barrels/day of oil in Saudi Arabia, Kuwait, and the UAE for exports over the longer term. Eliminating direct crude burning in power generation alone could save, on average, more than 600,000 barrels/day for the three GCC governments. Developing the same amount of production capacity could cost more than US$10 billion. (For comparison, the development cost of Saudi Aramco's Manifa development, which added 900,000 barrels/day of production capacity and

took eight years to complete, totalled an estimated US$17 billion.)

Importantly, fossil fuel subsidy reform in GCC countries would also have environmental benefits. In the past, environmental considerations for subsidy reform in the GCC were often trumped by other factors. (A Chatham House report from 2011 notes that the word 'sustainability', or '*istidaama*', is a relatively recent addition to the Arabic vocabulary.) If Saudi Arabia, Kuwait, and the UAE reduced domestic oil consumption by one million barrels/day by removing fossil fuel subsidies, the corresponding reduction of carbon dioxide (CO_2) emissions could be as high as 160 million tonnes (or 15 per cent of the three countries' combined CO_2 emissions in 2014), assuming that oil use is displaced with zero-carbon fuels or completely eliminated via energy efficiency and global demand were unchanged. It would also reduce local air pollution caused by SOx and NOx.

'SUBSIDY REFORMS CAN HELP CEMENT THE POSITION OF THE LEADING GCC OIL EXPORTERS IN THEIR DRIVE FOR GLOBAL MARKET SHARE …'

As the oil market has changed in the past year, so too has the oil policy of GCC countries, especially Saudi Arabia. The result of these changes is that removal of fossil fuel subsidies is increasingly in the GCC countries' self-interest. Subsidy reforms can help cement the position of the leading GCC oil exporters in their drive for global market share, and help them boost exports or increase their spare production capacity at little cost. Subsidy reforms could financially strengthen the GCC economies in the current weak oil price environment, and make it more likely they emerge as winners when prices begin to rise again. These changes will also slow the consumption of hydrocarbons, reduce carbon emissions and local pollution, and boost energy efficiency and renewable energy. Without subsidy reforms, Saudi Arabia and the other leading oil exporters in the GCC risk losing, both in the short and the long run.

Alternative industrial fuel prices could benefit the Saudi economy

Walid Matar

Oil consumption in Saudi Arabia has grown at around 5 per cent annually since the year 2000. This growth has raised concerns over the Kingdom's ability to maintain its large export capacity in the future. Limited supply of natural gas and low energy prices have contributed to the substantial use of oil for domestic industrial production. The low administered oil and gas prices offered to industrial firms have further discouraged investment in non-hydrocarbon power generation technologies, and the production of higher value-added products. In this respect, decision-makers in the Kingdom have particularly expressed interest in displacing the use of oil in inefficient power plants by deploying other technologies. Alternative industrial fuel pricing policies can mitigate the growth in domestic oil consumption and facilitate investment in non-hydrocarbon power generation.

Employing the KAPSARC (King Abdullah Petroleum Studies and Research Center) Energy Model (KEM) for Saudi Arabia, in this article we study the impact of economic policies, such as those pertaining to industrial fuel prices and technology change. The model characterizes the operational and investment decisions of the electricity, refining, water desalination, petrochemicals, cement, and upstream industries in the Kingdom. It has been designed from the outset to represent the government-set energy prices that permeate the Saudi economy. Energy prices in Saudi Arabia are generally set by the government. Crude oil is sold to industrial firms at US$4.24/barrel, and methane and ethane are sold at US¢75/MMBtu; refined oil products are even less expensive per unit of energy content. The current mix of equipment and fuels in the industry and, in particular, in the power and water desalination sectors, reflects the low administered fuel prices.

'ELECTRICITY IN SAUDI ARABIA IS ALMOST EXCLUSIVELY GENERATED BY BURNING CRUDE OIL, REFINED OIL PRODUCTS, AND NATURAL GAS.'

Electricity in Saudi Arabia is almost exclusively generated by burning crude oil, refined oil products, and natural gas. While simple-cycle gas turbines have historically been favoured because of low fuel prices (the gas price was even lower, at US¢50/MMBtu, before 1998), their quick lead time for construction, and low investment cost, utilities are now mitigating the growing use of fossil fuels by upgrading simple-cycle gas turbines to combined-cycle plants, and installing power capacity with higher thermal efficiency.

The examined industrial fuel pricing and incentive policy scenarios

The policy options studied focus on reforming industrial fuel prices and introducing incentives that encourage investment in alternative power generation technologies. We allow capacity expansion planning to begin in 2015, and the analysis is performed up to 2032, to take into account construction lead times for all plant types and future learning effects reflected by the decreasing costs of renewable technologies. In a 'business-as-usual' case, we hold the current fuel prices offered to industrial firms constant in real terms until 2032. We also study five alternative policies as follows:

1 Industrial fuel prices are immediately deregulated, starting in 2015. The prices of crude oil and oil products sold to industry are set at projected international market values. Since natural gas is neither exported nor imported, we use its domestic market-clearing price as determined by the model.

2 Beginning in 2015, the prices of industrial fuels are gradually deregulated over an eight-year period.

3 Current quantities of fuels consumed are allocated to the sectors at the administered prices and any incremental quantities demanded are valued at deregulated prices. The quantities priced at the administered level are phased out over an eight-year period.

4 The fourth alternative scenario moderately raises fuel prices and introduces investment credits offered by the government for renewable and nuclear power technologies. The objective of this scenario is to achieve fuel-to-capital cost ratios that are similar to those facing utilities observed in a deregulated setting (and thus facing similar operational and investment decisions).

5 In lieu of investment credits, this scenario introduces feed-in tariffs that would produce the same investment decisions observed when only investment credits are applied. The purpose of this scenario is to calculate the value of technology-specific tariffs needed to replicate the effect of investment credits. These incentive mechanisms have practical differences. Investment credits are a one-time payment at the time of construction, whereas feed-in tariffs are paid over the operating life of the plants.

The alternative policies show the optimal allocations of natural gas in the Kingdom's production sectors; those scenarios allow available gas to flow to where it adds the greatest value based on the domestic market-clearing price determined by the model. In all scenarios, the Kingdom honours the contractual agreements between the upstream and petrochemicals firms that set long-term methane and ethane prices at the current administered price. Additionally, electricity and transportation fuel prices are unchanged to households and other end-users.

All alternative scenarios yield large reductions in the use of fossil fuels in the analysis horizon. By keeping current policies, oil and gas consumption approaches 8 million barrels of oil equivalent (boe) per day in 2032. Our analysis suggests up to 2 million boe per day would be saved by applying the alternative policies. According to the Electricity & Co-generation Regulatory Authority, crude oil and refined products constituted more than half of the fuels used for domestic electricity generation in 2013. Utilities would continue to burn substantial quantities of oil if current fuel prices were maintained in real terms. When prices are deregulated and decisions are made based on the actual economic value of the fuels, oil is quickly displaced by other fuels and technologies. Available natural gas is used in efficient combined-cycle plants.

In short, future growth in domestic oil and gas consumption is mitigated by improving efficiency in the energy system over time. Of course, the lower dependence on oil for domestic industrial operation in the alternative scenarios allows the Kingdom to raise its crude oil export capacity.

Current price policies will dis-incentivize new technologies

Inefficient simple-cycle gas turbines and steam turbine plants dominate the current electricity generation mix. When present fuel prices are kept intact, the power sector gradually invests in upgrading existing gas turbines to combined-cycle plants. In this case, our analysis shows that in 2032 most of the electricity is produced by combined-cycle plants. The average efficiency of the electricity generated by power plants at that time would consequently increase, approaching 48 per cent.

'THE LEVEL OF RENEWABLE AND NUCLEAR CAPACITY DEPLOYED WILL BE SENSITIVE TO FUTURE NATURAL GAS AVAILABILITY …'

Despite improved generation efficiency, the continuation of current policies would prevent the price-induced investment in renewable and nuclear power technologies. The higher fuel prices and/or incentives in the alternative policy scenarios provide the proper fuel-to-capital cost ratios that lead to the emergence of renewables and nuclear. Investment in photovoltaic capacity is made despite the additional system costs of maintaining spinning reserves that mitigate the effects of intermittency. The level of renewable and nuclear capacity deployed will be sensitive to future natural gas

availability, as high gas supply will mean more gas-fired capacity.

The solution may lie in a gradual approach

We use the overall economic gain to gauge the efficacy of the alternative policy scenarios. This measure is defined as the discounted sum of the annual differences between aggregate revenue and social cost relative to a policy where current industrial fuel prices are unchanged. Immediate deregulation of prices generates the largest economic gain for the Kingdom and serves as a benchmark against which other policy options are assessed. When decisions are made based on deregulated prices, the higher economic value of oil leads the sectors to forgo its use, resulting in economic gains from its potential export.

Our results suggest that a more gradual transition, such as that in the second and third alternative policies, can achieve the vast majority of the benchmark economic benefits, without the shock of immediate deregulation. Furthermore, we find that most of the gains of immediate deregulation can be attained by raising fuel prices slightly (to well below their deregulated values) and offering financial support to the utilities for constructing renewable and nuclear capacity. The introduction of investment credits reduces the cash outflows that would be incurred by the utilities in a deregulated setting.

The observed overall economic gain does not necessarily mean that no additional costs are sustained if the analysed policies are implemented. But the incremental revenue of the aggregate system, which is mainly driven by the value of the oil saved, is higher in magnitude in all alternative scenarios than the corresponding additional costs. While the energy system as whole enjoys a substantial economic gain, the power and water utilities will experience higher costs by increasing fuel prices, since the prices of their products are unchanged. Manufacturing sectors that can export are able to alter the mix of exported products to gain increased revenue. The additional costs experienced by the petrochemicals sector are, however, alleviated by honouring existing long-term contracts that keep feedstock prices at the current values. The utilities' costs are mitigated in an investment credit policy in which the government bears a proportion of new capacity cost. The resulting lower net revenues in the alternative policy scenarios may either be absorbed by the sectors themselves or covered by financial transfers from the government.

Transitioning into a more efficient Saudi energy economy

Policies targeting industrial sectors such as petrochemicals, cement, and the power sector may be viewed as a first step in achieving a more efficient Saudi energy system. We show that large reductions in domestic fossil fuel use can be realized by the alternative industrial fuel pricing policies. The higher prices and/or financial incentives induce investment in more efficient industrial production technologies. While efficiency improvements are made over time under a business-as-usual scenario, the current prices would not encourage investment in renewable and nuclear power generation; also, crude oil would still be burned in large quantities to satisfy electricity demand. Although deregulated fuel prices induce the deployment of renewables and nuclear and achieve the highest economic benefits, the drastic increase in prices may not be politically tenable. Instead, our analysis shows that a large part of these economic benefits can be attained without a drastic surge in prices. Therefore, policies comprising a moderate increase in fuel prices, coupled with investment credits for non-hydrocarbon technologies, would facilitate the construction of renewable and nuclear plants in the Saudi power system, and attain most of the benefits of deregulation. Investment credits also alleviate the power sector's expenditure requirements.

'… LARGE REDUCTIONS IN DOMESTIC FOSSIL FUEL USE CAN BE REALIZED BY THE ALTERNATIVE INDUSTRIAL FUEL PRICING POLICIES.'

Reforming end-user energy prices could rationalize GCC energy demand

Jim Krane

The six GCC economies – Saudi Arabia, the UAE, Oman, Kuwait, Qatar, and Bahrain – are some of the world's most profligate consumers of energy and emitters of greenhouse gases, relative to their size. Other hydrocarbon exporters in the region, notably Iran and Algeria, are beset by similar circumstances. Observers have attributed this state of affairs to the very low prices at which energy is sold in these countries. However, there have been few attempts to quantify the effects of subsidies on domestic consumption.

This article takes a simplified approach to a complex topic by posing the following questions: What would happen if fuel and electricity prices in the Gulf monarchies were increased to world market levels? How would consumers respond? More specifically, would electricity demand in Abu Dhabi adjust to look more like that in unsubsidized, but otherwise similar, Arizona?

'SOCIAL CONTRACTS … REQUIRE REGIMES TO GIVE SUBSIDIZED ENERGY AND OTHER BENEFITS TO CITIZENS IN RETURN FOR POLITICAL SUPPORT.'

To regional experts and policymakers, these questions might sound overly hypothetical, even radical. Social contracts in the Gulf are understood to require regimes to give subsidized energy and other benefits to citizens in return for political support. In this context, subsidy removal could provoke social unrest. Despite the risks, the Gulf states have attempted reforms of subsidized energy prices, with varying degrees of success. The UAE's lifting of transport fuel subsidies in August 2015, if sustained, may offer some incentives for neighbouring states. Reforms have been catalysed by ominous projections that rising domestic energy consumption will bring about premature declines in oil exports.

Across the Gulf, Iran's ongoing subsidy reform, in which citizens are compensated with cash for acquiescing to higher prices, has been touted as a model for raising prices without inducing a backlash on the streets. My own survey work suggests that a majority of Saudi citizens would, like Iranians, agree to higher prices on electricity if compensated. The gathering momentum toward subsidy reform in the Gulf makes it worthwhile to consider whether increased prices on transportation fuel and electricity would significantly reduce the region's runaway energy demand.

Low prices inflate demand

Price is just one determinant of energy demand, alongside income, population, technology, and climate. Price affects demand in two ways: directly, by influencing choices in consumption of fuel and electricity; and indirectly, through choices of energy-consuming equipment and its efficiency, as well as how often it is used. In the Gulf, low prices relative to income offer little incentive for conservation, compared with the effects of pricing in unsubsidized markets.

Several authors have reached similar conclusions. Alyousef and Stevens describe low and subsidized prices in Saudi Arabia as '*the single most obvious explanation for the extremely high levels of energy use*'. Mehrara finds that subsidies in oil exporting countries explain their otherwise '*implausibly high energy intensity*'. Bourland and Gamble show that the kingdom uses ten times the global average of oil per unit of GDP, and argue that the '*key reason for the rise in consumption is very low energy prices*'.

How would energy consumption change if prices were dramatically increased?

In the short run, energy demand is understood to be inelastic; meaning that it is unlikely to respond in a dramatic fashion to an increase in price. In the longer run, energy demand is more elastic. Over time, consumers will change their behaviour and upgrade technology and building envelopes, thus reducing exposure to higher prices.

Here, I provide results of two series of calculations that focus on the long run. The first uses price elasticity to demonstrate that a hypothetical subsidy removal would *significantly* reduce energy demand in the GCC states. The results infer that a large portion of the region's outsized energy demand is indeed due to very low prices.

The second calculation uses a less hypothetical comparison of subsidized electricity demand in Abu Dhabi with unsubsidized consumption in Arizona. This exercise offers a way of controlling for income and climate effects, since both places are similarly hot and wealthy. By raising Abu Dhabi prices to Arizona levels, demand in Abu Dhabi falls sharply, but average consumption still remains higher than that in Arizona.

How sensitive is consumer behaviour to price?

Some scholars argue that energy demand in the wealthy Gulf is probably not very sensitive to price, and that a US$1 increase in price would have a smaller corresponding effect on demand than in an unsubsidized market. This argument is probably correct, but it overlooks the magnitude of the differences in energy prices between the Gulf and unsubsidized markets. Therefore, even at the relatively low estimates of price elasticity that circulate in literature on the Gulf, the price increases required to cover the full cost of energy products are so large that the resulting reductions in demand become significant.

A price elasticity of –1 implies a one-to-one relationship between price and demand. Here, I use a modest but plausible estimate of –0.3, meaning that a 1-point increase in price would produce a 0.3-point reduction in demand. This figure lies within the range covered in the literature, and represents the lower of two price elasticity estimates used by the IMF in a 2012 paper on Kuwait.

Effect of price increases on energy consumption in Gulf states

	Price (US$)	Unsubsidized price (US$)	% price increase to displace subsidy	% decrease in long-run demand at –0.3
Kuwait: electricity	0.007	0.135	1,829	–59
Kuwait: gasoline	0.23	0.65	183	–27
Saudi Arabia: gasoline	0.16	0.65	306	–34
Abu Dhabi: electricity (expatriates)	0.041	0.089	117	–20
Abu Dhabi: electricity (citizens)	0.014	0.089	536	–43
Oman: electricity	0.026	0.1	285	–33
Oman: gasoline	0.31	0.65	110	–20

Note: Electricity prices are in kWh and gasoline is priced per litre. Current prices and estimates of unsubsidized prices compiled by author. Price elasticity estimate is based on the lower figure used in the document 'Fuel Subsidies and Energy Consumption: A Cross-Country Analysis', Rodriguez, P., J. Charap, and A. Ribeiro da Silva, *Kuwait Selected Issues and Statistical Appendix, IMF Country Report*. Washington: International Monetary Fund. 2012. Demand effect calculations are based on energy demand formula in the same document, which uses a non-linear function that reflects effects of large price increases. Expatriates receive smaller energy subsidies in some countries.

Using a non-linear equation for price elasticity – due to the very large price increases needed to rationalize prices – the IMF found that Kuwait would have to raise its gasoline price by 183 per cent (from US¢23 to US¢65 per litre) to eliminate the implied subsidy. Faced with such an increase in gasoline prices, Kuwaiti consumers would reduce consumption by about 27 per cent (see the table *Effect of price increases on energy consumption in Gulf states*).

However, Kuwait's electricity pricing is distorted by a much larger subsidy relative to that on gasoline. Government figures show that the electric power subsidy covers about 95 per cent of the total cost. An increase of 1829 per cent would be required for a full rationalization of electricity prices. Such a massive price increase implies that long-run demand would respond by decreasing by 59 per cent, even when using the IMF's non-linear formula.

It is probably unrealistic to expect such a huge increase in price or decrease in demand. Regardless, the calculation remains useful in quantifying the outcome of the government's policy which has left electricity prices untouched since 1966.

The table *Effect of price increases on energy consumption in Gulf states* extends this method across various energy products in the Gulf. It shows reductions in long-run demand that would occur from price rationalizations, using a price elasticity estimate of –0.3 and the adapted IMF demand formula. Results show significant decreases across the board. These range from a 20 per cent reduction in electricity consumption by expatriates in Abu Dhabi (who pay higher electricity prices than citizens), and of gasoline in Oman; to reductions of about a third in demand for gasoline in Saudi Arabia and for electricity in Oman; to a drop of 43 per cent in citizen power consumption in Abu Dhabi and, as mentioned, a 59 per cent reduction in Kuwait. Of course, short-run effects would be smaller.

Regardless of whether one regards such price increases as a political possibility, these results suggest that price exerts strong encouragement of energy demand in the Gulf. The results also imply that a full reform of subsidies, all else being constant, would palpably reduce demand.

Comparing consumption in Abu Dhabi and Arizona

Moving to a less hypothetical example, to what extent is electricity consumption explained by price when comparing subsidized and unsubsidized markets that exhibit otherwise similar characteristics? In other words, what happens to consumption when controlling for income and climate?

The UAE emirate of Abu Dhabi and the US state of Arizona exhibit many similarities; these include a hot climate (average temperature 27 °C in Abu Dhabi and 24 °C in Phoenix), and high incomes (2007 GDP per capita US$76,000 in Abu Dhabi and US$42,000 in Arizona). But electricity prices are very different. Arizonans paid an unsubsidized average tariff of US¢9.7/kWh, while Abu Dhabi nationals (until prices were increased slightly in 2015) paid just US¢1.4 and expatriate residents paid US¢4.1. Comparing these cases offers a 'natural experiment' with most variables held constant, while prices vary.

As the table *Comparison of electricity consumption in Abu Dhabi and Arizona* shows, the two markets

exhibit major differences in household electricity consumption, with Arizonans consuming just a fifth as much electricity as Abu Dhabi nationals and just over half as much as expatriates in the emirate. Despite consuming so much less electricity, the average Arizona household still paid significantly more, on average, than households in Abu Dhabi.

How important a factor is price in determining the differences in electricity consumption between these two markets? Using the same price elasticity formula, would equalized prices lead Abu Dhabi's consumption to resemble that in unsubsidized Arizona?

For Abu Dhabi nationals, raising prices to match those of Arizona leads to a drop in long-run demand from 71,000 kWh/year to 40,000 kWh/y. This revised consumption figure, while remaining far larger than the 14,000 kWh/y per capita consumption in Arizona, suggests that price contributes considerably to demand. The remaining difference implies that other factors – such as higher average temperatures and incomes in Abu Dhabi, and the characteristically larger size of Emirati households and homes – remain important. Low prices also encourage path-dependent long-term structural effects which skew consumption patterns over time, and which cannot be undone to the same extent through price increases.

For Abu Dhabi expatriates, with typically smaller families and homes, rationalized prices adjust their consumption closer to that of Arizona. Using the price elasticity estimate of –0.3, long-run demand drops to 20,400 kWh/y, about 45 per cent above that of Arizona.

Reforming end-user prices could help rationalize demand

These calculations are intended to be simple illustrations of the role of price in energy demand in the Gulf, rather than an econometric disaggregation of all components of demand. Taken together, these two sets of estimates show that subsidized prices in the Gulf account for a significant share of energy consumption, which might be plausibly estimated at *between one fifth and one half of total demand* for electricity and transportation fuel.

'REFORMING END-USER SUBSIDIES BY RAISING PRICES WOULD GO A LONG WAY TOWARD RATIONALIZING DEMAND.'

Reforming end-user subsidies by raising prices would go a long way toward rationalizing demand. But price reform would not, by itself, be sufficient to permanently halt increases in energy demand in countries where growth in population, wealth, and industrialization continues.

Besides the benefits in reduced energy consumption, reforms would ease public spending and provide governments with increased revenue, since subsidies impose a cost, in fiscal terms and in lost opportunities to earn the full market value of natural resources. Reduced demand would also allow these countries to maintain hydrocarbon exports for a longer period.

However, one must view estimates for very large savings with some scepticism. Today's consumption is based on prices and development decisions made in a previous era. This means there is path-dependence on higher levels of demand based upon structural factors that cannot be changed as easily as prices. These include the patterns and density of human settlement, the prevailing characteristics of the built environment, and the available transportation alternatives. One cannot be certain whether the extent of this path-dependence is fully captured in the price elasticity calculation, an area where further research would be useful.

Finally, while these hypothetical reforms provide another important demonstration that low prices carry much of the blame for high energy demand in the Gulf, they also suggest that undoing damaging subsidies cannot transform all of the structures that encourage demand.

Comparison of electricity consumption in Abu Dhabi and Arizona

	Avg. consumption (kWh/yr)	Tariff per kWh (US¢)	Avg. yearly bill (US$)	Arizona demand as a factor of Abu Dhabi
Abu Dhabi nationals	71,000 (2006)	1.4	967	20%
Abu Dhabi expatriates	26,500 (2006)	4	1,082	53%
Arizona residents	14,000 (2009)	9.7*	1,600	–

Note: consumption is per household; * = average tariff
Sources: Abu Dhabi Regulation and Supervision Bureau; US Energy Information Administration

'Post-2015' presents green growth opportunities for Gulf oil exporters

Mari Luomi*

Starting with a discussion on the origins of the green growth concept, this article looks at how green growth and green economy policies relate to the post-2015 development agenda and global efforts to prevent dangerous climate change. It explains how the Gulf Cooperation Council (GCC) states relate to the green growth agenda and how they have been participating in advancing the UN sustainable development agenda, particularly in the area of sustainable energy. The article concludes by discussing how green growth and green economy policies can help Gulf oil-exporting countries reap the benefits of the new development agenda and the global shift to zero-carbon.

Limits to growth or green growth?

The Gulf oil exporters are sitting on a limited source of wealth. Either their fossil fuel riches will run dry in the next decades or – the more likely scenario – a global peak in demand for oil will lead to a depreciation in their value. Converting these resources to more sustainable wealth has underpinned the Gulf states' economic diversification efforts for decades. Today, turning 'brown' wealth into 'green' wealth figures among the key goals of the global development and energy agendas. This paradigm shift in development thinking has been brought about by a number of global systemic crises since the end of the 2000s, including the food price and global financial system crises, biodiversity loss, and climate change. These crises all relate to limits, and surpassing them.

'THE GULF OIL EXPORTERS ARE SITTING ON A LIMITED SOURCE OF WEALTH.'

The question of limits is a central one in debates on sustainable development. Scientific knowledge regarding our planet's limits has increased significantly over the past decade. The concept of an ecological footprint, which the conservation organization WWF has helped popularize, compares humanity's demand on ecological services with the Earth's carrying capacity. It shows that we are currently consuming 50 per cent more resources than the planet can generate. Another example of our evolving ability to understand the Earth's limits is the concept of carbon budget, which estimates how much carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions we can still safely emit. At the current pace, this budget could be exhausted in 30 years.

The concept of sustainable development itself has never been sufficiently functional for policymaking purposes, even when it has helped draw attention to the need for social, environmental, and intergenerational sustainability and equity. The concept lacks a clear, agreed-upon definition, partly due to its 'constructive ambiguity' (common in UN agreement text on issues where no consensus exists). The widespread three-pillar approach (economic, social, and environmental) has been criticized for being flawed. Proponents of 'strong sustainability' have pointed out that the three pillars are not interchangeable or autonomous: the loss of natural capital cannot be indefinitely replaced by an increase in man-made capital.

The concepts of 'green growth' and, to some extent, of 'green economy', have sought to strike a balance between the two extremes of the three-pillar approach and the strong sustainability approach. The idea that growth can (and should) happen, as long as it is based on sustainable use of natural resources, is central to green growth. Decoupling economic growth from ecological impact therefore becomes the central task of the green growth agenda.

The UN Environment Programme's (UNEP's) well known definition of 'green economy' describes it as '*one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*'. Even though the ideas of green economy and growth remain contested in some contexts (international trade in particular), they embody a can-do attitude generally not seen in more limits-oriented debates on sustainable development.

This discourse has resonated well in a number of emerging economies that are seeking to improve their peoples' standards of living and their economies' global competitiveness. In the Gulf, the United Arab Emirates (UAE) has adopted green growth as a key pillar of its development strategy. Other GCC states, too, have begun implementing policies (in such areas as fossil fuel subsidy reform and energy efficiency) that will allow for greening of their economies.

Year of sustainable development

The year 2015 marks a milestone for three major sustainable development governance processes under the UN umbrella. Firstly, at the Third International Conference on Financing for Development, held in July in Addis Ababa, 193 UN Member States agreed on a new global framework for financing sustainable development.

This is entitled the 'Addis Ababa Action Agenda' and it outlines concrete policies and actions for different sources of financing and cooperation in technology, science, trade, and capacity building, among others.

In a second major milestone, in September the UN adopted the post-2015 development agenda that includes 17 global Sustainable Development Goals (SDGs) for 2030. The SDGs will replace the Millennium Development Goals (MDGs) expiring this year and include 169 targets associated with the 17 goals, to be monitored through indicators established in October 2015. The post-2015 summit in September also saw the launch of a technology facilitation mechanism, which will be operationalized over the next months.

It is hoped that agreement in these two broad areas will help build momentum for the third key event, the UN Climate Change Conference in Paris, in December. The Paris conference is expected to result in a universal legal agreement and accompanying decisions that together will create strong enough incentives for countries to reduce their GHG emissions so as to avoid a dangerous climate change (defined as an average global temperature increase of more than 2 °C above the pre-industrial era).

'SOME OF THE GCC STATES HAVE PLAYED AN ACTIVE ROLE IN BRINGING THE POST-2015 DEVELOPMENT AGENDA TO LIFE …'

Some of the GCC states have played an active role in bringing the post-2015 development agenda to life, and many are active in the negotiations under the UN Framework Convention on Climate Change (UNFCCC). A proposal by Colombia and Guatemala in 2011, later supported by the UAE and Peru, among others, led to the launch of the process to develop the SDGs. Saudi Arabia and the UAE held seats in the Open Working Group that negotiated the 17 SDGs in 2013–14. Saudi Arabia, the UAE, and Kuwait have also been active in the UNFCCC. Among other things, they have sought to ensure that developed countries deliver on their obligations. In some cases, GCC negotiators have played key roles as facilitators in smaller group sessions, or as mediators seeking to find a middle ground in controversial topics.

All countries, both developed and developing, will be required to work towards achieving the SDGs at national, regional, and global levels. Similarly in Paris, all countries will be expected to inscribe their nationally determined contributions (NDCs) in the new climate agreement. NDCs may include mitigation (emissions reduction) and adaptation targets or actions, and contributions in the areas of finance, among others. Many GCC states are expected to come forward with their NDCs before the December conference. Given that the collective ambition of countries' mitigation NDCs is not expected to be sufficient to keep global warming below 2 °C, consensus is emerging that a review mechanism with a five-year cycle should be established in which all countries would be encouraged to re-evaluate and increase the ambition of their contributions on a regular basis.

Means of implementation

In order for all countries to deliver on both the post-2015 development agenda and their climate commitments, some means of implementation – finance, technology, and capacity building – will be essential. Green growth and green economy policies can arguably help in their mobilization. For example, the McKinsey Global Institute has estimated that resource savings would generate US$2.9 trillion per year through 2030, while the UN Conference on Trade and Development (UNCTAD) forecasts that financing the 17 SDGs will cost US$2.5 trillion per year through 2030. Financing for development will therefore not be an issue if the right policy and market incentives are put in place and financial flows are directed in an optimal manner.

Serious and robust commitments of scaled-up climate finance from developed countries – something yet to come – will be a key factor in ensuring success in Paris. Finance will be crucial for enabling developing countries, in particular the least developed countries (LDCs) and small island states (SIDS), to adapt to the negative impacts of climate change. It will also be key to achieving the emissions reductions required to stay within our carbon budget and limit global warming to a level below 2 °C.

A dialogue series hosted recently by the Organisation for Economic Co-operation and Development (OECD) concluded that: '*financing for sustainable development can promote long-term transformation to a low-carbon, resilient and sustainable future'* taking the forms of aid, investment, and tax. However, the dialogues stressed that policy coherence is crucial for this to happen as '*progress cannot be made by supporting solar energy on the one hand and subsidizing fossil fuels on the other'*.

Sadly in 2014, according to the Renewable Energy Policy Network for the 21st Century (REN21), global investments in renewable energy (excluding large-scale hydro) totalled US$270 billion while, according to the International Energy Association (IEA), in the previous, year fossil fuel consumption subsidies alone totalled US$548 billion.

'ENERGY PLAYS A KEY ROLE IN DEVELOPMENT, INCLUDING SUSTAINABLE DEVELOPMENT. IT IS SIMULTANEOUSLY THE PROBLEM AND THE SOLUTION.'

Sustainable energy for all

Energy plays a key role in development, including sustainable development. It is simultaneously the problem and the solution. On the problem side, two-thirds of the human-made GHG emissions are generated by fossil fuel combustion (data for 2010 from the Intergovernmental Panel on Climate Change), and according to figures from the Worldwide Fund for Nature (WWF) in 2014, CO_2 is the largest component of our ecological footprint.

On the solution side, energy is at the heart of the post-2015 development agenda. SDG number 7 calls for ensuring affordable, reliable, sustainable, and modern energy for all. Its three sub-targets relate to: ensuring universal access to energy services, substantially increasing the share of renewable energy in the global energy mix, and doubling the global rate of energy efficiency improvement.

SDG 7 also includes two means of implementation-related targets, which relate to enhancing international cooperation for access to clean energy research and technology, promoting investment in energy infrastructure and clean energy technology, and expanding infrastructure and upgrading technologies for modern and sustainable energy services in developing countries – LDCs and SIDS in particular.

The UN has declared the years 2014–24 as the Decade of Sustainable Energy for All. Related efforts are spearheaded by UN Secretary General Ban Ki-moon's Sustainable Energy for all (SE4ALL) initiative, which also played a key role in the development of SDG 7. High-level representatives from the GCC states – including Saudi Arabia's Deputy Minister of Petroleum and Mineral Resources and Chairman at the Saudi Energy Efficiency Center Prince Abdulaziz Bin Salman Bin Abdulaziz Al Saud, and the UAE's Minister of State and Special Envoy for Energy and Climate Change Dr Sultan Ahmed Al Jaber – are members of the SE4ALL initiative's advisory board.

The GCC states already have a commendable track record on work towards many of the SDG 7-related targets. According to World Bank data for 2012, their national electricity access rates are close to 100 per cent. They are also engaging internationally on developing methods of implementation, through participating in initiatives like SE4ALL and by focusing development assistance efforts on renewable energy projects in other developing countries. A broader analysis of the GCC states' participation in the 'international relations of the green economy' to acquire and provide means of implementation for sustainable energy is available in this author's recent OIES working paper 'The International Relations of the Green Economy in the Gulf'.

Sustainable energy for the GCC states?

On the targets of increasing the share of renewable energy and accelerating energy efficiency improvements, at the domestic level, the GCC states have a more difficult task ahead. The GCC economies are both carbon and energy intensive, owing to a mix of structural and policy-related factors. High energy demand growth is sustained by the oil, natural gas, and other energy-intensive industries, extensive need for desalination, the hot climate, low-density urban structure and energy-inefficient industries and buildings, and low domestic energy prices.

As a result of the abundance and low pricing of fossil fuels, production levels of clean energy, and its contribution to the economy across the GCC, are still negligible. Current electricity pricing patterns and lack of sufficient policy and investment incentives still discourage faster scaling up of renewables in most parts of the GCC – with Dubai perhaps an exception.

There are two strong motives for the GCC states to vigorously pursue the renewable energy and energy efficiency targets of SDG 7 domestically. Firstly, the GCC states will need to adapt their economies to a global transition to zero emissions by the end of the century. A goal to decarbonize the global economy 'over the course of this century' was officially endorsed by the Group of Seven (G-7) in June 2015. Most GHG reductions will need to come from phasing out (or decarbonizing) coal, oil, and natural gas use, given that these generate two-thirds of human-made GHG emissions. The task of economic diversification for the GCC states is therefore more urgent than ever. In 2014 (according to an estimate by the International Monetary Fund), before the current oil price slump, over 60 per cent of all GCC states' government revenue still came from oil exports, and oil accounted for approximately 50–90 per cent of their total exports.

'THE GCC STATES HAVE NOT MADE ADVANCES IN DECOUPLING ECONOMIC GROWTH FROM ENERGY CONSUMPTION AND CO_2 EMISSIONS.'

Secondly, given the imperative to decouple economic growth from ecological impact worldwide, the GCC states will need to change the basis of their competitive advantage from cheap resources to resource productivity. So far, the GCC states have not made advances in decoupling economic growth from energy consumption

and CO_2 emissions (see the author's OIES working paper 'The International Relations of the Green Economy in the Gulf'). It is argued that the concepts of green growth and green economy can offer tools for reconceptualizing energy as an engine for innovation and a sustainable source of prosperity for the GCC states.

A greener economy in the Gulf?

Green growth and green economy are opportunities-oriented approaches, in that they focus on possibilities, not limitations. The former is a tool to get to the latter. A key distinction is that green growth alone does not suffice for a green economy transition if 'brown growth' occurs at an equal or faster pace. In addition, for a truly green economy, countries also need to 'green the brown' by transforming existing infrastructure and natural resource consumption patterns to more sustainable ones.

As concluded in a recent volume *The Green Economy and the Gulf*, co-edited by Mohamed Abdel Raouf and the author of this article, great opportunities exist for the GCC states to green their investment and infrastructure in various sectors, including energy, water, buildings, and transport. Green jobs, trade, and aid also present huge opportunities. In the book, 18 authors examine key aspects of a green economy in the six GCC states, identifying barriers and opportunities, and drawing lessons and best practices from other countries. Barriers to greening are often linked to a broader socioeconomic context, and therefore require comprehensive and context-sensitive solutions.

The UAE's recent decision to begin deregulating transport fuel end-user prices is a great example of such a potential solution: well-timed (given the low level of global oil prices) and gradual enough to allow for consumers to start adapting to the idea that the time of under-priced energy is over.

Benefits of green economy policies for the GCC governments are numerous. Energy and water pricing reform, efficiency and performance standards, effective environmental regulation and enforcement, and integrated urban planning can generate important economic savings in the long term. Investing in green sectors, such as renewable energy or green buildings, can generate jobs, as can regulatory and policy frameworks geared at encouraging private-sector participation in green industries.

By fostering growth that is green and devising innovative and context-relevant solutions for 'doing more with less', the GCC states will position themselves as competitive players in the twenty-first century global economy. Green growth and international collaboration will both be key tools for achieving this.

**The views expressed in this article are those of the author, and do not necessarily reflect the views of the Emirates Diplomatic Academy or the UAE Government.*

The water–energy–food nexus in MENA

Eckart Woertz

The Middle East and North Africa (MENA) is the world's largest oil exporting region. It is also its largest importer of cereals, poultry, and sugar and one of its most arid regions. Its role in global energy and food markets is pivotal. In contrast, no comparable global market for water exists as 'blue water' (water in lakes and rivers, together with ground water) is a bulk commodity that is not very suitable for long-distance transportation. Yet via its food trade, the MENA imports huge quantities of 'virtual water' (water that was used to produce a commodity and is hence embedded in it). Virtual water trade has added the equivalent of a second river Nile to the water balance of the region and is the *conditio sine qua non* of its food security, as it had already lost the ability to produce all its required food from renewable water resources in the 1970s.

'WATER, ENERGY, AND FOOD ARE LINKED ON MANY LEVELS AND UTILIZATION OF ONE ITEM OFTEN CARRIES OPPORTUNITY COSTS FOR ANOTHER.'

Water, energy, and food are linked on many levels and utilization of one item often carries opportunity costs for another. Water is needed for the production of food, biofuels, and unconventional natural gas and for the cooling of power plants, but it can also produce energy itself via hydropower. Water systems in turn consume copious amounts of energy for pumping, desalination, irrigation, and treatment. Not only is agriculture the world's largest user of water by far, it also became increasingly dependent on hydrocarbon inputs in the twentieth century– spurred by mechanization, the globalization of supply and distribution chains, and the invention of the Haber–Bosch process (enabling nitrogen fixation and the production of mineral fertilizers). If deforestation,

distribution chains, fertilizers, and agricultural mechanization are considered, the global food system is the most potent emitter of greenhouse gases, comprising up to 29 per cent of the total. Climate change and environmental backlash in turn could compromise the agricultural production growth that is crucial to feeding 9 billion people by 2050.

The various interlinkages between water, energy, and food have led to attempts to conceptualize all three in one methodological approach – the Water–Energy–Food (WEF) nexus. Like its predecessor – Integrated Water Resources Management (IWRM) – it grapples with methodological issues of measurement, operationalization, and implementation and can mean different things for different people. However, it has been rather more in evidence at academic conferences than in politics.

Moves towards an integrated approach

In 2008, the World Economic Forum identified water, food, energy, and climate change as interrelated issues that should be tackled with an integrated approach. The German government followed suit in 2011 and organized an international conference on nexus-related issues, in an attempt to highlight Germany as an international champion of sustainability strategies. Yet transforming theory into policy making has proved to be elusive. Governments tend to address challenges in each sub-sector individually, although there have been attempts at bureaucratic unification. Morocco has integrated its ministries of energy, mining, water, and the environment into a single ministry. Saudi Arabia stripped the water portfolio away from the Ministry of Agriculture and put it into a separate Ministry of Water in 2001. In 2004, it added electricity to the latter's portfolio, making it the Ministry for Water and Electricity, in the hope of facilitating better management of the intertwined generation of power and desalinated water.

A number of MENA countries have sought to increase the efficiency of natural resource utilization via green growth initiatives, such as the expansion of renewable energy production in the Gulf, Morocco, and Egypt. Gulf countries have established bespoke institutions – like Masdar City and the International Renewable Energy Agency (IRENA) – which are based in Abu Dhabi or the King Abdullah City for Atomic and Renewable Energy in Riyadh. Local governments are interested in enhancing their international standing via such highly publicized initiatives, yet upon closer scrutiny renewable energy targets are limited and are still dwarfed by lavish hydrocarbon subsidies. Abu Dhabi hopes to use renewable energies for 7 per cent of its installed power generation capacity by 2020; however this boils down to only about 2.5 per cent of actual electricity generation if the relatively low degree of capacity utilization of intermittent renewable sources like solar power is taken into consideration. This number is hardly earth shattering or ambitious; reining in runaway demand would offer much larger reductions in greenhouse gas emissions, but local regimes are reluctant to tackle this issue due to political concerns.

'AFFORDABLE FOOD, WATER, AND ENERGY ARE CRUCIAL FOR POLITICAL LEGITIMACY.'

Affordable food, water, and energy are crucial for political legitimacy. All three are highly political commodities and so is their nexus, yet nexus approaches tend to be informed by technocratic mindsets of engineers and economists who hope to find ideal technical fixes and allocation functions, while underestimating the importance of politics. The only political concept that enters their way of thinking is that of 'governance', a perceived standard of appropriate administration that is called upon to implement 'solutions' that have been 'objectively' identified. Yet politics is different from governance; it entails winners and losers and it is used to cement the prevailing elite narratives of development and legitimacy. As such, nexus narratives are hardly new and have not been invented by the World Economic Forum. In the case of Egypt, the hydraulic mission goes back to Muhammad Ali 200 years ago. Consecutive Egyptian elites have been well aware of the interconnections between water utilization and food and energy production, and have used nexus narratives to justify rent seeking, influence peddling, and attempts to attract foreign capital.

Issues associated with MENA's energy demand

The MENA's domestic energy challenges are by now well established. In contrast to earlier periods, the region is not only the world's petrol station, it has also become its own best customer. Population and income growth together with lavish hydrocarbon subsidies fuel demand. The same is true for some food products and water provision. Related subsidies are part and parcel of the social contract of rentier and semi-rentier states in the region. It is difficult to unravel them or change their direction. In so far as reform has been undertaken, energy subsidies have been first in line, for example in Egypt and Kuwait. Not only are such subsidies much larger than those on food, they also disproportionately benefit the middle and upper classes that own cars and electrical appliances. In contrast, food subsidies are self-targeting, as poor people spend a relatively high share of their income

on food. However, reductions in energy subsidies have already caused increased food prices because of the fuel needs of production and distribution processes.

Energy subsidies have also benefitted industrial producers, encouraging energy-intensive production processes, like Egypt's steel industry, in particular. However, in the Gulf states, the competitive advantage formerly enjoyed by heavy industries that relied on cheap natural gas as feedstock is now under pressure, as every country except Qatar now faces a natural gas shortage and alternative energies will likely come with a higher price tag. This will also affect the pumping of groundwater for agriculture and the production of desalinated water, which forms the bulk of residential water supplies.

Increasing awareness of the value of water

While farmers have used non-renewable fossil ground water for irrigation purposes, aquifers run dry, and in 2008 Saudi Arabia started to phase out its subsidized wheat production – by 2016 it will rely solely on imports. Similarly, the UAE is phasing out the water-guzzling production of Rhodes grass for its livestock sector. Improvements to irrigation systems offer great potential, as in many cases inefficient flood irrigation still prevails. Yet a word of caution is in order. In Morocco and Israel the introduction of drip irrigation has led to *increased* water consumption, as the efficiency gains were used to expand agricultural production. Ultimately, some degree of rationing and reduction of agricultural activity might be unavoidable. The fact that the population in occupied Palestinian territories only gets a fraction of the water allocation of Israeli citizens also illustrates once more the political nature of resources management that fails to be addressed by mere technical approaches.

If the negative externalities of the energy and agricultural sectors, in the form of emissions, have been ignored, the positive externalities of water have been taken for granted. It has been regarded as an essentially free commodity for a long time. Water is different from other commodities due to various characteristics such as its bulkiness, low tradability, and heterogeneous demand patterns that encompass vastly different categories (residents, industry, farmers, and those – such as 'the environment' and the poor – who are unable to pay). Substitutability of water is limited, and it is essential for human life. Hence it has low excludability and governments play a prominent role in its management, even in the cases where blue water provision is privatized. In many ways water is a public good rather than an economic good. This is even more apparent if one goes beyond the localized provision of blue water supplies for residential consumption and irrigation. Water is recycled through the atmosphere, not locally. It is crucial to take the complete hydrological cycle into consideration and the provision of water by functioning ecosystems, especially as about 70 per cent of the world's crops are not irrigated, but grown with green water (water encapsulated in the soil as a result of rainfall).

'GOOD STEWARDSHIP OF WATER WILL REQUIRE GOVERNMENT REGULATION AND THE PARTICIPATION OF FARMERS.'

Good stewardship of water will require government regulation and the participation of farmers. Agriculture withdraws the vast bulk of water resources – the global figure is around 70 per cent, but in the MENA it can reach 80 per cent. Its share in *consumptive* water use is even higher (around 92 per cent), as evapotranspiration of plants is a one-off occurrence in each hydrological cycle, while residential and industrial withdrawals can be recycled or used twice (for example, water used for cooling a power plant can be used downstream for something else).

The importance of value chains

Value chains in energy, water, and food provision are crucial in managing water supply. Energy value chains are much more concentrated in the upstream sector than food, where one finds half a billion farmers globally. Although some MENA countries are largely urbanized, the rural population still represents a large minority in some of them (such as Syria) or even the majority (Egypt, Yemen). Farmers are crucial in the value chain for food provision and they are by far the largest consumers of water, yet they are disempowered. The global food system is heavily concentrated on the functions of procurement and distribution.

Food trading houses and food processers have considerable contractual leverage over farmers, who manage most of the water, but there has been limited incentive or awareness in these parts of the value chain to engage with the farming sector for better water stewardship so far. Mostly they communicate with the agricultural upstream sector via contracts that ignore or misprice water and its economic externalities. Reporting systems are underdeveloped and accounting rules absent. An economics textbook wisdom – that worships GDP growth as a panacea and an unquestionable assumption, while ignoring and underestimating negative externalities of such growth – prevails.

Only in some semi-arid OECD countries, such as Australia or Israel, have tariff and market arrangements

that link (to some extent) the costs of blue water utilization and stewardship been installed for irrigated farming. Some regions in the south-west of the USA, northern China, Central Asia, and the MENA might be forced to embark on similar paths in the near future due to aggravating drought, water scarcity, and exponential growth of competing water utilization in non-agricultural sectors. The OECD expects freshwater consumption to grow by 55 per cent between 2000 and 2050, with the growth in manufacturing (400 per cent) and electricity generation (140 per cent) particularly high.

Nexus-related policy areas

Against this backdrop the following nexus-related policy areas will be of importance in MENA countries:

The reduction of hydrocarbon energy subsidies, which are among the highest in the world, disproportionately benefit the middle and upper classes and favour capital-intensive production technologies that are less likely to absorb the region's burgeoning youth population into labour markets.

At the same time the region might want to consider *shifting some of the hydrocarbon subsidies into the support of renewable energies like solar,* that offer diversification potential and have less negative environmental externalities. Capital transfers by Gulf development funds to poorer MENA countries could prove beneficial in such strategic reallocations towards green growth initiatives.

'THE MENA'S DEPENDENCE ON FOOD IMPORTS WILL GROW WHILE THE CURRENT GLOBAL FOOD SYSTEM IS UNSUSTAINABLE.'

The MENA's dependence on food imports will grow while the current global food system is unsustainable. Engagements with international organizations and global supply chains to ensure greater environmental sustainability should be in the best interest of MENA countries. Yet its institutional capacities to do so are underdeveloped. Food subsidies are self-targeting and disproportionately benefit the lower classes. Their reduction is less likely, but subsidy reform might prove possible if better targeting, via smartcards, is undertaken or compensating financial benefits are offered to vulnerable segments of the population.

Water consumption is unsustainable in the MENA and hugely inefficient. Water will need to be (better) priced and the role of farmers will need to be upgraded to ensure better water stewardship. In many ways, water is a public good that requires functioning ecosystems, and government regulation to preserve them. However, greater irrigation efficiency might lead to increased water consumption, if such gains are used for production expansion, as has happened in Morocco and Israel. Ultimately, some reduction of agriculture might be necessary to funnel scarce blue water resources into economic sectors that create more value added and employment – like industries and services. About 90 per cent of rain water in dry marginal areas is lost to evaporation. However, even if blue water resources in the MENA are overallocated, its green water resources are underappreciated and offer considerable potential for improvement – such as better management of rangelands, water harvesting and supplementary irrigation, and the development of seeds that better withstand drought and soil salinity.

No formal agreement about the sharing of transnational water resources exists in the MENA. While hydropolitics along the Euphrates, Tigris, Nile, and Jordan attract a lot of media attention, and rightfully so, groundwater depletion has developed into an even more pressing issue in countries like Syria, Iraq, Yemen, the Gulf, and Jordan.

At their core, the MENA's challenges of administering water, energy, and food supplies are often closely interrelated and merit greater coordination across political institutions. Rather than following top-down approaches, these institutions would need to cooperate more with actors along the value chain and with civil society in general. A more open political environment, with more empowered mid-level institutions and possibilities for association from below, would be more conducive to such efforts.

Climate change and green policy in the UAE

Nivine Issa and Phillipa Grant

Climate change is an increasingly important consideration in the UAE. The growing impact of climate change has been particularly apparent through precipitation changes, rising sea levels, and more obvious climatic fluctuations such as harsher summers and cooler winters. According to a document (*Climate Change Impacts,*

Vulnerability and Adaptation) produced by the Abu Dhabi Environment Agency in 2009, the UAE is already subject to extreme weather conditions – even small variations in temperature and precipitation could negatively affect the country's fragile natural resources and its strength to adapt. The uncertainty and unpredictability of climate change in the region, together with its non-quantifiable effects, have urged the UAE to push ahead in the sector of sustainability, ahead of many of its neighbours.

In 2008, a national study (reported on the website of the Emirates Nuclear Energy Corporation (ENEC) in the document 'Nuclear Energy in the UAE') was conducted into the country's growing energy and electricity demand. It determined that the UAE's electricity generation needs will exceed 40,000 Megawatts by 2020 – an annual rate of increase of 9 per cent, which is three times the global average. With its existing generation capacity, the country will not even be able to meet half of this demand; therefore, it is faced with an urgent need for policy planning and exploring alternative sources of energy.

In consequence, the UAE has approached the energy sector from both ends of the spectrum: *supply management* by exploring alternative sources of energy and *demand management* by reducing energy demand and improving efficiency. This article synthesizes the way in which the UAE tackles the subject of sustainability in the energy sector, how this ties in to the growing energy demand, and the challenge of meeting demand with sustainable policy planning through green building codes, energy efficiency, renewables, and nuclear energy.

Green building codes

In response to rising energy demand and its consistently growing population, the UAE has made energy demand management strategies (specifically through sustainable policy planning) a central pillar of its long-term economic planning. As part of its 2030 Plan, Abu Dhabi's Urban Planning Council (UPC) established sustainability at the core of its vision; with the unveiling of the Estidama Pearl Rating System in 2009, the Emirates' vision of promoting sustainable urban development came to life. The Estidama rating system (applicable to buildings, communities, and villas throughout the processes of design and construction) has been tailored to the specific conditions and needs of the region and allocates significant weighting to water and energy conservation.

The UPC made Estidama a mandatory step in the process of acquiring a building permit, from its inception in 2009. The minimum 1-Pearl rating has been set as a target for all private developments, while a further commitment to green building has been set for government projects by mandating a 2-Pearl rating. Estidama has proven efficient and effective at reducing the energy demand of new buildings in Abu Dhabi through holistic planning and sustainable design. In fact, energy credits guide design teams towards passive design measures (such as building orientation and maximized shade), an efficient building envelope and mechanical systems, in addition to reduced electrical loads.

Likewise in Dubai, in 2011 the Dubai Municipality, in collaboration with the Dubai Energy and Water Authority (DEWA), released its own green building regulations and specifications; this is a set of guidelines with which all developers are to comply. In fact, unlike Estidama and the Leadership in Energy and Environmental Design (LEED) system mentioned below, the Dubai Green Building Code is not a multi-tiered rating system but a list of regulations that has to be implemented in all new developments.

There has also been a significant voluntary uptake of the LEED rating system – which certifies buildings against a set of sustainability criteria – by the country's private developers. The UAE has witnessed rapid growth in the adoption of sustainable design principles as developers, owners, and design firms have adopted the above green building codes; this has increased overall awareness and investments in 'green' products. In fact, the U.S. Green Building Council (USGBC) recently ranked the UAE eighth in the world for having a cumulative LEED-certified Gross Floor Area (GFA) of 3.13 million square metres.

Dubai's Integrated Energy Strategy 2030

Another integral part of national policy planning, the Dubai Supreme Council of Energy, has released Dubai's Integrated Energy Strategy of 2030; this aims to reduce the emirate's energy demand by 30 per cent and diversify energy sources to include gas, nuclear, solar, and clean coal by 2030. Buildings are considered to have the largest potential for increases in energy efficiency, therefore reducing demand.

'BUILDINGS ARE CONSIDERED TO HAVE THE LARGEST POTENTIAL FOR INCREASES IN ENERGY EFFICIENCY …'

It does not suffice to set targets for new buildings, however, existing targets should also be revisited to curb rising energy demand. As described in the 'State of Energy Report – Dubai' (produced in 2014 by the UNDP), the Regulatory and Supervisory Bureau (RSB) plans to nurture and support the ESCO market as it represents a promising solution to the country's retrofitting needs. An ESCO is an Energy Service Company that offers

performance-contracting services; these allow building owners to make necessary improvements to an existing building with little or no initial investment. Through installing energy-efficient equipment, and maintaining existing machinery over the duration of the contract, the building owner achieves cost savings by reducing consumption over a period of, typically, five to ten years.

In fact, in early 2014 the Dubai Energy and Water Authority helped to establish the first large-scale super-ESCO in the region: Etihad Energy Services. Its key role as an organization is to form an interface for energy efficiency projects, through financing them and subcontracting ESCOs for project implementation.

Energy Supply Management

A one-sided approach towards the reduction of energy demands is not sufficient to meet the demands of a growing population and a booming economy in a sustainable manner. This is why the UAE has also invested substantial effort in the development of alternative sources of energy.

'… SOLAR HAS EMERGED AS THE PRIMARY RENEWABLE ENERGY MARKET WITHIN THE UAE.'

Solar. As expected, solar has emerged as the primary renewable energy market within the UAE. The Research Centre for Renewable Energy Mapping and Assessing (RCREMA), part of the Masdar Institute Research Centre, has developed a Solar Atlas for the UAE (available on the Masdar website), whereby satellite imagery has been utilized to develop a map of solar potential across the UAE. The need for this map arose from the high demand for solar power and the search for suitable PV sites. The results of this study proved the existence of high yearly variability in solar irradiation in the UAE. Figures for direct, diffuse, and global horizontal irradiation varied between 1800–2200, 750–900, and 2100–2300 kWh/m^2 respectively, over the course of the three year period 2008–2010, for the UAE region. With this significant energy resource available, solar energy has been embraced on a commercial and residential scale. Notable solar installations include the solar fields at Masdar City – which include the Concentrated Solar Power (CSP) installation Shams 1, and the Masdar City Solar PV plant – in Abu Dhabi, and the Sheikh Mohammed Bin Rashid Al Maktoum Solar Park in Dubai.

According to the Masdar website Shams 1, located in western Abu Dhabi and completed in 2013, has emerged as one of the world's largest CSP projects. With a total area of 2.5 km^2 and an installed capacity of 100 MW, it has the capability to provide power to more than 20,000 local homes. Shams 1 utilizes Concentrated Solar Power (CSP), as opposed to the popular photovoltaic (PV) systems, and is connected directly to the grid.

Masdar City's other solar field, the Masdar City Solar PV plant, is currently the largest solar PV system in the UAE. The plant occupies an area of 210,000 m^2 and has an installed capacity of 10 MW. This generates 17,564 MWh annually.

According to the 2015 report 'Solar Energy in Dubai Mohammed Bin Rashid Al Maktoum Solar Park United Arab Emirates – Dubai' produced for the Dubai Electricity and Water Authority by the Middle East Solar Industry Association (MESIA), the Sheikh Mohammed Bin Rashid Al Maktoum Solar Park will be constructed and operated in stages, with the final stage expected to complete by 2030. The total area of this solar park is planned at 40.45 km^2 with an installed capacity of 1,000 MW. It will utilize the more conventional PV technology and is managed and operated by DEWA. The most notable characteristic of the project is that it is based on the Independent Power Producer (IPP) model; this has resulted in unprecedented competitive pricing, constituting the world's lowest price to date (by a significant margin) for solar PV energy.

As for residential solar power, the market has been relatively slow to date, with little impact on the overall energy markets. In March 2015, DEWA announced the introduction of their smart initiative 'Shams Dubai', with the aim of encouraging personal residential solar power installations by allowing connection to the grid under the net metering system.

There are also solar hot water systems within the UAE, and they are now mandated for certain residential developments. The fast returns on investment, together with their relatively simple technology, have led to a fast uptake of the systems in rooftop applications.

Nuclear. In 2008, the Emirates Nuclear Energy Corporation (ENEC) published the UAE's Nuclear Energy Policy, under the title 'Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy', emphasizing standards for safety, transparency, and security. The six key principles covered by the policy include:

- complete operational transparency;
- the highest standards of non-proliferation;
- the highest standards of safety and security;
- working directly with the International Atomic Energy Agency (IAEA) and conforming to its standards;

- partnerships with responsible nations and appropriate experts; and
- long-term sustainability.

Based on this Policy, in 2009 a UAE Federal Law was signed regarding the peaceful uses of nuclear energy, an independent federal agency the Federal Authority of Nuclear Regulation (FANR) was established, and systems allowing the development of nuclear materials were enabled. With a target of 25 per cent of the UAE's energy requirements to be provided by 'clean' energy, the first nuclear reactors have commenced construction in the western region of Abu Dhabi, with the first unit expected to complete in 2017 and all four units to be completed by 2020 (the ENEC website gives a useful summary of the key dates).

The evolution of the 'Green' Market

The rapid growth of the green market in the UAE has come hand-in-hand with the aforementioned drivers, legislation, and initiatives, as the demand for 'green' products and services keeps rising – creating countless opportunities in the economy.

For instance, as reported in the article 'UAE solar sector heating up with 1,000 new jobs expected' by LeAnn Graves on 19 May 2015 in *The National*, MESIA has estimated that around 1,000 jobs will be created within the UAE solar industry in the next two years.

Furthermore, also in *The National*, it was reported on 18 January 2014 (in the article 'UAE renewable energy projects bring the future into view' by Dania Saadi) that the online service MEED Projects had analysed the current total value of renewable energy projects and master plans, either operational or under construction, in the GCC region at an estimated US$4.5 billion. Projects to the value of US$1 billion are located in the UAE, making the UAE the current largest contributor to the GCC renewables market. Between now and 2025, from the number and value of renewable projects awarded, the total estimated value in the GCC region is expected to increase to US$162 billion.

'THE UAE … EMERGED AS REGIONAL PIONEERS IN THE RENEWABLE ENERGY AND SUSTAINABLE BUILDING SECTOR OVER THE PAST DECADE.'

As for 'green' products, it has been particularly noticeable that suppliers of building materials have been capitalizing on 'green-er' products, such as more efficient architectural, HVAC (heating, ventilation, and air conditioning), and electrical materials as well as more environment-friendly interior design products. This change has been specially reinforced with the implementation of the green building codes that created a substantial increase in demands for green products.

Looking to the Future

The UAE have much to be proud of through their successful infiltration of the international green market, having emerged as regional pioneers in the renewable energy and sustainable building sector over the past decade. The timeline below illustrates the key milestones and intensive activity within this industry since 2008, emphasizing the effort that the UAE has invested in energy supply and demand management. However, as with every success story, there are still areas to be improved on and developed.

Within the new sustainable building sector, the greatest barrier to efficient and successful projects undeniably lies within professional understanding and education. Since the introduction of sustainable building legislation, there has been a definite and consequential improvement in quality, efficiency, and life expectancy of developments; however, the major factor hindering this improvement is the lack of understanding and expertise among construction professionals. This has been slowly but effectively improving as a result of governmental, private, and national initiatives and investments.

Another significant barrier to the achievement of the UAEs' energy efficiency targets is the lack of community engagement, as a key factor in the success of these targets is the public's understanding and contribution. An energy-efficient building operated by an immoderate and uninformed population can be more detrimental than beneficial. Schemes such as DEWA's 'Green Footprint Initiative' in Dubai are aiming to increase community engagement through the education and involvement of the public. DEWA has started including the 'Green Footprint' symbol on customers' energy bills, to raise awareness of the scheme; this involves including information on the carbon footprint of energy-consuming activities, as well as steps people can take to reduce their energy consumption, and subsequently their individual carbon footprint. From a country known worldwide for its oil production and energy-intensive construction industry, this transformation of the UAE within the international 'Green Community' is quite remarkable.

Solar aid

Kishan Khoday and Stephen Gitonga*

Vast scale of large-scale migration

Rarely has the world seen the intensity and severity of change being experienced today in the Middle East. Among the record 60 million forcibly displaced people today around the world (the first time this level has been reached since World War II), more than 20 million are now suffering as refugees, internally displaced persons (IDPs), and forced migrants in the Middle East. This includes approximately eight million IDPs in Syria and four million Syrian refugees in neighbouring countries such as Lebanon and Jordan, two million IDPs in Iraq, and large and growing numbers in Yemen. The level of forced displacement is higher than ever before, re-shaping the nature of development challenges in the region, including challenges of energy security.

'MORE THAN 20 MILLION ARE NOW SUFFERING AS REFUGEES, INTERNALLY DISPLACED PERSONS, AND FORCED MIGRANTS IN THE MIDDLE EAST.'

Among the many priorities for the post-2015 era, Sustainable Development Goal (SDG) 7 focuses on the world's aspiration to: '*Ensure access to affordable, reliable, sustainable and modern energy for all*.' To address this goal of expanding energy access for the poor, in addition to scaled-up levels of assistance in Least Developed Countries (LDCs) around the world, support is also crucially needed to address the unique plight of forcibly displaced communities in the Middle East, now among the world's poorest and most vulnerable communities. Alongside issues of access to shelter, food, and water, issues of energy access have been a growing cause of concern by displaced communities, host countries, and international partners alike.

Energy security and refugees: challenges facing LDCs

Today, the vast majority of refugees and IDPs globally are hosted in developing countries; countries that already face strained levels of energy security. Examples of such countries in the Middle East include Lebanon, Jordan, Iraq, and Syria, all of which faced energy challenges even before the refugee and IDP crisis began, and where the vast majority of refugees and IDPs now live in cities and towns rather than in camps. For communities living in cities and towns, constraints to sustainable provision of energy access exist, either owing to ongoing conflict and destruction of infrastructure, as in Syria and Iraq, or from lack of fiscal space and limited ability to expand already stretched local energy supplies, as in Lebanon and Jordan.

Whether for those living in cities and towns, or for those hosted in refugee camps, a lack of sustainable access to energy creates dire challenges for daily life and for the ability to recover from the devastations wrought by conflict and forced migration. Energy deficiencies have important social consequences. Lack of access to energy hinders the ability to earn a living and use basic communication devices, while refugees and IDPs often resort to using wood, coal, or charcoal for cooking and heating needs. This exposes women and children to serious health impacts and to security risks in the search for fuel. The search for wood can also lead to encroachment into protected forest areas, in some cases causing tensions with local host communities.

Potential for solar power to improve energy access

Expanding the use of sustainable energy solutions like solar power to meet the basic needs of refugees and IDPs is therefore important and urgent, not only from a humanitarian perspective, but also from a development perspective. This is because it helps reduce pressures on the energy systems of host countries, which are already under strain, and it helps achieve goals of inclusion and sustainability for the benefit of refugees and IDPs as well as local communities.

In this regard, three key opportunities should be in focus for responses in the Middle East:

1 Expanding decentralized solar power solutions in host communities to increase their resilience and offset increased demands from refugees and IDPs,

2 Deployment of off-grid solar energy technologies for use in refugee camps to meet basic needs, and

3 Prioritizing sustainable energy within the international community's humanitarian and development responses to the refugee and IDP crisis.

Decentralized and distributed generation models to increase host country resilience

The first priority should be on expanding decentralized solar power in crisis-affected countries and refugee host communities, through engaging the role of solar technology and innovation to reduce systemic risks to development pathways from the

converging crises of energy insecurity and refugee and IDP influx. This is particularly important in cities and towns in Lebanon, Jordan, Iraq, and Syria which are playing host to large numbers of refugees and IDPs. These cities and towns are facing pressures in various ways, with pressures on energy supplies among the most crucial.

Lebanon is an important example. It now hosts over 36 per cent of all refugees that have left Syria over the past four years, a major global contribution by a relatively small country. According to some estimates, the share of Syrian refugees has reached 25 per cent of the overall population in Lebanon, the highest relative share of any country hosting refugees during the current crisis. This brings various risks to Lebanon's development pathway, including energy.

With the vast majority of refugees living in cities and towns, rather than camps, pre-existing challenges of national and local energy insecurity are being exacerbated by the surge of extra energy demand from the large population influx. These challenges include rising prices for basic fuel supply and the impact of regular power cuts, creating risks for the ability of both Lebanese host communities and Syrian refugees alike. As part of Lebanon's Response Plan to the Syria Crisis, a series of activities has been launched by the Government, with the support of the UNDP and Germany, to expand the use of renewable energy solutions for basic energy needs such as household cooking, heating, and community lighting needs in communities in North and Bekaa regions. These are among the poorest areas of the country, while also being the areas where a majority of refugees reside.

Another example is in neighbouring Jordan, also a major global contributor to the hosting of Syrian refugees. Jordan is, however, one of the world's most energy insecure countries, with an expensive import bill covering 97 per cent of its local energy needs alongside increased energy subsidies to households for their basic needs. With approximately 80 per cent of refugees residing in regular cities and towns across the Kingdom, additional energy demands have resulted in increased pressure on public expenditures, and thus in some level of risk to fiscal stability and community resilience.

Owing to these systemic risks from rising energy demand, Jordan has made a concerted effort to integrate sustainable energy solutions into the Jordan Response Plan (JRP) to the Syria crisis. Depending on the level of support by the international community, this would involve approximately US$100 million of proposed renewable energy and energy efficiency activities in host communities across the country. Like Lebanon, Jordan's proposed activities focus on the most affected governorates, where converging pressure from refugee population influx and baseline levels of energy insecurity are highest.

Proposed activities in the JRP include: scaling up the use of solar water heaters, energy efficient lighting, and solar lamps and chargers. If done at scale and across several host communities, such projects can offset increased demands from refugees, reduce levels of energy intensity, provide green and clean solutions for basic household needs, and manage overall risks to fiscal stability and national development pathways.

In these and other cases, with large and growing levels of incremental energy supply needed to effectively respond to the Syria crisis in the region's cities and towns, responses can align to, and benefit from, the new level of renewable energy investments planned as part of the region's overall drive for a *green growth model*. Rather than expanding import-dependent fossil fuel capacities, extra loads can instead be addressed through scaling-up solar energy solutions, as in the cases above. This would be a strategic means of connecting the region's general interests in expanding solar investments for green growth with addressing the pressing energy access needs for crisis-affected communities.

'ACCESS TO SOLAR SOLUTIONS IN CRISIS-AFFECTED COMMUNITIES CAN HELP RELIEVE INCREMENTAL PRESSURES ON ENERGY SUPPLIES …'

Across the region, expanded access to solar solutions in crisis-affected communities can help relieve the incremental pressures on energy supplies and thus greatly help national energy security, while also bringing benefits to host communities and refugees alike in terms of household- and livelihood-related energy needs. Other advantages include: important health benefits from reduced use of fossil fuels like diesel in dwellings, improved education through enhanced lighting for reading, less need for women and children to seek out energy provision (thus reduction in risks to their security), fewer cases of unregulated or illegal felling of wood from forests, and cash savings from reduced energy costs (which can be reallocated to many other basic development needs by host communities and refugees alike).

There are many models for expanding the use of renewable energy in refugee host communities in the region. Distributed energy generation solutions are expanding in scope and many are at the stage of readiness for scaling-up. Recent years have seen significant cost reductions for solar PV and for a number of renewable technologies. More efficient end-use technologies for activities such as cooking and lighting

are readily available, while solar-based distributed power generation is an increasingly cost-effective alternative to fossil fuel-based solutions (like diesel).

To rapidly expand access to energy for communities now at risk, decentralized and distributed generation models are now an effective solution. Options include solar PV, solar water heaters, hybrid solar–diesel and/or solar–wind power sets, and biomass/biogas waste-to-energy generators. In reviewing options (including solutions like off-grid and mini-grid networks) for decentralized solar solutions, host communities should be engaged in the design and implementation of projects, there should be support for mobilization of financial resources from the international community, and documentation and sharing of good practice on use of solar for crisis recovery and community resilience building efforts.

Off-grid solar technology for use in refugee camps

A second priority is to rapidly scale up deployment of off-grid solar energy technologies in refugee camps specifically. While a smaller share of refugees currently in the region inhabit camps (relative to those being hosted in cities and towns as noted above), it is equally important to expand energy access in refugee camps, especially given their isolated location away from basic supplies of energy and other commodities.

Both historically and today, access to energy has not been adequately captured within the humanitarian response system. While rapid crisis response and recovery efforts around refugee camps do prioritize issues of shelter, food, water, and health, the same cannot be said for the underlying energy needs of these and other aspects of life in a refugee camp. This is even more the case when, as in the Middle East, crises and resultant flows of refugees and IDPs are of a protracted nature.

'BOTH THE IMMEDIATE AND THE MEDIUM-TERM ENERGY REQUIREMENTS IN REFUGEE CAMPS ARE IN DIRE NEED OF ATTENTION …'

Both the immediate and the medium-term energy requirements in refugee camps are in dire need of attention by recipient countries and the international community. Inhabitants of refugee camps, particularly women and children, face health impacts from fossil fuels like coal, charcoal, and diesel, and face growing levels of grievance from local communities neighbouring the camps owing to unregulated or illegal felling of wood. Scaling up the use of solar power in camps can bring more sustainable electrification for water pumping, lighting for public walkways and individual family needs, mobile phone charging, basic cooking needs, and a host of other aspects of daily life.

Most refugee camps globally and in the Middle East are not connected to the national power grid since they are meant to be temporary in nature. But owing to the often protracted nature of crises, including those faced today in the Middle East, this results in a major gap, with serious risks to the overall resilience of the refugee camps, and to the ability of countries and the UN to adequately provide social services and basic needs to refugees.

In Jordan for example, the Za'atari Refugee Camp, in the north of the country, is now one of the world's largest refugee camps, and sits on top of the country's largest groundwater aquifer. Having evolved from a modestly sized operation in 2012, hosting refugees in the hundreds, it has now grown to the size of a small city with a population of approximately 100,000 refugees. As demands for basic services and needs grow, a number of energy access issues have arisen. While efforts to date have been scattered and largely focused on use of coal, charcoal, and diesel, more sustainable solutions are being considered.

Through the support of the UN and donor countries, a solar power facility is being considered for construction at Za'atari in 2016; this would greatly reduce the cost of providing power to camp residents and make their access to energy in both public and private areas more sustainable and cleaner, while improving basic needs, living conditions, and livelihood co-benefits from energy access. In the nearby Azraq Refugee Camp, a plan to install a solar power facility is likewise underway for 2016, while solar street lights have already been installed and solar lanterns are being provided, bringing lighting for general family needs including education, along with a phone-charging capacity in the lanterns which is critical given the broad benefits from mobile phones for livelihoods, safety, and security.

Vital role for sustainable energy within international community's humanitarian and development responses

Last, but not least, is the need to mobilize the international humanitarian and development community to support the scaling up of solar solutions in both host communities in the region's cities and towns, and refugee camps. This includes efforts to integrate sustainable energy access into crisis response, relief, and recovery policies and programmes by multilateral and bilateral donors. The Regional Refugee & Resilience Plan in Response to the Syria Crisis (3RP) – a platform for identifying and responding to country needs and for building greater synergies between

the humanitarian and development aspects of such responses – is a key opportunity for such an effort. While issues of shelter, education, food, and water rightly feature at the core of the plan and process, access to energy has also begun to be integrated.

In Jordan, for example (through UN technical assistance provided to the Government) approximately US$100 million of proposed solar energy and energy efficiency projects were integrated into the Jordan Response Plan (JRP) – the national instrument to define local needs under the 3RP process. If funded, such measures could bring solar solutions to both cities and towns across Jordan, and to refugee camps, which together host over one million Syrian refugees. But while planning is underway to scale up solar solutions, large gaps in this important 'solar aid' agenda, which need the engagement of donor partners, remain.

In addition to the potential role of Western donors in contributing to solar initiatives as part of national responses to the refugee and IDP crises, the countries of the Arab Gulf have also emerged as leaders, both globally and in the region, in the provision of humanitarian aid and development assistance, having jointly provided over US$100 billion of support since the 1970s. They are also world leaders in the energy sector, and are increasingly aspiring to emerge as a global and regional hub in the development and deployment of solar technology that is adapted to regional conditions of heat and sand, and in investigating regional needs for innovation in areas such as energy–water co-benefits.

Partners like the UAE Ministry of International Cooperation and Development, the OPEC Fund for International Development (OFID), the Islamic Development Bank (IsDB), the Saudi Fund for Development, the Kuwait Fund for Development, to name but a few, have provided energy access investments and aid to countries for many years. The UAE, for example, now provides over US$400 million for solar energy development in countries around the world, while OFID is providing over US$100 million towards the important nexus of energy access to water and food security, to countries around the world. Mobilizing some of these resources and experience towards the plight of refugees and IDPs in the region can help bring about a new model of assistance that places energy at the centre of crisis response and recovery frameworks.

'AN IMPORTANT OPPORTUNITY NOW EXISTS FOR GULF PROVIDERS … TO PLAY A LEAD ROLE IN THE PROVISION OF SOLAR AID.'

An important opportunity now exists for Gulf providers of humanitarian and development assistance to play a lead role in the provision of solar aid to refugee and IDP host communities across the region, and beyond. This can help bring forth the important role of energy in forging a stronger nexus between humanitarian and development systems of support, the nexus of energy access to the basic shelter, food, and water needs of refugees and IDPs; this can be of invaluable benefit to countries and beneficiaries in the Middle East.

In concluding, one may take heed of the call many years ago by Mahatma Gandhi to:

> *Recall the face of the poorest and the weakest man whom you may have seen, and ask yourself, if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny? In other words, will it lead to swaraj [freedom] for the hungry and spiritually starving millions?*

This call to action rings true as much today as ever. New sustainable energy partnerships that address the plight of today's refugee and migration crisis in the Middle East can help serve as a model for efforts to bring the benefits of green growth and innovation to the most needy in the world, in line with the new post-2015 development agenda and Sustainable Development Goal 7 on Energy.

**The opinions expressed herein are solely those of the authors, and do not necessarily represent the views of the United Nations, UNDP or its Member States.*

CONTRIBUTORS TO THIS ISSUE

Osamah Alsayegh is Director of Science and Technology at the Energy and Building Research Center, Kuwait Institute for Scientific Research

Waleed S. Alsuraih is Senior Energy Specialist at the World Bank

Alissa Amico is Project Manager, Middle East and North Africa at the Corporate Affairs Division, OECD

Jason Bordoff is former energy advisor to President Obama, Professor of Professional Practice in International and Public Affairs and Founding Director of the Center on Global Energy Policy at Columbia University, New York

Rabia Ferroukhi is Deputy Director, Knowledge, Policy and Finance Centre at the International Renewable Energy Agency (IRENA)

Stephen Gitonga is Regional Sustainable Energy Specialist in the Arab Region at the United Nations Development Programme (UNDP)

Phillipa Grant is Sustainability Coordinator at AESG, Dubai

Nivine Issa is Sustainability Consultant at AESG, Dubai

Laura El-Katiri is Research Fellow at the Oxford Institute for Energy Studies

Arslan Khalid is Associate Programme Officer at the International Renewable Energy Agency (IRENA)

Kishan Khoday is Team Leader for Climate Change, Energy and DRR in the Arab Region at the United Nations Development Programme (UNDP)

Jim Krane is Wallace S. Wilson Fellow for Energy Studies at the Baker Institute for Public Policy, Rice University, Houston

Akos Losz is a graduate student at the School of International and Public Affairs, Columbia University, New York

Mari Luomi is Senior Research Fellow, Emirates Diplomatic Academy, Abu Dhabi

Walid Matar is Research Associate at King Abdullah Petroleum Studies and Research Center (KAPSARC), Riyadh, Saudi Arabia

Robin M. Mills is Non-Resident Fellow for Energy at the Brookings Doha Center and author of *The Myth of the Oil Crisis*

Alessandro Rubino is Lecturer in Economics, University of Bari, Italy

Ernesto Somma Professor of Industrial Organization, University of Bari, Italy

Jonathan Walters is a former World Bank Director of Regional Programmes in MENA and is now an independent economist

Eckart Woertz is Senior Research Fellow at CIDOB (Barcelona Centre for International Affairs)

Thani Al Zeyoudi is Director of Energy and Climate Change at the Ministry of Foreign Affairs, United Arab Emirates, and UAE permanent representative to the International Renewable Energy Agency (IRENA)

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57 Woodstock Road Oxford OX2 6FA
Direct Line: +44 (0)1865 889136
Reception: +44 (0)1865 311377
Fax: +44 (0)1865 310527
www.oxfordenergy.org

EDITOR: **Bassam Fattouh**
CO-EDITOR: **Laura El-Katiri**
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