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

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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

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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