THE OXFORD INSTITUTE FOR ENERGY STUDIES

February 2017

Financing renewable electricity in the resource-rich countries of the Middle East and North Africa: A review

OIES PAPER: EL 22

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ISBN 978-1-78467-078-8

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Abstract

Renewables in the resource-rich countries of the Middle East and North Africa (MENA) are inconsequential contributors to regional total primary energy supply, but recent project developments and overt support from a range of influential regional actors suggest a general trend towards a more environmentally sustainable electricity supply. This trend is driven just as much by economics as other factors, as rapidly falling renewable energy capital costs are complementing favourable policy environments, technical suitability, and concerns around the impacts of anthropogenic climate change. Finance is an especially important consideration in this transition, yet it receives insufficient coverage. This paper seeks to remedy this deficiency of academic inquiry. At the root of our inquiry lies a simple pair of questions: what makes a project financeable, and what can the resource-rich nations of the region do to create vibrant clean electricity financing markets for renewables? We outline the factors that affect the financeability of projects, review the latest developments in renewable energy finance in the region, and present policy recommendations going forward.

Keywords: Renewable Energy; Energy Finance; Resource-rich countries of MENA

JEL classifications: Q28, Q48, G11, G24, G31

Acknowledgments

We would like to extend our sincere thanks to the many respondents who gave so generously of their time in answering our questions and challenging our initial positions. We would also like to thank the numerous internal and external reviewers that offered helpful thoughts that refined our thinking (particularly Danny Harvey of the University of Toronto, Malcolm Keay of the Oxford Institute for Energy Studies, David Robinson of the Oxford Institute for Energy Studies, Steve Griffiths of Masdar Institute, and Marc Norman of Chadbourne & Parke, as well as others who wished to remain anonymous). All errors remain the responsibility of the authors.

1. Introduction

In a recent procurement of new solar electricity by the Dubai Electricity and Water Authority (DEWA), a winning auction bid of 2.99 USD cents per kilowatt hour (kWh) was submitted for the third phase of DEWA's Sheikh Mohammed bin Rashid Al Maktoum array. This figure constituted exactly half a previous world record of 5.98 cents/kWh, set in Dubai a year and a half earlier for the second phase of the same project. It has been argued that such prices make solar an economic generation source (on a levelized cost basis) compared to oil (at any price over $23 per barrel (bbl)) and natural gas (at any price over $4 per million British thermal units (MM/Btu)). Should this declining cost trend continue, Mills (2016) contends that unsubsidized[1] mature solar photovoltaics can become among the most economic options in the region's price-sensitive electricity business[2].

Many factors contributed to this record low price, including declining renewable electricity capital costs and a well-designed auction procurement system[3]. Importantly, significant amounts of low-cost bank debt, combined with equity-holders accepting low returns, played a key role in ensuring the project's economic viability. Yet despite the centrality of financing in ensuring greater private sector involvement in renewable electricity in the region (as evidenced in the DEWA project), the topic has been conspicuously under-represented in the literature. To address this shortcoming, this paper presents some key issues for consideration. At the root of our inquiry lies a simple pair of questions: *what makes a project financeable, and what can resource-rich nations of the region do to create vibrant financing markets for renewables?*[4] We will be focusing here on the key measures that entice private investors (rather than straightforward direct government investment) as we anchor our analysis in the Gulf Cooperation Council (GCC) countries to draw out implications for the resource-rich nations of the Middle East and North Africa (MENA) region.

To date, a great deal of coverage in the academic and practitioner literature has been extended to the policy, sociopolitical, environmental, and technological aspects of renewable electricity in the region. This expansive assortment of information, provided through numerous reports and articles, provides a solid basis for understanding key features of renewable electricity in the region. Major academic topics covered to date include analysis of the policy, technology, and governance[5] aspects of the issue. Topical practitioner reports[6] on the economics, policy, regulatory, and legal frameworks for renewables in GCC/MENA countries have also been written (and help to lay the framework for our coverage here). This work builds on these foundations; to the best of our knowledge, this constitutes one of the first pieces of academic research assessing GCC renewable electricity financing opportunities (complementing other recent publications, such as Dubey et al., 2016).

The next section provides a primer on the benefits of renewable electricity and the current status of renewables (overall and GCC-specific). This is followed by a description of what makes a project

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[1] We refer here to explicit subsidies, as some implicit subsidies can be found in the DEWA procurements. For example, Griffiths & Mills (2016) note that land and interconnection costs were assumed by the government. In addition, syndicated loan rates (partially offered by state-owned banks) were low, and debt had long tenors.

[2] This trend appears to be continuing; after the time of initial writing, a bidder submitted a 2.42 cents/kWh bid for a project near Abu Dhabi (Pothecary, 2016).

[3] Auction design includes the whole process of procurement, from estimating demand, pre-qualification stage, rules for selection of winners, and choosing between technology-neutral and technology-specific approaches (among others).

[4] Although renewable electricity deployment could be fully or partially met through directly allocating fossil fuel export revenues to renewable electricity capital expenditures (Sgouridis et al., 2013), we assume that private capital will be necessary to meet the scale of the requirements for clean electricity supply (OECD report, 2015).

[5] Notable regional academic coverage includes Abdmouleh et al. (2015), Mondal et al. (2016), and Bhutto et al. (2014), while country-specific examinations include reports such as Sgouridis et al. (2013; 2016).

[6] Noteworthy examples include pieces by PricewaterhouseCoopers (PwC) (2016), King Abdullah Petroleum Studies and Research Center (KAPSARC) (2016), the Middle East Solar Industry Association (MESIA) (Bkayrat, 2016), and the International Renewable Energy Agency (IRENA) (2016).

financeable, with region-specific insights derived from key stakeholder interviews bringing a mix of academic and practitioner perspectives. We then move to a discussion on the history of GCC renewable electricity finance, with reference to case studies on very recent investment initiatives in the region. We conclude with a series of policy recommendations that incorporate discussion on an optimal path going forward.

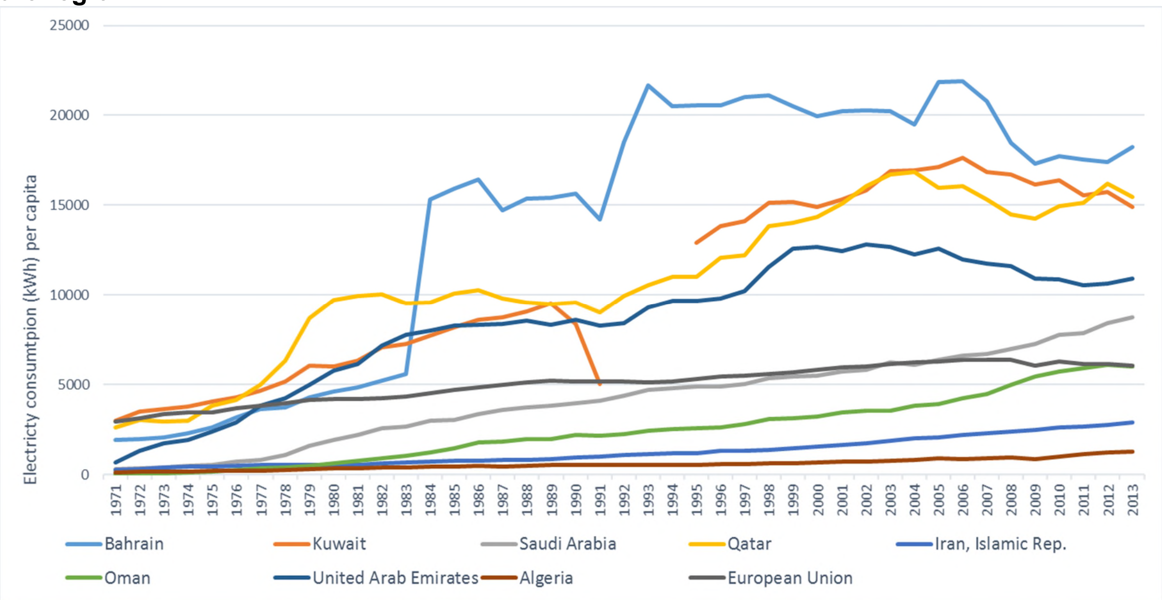
2. Renewable energy sector activity

2.1 The rationale for renewable energy

Generally, the benefits of achieving the normative levels of renewables deployment called for by both the governments of the region and relevant supranational organizations have received a great deal of attention in the academic literature.

An important motivation for deploying more renewables (ideally in concert with energy efficiency improvements) stems from renewable electricity's ability to address increasing domestic energy demand – a situation that El-Katiri & Husain (2014) call one of the most important public policy challenges facing the region. As seen from Figure 1, electricity consumption per capita in the region has been growing very quickly over the last four decades and, for some countries, it is even higher than the average of developed economies (such as those found in the European Union). At the same time, the region is experiencing significant population growth – a scenario with obvious implications for electricity consumption growth over the coming decades. This is an opportunity for renewables to "green" an energy-intensive group of economies that are experiencing rising domestic demand for fossil fuel energies, with the attractive ancillary benefit of allowing for more conventional energy to be exported and thus increase government revenues (Lahn & Stevens, 2011).

Figure 1: The historical growth of electricity consumption per capita in selected countries of the region



Source of data: World Bank Group (2016b)

Moreover, renewable energy's output is often technically well-matched to the needs of the region's energy demands (for example, the peak output for solar photovoltaic arrays coincides with high air conditioning loads). Abundant land in many areas allows for renewable generation options such as photovoltaic arrays to shave off the need for additional peaking plants (which are often already generally operating at, or close to, maximum capacity), as well as the ability for generation to be situated closer to load. Economic benefits that are linked to renewable energy supply build-outs range from more sustainable trade balances (as a result of harnessing an endogenous energy source[7]), to the potential for economic diversification into knowledge industries, to the potential for creating high quality jobs demanded by the educated population in these countries.

Policymakers tend to be especially concerned with energy security. Renewables provide clear enhancements in this regard: by improving the resiliency of supply and/or reducing susceptibility to fuel supply shocks, through diversifying the supply mix, and through contributing to the mitigation of accelerating anthropogenic climate change.

Renewable electricity generation can help meet broader environmental goals, such as the reductions in the generation of climate-altering greenhouse gases that were agreed by the nations of the region in the recently concluded Paris Agreement (Sarant, 2015). This last point ties into yet another benefit raised by El-Katiri & Husain (2014); namely, that renewables provide local environmental benefits, such as the ability to at least partially address the crippling air pollution that faces inhabitants of many of the region's urban areas.

While seemingly there is a bright future ahead for renewable electricity in the region, renewable integration will probably not be straightforward. Any large renewable electricity deployments face a series of formidable barriers, not least that there still remains a fairly limited history of renewable electricity development in the region, and actions undertaken going forward will involve navigating somewhat uncharted territory. More specifically, the region faces a number of identifiable obstacles, such as state monopoly control of the power sector, subsidization of incumbent fossil fuel generation types[8], and a lack of institutional capacity[9] (Clover, 2016). Lilliestam & Patt (2015) draw special attention to the need for bureaucratic reform. Technical barriers are also present; for example, it has been long-observed that the GCC is not well interconnected (Al-Asaad, 2009), and it is well-known that much of the region's grid infrastructure (for instance, substations and power lines) and grid codes are in need of upgrading. Moreover, having sufficient sources of flexibility will be necessary for increasing renewables penetration beyond current maximums of around 20 per cent, and coping with the inherently intermittent production of renewable electricity technologies. Finally, climactic factors play a role – high humidity and dust in many countries of the region markedly reduce potential renewables production (Atalay et al., 2016).

2.2 Overall global renewable energy investment

Estimates suggest that, between 2015 and 2035, over $50 trillion USD in global energy supply infrastructure and energy efficiency investment will be required if the world is to maintain even a small chance of remaining within 2 Celsius degrees of global warming[10] (OECD, 2015). Some evidence of a trend towards this large (but achievable) cumulative capital mobilization can now be seen in international financial markets. In 2013, global renewable energy investment exceeded that in fossil-based electricity infrastructure (Randall, 2015). In 2015 renewables accounted for more than half of all

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[7] It is often assumed that the resource-rich states of MENA do not import oil and gas, but this is not the case. Kuwait and the UAE – two of the world's largest hydrocarbon exporters – rely on LNG imports for electricity (El-Katiri & Husain, 2014). In fact, thermal power generation in the region is often expensive, as natural gas is imported in some of these countries.

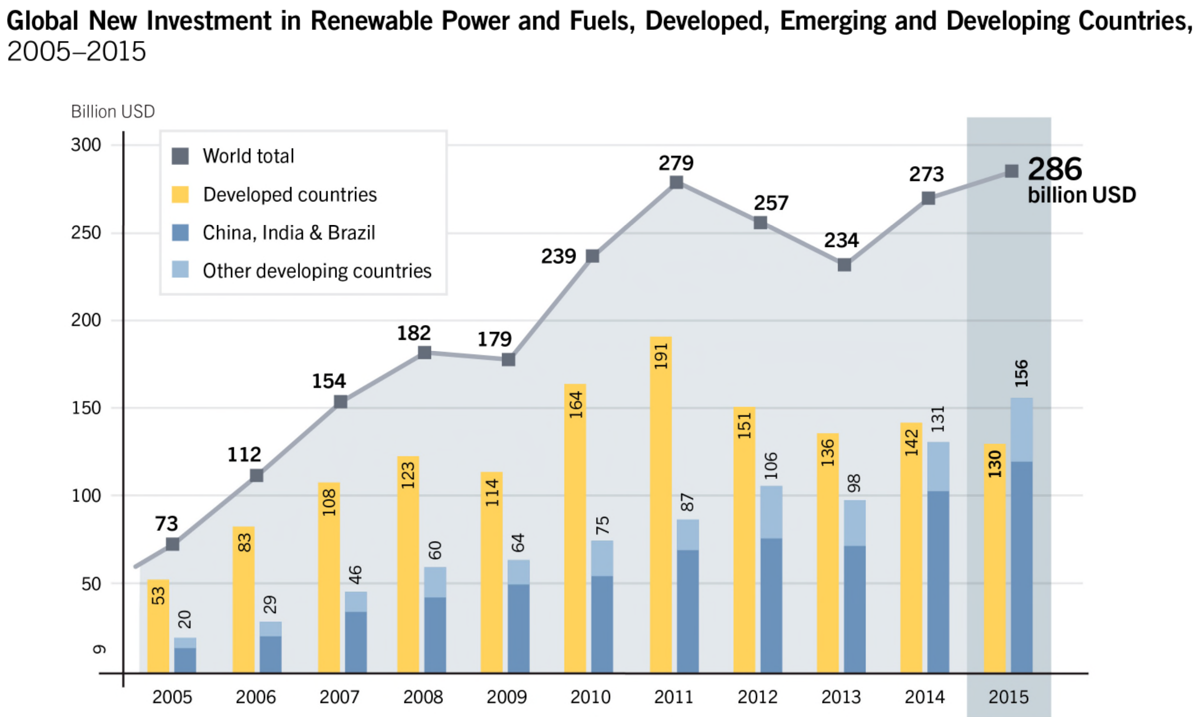
[8] Fattouh & El-Katiri (2012) found a range of burdens associated with subsidies (including a pro-rich apportionment of benefits, underinvestment in energy infrastructure, and substantial growth in primary fuel and electricity usage). Of particular relevance to this paper, subsidies act as a significant disincentive for large-scale renewable electricity deployment. At the present time, very low prices still dominate retail and industrial markets. Good reasons exist for these low prices - retail consumers see low energy prices as part of the state's duties to citizens, and state economic diversification strategies aim to attract petrochemical firms that require low-cost feedstock – but the damage of these overt subsidies for renewable electricity is exacerbated by harms associated with indirect subsidies (for example the lack of carbon pricing).

[9] The region is hampered by a weak legal and contractual framework. For example, Qatar ranked #112 on World Bank "Doing Business" report for contract enforcement (World Bank Group, 2016a).

[10] A figure that is likely necessary to avoid the worst consequences of anthropogenic climate change (Wagner & Weitzman, 2015).

newly installed power generation capacity, with around $286 billion allocated to the renewable power and fuels sector (see Figure 2) (United Nations Environment Programme, 2016; Bloomberg New Energy Finance, 2016).

Figure 2: Global new investment in renewable power and fuel, disaggregated by region



Source: REN21(2016)

2.3 Renewable energy investment in the resource-rich countries of MENA

While much of the aforementioned strong growth occurred in China or developed markets, GCC and MENA countries are seen by many experts as some of the most exciting upcoming frontiers[11]. In recent years, renewable energy has climbed up the agenda of policy makers, even though the region has lagged other parts of the world in terms of renewable investment (see Figure 3). Countries such as Iran see renewable power as an opportunity to reduce domestic consumption of fossil fuels and improve energy security through satisfying a growing electricity demand which has resulted from population expansion, growth of energy-intensive industries and industrialisation. The dynamics of the sunny Gulf Cooperation Council[12] (GCC) nations' electricity markets include demand drivers - desalination demands, substantial air conditioning loads, desired increases in domestic resident employment growth, and aspirations for greater energy diversification – that provide added push for renewable generation capacity growth going forward. Currently, renewables seem poised to move from peripheral

[11] Perhaps unsurprisingly, GCC member countries do not fit a single mould, as their diverse ambitions mirror the assortment of frameworks currently available within the broader MENA region. Beyond the GCC, countries such as Egypt, Jordan, and Morocco are demonstrating significant progress towards realizing a transition to a cleaner energy future.

[12] Like Boersma & Griffiths (2016), we are aware that every state within the GCC maintains its own distinct political economy. However, we feel that this designation for the hydrocarbon-exporting monarchies is a useful grouping that allows for commonly applicable insights.

applications (such as isolated areas or research sites) to the mainstream utility-scale[13] electricity markets of the region, creating diffuse economic, social, and environmental benefits in the process.

In the short-term, several of the states in the region are initiating modest plans out to 2020. Qatar, for example, intends for renewable electricity to meet sixteen per cent of total power generation by 2020 through the deployment of 1,800 megawatts (MW) of solar power capacity (Mittal, 2016), while Kuwait is seeking five per cent renewables in the generation mix by 2020 (Oxford Business Group, 2015). Iran's government plans to integrate five gigawatts (GW) of installed capacity of renewable power into the current 74 GW system in the next five years[14]. The Emirate of Dubai is aiming for seven per cent of energy from clean sources in the broader energy mix through the Dubai Clean Energy Strategy (Everington, 2016).

Longer-term action is significant and more ambitious. Iran hopes to expand its current total installed power capacity from 74 GW to 120 GW by 2025, with a great portion of this growth coming from renewables (Hubeaut, Addison, & Ege, 2016). Saudi Arabia – the only GCC state to register in the top 40 of a recent iteration of the global Renewable Energy Country Attractiveness Index (RECAI) (Ernst & Young, 2015) [15] - is planning large manufacturing facilities for solar components, while its state oil giant Saudi Aramco[16] intends to build numerous renewable electricity projects to complement the 9,500 MW of renewable deployment called for in the Vision 2030 document[17]. The United Arab Emirates plans to expand the Mohammed bin Rashid Al Maktoum Solar Park from the current 13 MW capacity[18] to over 5,000 MW by 2028 (a significant increase from the original 2028 target of 3,000 MW - Bkayrat, 2016). Kuwait, meanwhile, has declared similarly ambitious targets (4,500 MW of solar and wind energy by 2030, according to Bkayrat, 2016). Overall, it is estimated that at least $750 billion of net benefit could materialize for the GCC if renewable goals to 2030 are met (Clover, 2016).

Although each country of the region maintains specific reasons for adopting renewable energy, the impetus for a clean energy transition is at least partially motivated by a collapsing oil price environment, and the need for economic diversification and energy price reform. For example, approximately 85 per cent of Saudi Arabia's export earnings are linked to oil and gas exports (Organization of the Petroleum Exporting Countries, 2016) - a concentration which has led to calls for much greater solar supply penetration (partially to diversify the economy) and a broader "re-think" of industrial policy. Other countries, such as the United Arab Emirates and Qatar, are focused on the implications of a lower oil price (and associated lower capital inflows) that reduces budgetary capacity for maintaining domestic energy subsidies; indeed, drastic reforms that bring local fuel costs more closely in line with (now lower) international benchmarks have been implemented in these two countries (Boersma & Griffiths, 2016; Sergie, 2016). Moreover, the countries of the region are signatories to the Paris Agreement, which requires a strategy to reduce greenhouse gas emissions and adds additional momentum to a well-

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[13] While we refer throughout this piece to utility-scale projects, we are aware that the securitization of smaller-scale projects has the potential to reach a significant scale. In the aggregate, distributed solar rooftop generation could begin to play an especially significant role. For example, Dubai's Solar Shams program makes rooftop solar universally mandatory by 2030 (Griffiths & Mills, 2015). Therefore, "utility-scale" should be read as synonymous with large-scale.

[14] Due to economic sanctions in the past, renewable growth has been slow in Iran. However, this status quo is expected to change as the country gains a new post-sanctions momentum.

[15] Although it was present on the RECAI in 2015, Saudi Arabia is not found on the most recent iteration of this industry report (Ernst & Young, 2016).

[16] The most valuable company in the world, according to some estimates (such as The Economist, 2016).

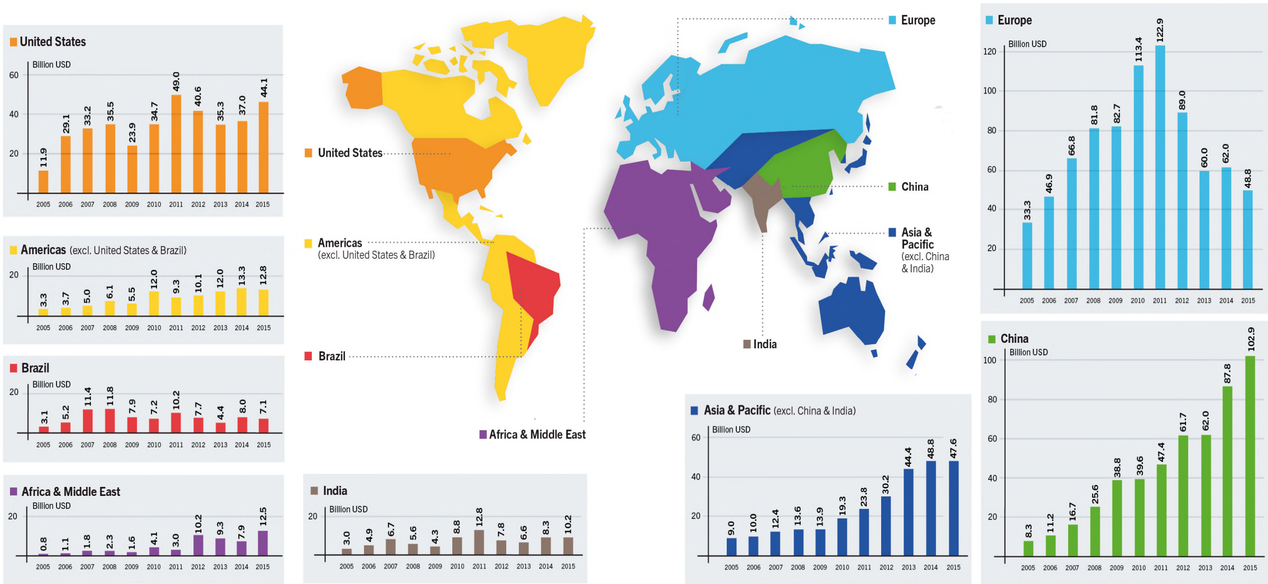
[17] This calls for a revamping of industrial policy, the partial privatization of state-owned energy producers, and - of particular relevance to this piece - a wide array of renewables-related measures, including the localization of the renewable energy value chain in Saudi Arabia, the initiation of public-private partnerships, and the gradual liberalization of fuel markets (Al-Arabiya, 2016).

[18] We note that this constitutes only a small percentage of a national portfolio which includes solar projects such as Masdar's 10 MW plant and the Shams 100 MW plant concentrated solar thermal plant (discussed on page 21 of this paper). Further expansion is planned.

established case for making the removal of fossil fuel subsidies central to any climate change mitigation effort (see, for example, Wagner & Weitzman, 2015; Coady et al., 2015).

Figure 3: Global new investment in renewable energy (power and fuel), disaggregated by region

Global New Investment in Renewable Power and Fuels, by Country/Region, 2005–2015



Data include government and corporate R&D.

Source: REN21 (2016)

3. Financing renewables: an analytical framework

Financing cost is one of the main components of renewable electricity's cost - not least because capital expenditure constitutes the largest share of total cost. This capital expenditure intensity means that capital spent at the inception needs to be paid back over time; given that money has a time value associated with it, the ultimate implication is that this capital is more expensive than if it were tapped more over the course of the operating life of the asset. In addition, the uncertainty in investment return and/or payback period can increase the cost of capital.

Perhaps the most useful method for conceptualizing the criticality of finance to renewable electricity can be determined with reference to the denominator of the simple equation used to determine the levelized cost of electricity (LCOE). Although the LCOE is a somewhat crude measure for determining electricity cost (it does not incorporate all costs of final delivered electricity, including back-up generation, ancillary services and transmission and distribution (T&D), nor does it reflect the different value assigned to generation at specific times in the day), the formula below is illustrative for our purposes (ECOFYS, 2014):

$$LCOE = \frac{\sum_{t=1}^{n} \frac{I_t + O\&M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}} \quad (1)$$

where:

I_t = Investment in year t ($/kW/year)

$O\&M_t$ = Operations and maintenance (O&M) ($/kW/year)

F_t = Fuel cost ($/kW/year)

E_t = Electricity output (kWh/kW/year)

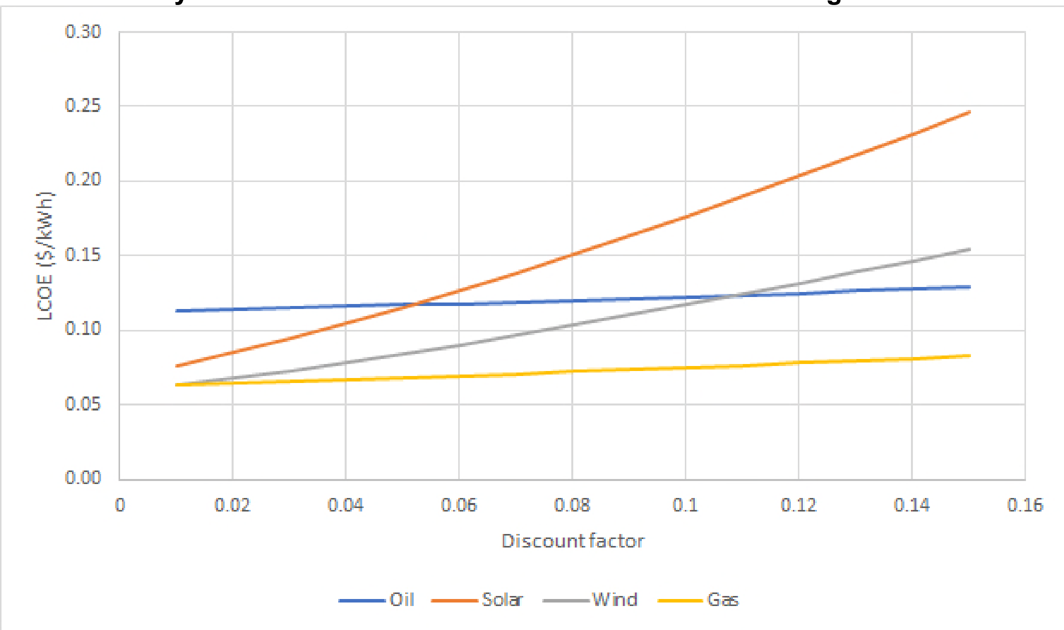
r = discount rate

t = lifespan (years of the project)

This equation computes the LCOE as the ratio of the discounted value of initial and all future costs to the discounted value of all electricity generated. The denominator within each summation term reflects the discount rate - a factor which is reliant on a proportionately weighted combination of returns required by equity investors and the lending rates of creditors. For fossil fuels, I_t may be relatively small and largely in year 1, while F_t is nonzero but spread over the project lifespan. For renewables, I_t may be large and mostly in year 1, while $F_t = 0$. Thus, there will be little to no discounting of the total costs of renewable energy. For both fossil and renewable electricity, future electricity production is discounted – without a corresponding discounting of any part of the costs. Thus, as shown by Ondaczek et al. (2015) and many others, small changes in the discount rate (a variable dependent on a wide mix of assumptions on risks, sources of funds, and policy or political frameworks) can have high impacts on the cost of renewable electricity generation.

The effect of discount factor on the cost of generation can be seen from Figure 4, which shows the sensitivity of LCOE to discount rate for various technologies. The figure shows that the LCOE of renewables is more sensitive to the discount rate (when compared to fossil sources) because, as previously discussed, capital cost rather that operating expenditures constitutes a higher portion of low or fuel-free renewable energy's total cost. In addition, for oil and gas generators the cost and energy produced are more uniformly speared over the life of the project, whereas this is not the case for renewables. These clearly indicate the importance of financing cost in renewables decision-making. A simple heuristic is that the lower the cost of capital, the better the prospects for an investment's financial attractiveness and, in turn, execution. However, arriving at the lowest possible rate requires an understanding of the factors financiers assess when determining whether or not to invest in a project.

Figure 4: Sensitivity of LCOE to discount factors for different technologies in MENA



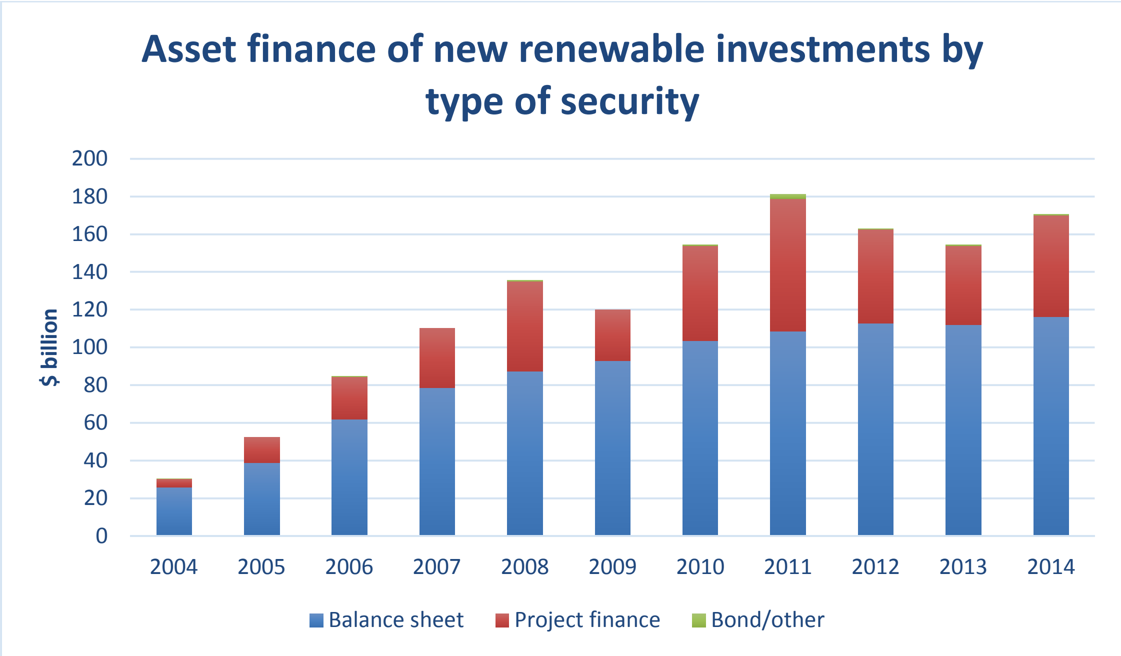
Source: Authors

3.1 What makes a project financeable?

The finance structure of a particular renewable project is a combination of debt and equity. If the state utility company (or another large energy firm) develops the renewable energy project, these actors may decide to use corporate finance (wherein a company uses a combination of access to debt and their own internal resources, with as much as 100 per cent equity ownership being possible when sufficient assets are present on their balance sheet). Although corporate (or balance sheet) finance is usually more straightforward, the parent company sometimes may not have a strong balance sheet to use as collateral, or for some other reason it may not want lenders to have recourse to its capital and assets. In this situation, project finance, wherein financing is tied to the cash flows associated with a particular project, is the alternative method of choice. Over the last ten years, project (or asset) finance has been increasingly becoming popular in the renewables industry (see Figure 5). There are other methods as well, such as green bonds, but their share in global asset finance for new renewable energy is negligible.

Financing renewable projects requires securing the right conditions. If a favourable economic environment exists, mobilizing the necessary capital is not difficult - money tends to follow the right conditions. However, putting every requisite component in place to ensure that sufficient capital is allocated can be challenging.

Figure 5: Global asset finance in new renewables by type of security



Source of data: FS - UNEP (2016)

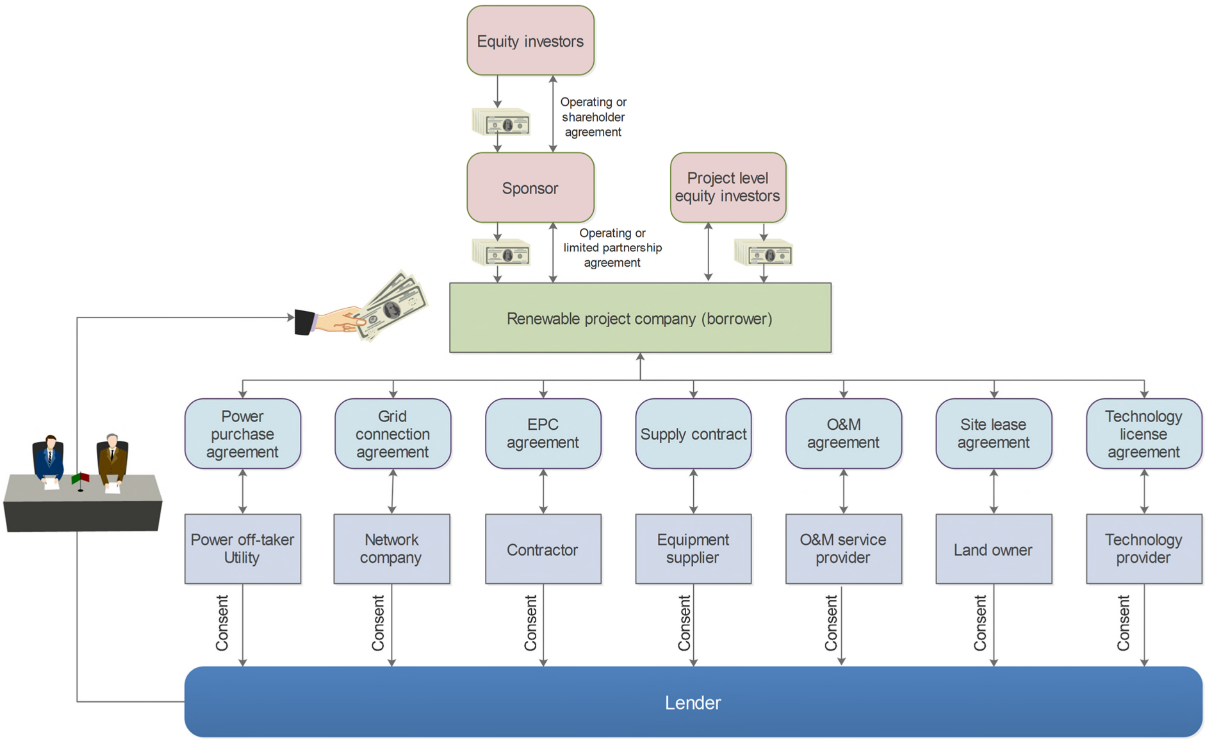
Generally, a number of key criteria must be met in order to ensure financial sector interest in the non-liberalized electricity markets found in the countries of MENA[19]. First, a renewable project needs to have a sustainable stream of revenue (that is, clarity around business model adequacy, which can be guaranteed by a long term power purchase agreement (PPA)), grid access (that is, guaranteed grid access, priority dispatch if necessary, technical capability of system operators for grid operation, and favourable network codes[20]), the ability to provide appropriate documentation (such as an Engineering-Procurement Construction (EPC) agreement, a site lease agreement, an O&M agreement, an equipment supply contract and a technology licence agreement) and, finally, a level of risk which is proportional to the return on capital (with access to risk mitigation instruments). Figure 6 presents a typical renewable project finance structure and all the associated agreements that would need to be in place before a project can proceed.

The appropriate business model for renewable projects is a function of government's renewable policies (that is, incentivizing renewable investment through subsidies, market pull due to cost-competitiveness, or a combination of the two - for a detailed discussion see Poudineh et al. (2016)). Other factors, such as a supportive financial infrastructure, the presence of creditworthy EPC contractors, and access to the site, are also important.

[19] Typically, in energy finance fuel supply agreements would also be relevant, but as previously noted a major benefit of renewables is that there is no fuel input requirement (with the exception of biomass, a technology generally not heavily deployed in MENA).

[20] By networks codes we refer to the technical requirements of renewable integration, including dispatch rules, balancing obligations, and ancillary service provision requirements (among others).

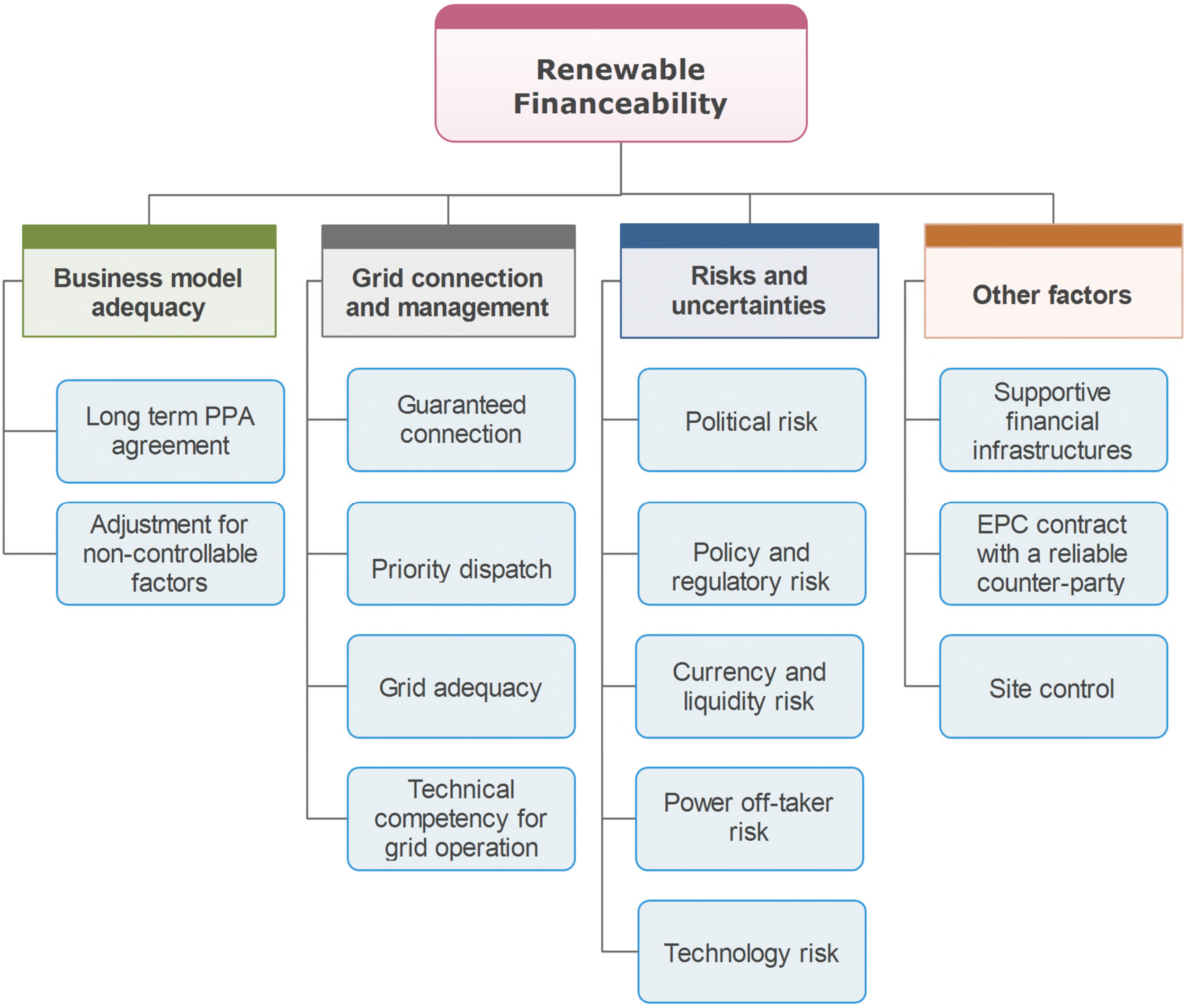
Figure 6: A typical renewable project finance structure



Source: Authors, adapted from Groobey et al. (2010)

Overall, the factors that affect the financeability of renewable projects in the resource-rich countries of MENA can be categorised as business model adequacy, grid connection and management, risk and uncertainties and other factors related to project development (see Figure 7). Risk and uncertainties are major barriers of financing renewables as these directly affect their cost of capital and financeability. The risks of renewable projects include political risk, policy and regulatory risk, counter-party risk, currency and liquidity risk, and technology risk. In what follows we explain the factors affecting renewable electricity financing in the context of MENA countries in more detail.

Figure 7: Factors that affect the financeability of renewable projects



Source: Authors

3.1.1 Business model adequacy

As renewable energy generation is competing with end-user energy prices that are heavily subsidized in the oil-rich countries of MENA, investment will not take place based purely on price signals and market incentives. This means that government support (through, for example, provision of subsidies) is the key for renewable generators to have a viable business model. There are various potential models of support schemes that government can adopt; however, as stated in Poudineh et al. (2016), a renewable support policy for MENA countries needs to satisfy a set of criteria such as compatibility with the structure of the electricity system in the region, harmony with the existing institutions, suitability for the scale of the project, coverage of economic risks and the provision of efficiency.

The structure of the power sector in almost all countries of MENA is a variant of single buyer, in which the state utility is the counterparty for electricity supply contracts with the private sector. Under this structure, there are two ways to engage private sector actors. One model involves the utility company owning the renewable generation facility and contracting a private sector developer to construct and/or operate and maintain the system. The second approach involves a private sector developer owning and operating a generation facility, and then selling the energy to the utility company. The latter approach, which is known as the independent power producer (IPP) model, is becoming increasingly popular in the region (see Table 1). The reason for this popularity is simple; namely, that the IPP approach brings in private sector skills, management and resources for investment in renewables generation. At the same time, it avoids the need for the government to pay the upfront capital cost, and thus reduces pressure on the public budget. If the IPP model is the method of choice for renewable promotion, a systematic comparison of different incentive models by Poudineh et al. (2016) shows that the most efficient scheme that satisfies all the aforementioned criteria for support policy is an auction that awards a PPA, potentially linked to a pre-defined escalator over time, to the lowest cost developer.

Table 1: Examples of recent renewable energy PPAs in the resource rich countries of MENA

Project and generation technology	***Capacity***	***Country***	***Year***	***Contract price (US cents/kWh)***
Sheikh Maktoum Solar Park Phase II - Solar PV	200MW	UAE	2015	5.98
Sheikh Maktoum Solar Park Phase III – Solar PV	first 200MW	UAE	2016	2.99
Al-Aflaj Solar PV	50MW	Saudi Arabia	2015	4.9
Northern Mountains Wind	270 MW	Iran	2017	Not disclosed
Feed-in Tariff Projects - Solar and Wind	>1MW	Algeria	2015	11.87- 15.94

Source: Authors

The structure of the MENA electricity industry does not support incentive models that require a liberalised electricity market with many buyers and sellers (such as the renewable portfolio obligation model based on Renewable Energy Certificates (RECs), the approach favoured in the United States (U.S.)), and renewable investment is still considered too risky without a long term guaranteed purchase agreement. A PPA alleviates issues (especially higher risk) associated with market price fluctuations if power markets in the MENA region become liberalised during the lifetime of the project. The term of the PPA should exceed that of the loan (typically 20-25 years into the future), and provide the comfort that enforceability and contract security provisions are in place. This allows private investors to feel confident that, in the event of a policy shift or other such change, the off-taker's willingness to honour the contact will not be compromised.

3.1.2 Grid connection and management

Grid access guarantees are important, as they provide assurance that the project will not be hindered at the connection stage. In relation to the network, there are two important questions from the IPP entity's perspective: first, identifying who is responsible for grid interconnection and grid reinforcement and second, identifying who bears the costs. Under the scenario that a given off-taker does not have sufficient resources or wants to avoid paying liquidated damage in the case of a construction delay, the IPP may be required to pay transmission costs, in which case it needs to be competitively tendered to guarantee the best price. The most important point for IPP entities, however, is whether they are allowed to recover grid connection costs through tariffs. This is because the method of allocation of network connection costs has an important impact on the incentives to investors. In general, the network connection costs can be paid by the project developer (i.e., the IPP), covered by the off-taker (state utility or government), or shared between the two. Depending on whether deep or shallow connection charge methods[21] are adopted, the cost of the project to the IPP can vary. Deep connection charges, which transfer the network reinforcement costs to investors, will increase the cost of renewable projects, meaning investors require higher direct and/or indirect financial supports to proceed with investment.

The other important grid issue that can adversely impact the revenue stream of renewable generators is curtailment. This happens when the power system does not have sufficient flexibility and resiliency, or grid operators lack the competency to manage variable generation. Therefore, evidence of competently managed and stable grid systems that are capable of handling voltage fluctuations and other inherent by-products of intermittent renewable energy generation is beneficial[22]. For non-dispatchable generators such as wind and solar, the PPA should have a provision that when their energy is not needed because of either market conditions (for example, demand changes, infusions of energy supply from other sources, or inaccurate forecasting) or grid issues, the off-taker compensates the IPP[23]. Furthermore, depending on the type of renewable incentive (production-based or investment-based) and stage of market liberalisation, priority dispatch and a favourable network code (with stipulations such as exemption from balancing responsibility) may be necessary.

Currently, all resource rich countries of MENA allow for third party access to the grid, and there are dedicated agencies to authorize such licences. For example, Kuwait's Ministry of Electricity and Water (MEW) authorises connection to the grid for renewables, and provides a guideline regarding design and procedural requirements as well as safety features, experience and responsibilities. In Qatar, Qatar General Electricity & Water Corporation (KAHRAMAA) facilitates grid connection. Unlike Qatar and Kuwait (where connection rules are relatively straightforward), countries such as Algeria (and, to some degree, Iran, UAE and Saudi Arabia) possess more detailed network codes that are developed to facilitate the connection of renewable generators. However, connection rules, including those relating to cost sharing, priority access and priority dispatch, vary from country to country.

In Saudi Arabia, National Grid Saudi Arabia (NGSA) applies a shallow connection charge approach, but does not provide priority dispatch and/or priority access. In the case of Iran, the developer pays the cost of connection to the nearest grid point, and the regional distribution company provides guaranteed access when a generator needs to become connected to low voltage systems. The grid code of Algeria, however, not only provides guaranteed access and priority dispatch, but also grid costs are shared in a more generator-friendly way. In their model, the IPP is responsible for the grid costs only after the first 50 km of grid connection lines in the case of a transmission network and after the first 5km in the case of a distribution network (Clyde & Co, 2014). Such an approach is helpful for competition because renewables are more constrained by their location compared to conventional generation (for example, the requirement of placing on-shore wind farms in windy locales compared to the geographic indifference of a gas-fired generation plant).

3.1.3 Risk mitigation issues

There is a range of risks facing renewable generators for which appropriate risk mitigation instruments are required. Political risk mitigation measures are a central consideration for MENA, although the degree of exposure of investors to political risk varies from country to country. The same applies to policy and regulatory risks. Perceptions of high-risk - such as policy inconsistency, gaps in the development lifecycle, or the potential for unannounced regulatory revisions - increase the equity returns that investors demand and the interest rates charged by lenders. In principle, any change in policy, law or regulation must not alter the financial position of the IPP during the term of its PPA. Any

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[21] Deep connection charge describes a situation where an IPP pays for connection to the grid and all the necessary network reinforcement stemmimg from this generator connection. Shallow connection charge is found when an IPP pays only for connection to the nearest grid point.

[22] In certain instances, this can be managed through risk allocation processes that pass risk to the off-taker in the event of a controllable grid disruption.

[23] If the generator is dispatchable, such as hydro, then the tariff structure usually includes a capacity charge and an energy component based on the amount dispatched.

changes would require a tariff adjustment (a mitigation mechanism which may be required to neutralise the effect of policy change), with the additional caveat that policymaking perceived as unreliable will likely discourage investment altogether. Sending indications of policy stability, such as multi-year policy directions with reasonable digressions or step-downs over time, is a must for ensuring sustained private sector involvement.

Additionally, clarity and simplicity in defining key policies (such as “localization” needs) is also essential. In the GCC, states are understandably keen to bring lasting benefits to their citizens, and have explicitly stated that they wish to enhance the capacity of locals. However, investors must be confident that a project will not be blocked by a lack of access to domestically produced parts, a shortage of qualified local human capital, or other similar barriers that stem from a national interest in domestic capacity-building.

Moreover, the presence of a creditworthy counterparty that will ensure reliable off-take of all generated electricity (along with timely payment) remains one of the single most important factors. Ideally, this would be enhanced by a government guarantee, or other similar credit enhancements. In terms of risk allocation, the off-taker should bear the risk that energy generated is not needed or curtailed for technical or market reasons; however, the off-taker must not pay for capacity that is not made available by the IPP.

Another key issue is foreign currency exchange risk mitigation. This is a problem in the wider MENA region, although we note that it is currently not a serious concern in the GCC as a result of a monetary policy that pegs local currencies to the US dollar[24]. In countries, such as Iran or Algeria, that exhibit currency risk, appropriate risk mitigation instruments need to be provided. This includes the denomination of tariff components in debt currency with payment in local currency equivalent, the use of derivative and future currency swaps, and currency hedges to mitigate sharp devaluation risks. In addition, the investors and lenders in the MENA region expect that payment currency to be easily convertible to debt currency (for example, a developer would be able to set up a reserve off-shore account to service debt backed by government assurances on currency convertibility) with no limitation on the transfer of funds abroad. Furthermore, ease of transactions (for example liquidity) for secondary market sales is helpful, although conditions for transfer of obligations need to be clearly specified. While many investors are willing to hold illiquid assets, they expect not only to be compensated with higher returns for holding these slower-to-transfer assets, but also to have readily accessible routes for an exit.

A strong pipeline of projects with a lengthy operational history is another core consideration. Investors are concerned about technology risk, preferring well-established technologies backed by years of pre-construction testing for solar irradiance or wind speed. A robust potential deal flow[25] opportunity could entice investment organizations to set up teams in the region, and allows for service providers along the value chain to strategically ramp up their product offerings.

3.1.4 Other factors

There are a range of other factors not directly related to business model, grid connections or risk issues that nevertheless affect the financeability of renewable projects. For example, the presence of a network of renewables-friendly financial institutions, ideally backed by proximity to a range of supporting services (consulting, accountancy, legal), is an important consideration. This allows developers to maintain a high debt-to-equity ratio that greatly improves the economics of renewable electricity generation technologies (which tend to be low-margin plays that benefit from amplifying equity returns), as debt is usually lower cost than equity. Also, active banking teams led by financiers who are knowledgeable and

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[24] In the broader MENA region, this has been a key point to address; for nearby Morocco, this potential barrier to investment was mitigated through the introduction of US dollar-denominated power purchase agreements. Currency risk may one day emerge as an issue if the GCC nations opt to let their currencies float.

[25] Solar photovoltaics have been used (albeit in mostly smaller and niche applications for the first few decades) since the 1960s, making that technology a prime focus for the sunny GCC region.

comfortable in the sector can offer debt on attractive terms – especially if partially backed by the state – and familiarity with documentation underlying a project reduces lender transaction costs (and the associated risk profile). Moreover, high activity levels in the renewables sector will allow creditors to offer the most competitive terms on debt, and to avoid some of the educational pitfalls (such as misconceptions about technology risk) that could hinder deployment.

An EPC contract with a creditworthy counterparty helps to ensure that the project will be built in a timely manner and at the agreed price. The availability of a strong O&M framework is also essential. Once a project has been commissioned, investors need assurance that there will be entities in place capable of ensuring that the project remains seamlessly operational. In addition, developers require site control, and the ability to access the site freely for the entirety of the pre-construction, construction, commissioning, and post-commissioning stages. Although securing land use is often the responsibility of the IPP, the permit process needs to be facilitated where government are responsible for granting access to land.

The viability of sponsors is an important emerging consideration. Recent high-profile financial problems at select developers (notably companies linked to SunEdison) have caused trepidation in energy markets around the stability of companies developing new projects. Lastly, the process for resolving disputes between developers and off-takers needs to be clearly specified. The best approach is to use international arbitration; the commonly-used international bodies for this process are the International Chamber of Commerce, the World Bank International Centre for Settlement of Investment Disputes and the United Nations Commission on International Trade Law (among others). Dispute settlements coordinated through national bodies run the risk of bias, and should therefore be assessed in international fora.

3.2 Finance: what has been done to date?

There is no single model for approaching the financing of inherently idiosyncratic renewable electricity projects with varying risk profiles, diverse geographies, and sometimes-dissimilar production histories. Generally, early-stage initiatives (such as research and development (R&D) work) are funded by governments and, in certain cases, private sector actors with commercial reasons for focusing on R&D. Once basic research has been completed and a potentially viable prototype is available (a process sometimes complicated by the so-called "valley of death", wherein risky technologies struggle in the gap between research and mass uptake of a refined prototype), seed capital-stage projects often rely on venture capital (VC) investors to carry a technology through to a bigger scale[26].

The development of utility-scale assets usually involves IPPs, private equity firms, or utilities. Corporate finance is often available at this stage. Power producers may be willing to develop or acquire projects "on balance sheet", as small-capitalization to large-capitalization firms have access to the capital markets for debt and equity financing. Operational and mature technologies, such as the monocrystalline solar photovoltaic arrays or utility-scale wind farms that are the subject of this paper, are capable of accessing a broad array of financing options; for example, commercial banking can provide debt, while institutional investors or infrastructure funds can act as buyers of commissioned projects. If debt access is constrained, project finance (the focus of much of the discussion in this piece) or project bonds tied to the contractual revenues of a specific project can be raised.

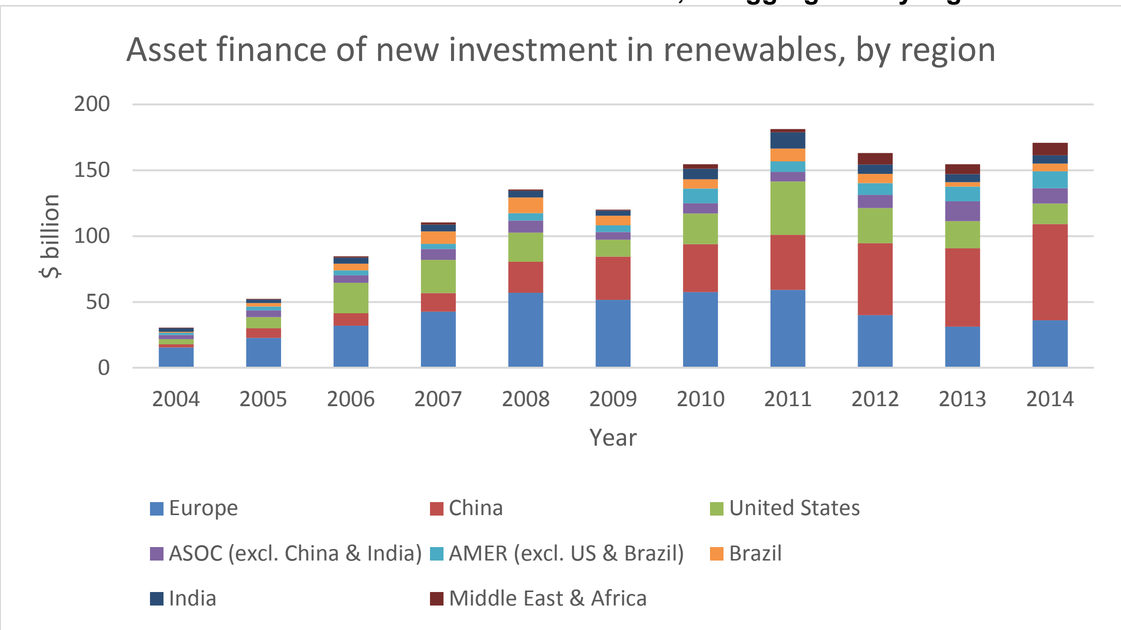
3.2.1 The experience with renewable energy financing in the region

Traditionally, the MENA region has been lagging behind the world in financing renewable energy projects (see Figure 8), Even as recently as ten years ago, renewable electricity financing was not an important consideration in the resource-rich countries of MENA – in no small part because overall

[26] These investors use sector-specific knowledge and other sophisticated strategies to de-risk technologies and sell them at an attractive multiple. In certain situations, the venture capital cousin of private equity may also get involved, especially in the de-risking of assets perceived by the market to be risky.

regional renewable electricity activity was limited by constraints ranging from weak legal and policy frameworks to a lack of human capital to the high cost of renewable energy technologies (Patlitzianas et al., 2006). Any renewable electricity developments were largely confined to R&D, originating primarily from multilateral institutions or state research institutions such as the universities of technology in Iran, the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, or the Kuwait Institute for Scientific Research (KISR)[27]. Until recently, renewable electricity's contribution to the electricity generation mix was essentially nil (with some variations between resource-rich countries), as policymakers opted to maintain a power sector reliant on the abundant (but subsidized) fossil fuel sources in the region.

Figure 8: Asset finance of new investment in renewables, disaggregated by region



Source of data: FS - UNEP (2016)

Interest in increasing the generation mix beyond oil and natural gas has expanded dramatically for the reasons already outlined. Some of the capital to build projects has been internally generated: for example, corporate equity from National Oil Companies (NOCs) – including Saudi Aramco, Qatar Petroleum, and others looking for renewables investments for their own electricity needs – has been mobilized. International banks have been providing some capital, but any initial "international banking" dominance has diminished with the increasing attractiveness of investing in renewable electricity (regional commercial banks, some of which are state-backed, are beginning to see the sector as an important source of growth[28]). Multilateral organizations are active within the broader MENA region, with limited activity in the GCC[29].

It should be noted that private investment involvement in the electricity sector in the GCC is nothing new, as private investments in fossil-based power are long-standing (according to Bounouara et al.

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[27] Mondal et al. (2016) present a complete list of GCC R&D facilities conducting research into sustainable energy.
[28] IRENA (2016) noted that these institutions seem to be offering loans with long tenors and reasonable interest rates.
[29] Within the broader MENA region, a range of bond issuers, insurers, supranational organizations, and development entities are currently active, including the International Monetary Fund, the World Bank, the International Finance Corporation, the Islamic Development Bank, and the Arab Bank for Economic Development in Africa. The multilateral agencies do not have a significant mandate in the (generally) wealthy GCC countries.

(2015), IPPs have been successfully operating in the region since the late 1990s)[30]. A similar opportunity has now emerged for renewable generators, given that a declining cost curve is making solar (as well as wind) competitive with fossil sources in the region. The fossil-based ecosystem of public sector co-investment with private sector actors provides the baseline for what can be done. Meeting the needs of private (and, to some extent, quasi-public) sector investors – both for equity and debt - is all that is needed. The following case studies support the description we have provided thus far.

3.2.2 Case studies of clean electricity development in the region

As there has been limited movement in the renewable electricity sector to date, our options for presenting case studies are constrained. Nevertheless, we highlight here three case studies that provide useful lessons. The first example, based in the UAE, presents a well-designed template that, properly replicated and adapted to the idiosyncrasies of related regions, is likely to attract significant private sector interest. The second case study, also based in the UAE, was partially successful, with some room for improvement. The third (from Saudi Arabia) provides informative opportunities for amelioration. Throughout this list, we apply our four-part financing framework (namely business model adequacy, grid connection, risk mitigation issues, and other factors), and find that successful projects meet all four conditions.

Case study 1:

The Sheikh Al Maktoum solar park is an ongoing solar array development that has been considered as an example of best practice. The first phase (13 MW, of an eventual 5,000 MW facility) was implemented by the Dubai Supreme Council of Energy. The project was developed in partnership with U.S.-based photovoltaic systems provider First Solar, who not only completed the EPC work, but also received a post-commissioning O&M contract. Built in less than 30 weeks, it was (at the time of commissioning in October 2013) the largest such facility in the region (First Solar, 2013).

The rollout of Phase 1[31] set the stage for a 100 MW tender in Phase 2. In total, 24 consortia were prequalified for this bidding process, with ten ultimately submitting bids. The final bid – 5.98 cents per kWh – was bankable, as the tendering process (well-established in regional thermal generation procurement) was slightly modified to suit the idiosyncratic needs of PV (Borgmann, 2015). Borgmann calls such an achievement the confluence of "rock-bottom EPC cost, optimized O&M concept and low-cost finance", as the debt involved a consortium of local lenders (National Commercial Bank, First Gulf Bank, and Samba) working in partnership. Finally, Phase 3 led to the ultra-low capacity bids of 2.99 cents per kWh for 800 MW. The financing parameters of Phase 3 – a loan tenor extending out 27 years, an interest rate of 4 per cent, and an elevated debt-to-equity ratio of 86 per cent - underpinned a record-low auction price.

From a financing perspective, this project was successful for many reasons. The project's second phase has a viable business model that includes a 25 year PPA with Dubai Electricity and Water Authority (DEWA). This covers most market risks that concern investors, and provides a great deal of certainty in project revenue streams. As the second phase is in the form of an IPP, the developer will be provided guaranteed access to the DEWA grid upon completion. The necessary gird reinforcement, along with

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[30] One extended passage from Bounouara et al. (2015) clearly explains how one utility constructed over 13,000 MW of fossil fuel capacity partially financed by private investments:
"…Abu Dhabi Water and Electricity (ADWEA) went out to tender for overseas investors to bid to build, own and operate a large-scale gas-fired power and water desalination station in Abu Dhabi. Under this structure the bidders were asked to provide a technical solution and to bid for the price of power they would charge to sell capacity and output to an ADWEA affiliate. The successful bidder entered into a shareholders' agreement with another ADWEA affiliate and formed the project company to undertake the project on the basis of equity provided by the successful bidder and ADWEA, alongside significant project finance debt provided by commercial banks."

[31] We acknowledge that Phase 1 was plagued by some minor controversy, with commentators questioning the process through which it was accorded to First Solar.

protection, automation, control and communication systems, was awarded to ABB Group. The risk issues were mitigated through simply borrowing from what worked in the 13 GW of fossil capacity deployed in a similar manner. The generation technology adopted (solar PV) has a proven track record of successful operation in the region. Finally, political risk was low, as the UAE is a relatively stable country (especially compared with the wider Middle East region) and the government has shown that it has real political will and commitment to promote renewable energy in the generation mix.

The PPA in this project was denominated in US dollars, and the process was supported by a creditworthy counterparty (a structure modelled on what has worked in the fossil sector), providing a great deal of comfort for prospective developers and making the outcome bankable. The capacity bidding structure allowed investors to work to gain a toehold in the region, but simultaneously maintained a level playing field through an emphasis on cost reductions and an absence of favouritism to certain firms. Finally, ample involvement from a range of financial institutions led to low-cost debt being offered over favourably long tenors.

Case study 2:

The development of Masdar's Shams 1 project remains part of a broader Abu Dhabi drive to support renewable energy. This transition, described in-depth in Mahroum & Al-Saleh (2016), is a movement that encompasses renewable energy sector activities ranging from R&D (including academic research collaborations) to international investments to world-leading conferences. Shams 1 involved the design, construction, operation, and maintenance of a 100 MW concentrating solar thermal power plant (CSTP) (Shams Power Company, n.d.). The project is designed to give the UAE a competitive edge in a technology with potentially significant implications for the region (that is, CSTP with storage), facilitated by the backing of the UAE state.

The financial parameters of this project finance structure are noteworthy. The final cost was $600 million (Masdar, 2016). It involved ten regional and international lenders, and was oversubscribed due to strong investor interest (Shams Power Company, 2011). It achieved a strong debt-to-equity ratio (80 per cent), as well as a lengthy loan tenor of 22 years (International Renewable Energy Agency, 2015). Clearly, it met all conditions of a suitable PPA and grid connection.

According to recent coverage of Shams 1 performance history (Casey, 2016), the engineers responsible for Shams 1 appear to have mitigated some of the most serious hurdles facing the project (which was prone to significant technology risk). First, the region's weak supply chain for CSTP – which led to a majority of components being sourced from Europe – was complicated by the fact that the extant CSTP technologies were not necessarily specially designed for the GCC's climate. Design innovations were crucial; a giant wall was constructed that would facilitate protection for the facility from dust storms, and the equipment contained safeguards to reduce wind damage. Water scarcity and temperature-related equipment malfunctions needed to be controlled; answers were found in the use of advanced robotic machinery and sophisticated performance monitoring systems (respectively).

However, from a financing perspective, there were some problems with the initiative. For one, while the technical elegance of the facility is evident and some financial parameters were released, no transparent data on costs was released. This makes replication difficult, as investors have no benchmark (either general or specific) for the cost of developing a highly useful (in that it could potentially provide firm capacity) but technologically risky large-scale project involving CSTP technology. The necessity of seeking cost efficiencies is especially crucial for CSTP – a technology which has not mirrored the cost digressions of solar photovoltaics, even if the countries of the region maintains a strong industrial position in producing many materials (for example glass) that are related to building new facilities.

Second, there was no storage integration due to risk perceptions (Casey, 2016), even though CSTP has the potential to be dispatchable. A large-scale demonstration plant at this stage would have been invaluable. However, investors do not have the benefit of an existing storage-equipped facility for benchmarking further CSTP deployments. Finally, the project did not necessarily lead to clear reductions in cost, as it involved a complex series of inherently idiosyncratic steps – thereby making it unlikely to be a “stand alone” initiative that could be supported by private sector actors. So long as state-backing is required, self-supporting financial infrastructure to support the sector is unlikely to arise.

Case study 3:

The final case study we discuss here can serve as a cautionary example of a model to avoid[32]. An extremely ambitious solar buildout plan was announced by Saudi Arabia’s leadership in 2012. The work was to be overseen by the King Abdullah City for Atomic and Renewable Energy (shortened to KACARE, an agency set up in 2010 to administer the procurement program). In total, 41 GW of solar[33] and 21 GW of nuclear, wind, and geothermal were to be deployed over two decades (Mahdi & Roca, 2012). An aggressive timeframe for tendering was initiated, and a white paper was produced that provided a framework for the power procurement process.

While KACARE’s leadership role was initially announced to great fanfare, there was no formal execution of their mandate. The lack of commitment damaged market confidence, as no bankable PPAs were issued and no grid access for prospective projects was provided. The post-announcement action appeared to represent an absence of policy delivery, as KACARE seemed unable to coordinate a wide array of organizations competing in the renewable energy sector (Borgmann, 2016). This could have unintended consequences for investors weighing the prospect of the new renewable energy launch that the Kingdom is undertaking. Today, KACARE is not leading the discussion, as targets for renewable electricity are managed under the guidance of a new ministry entitled the Ministry of Energy, Industry, and Mineral Resources (Mahdi & Razzouk, 2016). This shift sends confusing signals to the market over how best to prepare, and makes it difficult for supportive financial infrastructures to take root.

Furthermore, the project appeared to be too ambitious and reliant on government budgets (the latter being an especially serious issue given, inter alia, the heavily distorted energy prices found in Saudi Arabia due to end-user subsidies). The issue of fiscal sustainability was exacerbated after the 2014 oil price drop and caused the government to push back the timeframe of the project from 2032 to 2040. Additionally, there was dramatic disharmony and contradictory claims to ownership over the program among various government entities within Saudi Arabia. In summary, it provides a cautionary tale which other states can learn much from as they prepare their renewable integration plans.

4. Moving towards an optimum financing model for renewables

Encouragingly, resource-rich MENA countries have the potential to make rapid and far-reaching commitments that would be more politically difficult in OECD countries - even in areas that the literature has identified as problematic (such as in Saudi Arabia’s political context, as discussed above). Building momentum for change is, therefore, essential. To that end, we have prepared a set of policy recommendations to improve financeability of renewable projects. While recognizing the multi-faceted nature of this question, we have focused solely on current market considerations[34].

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[32] While the initiative we describe here did not ultimately emerge into any concrete outcome, this example illustrates the dangers to renewable energy finance posed by governments failing to execute on a proposed mandate.

[33] This would be 25 GW of CSTP and 16 GW of PV.

[34] It is clear that it will not be easy to entice the requisite capital for altruistic or environmental reasons; therefore, while we acknowledge the urgency required to support humankind’s efforts to address anthropogenic climate change, our recommendations have financial roots.

4.1 Measures to improve the financeability of renewable energy projects

(i) Maintaining emphasis on cost-effective auction procurement models

Traditional deployment subsidies, such as feed-in tariffs (FiTs) or others that provide strong investment incentives (such as guaranteed premium pricing and priority dispatch) have been shown to hold a significant advantage for supporting nascent technologies. It is acknowledged that some of the MENA countries are pursuing the German model (for example, Iran is currently undertaking a FiT process as it emerges from the era of sanctions). Initially, investors appreciate the premiums and prioritization, and – at least in certain contexts (such as the conditions found in less price-sensitive and environmentally-conscious Germany) - FiTs can be sustainable over the long-run.

However, premium pricing, set-asides, and other common renewable electricity policies do not harness the power of economic incentives – rates are pre-determined and procurement is fixed, so there is little incentive for the private sector to compete on price. As a result, government subsidies are likely to be perceived by key stakeholders as too costly or are (sometimes unfairly) blamed for broader structural costs in the perennially evolving electricity market. This leads to a particularly troubling prospect for investors; namely, that such premium policies (especially if generous) will be subject to political interference. The chilling effect that this uncertainty imposes on investment interest is significant, as was spectacularly evidenced in Spain's retroactive cuts to that country's FiT rates (and the subsequent collapse in global investor interest for that European country as well as others that undertook similar retroactive cuts).

Therefore, following the incredibly low bids from a varied bidder pool (found in the UAE case study referenced earlier), it appears that the auction model is likely to be the most attractive option for both investors and government in rapidly ramping up renewable electricity investment going forward (a suggestion supported by a recent meta-analysis in Atalay et al., 2017). Such a model allows the private sector to develop bankable business models that find efficiencies and drive down costs, while providing electricity ratepayers (in the case of the GCC, both governments and citizens) with low-cost and low-risk power sources. Renewable electricity technologies are likely to fare best if they are capable of competing with fossil-fuel counterparts on their own merits. It is now clear that auctions - a model long-used for cost-effective procurement of wind energy in Brazil (de Jong et al., 2016) - are increasingly replacing premium price schemes in places such as Canada (Independent Electricity System Operator, 2016) and the United Kingdom (Downing, 2015).

Of course, it would be remiss to avoid mentioning that such auctions can have undesirable effects. For example, in a recent case in India, the now-bankrupt SunEdison crowded out competitors by bidding for solar projects at such a low cost that they now look unlikely to be built. This should serve as a warning on the limits of auctions. Although useful for driving down costs and finding efficiencies, auctions could spur on an unsustainable race to the bottom when strategic underbidding is not prevented at the inception of the procurement process through sensible auction design. Developers may sacrifice equity returns and take on ultra-low margin projects to gain market share, but ultimately be unable to execute due to poor profitability and unexpected cost overruns. It is important that policy-makers undertake measures, such as implementing penalties that prevent the "low-balling" of bids and applying initial due diligence to verify the solvency of developers, in order to ensure that the auction model proceeds smoothly.

(ii) Capitalizing on the current sense of urgency to show investors the potential for a long-term pipeline of renewable energy builds

A pervasive sense that the status quo must change can be found across the region. Some of this is associated with the immediate fiscal strains resulting from an unexpectedly prolonged low oil price[35], but an unquantifiable percentage can likely be attributed to a rethinking of the region's long-term

[35] This situation is spurring the enactment of radical and far-reaching reforms once thought impossible.

balance sheet (Boersma & Griffiths, 2016). In a world where fossil fuel prices may never return to their 1979 and 2008 levels (Helm, 2016), nation-states in the region should continue to seize this unexpected opportunity to initiate sustainable energy transformations that can complement general transitions in the region as a whole.

Many policymakers in the resource-rich countries of MENA have evinced a clear understanding of both the challenges and opportunities ahead. Saudi Arabia's deputy economic minister Ibrahim Babelli recently remarked on the important potential of exploring concentrated solar thermal power, photovoltaics, and storage. He notes that such a combination can provide the appropriate baseload and peaking capabilities (Graves, 2016). The UAE has long been a leader in this area, with strong sustainability supports stretching back nearly a decade (see Reiche, 2010a; Reiche 2010b), and other countries in the region have clearly indicated their interest in creating long-term solutions.

To ensure sustained investor interest, the hydrocarbon-based economies of MENA should lay out clear medium to long-term plans that show investors the potential for a bankable series of power procurements. Recent action in the U.S. provides a suitable model of how such a long-term horizon might appear. After years of stop-start policy incentives for new renewable energy builds, the U.S. Congress passed an 'unexpectedly generous' subsidy extension through a government funding bill that will unlock an estimated $73 billion in incremental renewable electricity technology funding (Bloomberg New Energy Finance, n.d.). Among other advantages, this bill provides certainty for investors and gives a timeframe for step-downs in incentives before a phase-out[36].

(iii) Thinking outside the box: consider innovations and broaden the capital base

It is impossible here to cover the enormous range of innovations in renewable electricity financing currently underway, especially at the level that other authors have already presented (such as Ottinger & Bowie, 2015). However, there is no shortage of renewable energy tools that have been tested in other markets which – if properly applied – could ameliorate the potential for success when implementing our financing framework. We are aware that it is often difficult to apply successful extra-jurisdictional lessons to the nuanced MENA context. Throughout our discussions with market practitioners and academics, we found varying degrees of interest in each of the trends discussed here, and acknowledge that each of the proposed options below brings challenges and opportunities.

The first option to consider is encouraging the issuance of green bonds. Green bonds represent a growing market segment that can meet some of the long-term capital needs of the renewable electricity market. The World Bank (n.d.) - the longest-running issuer of these debt vehicles - has posted a list of select investors in their international issues (including large investment houses, notable asset managers, and institutional investors) that shows investor appetite. Of particular relevance to the region, an Islamic application of the Green Bond (the green *sukuk*, a financing structure that is compliant with Shariah law) would be welcome[37].

Second, creative solutions could be initiated by engaging international market counterparties. For example, Japanese banks are not subject to the same capital constraints as other international financial institutions (notably US-based entities), and could therefore supplement shortcomings in local bank financial resources. In South Korea or Japan, the hydrocarbon-based economies of MENA could hedge the risks associated with long-term electricity contracts by signing fixed LNG supply contracts with Asian counter-parties that link every unit of LNG supplied to every unit of clean electricity produced (this readily financeable arrangement, as argued by at least one expert respondent in our interview process,

[36] We point out that this example incentive is not perfectly well-suited, as it is associated with tax policy (an unlikely avenue for renewable electricity incentivization in MENA), but is used for its longer-term outlook.

[37] Given the political economy of the region, Islamic Finance structures such as *sukuk* and *mudaraba* should be at the forefront of the minds of regional policymakers looking to encourage project finance. The characteristics of Islamic Finance – the need for ties to a real asset (rather than a financial asset), the prohibition on speculation (*maysir*) and uncertainty (*gharar*), the encouragement of long-term asset holds – all match well with the region's nascent renewable electricity sector needs.

could be marketed as "green gas", as it would serve to displace intra-region fossil fuel usage and would provide both parties with energy supply security). Other options are available; the brightest minds with knowledge of the region should be tasked with finding them.

Third, a national or regional green investment bank is an increasingly popular method to introduce a market multiplier effect and use financial de-risking tools. The basic premise is that a Green Bank works by harnessing the creditworthiness of the state to de-risk the deployment of new renewable technologies. Leonard (2014), in a study on state green banks in the U.S., has outlined the many benefits that can be brought forward through a green bank investment model. She argues that the primary benefits stem from being capable of increasing private capital allocations (primarily through de-risking with public dollars), enhancing partnership offerings, and ameliorating standardization. Individual countries of the region could borrow from the experiences of national governments in the United Kingdom or Australia, or could initiate a one-of-a-kind regional bank (funded proportional to a standard that is mutually agreeable to each country) that was not limited by specific country boundaries.

Finally, institutional investors seeking investment-grade securities could also play a valuable role in any mass buildout of renewable electricity systems in the region. While it is essential to be realistic about their potential (including the fact that developed country institutional investors with infrastructure allocations often have no financial incentive to move outside of the developed countries), enhancing the involvement of these investors - who are a natural fit with the sector owing to their need for long-term asset-liability matching and their interest in tapping into regulated assets with low risk – should be a long-term priority. Regional Sovereign Wealth Funds (SWFs), such as the Kuwait Investment Authority (KIA) or the Abu Dhabi Investment Authority (ADIA), could play a much larger role than they are currently playing. Boubakri et al. (2011) note that while the traditional role of Middle Eastern SWFs was as a source of stabilization that could smooth capital flows associated with natural resource development (mainly fossil fuel extraction) and facilitate overall macroeconomic stability, recent years have seen them transition into other roles. Renewable electricity finance is a natural place for these institutions to explore, as the asset-liability matching and stable revenue of contracted clean energy assets matches well with their need for growing inter-generational wealth. Most intriguingly, the IEA (2012) notes that:

> "*of total SWF assets, 56% is derived from oil and gas exports...clean energy [is] an attractive investment vehicle for funds wanting to hedge against future changes in the energy sector…[SWFs] are in a unique position to help new and emerging technologies establish an investment track record".*

Already, some movement in SWF integration is underway. The UAE has set up Masdar - an investor in, and developer of, renewable energy – distinct from the assets of ADIA (the region's largest SWF). Meanwhile, Ambavat (2015) notes that ADIA has already shown interest in significant co-investments in private renewable energy developers operating in non-developed markets (although no activity has been undertaken domestically due to diversification mandates that prevent domestic investment). The aforementioned KIA has been active in innovative stages of the renewable energy lifecycle, taking stakes in both Kuwaiti and overseas energy solutions companies ("ACAL energy wins further investments", 2011). Given that SWFs do not face the constraints facing other institutional investors (such as investment restrictions, regulatory capital minimums, and solvency ratios) and have an obligation to ensure the sustainability of their countries, there is no reason for the role of the SWF to cease growing. Decision makers should look carefully at how this potential might be unlocked (suggestions include the creation of dedicated internal investment teams who could, among other actions, initiate direct renewables investment, as well as securing the services of renewables-focused outside managers capable of identifying attractive risk-adjusted return investment opportunities).

Recognizing more specific domains in which the countries of the region could hold a competitive financing advantage will be crucial. Patient capital through long-term venture capital (VC) – notably present in ventures such as Bill Gates' Breakthrough Energy Coalition - could be offered by the SWFs to fund local initiatives and overcome some of the problems that have historically plagued VC investments in the space (as outlined in Gaddy et al., 2016). Non-SWF actors can be involved as well;

for example, while it is unlikely that regional manufacturers will be able to compete with Asian manufacturers on mainstream solar panels, countries in the region may be able to compete on financing the advanced manufacturing of bulky wind turbine towers not amenable to containerization. O&M providers that can provide expertise and support for developers are essential for optimizing the performance of renewable electricity assets[38] (PV Insider, 2014), and the resource-rich countries of MENA can develop expertise in financing their operations.

(iv) Continuing to enhance, stabilize, and clarify policy and regulatory frameworks

Investors crave predictable policy and regulatory frameworks. ***Enhancing*** policy and regulatory processes is the starting point. Energy markets are the result of very carefully planned processes. Giving renewables time to compete on their own merits will enable them to emerge as viable competitors, but a viable market structure is an obvious prerequisite to success. Enhancing extant frameworks by plugging gaps - such as the current lack of permitting laws or regulations in Kuwait - are an obvious initial starting point for policy makers to address.

The second key point is ***stability***. Time and again, private investors speak disapprovingly of stop-start, uncertain policy and regulatory environments (see Potskowski & Hunt, 2015). Given the regional political economy and the monopolistic nature of MENA energy markets, a pattern of continuity should be relatively easy to ensure. Related to this point is the concept of maintaining clear political support for investors seeking a reliable energy policy when assessing potential investments.

Finally, ***clarifying*** work on the ground is essential. Ensuring straightforward, long-term energy planning and coordination between all relevant entities and involving generation, transmission, storage, and load shifting entities is crucial. Where multiple (and potentially overlapping) agencies are present, it is crucial that each position be clarified[39].

5. Conclusion and policy implications

Renewable electricity is by no means guaranteed within the resource-rich countries of MENA; indeed, substantial uncertainty is still present in the region's renewable electricity outlook. Chronically low oil prices could jeopardize renewables momentum if the creditworthiness of state utilities becomes more suspect. Ongoing unrest within the broader MENA region - and the possibility of pernicious spillovers from less stable to more stable regions - increases political risk perceptions. Efforts at overcoming technical challenges, such as a lack of storage and concerns with the potential for dust to inhibit electricity output in some of these countries, have shown promise, but may take longer to address than anticipated.

Nevertheless, the trends described here generally suggest that there will be a vigorous future for new renewable electricity builds in the resource-rich counties of MENA. In this paper, we have primarily focused on the GCC (with some discussion on resource-rich nations such as Algeria and Iran) as a means to present lessons for the hydrocarbon-reliant economies of MENA as a whole. This has included a detailed overview of what will need to be in place for project financiers to enter this arena in significant numbers, as well as the potential options (such as new capital innovations) that can assist in this transition. We have emphasized the usefulness of auctions, and highlighted the importance of maintaining stability at the policy level. It is especially crucial that the mistakes that beguile investors – especially a lack of certainty or clarity – are not repeated, while positive trends (including strong political will, the opportunity to act decisively in a "new normal" of lower fossil fuel prices, and the presence of

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[38] This is because a short downtime (such as in the event of a production interruption) can have substantial impacts on output and, consequently, debt coverage ratios.

[39] As discussed in an earlier section, Saudi Arabian renewable electricity sector stakeholders encountered issues when KACARE's mandate shifted.

effective auction-based procurement systems) are maintained. In addition, accessing the enormous pools of capital in the SWFs and adopting best practices of renewable energy finance that have been used elsewhere present promising options.

Within this context of great potential, we note that altruism need not be a driver of greater renewable energy integration. In this paper, we have outlined that relatively little action has been undertaken to date in renewables financing of the region. This *tabula rasa* in the context of a region with a growing, energy-intensive economy presents a tremendous opportunity to avoid making the mistakes that have plagued the policy choices of many developed countries. Financing can hold up progress, but – as we noted earlier - capital tends to follow the right conditions. The policy makers in the region have the chance to usher in a sustainable future - getting the “money” questions right would be a great start.

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