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Advancing Renewable Energy in Resource-Rich Economies of the MENA

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Abstract

As much of the world pushes ahead with the deployment of renewable energy, resource-rich MENA economies are lagging behind. This paper contends that while the main obstacles to deployment of renewables are grid infrastructure inadequacy, insufficient institutional capacity, and risks and uncertainties, the investment incentives lie on a policy instrument spectrum with two polar solutions: (i) the incentive is provided entirely through the market (removing all forms of fossil fuel subsidies and internalising the cost of externalities); or (ii) the incentive is provided through a full government subsidy programme (in addition to the existing fossil fuel subsidies). However, there is a trade-off between the two dimensions of the fiscal burden and political acceptance across the policy instrument spectrum, which implies that the two polar solutions themselves are not easily and fully implementable in these countries. We propose a new dynamic combinatorial approach (partial subsidy programme and partial fossil fuel price adjustment) that gradually moves towards market-based incentive provision over the medium to long-term where energy subsidies are eventually phased out. The approach balances fiscal sustainability with political stability, enabling the gradual scaling up and development of markets for renewables.

Keywords: renewable incentives; removing fossil fuel subsidies; renewable subsidies; combinatorial approach; renewable barriers; MENA resource-rich countries

JEL classification: Q40, Q48, Q28

Abbreviations

ADWEC	Abu Dhabi Water and Electricity Company
CfD	Contract for Difference
CG	Captive Generation
CREG	Commission de Régulation de l'Electricité et du Gaz
CSP	Concentrating Solar Power
D	Distribution
ECRA	Electricity and Co-generation Regulatory Authority
FiT	Feed in Tariff
G	Generation
GCC	Gulf Cooperation Council
GCCI	GCC interconnection
GDP	Gross Domestic Product
GW	Gigawatt
HVDC	High-Voltage, Direct Current
ICC	International Chamber of Commerce
IPP	Independent Power Producer
ISO	Independent System Operator
IWPP	Independent Power and Water Producer
KACARE	King Abdullah City for Atomic and Renewable Energy
KAHRAMAA	Qatar General Water and Electricity Corporation
kWh	Kilowatt-hour
LCOE	Levelised Cost of Energy
Mcf	Million cubic feet
MENA	Middle East and North Africa
MMBtu	Million British thermal units
MWh	Megawatt-hours
OECD	Organisation for Economic Cooperation and Development
PPAs	Power Purchase Agreements
PV	Photo Voltaic
SABIC	Saudi Basic Industries Corporation
SEC	Saudi Electricity Company
SUNA	Renewable Energy Organisation of Iran
T	Transmission
T&D	Transmission and Distribution
TGC	Tradable Green Certificates
TSO	Transmission System Operator
UAE	United Arab Emirates
USD	United States Dollars
VIM	Vertically Integrated Monopoly
WEC	Saudi Arabia Water and Electricity Company

1. Introduction

Countries in the MENA region are richly endowed with renewables – particularly solar and to some extent wind – with among the world's best direct normal radiation levels (Griffiths, 2017). The GCC countries[1] alone lie in the 'global sunbelt' – a region abundant with solar radiation of more than 6 kWh/square metres per day – with 59% of their surface area suitable for solar deployment, and 56% for wind (IRENA, 2016; Alnaser and Alnaser, 2011). Despite this huge potential, renewable energy accounts for just 1% of total primary energy and 3.5% of electricity generation across the MENA. More than 90% of renewables consists of hydroelectricity (IISD, 2014), whilst non-hydro renewables barely exceed 1% of total electricity generation (see Table 2).

The literature on renewables deployment in the MENA region has hitherto primarily focused on net energy importing countries.[2] The focus on renewables in resource-rich MENA countries is comparatively recent, as their energy policies have been driven by their massive hydrocarbon endowments (representing 52% of global proved oil and 42% of gas reserves) and access to cheap (subsidised) energy. Consequently, literature on renewables deployment in MENA resource-rich countries is relatively sparse, and can be broadly grouped into three categories. First, the group that analyses the introduction of renewables into the energy mix through instruments that reduce the downside financial risks of renewables adoption to investors (Wustenhagen and Menichetti, 2012). Matar et al (2015) conclude that the use of investment credits (producer subsidies) alongside a

[1] The Gulf Cooperation Council (GCC) comprises UAE, Saudi Arabia, Qatar, Oman, Kuwait and Bahrain.
[2] Primarily driven by energy supply (import) security concerns, in addition to Green House Gas (GHG) mitigation (e.g. Morocco) (Carafa et al, 2014).

continuation of subsidised energy prices presents the optimal approach, whereas Trieb et al (2011) argue that long-term Power Purchase Agreements (PPAs) combined with investment guarantees provided by multilateral agencies provide the best financial de-risking approach for renewables. Some studies consider other risks, such as political and regulatory, but propose financial de-risking as a means to address these risks (Komendantova et al, 2011). These studies largely promote the use of government support (including explicit or implicit subsidies), but say little about the longer-term evolution of such an approach in these countries, especially given their large fiscal burden from existing fossil fuel subsidies (Abdmouleh et al, 2015).

A second category of literature supports the need for an overarching policy framework to promote renewables deployment in resource-rich MENA countries. Al-Amir and Abu-Hijleh (2013) and Mezher et al (2012) suggest energy sector deregulation and the market provision of renewables as an end-goal, but fall short of specifying a policy path to best achieving this. Sgouridis et al (2016) map different renewable options by sector for the UAE showing that the benefits outweigh implementation costs, but acquiescing that an actionable plan is necessary to enable the transition from fossil fuels. A final category of techno-economic literature focuses on modelling these countries' transitions to renewable energy using long-term optimisation. For instance, Mondal et al (2012) explore technology choices (including renewables) to meet future demand in the most cost efficient way.

A review of existing literature exposes three gaps. First, existing studies focus on 'what' should be done to promote renewables at any point in time, and less on developing an overarching, long-term, self-sustainable dynamic framework. Second, existing studies fail to recognise the trade-off faced by resource-rich MENA countries between fiscal sustainability (the continued use of subsidies) and political stability (the continued provision of low priced energy which underpins the 'social contract' with their citizens due to political structure). And third, existing studies focus dominantly on individual country cases, with limited applicability to the wider region despite shared barriers to deployment. For instance Bhutto et al (2014) in a review of MENA renewables literature since 2005, find that only nine out of fifty-six peer-reviewed studies had a regional as opposed to country-specific focus, and that was limited to the GCC rather than MENA resource-rich countries as a whole.

The motivation for this paper is fourfold. First, the Paris Climate agreement has accelerated policy measures towards hydrocarbon substitution and energy efficiency in the future centres of global energy demand growth (such as China and India). Most MENA countries are party to the agreement, and although they differ in their approaches, most have set out some plans to adopt renewables (Griffiths, 2017) [3] (see Table 1). Second, in addition to structural shifts on the demand-side, the entry of US shale producers into the international market has altered the dynamics of oil market equilibria, dampening prices and increasing competition for a potentially smaller market share. MENA countries that want to monetise their reserves and maximise export revenues before global demand for petroleum is affected, can do so by increasing the current share of renewables in their electricity sectors, freeing crude oil and natural gas for export (Trieb et al, 2011)[4].

[3] In the GCC, IRENA (2016) estimates that by 2030, carbon emissions can be reduced by a cumulative total of around 1 gigatonne (Gt), resulting in an 8% reduction in the region's per capita carbon footprint.
[4] Crude oil, natural gas and oil products constitute almost 100% of fuel mix for power generation in resource-rich MENA countries.

A third reason relates to rapidly rising domestic demand and energy security. Despite having substantial reserves, apart from Iran, Qatar, Algeria and to some extent Oman, in most countries of the region demand for gas has been growing faster than exploration and utilisation of new gas reserves[5]. This has impacted the security of gas to power supply chains in these countries (e.g. Kuwait and UAE are already net importers of gas). If the increase in electricity demand is not met with natural gas or renewbales, it will inevitably need to be met by oil or oil product plants, which have high opportunity costs in these countries. Finally, concerns over long-term fiscal stability (due to their hydrocarbon-based economies) have led policymakers to view renewables as an industry providing opportunities for economic diversification.[6] This idea is underpinned by rapidly falling costs of renewables in the MENA[7].

This paper investigates the following key questions: (i) what are the policy solutions for incentivising investment in renewables in these countries; and (ii) what are the barriers to the deployment of renewables? Through a systematic analysis we provide insights into the issues and options for renewables deployment in resource-rich MENA countries. We propose a combinatorial approach in which incentive for investment is provided partially through the market and partially through government subsidies. The combinatorial approach can be part of a dynamic process where governments start from the most feasible point on the proposed policy instrument spectrum and gradually move towards market-based incentive provision over the medium to long-term where energy

[5] Due to challenging extractive conditions, subsidised prices and unattractive investment terms (Griffiths, 2017).

[6] IRENA (2016) estimates that the GCC could create an average of 140,000 jobs/year through renewables, although it is unclear which segments of the supply chain will generate these.

[7] Phase 2 of Mohammed bin Rashid Al Maktoum Solar Park was auctioned at 5.85 US cents/ kWh, amongst the lowest in the world. Dubai's DEWA reportedly received 5 bids from international firms to build the third phase of the park, the lowest of which is 2.99 US cents/kWh (MEES, 2016b).

subsidies are eventually phased out. The dynamic combinatorial approach not only reduces fiscal pressure on government budgets (compared to a fully subsidised model), but also averts political risks by allowing businesses and households to slowly adapt to the new environment, where energy carriers are priced at their full economic costs.

Section 2 of the paper discusses models of incentive provision for renewable investment and presents the combinatorial approach. Section 3 analyses the challenges of renewable deployment in the MENA hydrocarbon economies. Section 4 discusses the issue of power sector reform in these countries in light of renewable policies. Section 5 concludes.

Table 1: MENA Domestic Targets on Renewable Energy

	Target	***Date***
Kuwait	15% of electricity demand (generation)	2030
Saudi Arabia	9.5GW of renewable energy	2023
UAE	24% clean energy (including nuclear) in energy mix by 2021; Abu Dhabi-7% of capacity by 2020; Dubai-7% capacity by 2020 and 15% by 2030 (versus 'Business As Usual')	2021, 2030
Oman	-	-
Qatar	1.8GW solar (16% of generation) by 2020; 10GW solar PV by 2030	2020, 2030
Bahrain	5% of installed capacity	2020
Iran	5GW wind and solar capacity	2020
Morocco	42% of installed capacity by 2020; including 2GW solar & 2GW wind	2020
Jordan	10% of generation	2020
Egypt	20% of generation	2020
Yemen	15% of generation	2025
Algeria	20% of generation	2030
Tunisia	25% of capacity	2030

Source: IRENA (2013; 2016); Mittal (2016); IEA (2016)

Table 2: Renewables (ex-Hydro) Electric Installed Capacity in MENA Countries

	Wind MW	**Solar PV MW**	**Solar CSP MW**	**Other Renewables MW**	**Total Renewables Installed Capacity Megawatts**	**Renewables as% of Total Installed Capacity**	**Total Installed Capacity Gigawatts**

Algeria	10	7.1	25	0	42.1	0.24	17.24
Bahrain	0.5	5	0	0	5.5	0.14	3.97
Egypt	610	15	20	0	645	2.05	31.45
Iraq	0	0	0	0	0	0.00	13.28
Iran	135	34	0	6.8	175.8	0.00	70.03
Jordan	1.45	13.6	0	3.5	18.55	0.52	3.56
Kuwait	0	1.8	0	0	1.8	0.01	14.99
Lebanon	0.5	1.6	0	0	2.1	0.08	2.50
Libya	0	5	0	0	5	0.10	5.15
Morocco	750	15	20	0	785	10.21	7.69
Palestine	0.7	4	0	0.2	4.9	3.50	0.14
Qatar	0	1.2	0	40	41.2	0.47	8.75
Saudi Arabia	0	19	0	0	19	0.03	61.87
Sudan	0	0	0	0	0	0.00	2.26
Syria[8]	0.15	2	0	0	2.15	0.04	4.80
Tunisia	245	20	0	0	265	6.12	4.33
UAE	0	33	100	1	134	0.46	28.96
Yemen	0	3	0	0	3	0.35	0.85
MENA	**1,728**	**146**	**165**	**52**	**1,974**	**1.0**	**283**

Source: RCREE/AFEX (2015); MEES (2015); MOEM (2016); AOGD (2015); SHANA (2015)

2. Incentivising renewable deployment

Although governments of MENA hydrocarbon economies may have different objectives to achieve by deploying renewables, the solution always involves creating incentives and eliminating or lowering the barriers to investment. MENA governments have historically played a significant role in supplying energy, with the main energy companies under state-ownership. Therefore, the solution to the challenge of renewable deployment implicitly defines the role of the government. The nature of barriers in resource-rich countries are to some extent similar to other developing countries, but the options for investment incentives differ because of their dependency on oil/gas export revenues and huge domestic consumption of subsidised fossil fuels.

Figure 1 presents a stylised framework for promoting renewables in the generation mix. Governments need to design appropriate policies to tackle deployment barriers in the areas of

[8] Limited data availability.

grid connection and management, institutional challenges and risk and uncertainties. Governments must simultaneously design policies that create investment incentives. There are two extreme policy solutions to incentivise renewable investment in resource-rich countries. In one approach, the government introduces a full renewable subsidy programme (alongside existing fossil fuel subsidies) and steers investment towards specific renewables. This requires long-term government support and commitment in order to create investor confidence. In the other case, the government eliminates barriers and lets economics determine market outcomes with respect to the quantity and type of renewable technologies installed. This requires the complete removal of fossil fuel subsidies (and internalising the cost of externalities) so that renewable technologies that are already competitive can kick in.

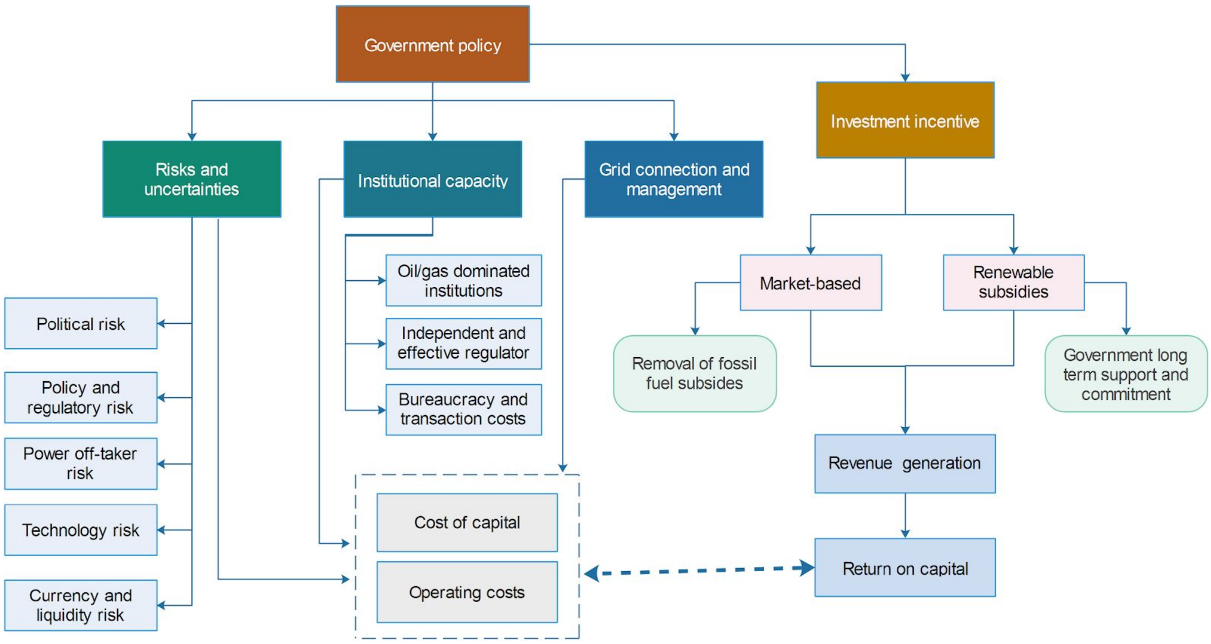

Figure 1: A stylised model of renewable enhancement

[Source: Authors]

However, both approaches are polar solutions on a policy instrument spectrum. More market-based approaches result in political challenges, whereas moving towards a fully subsidised renewable programme increases economic pressures. Recent attempts at energy pricing reforms in the GCC countries illustrate these pressures.[9] Therefore, there is a fundamental trade-off between these two polar solutions in resource-rich MENA countries, implying that they are not implementable in their pure forms. Therefore, we argue that investment incentives for renewable deployment in these countries need to be provided through a combinatorial approach, which involves partial energy price reform and a partial subsidy programme. We discuss the two polar solutions below and highlight some of the main challenges of implementation in resource-rich MENA economies. We then present the combinatorial approach, which potentially avoids the challenges of two polar solutions and is more compatible with the economic and political context in these countries.

2.1 Market-oriented approach

As the first-best solution, the market-based model comprises a set of measures to promote efficiency and innovation in the energy sector through markets and competition (as opposed to government) and facilitate private sector participation. This approach, depending on the manner of implementation, can overcome economic barriers to renewables deployment and enhance the institutional and technical capacity of the country. In practice, the first-best solution involves steps such as the removal of fossil fuel subsidies and internalising the cost of externalities (i.e., putting a price on carbon emission) alongside addressing barriers in the areas of grid access, institutions and risk and uncertainties.

Therefore, the success of the market-oriented approach depends, to a great extent, upon the price of fossil fuels. There is a (range of) price for oil (and gas) below which the market

[9] For instance, in January 2015, in response to fiscal pressures from falling oil revenues, Kuwait's government increased diesel, kerosene, and aviation fuel prices. However, it faced political opposition and public protests, and eventually reinstated the old prices a few weeks after the announcement, for some users (Fattouh et al, 2016).

cannot incentivise investment in renewables on its own (i.e., without government intervention). This price depends on factors such as the levelised cost of energy (LCOE) for renewables, prospect for technological improvement and cost reduction of alternative resources, heat rate of fossil fuel generators and heat content of fossil fuels. The calculation of this price requires a detailed study for each oil and gas producing country of the region. However, for illustrative purposes and to highlight its importance for the market liberalisation approach, we do a back-of-the-envelope calculation. According to EIA (2016), generating 1 MWh of electricity requires 1.73 barrels of oil or 10.11 Mcf of natural gas.[10] On the other hand, IRENA (2016) estimates the LCOE for a utility scale solar PV in the Middle East to be between $58-100/ MWh.[11] Using the lowest LCOE for PV technology (i.e., $58/MWh) we conclude that oil needs to be at least at $34/bbl and gas needs to be a minimum of $5.7/Mcf for the market to incentivise renewables deployment without any subsidy and government support.[12] If the upper bound for levelised cost of solar is adopted, the oil price should be at least $57/bbl and the natural gas price should be at least $9.89/Mcf. The LCOE ignores the costs of integration, implying that if the cost of intermittency is taken into account, the prices of oil and gas need to be even higher. This calculation is of course simplistic and sensitive to the aforementioned assumptions; it is sufficient to make the point that a pure market-based approach depends on the price of competing fuels.

[10] Assuming the heat rate of petroleum to be 10,156 Btu/kWh and natural gas to be 10,408 Btu/kWh. Fuel heat content is assumed to be 1,029,000 Btu per 1,000 cubic feet (Mcf) for the Natural gas and 5,867,946 Btu per Barrel (42 gallons) for Petroleum.

[11] The lowest estimate is based on the latest auction on the second phase of Mohammed bin Rashid Al Maktoum Solar Park which cleared at 5.85 US cents/ kWh but the highest estimate is based on project level data and expert opinion (IRENA, 2016).

[12] Some have estimated the break-even price as low as $23/bbl for oil and $4/MMBtu for natural gas. (http://www.thenational.ae/business/energy/robin-mills-remarkable-solar-bids-in-dubai-should-spur-on-other-gulf-nations)

2.1.1 *Removing fossil fuel subsidies to enable markets*

Fossil fuel subsidies are often justified on the basis that they protect low-income consumers and improve the competitiveness of energy intensive industries. But they also constitute the main barriers to renewables deployment and market functioning as under-pricing of fossil fuels incentivises their consumption at the expense of renewables.[13] In practice, subsidies have created an 'incumbent advantage', slowing down not only renewables deployment but also learning rates and cost reductions.

Coady et al (2015) estimates that pre-tax MENA energy subsidies (defined as the difference between consumer prices and the costs of supply) amounted to $154 Bn in 2015 (46% of global pre-tax energy subsidies) or 4.5% of combined MENA GDP. It further estimates that on the basis of post-tax energy subsidies (pre-tax subsidies plus an environmental tax and a consumption tax), petroleum, natural gas and coal account for the largest share (around 89%), whereas electricity subsidies account for 11%.[14] Of the large resource-rich MENA countries, Iran accounted for the highest level of subsidies measured by this metric, at 15% of GDP, and Qatar for the lowest (1.64 %), with Saudi Arabia's subsidies estimated at 9.3% of GDP.[15] MEES (2016d) estimates that in Kuwait, 70% of the total subsidy allocation of $11.9 Bn in 2015 went to petroleum products (especially gasoline) and electricity (mainly in terms of fuel for power plants). With fossil fuel subsidies, it is not only harder for renewables to compete

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[13] Criticisms of subsidies include: pressure on government budgets leading to budget cuts elsewhere, low cost recovery in electricity, adverse environmental impacts, and disproportionate amount of benefits for high income deciles. For instance, the poorest quintile in Egypt, Jordan, Mauritania, Morocco, and Yemen receives only about 1–7% of total diesel subsidies, while the richest quintile received subsidies of 42–77% of the total (El-Katiri and Fattouh, 2015; Sdralevich et al., 2014).

[14] Each of these subsidies (petroleum, natural gas, coal and electricity) refers to the difference between the cost of supply and the price of the product plus an assumed environmental tax and consumption tax (IMF, 2015). However, it must be noted that this is simply one estimate/measure of subsidies and may not be entirely accurate.

[15] Saudi Arabia's total energy subsidy bill in 2015 was $61Bn, including $23 Bn each for diesel and electricity, and $9.5 for gasoline MEES (2016c).

with existing generation sources, but also for electricity to compete with fossil fuels in end markets, particularly transportation.[16]

Fossil fuel subsides has led to a huge gap between the LCOE and retail electricity tariffs on a per kilowatt-hour basis. Table 3 illustrates this, showing that at the estimated LCOE, solar is just about competitive in the UAE, but cannot compete with heavily subsidised fossil fuels in many other MENA countries at the estimated retail tariffs[17]. Filling this gap with fossil fuel price reform would be challenging for a host of economic and political reasons. First, significant energy price rise can result in a supply-side shock to the economy, negatively affecting the competitiveness of energy intensive industries. Other industries will be indirectly affected because of a rise in the general level of prices. For example, following the announcement of energy price reform in Saudi Arabia, a number of listed companies announced that their cost structures would be impacted – the petrochemical giant SABIC reported a 5 % annual increase in its cost structure (Fattouh et al, 2016). Likewise, the demand side may respond with a sudden drop in consumption, and may or may not recover. Therefore, large energy price increases can lead to inflation, and potential economic slowdown.

Table 3: Renewables LCOE versus retail tariffs in resource-rich MENA countries

LCOE for recent projects				Retail tariffs[18] (US Cents/kWh)		
Location	***Technology***	***LCOE (US Cents/kWh)***		***Residential***	***Industrial***	***Commercial***

[16] Due to the lack of transparent data, it is difficult to differentiate accurately between fossil fuel subsidies and electricity subsidies.

[17] In Iran, which has started reforming energy prices, the retail tariff is well below costs of production across most ranges of consumption. Additionally, the depreciation of the Iranian Rial has meant that price reform in practice did not lead to a major adjustment of real energy prices, given the opportunity cost of using fossil fuels in power generation.

[18] The industrial tariff in Iran excludes water and agriculture. Also, industrial and commercial tariffs are categorised based on maximum contracted capacity (differs based on being lower or higher than 30 kW). Residential tariff is an inclined block tariff and along with commercial tariff differs for cold and hot regions of the country (lower in hotter regions). Exchange rate used for conversion is 1 USD=30550 Iranian Rials.

UAE	Solar PV	5.85	**Saudi Arabia**	1.3	3.2	4.1
Jordan	Solar PV	6.1-7.7	**Iran**	0.4-9.6	0.6-4.3	2.6-10.7
Egypt	Onshore Wind	4.1-5.0	**Kuwait**	0.7	0.7	0.4
			UAE (Abu Dhabi)	5.6-8.7	4.2	4.2-8.0
			UAE (Dubai)	7.8-12.1	7.8-12.1	7.8-12.1
			Qatar	2.2-6.0	2.5-4.9	2.2
			Bahrain	0.8	0.8	3.8
			Oman	2.6	5.2	4.2

Source: IRENA (2016); IEA (2015); MoE (2015)

Furthermore, energy price reform is a politically sensitive issue in the MENA's resource-rich monarchies. Measures perceived as disruptive to the established structure of political institutions potentially risk social discontent. The implicit social contract between rulers and citizens of these countries endows governments with the privilege of governing hydrocarbon resources in exchange for the redistribution of resource rents (Fattouh et al, 2016). The complete removal of fossil fuel subsidies, which in the short run takes away wealth from consumers, may be perceived as the breakdown of the implicit social contract, and could face social opposition if mitigating measures are not taken. Gradual energy pricing reform accompanied by clear communication to the public and balanced by compensatory measures for lower-income consumers and mitigation measures for the private sector, could sustain a more 'elastic' social contract (Fattouh et al, 2016).

2.1.2 Pricing carbon (internalising externalities)

A carbon tax can provide market-oriented incentives for deploying renewables, specifically when energy price reform alone cannot provide the incentives needed. The carbon tax is a direct tax on burning fossil fuels (e.g. in power generation) and thus internalises the cost of externalities. In economics, it is the most effective way to incentivise renewable energy because it relies on the free market to choose the most efficient clean energy innovations and investments. However, a carbon tax adversely impacts the economy in the short run and hurts low-income consumers. One solution would be to redistribute carbon tax revenues to alleviate electricity bills and reduce other taxes (e.g. income tax and capital gains tax).[19]

However, the problem of taxation in the MENA resource rentier economies goes beyond these distributional and economics challenges. First, these countries lack an established tax collection system and relevant institutions. For example, in the GCC, tax revenues (primarily from corporate, trade and property taxes) comprise a tiny fraction of government revenues.[20] Additionally, taxation is a politically sensitive issue everywhere, but more so in resource-rich countries because introducing new taxes undermines a government's source of legitimacy and public support obtained through the distribution of resource rents. Therefore, under prevailing conditions, a carbon tax policy is unlikely to be implemented in these countries - something which even developed economies with a long tradition of taxation struggle to establish.

2.2 Fully subsidised renewable energy programme

In contrast with the market-based approach, a fully subsidised renewable programme can incentivise investment by offering direct and indirect financial incentives. This approach requires the heavy involvement of government in the process of renewables deployment, from designing to implementation and management of support schemes. There is a wide

[19] This is sometimes referred to as a revenue-neutral carbon tax, such as the one introduced in British Columbia, Canada.

[20] Total tax revenues as a percentage of GDP in the GCC is as follows: Oman (2.8%), UAE (2.5%), Qatar (1.7%), Saudi Arabia (1.4%), Kuwait (0.8%) and Bahrain (0.6%) (Fattouh et al., 2016).

range of schemes that governments can select from, some of which can be implemented in non-liberalised electricity sector structures, and alongside fossil fuel subsidies. Overall, renewable policy support policies can be broadly classified into production-based and investment-based schemes (see Figure 2). These can be further divided into price-based and quantity-based models. Definition of various models of support schemes is provided in Table 4.

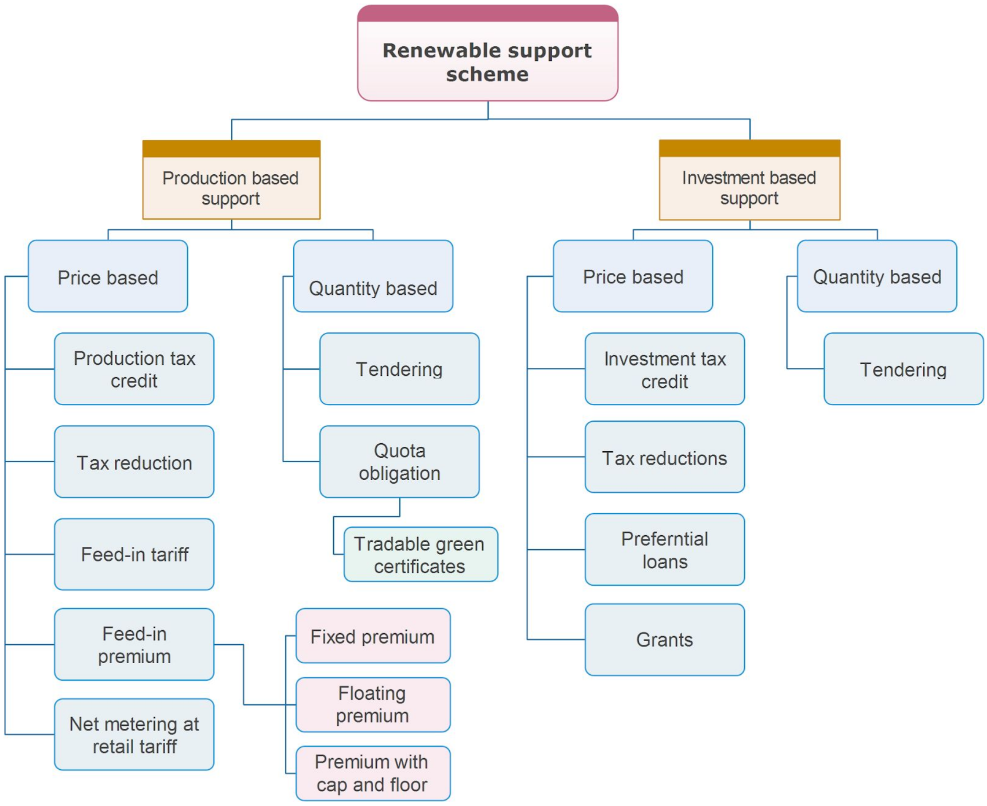

Figure 2: Classification of renewable support schemes

[Source: Authors]

Table 4: definition of support schemes

Type of scheme	Definition
Feed-in-tariff	Feed-in-Tariff (FiT) is a long-term contract (e.g., 15 years) between the off-taker (usually government) and the producer of renewable electricity in which a guaranteed payment is made for each unit of energy fed into the grid.

Feed-in-premium	Feed-in-premium is a scheme in which the owner of renewable generation receives a payment on top of what he normally receives from the sale of his energy in the electricity market. The premium can be fixed, floating or can have a cap and floor.
Net metering at retail tariff	Net metering is a policy whereby the net consumption of user (which can be positive or negative) is tracked through a bi-directional meter. The consumer pays a retail electricity tariff when the net consumption is positive during the billing period. On the other hand, when the net consumption is negative, the consumer is compensated at retail tariff (or wholesale price). Alternatively, end-user can bank the surplus energy credit for the following period.
Tradable green certificates	A tradable green certificate (TGC) entitles renewable generator to the revenue from TGCs on top of the revenue from the sale of their energy in the electricity market. TGC is issued for each unit of energy by renewables (e.g., MWh). The electricity suppliers are required to surrender a sufficient number of TGCs in order to comply with their obligations. A penalty is imposed (per MWh) on suppliers in the event they fail to submit the required certificates which, in practice, acts as a cap for TGC prices.
Tendering (production or investment)	In the tendering model, the government specifies the quantity of renewable energy that needs to be procured and runs an auction in order to discover the price (per MWh or MW) and grant contracts to the most efficient suppliers.
Tax credit (production or investment)	In a production tax credit, renewable facility is partially or totally exempted from tax liabilities during a specific year based on the amount of energy produced. Investment tax credit on other hand provides tax exemption based on the amount of capital expenditures on the renewable energy technologies.
Tax reduction (production and investment)	Tax reduction is a cut in tax based on the energy produced or capital expenditure and can include sales, value added, carbon or energy taxes.
Preferential loans	In preferential loans governments cover part of the interest rate (e.g., 50%) for the finance provided by financial institution to renewable energy technologies. If the perceived project risk is high, the government may provide a guarantee to cover a share of the outstanding loan principal in order to lower the capital cost to investors.
Grants	It is a fund given by government to cover part of the capital expenditure of renewable facility.

Source: authors

Although from an economic perspective, renewable support schemes imply further distortion to the electricity market, this approach is more likely to achieve a particular renewable target. Additionally, it can be used to achieve objectives beyond renewable deployment such as job creation and growth of domestic industry. For instance, in order to incentivise the use of domestically manufactured products, equipment and technologies, Iran applies a 15 % increase to the standard rate of power purchase agreements of locally sourced renewable plants.[21] Similarly, KACARE (King Abdullah City for Atomic and Renewable Energy) incorporates local content stipulations in competitive procurement including a fiscal incentive for local employment.

The type of schemes that can be adopted by resource-rich economies depends on a number of factors including the project scale, degree of maturity of renewable technology, size of renewable targets, financial/fiscal constraints, risk attitude, presence of relevant institutions and stage of electricity market liberalisation. For example, schemes such as production tax or investment tax incentives are unsuitable for small-scale projects such as rooftop solar PV, because households may not have tax liabilities to offset. For immature technologies or those at a demonstration stage, investment-based schemes are more suitable than production-based schemes. However, investment-based schemes are unsuitable for countries facing fiscal constraints because of the lump sum payments needed. For risk averse investors, a feed-in-tariff with full cost coverage is an effective approach, as opposed to a feed-in-premium in which subsidies partially cover the project's cost and investors need to rely in part on volatile electricity market prices. Furthermore, feed-in-tariffs have proved to be more successful in promoting scalability and realising ambitious renewable targets. Nonetheless, this model treats both efficient and inefficient projects similarly thus can become costly over time.

[21] http://www.wfw.com/wp-content/uploads/2016/05/WFW-Briefing-Renewable-Energy-in-Iran.pdf

Some support schemes require the existence of specific institutions: for example, a tax-based incentive is ineffective in countries that lack strong tax institutions/systems (i.e. MENA). Further, schemes such as feed-in-premiums and TGCs under quota obligations require a liberalised electricity market in which there are many buyers and sellers, whereas others such as feed-in-tariffs can be implemented even under a monopoly market structure.

Support schemes also differ in their degree of price exposure (i.e., market risk- when it is applied in a liberalised platform), and can be technology-specific or technology-neutral. In order to take advantage of the best features of different support models, schemes can be combined. For instance, feed-in-tariffs can be combined with tendering to ensure efficiency, or with tendering and contract for difference (CfD) in order to take advantage of electricity price movements. The UK has adopted the latter to support renewable development as part of its recent electricity market reform. Subsidy schemes can also be distinguished based on whether they focus on incentivising the supply side (e.g., feed-in-tariff) or the demand side (e.g., quota obligation). Consequently, governments need to make a decision about adopting appropriate forms of renewable support schemes.

An effective renewable support policy scheme for resource-rich MENA countries is one which:

- is compatible with the structure of electricity markets in the region
- promotes scalability and covers most risks that investors are exposed to
- can also be implemented in a low oil price environment (suitable for fiscally-constrained countries)
- the relevant institutions exist and
- is market-oriented to the extent possible

Matching above criteria to the existing economic and institutional context of resource rich countries, the following propositions can be derived. These statements are key to the understanding of the checklist analysis presented in Table 5.

(i) A scheme is not compatible with current electricity market structure in the region if a renewable generator's revenue partially dependent on the wholesale market.

(ii) Suitability of scheme for large-scale projects depends on the extent to which the support scheme is market oriented.

(iii) A support scheme is market oriented if the price is discovered in either a decentralised market or a centralised market (for example auction).

(iv) Full cost coverage happens when the level of support is at least equal to levelised cost of energy (LCOE) over the lifetime of the project.

(v) A support model is suitable for financially constraint country if it does not require a lump sum payment; the payment rather is distributed over the lifetime of asset.

(vi) A scheme is compatible with current institution in the MENA countries if it does not require a specific taxing system or a liberalised market structure.

As it is shown in Table 5, apart from (production-based) tendering, none of the schemes meets all of the aforementioned criteria. In terms of economics, auctions are the most efficient method of resource allocation if a sufficient number of non-colluding bidders participate. Currently, tendering is widely adopted for utility scale renewable investment in the region (see Table 6). The next best approaches are feed-in-tariff, preferential loans and grants. Feed in tariff is employed both for small and large projects and similar to grants and loans its implementation does not have the complexity of auction process. The remaining models are either not adopted or less popular in the region apart from the net metering.

Net metering based on retail tariffs, which was popular in the USA, does not require a liberalised electricity market but needs undistorted retail electricity prices and a suitable retail tariff structure (e.g., a two-part tariff). This is because when retail tariff are volumetric, net metering can lead to bankruptcy of network utilities who cannot recover their fixed costs (self-generation reduces the metered consumption of users without a proportional change in their level of grid access). It also raises the electricity bill of low-income consumers who cannot afford self-generation. Nonetheless, the UAE has already adopted this approach (see Table 6) but others such Saudi Arabia also considering it.

Table 5: Evaluation of suitability of support schemes for resource rich countries of MENA

Type of scheme	Compatible with a non-liberalised electricity market?	Suitable for large-scale projects?	Full cost coverage for the project?	Suitable for financially constrained countries?	Relevant institutions exist?	Market oriented?
Feed-in-tariff	✓	✕	✓	✓	✓	✕
Feed-in-premium	✕	✓	✕	✓	✕	✓
Net metering at retail tariff	✓	✕	✕	✓	✓	✕
Tradable green certificates	✕	✓	✕	✓	✕	✓
Tendering (production)	✓	✓	✓	✓	✓	✓
Tendering (investment)	✓	✓	✓	✕	✓	✓
Tax credit (production and investment)	✓	✓	✕	✓	✕	✕
Tax reduction (production and investment)	✓	✓	✕	✓	✕	✕
Preferential loans	✓	✓	✕	✓	✓	✕
Grants	✓	✓	✕	✓	✓	✕

[Source: Authors]

Table 6: Renewable support policy schemes currently adopted in the MENA

Country	Support Policy	Further financial information
Kuwait	Competitive tenders; public investment, loans or grants	N/A
Saudi Arabia	Competitive tenders; public investment, loans or grants	N/A
UAE	Public investment, loans, grants, competitive tenders, net metering	Over $700 million allocated since 2013.
Oman	Fiscal incentives; public competitive bidding; public investments, loans, or grants	N/A
Qatar	Public investments, loans or grants	N/A.
Bahrain	-	N/A
Iran	FiTs, capital subsidies, soft loans	The base rate for FiT of maximum 5 years is at 4628 Rials/kWh (Cost of production and transition to 20KV station) and 4480 Rials/kWh (only electricity production).
Morocco	Competitive tenders; public investments, loans or grants	In 2012 auction opened for 850 MW of wind capacity. Average auctioned price was USD 25-30/MWh
Jordan	FiTs, net metering; tax incentives; competitive tenders; public investments, loans, or grants	The ceiling tariff is set at: 85, 135, 120, 90 and 60 fils/kWh for wind, solar thermal, PV, biomass and biogas respectively. If a fully Jordanian origin facility is installed the tariff can be increased by 15%.
Egypt	FiTs, competitive tenders	Feed-in tariff for PV systems ranges from 84.8 Pt/kWh for less than 200 kW to 102.5 (or equivalent of USD cent 14.34) for 20 MW – 50 MW. Feed-in tariff prices for wind projects from 82.08 Pt/kWh (11.48 USDcent/kWh) for 2500 operational hours to 32.90 Pt/kWh (4.60 USDcent/kWh) for 4000 operational hours.
Yemen	Competitive bidding	N/A
Algeria	FiTs; competitive bidding	Feed in tariff range for solar PV installations from 20.08 DZD/kWh ($255/MWh) (1 MW – 5 MW) and 16.06 DZD/kWh ($204/MWh) (> 5 MW) for 1275-1349 operational hours to 11.80 DZD/kWh ($150/MWh) (1 MW – 5 MW) and 9.44 DZD/kWh ($120/MWh) (> 5 MW) for ≥1725 operational hours.

Tunisia	Net metering; fiscal incentives; public investments, grants or loans	In 2009, the annual average price was DTN 92 millimes/kWh for renewable energy sourced electricity and DTN 72 millimes/kWh for electricity from co-generation.

[Source: IRENA (2013; 2016), IEA (2018)]

2.2.1 Long term government support and commitment

The government needs to reassure investors of its commitment and demonstrate that support for renewables is not 'just for show' but an integral part of an overall strategy for energy and economic development. This can be done by, for example, integrating renewables within national energy strategies and utilising the many positive externalities created by renewables. It also requires measures such as introduction of dedicated financial support mechanisms. Priority sector lending, convertible loans and grants and guidelines for issuing green bonds are among many examples of financial support commitment. The government can also provide support such as technical assistance and grant funding for feasibility studies and document preparation to increase the pipeline of projects ready for investments (IRENA, 2016b).

One important lesson from Europe's experience is that frequent changes in renewables subsidy policy sends the wrong signals to private investors. For example, at the time of writing, the UK Low Carbon Contracts Company terminated the Contract for Difference feed-in-tariff that had been awarded to Mainstream Renewable Energy's Neart Na Gaoithe offshore wind farm in 2015.[22] This unprecedented action was followed by the announcement that the Danish government may cancel a competitive auction planned for a series of nearshore wind farms. These measures have left offshore project developers on

[22] http://www.offshorewind.biz/2016/05/12/mainstream-disputes-neart-na-gaoithe-cfd-termination/

the hook for millions of Euros in upfront development capital. These types of policy 'U-turns' would be detrimental, specifically in the nascent markets of resource-rich MENA economies. In Egypt, for instance, the government changed regulations on international arbitration for renewables projects in May 2016, leading to considerable investor uncertainty.[23] Unpredictable changes therefore need to be avoided, and a mechanism for change set out within the policy itself to avoid surprising market players. Moreover, investors need to have enforceable contracts and a mutually agreed dispute resolution method specified in the terms of contract (for example through the international chamber of commerce (ICC)).

The cost of support schemes could potentially compromise government commitment and long-term support, as subsidising renewables is expensive and pressurises already tight government budgets in a low oil price environment, given current fossil fuel subsidies which constitute a significant part of governments' expenditures. Following the 2014 oil price fall, many oil producing MENA countries ran into budget deficits, and embarked on expenditure cuts in various economy sectors, alongside the suspension of some planned infrastructure projects. Figure 3 shows that the major resource-rich MENA countries have high gross debt and/or negative fiscal balances (as percentages of GDP). Although fiscal buffers are plentiful, they are temporary in the event of a prolonged decline in oil prices (Fattouh et al, 2016).

Therefore, given ambitious renewable targets, along with exorbitantly high cost of fossil fuel subsidies in MENA countries, a full renewable subsidy programme is unlikely especially in the unfavourable economic conditions due to the oil price decline.

[23] 'Egypt's solar power upset clouds outlook for foreign investors', *The Indian Express*, 5 August 2016. http://indianexpress.com/article/world/world-news/egypts-solar-power-upset-clouds-outlook-for-foreign-investors-2955324/

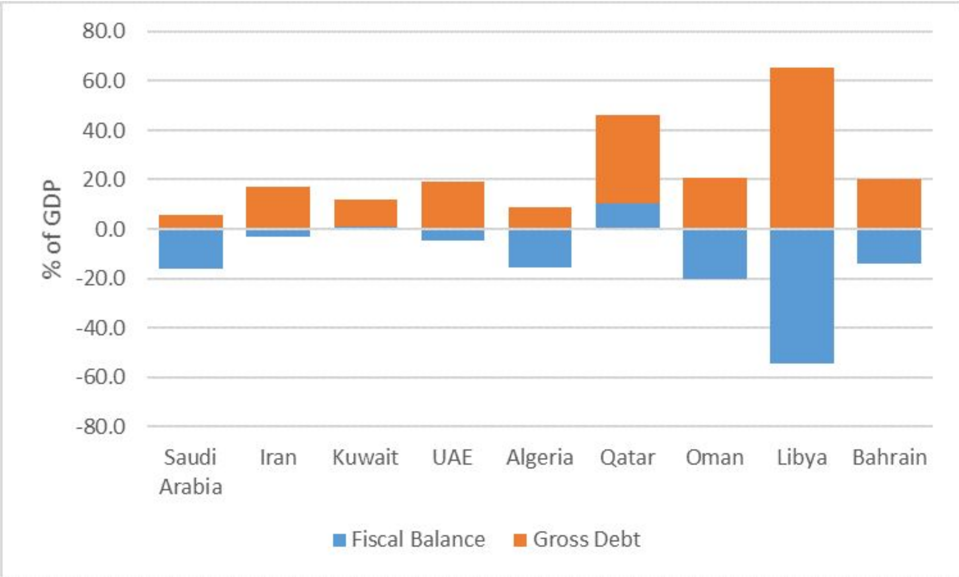

Figure 3: fiscal balances and gross debt (% of GDP), 2015

[Source: IMF (2016)]

2.3 A combinatorial approach

A long-term fully subsidised renewable energy programme, added to existing fossil fuel subsidies, is fiscally difficult across all resource-rich MENA economies. Similarly, the implementation of full energy price reform to enable the market, in a short time period, would be nothing short of a revolution. Therefore, the application of polar solutions in their pure forms would be extremely challenging, if not impossible.

Any in-between strategy constitutes a combinatorial approach that takes some elements from the two polar solutions and depending on where it lies in the policy spectrum, the weight of one set of instruments (for example, market-based) can be higher or lower than other instruments (direct renewable subsidies) (Figure 4). In the early stages of introduction of renewables, it is likely that subsidies are the main means of incentivising investment in alternative energy (i.e., renewable support subsidies outweigh other policy instruments at initial stages). Over time, two effects will likely change this: one is that the cost of renewables is continuously falling and the other is that many of resource rich countries of MENA are keen to do away with fossil fuel subsidies. Figure 5 shows that since 2010 the costs of most renewables especially solar and wind has been falling dramatically. In some countries, solar and wind are already competitive with fossil fuels (Figure 5).

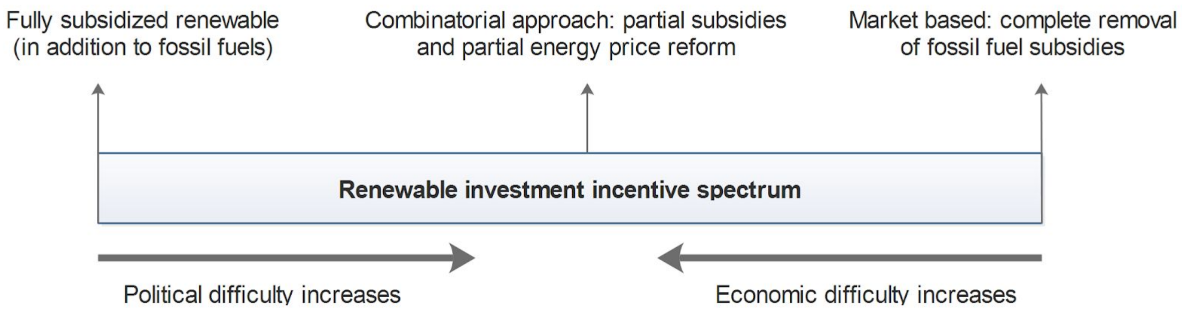

Figure 4: Policy instrument spectrum for incentivising renewable investment

[Source: Authors]

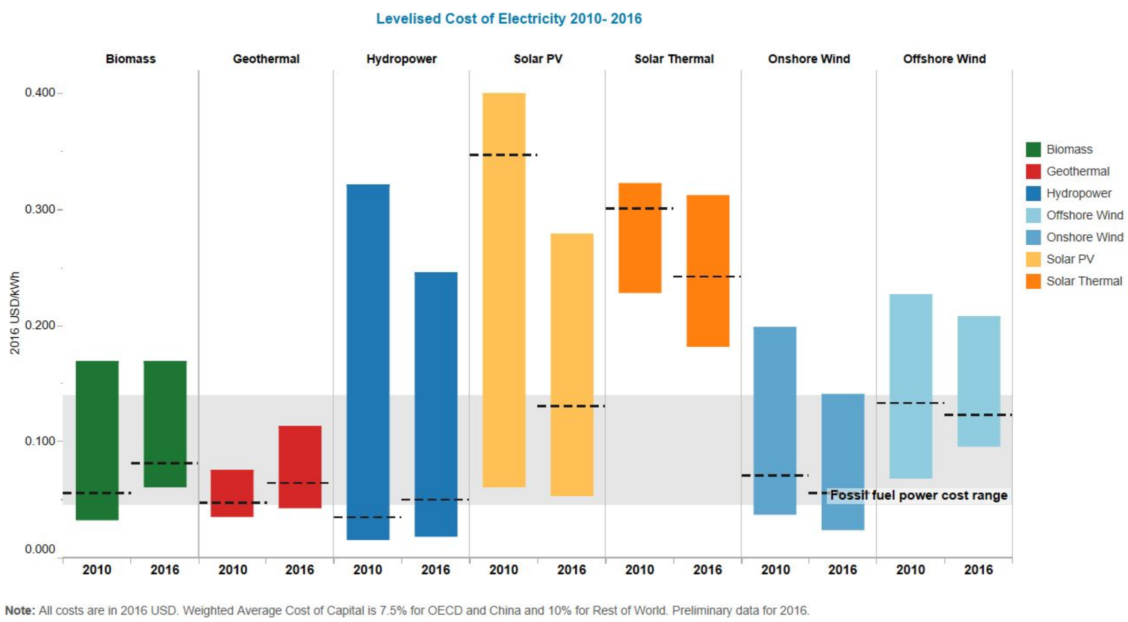

Figure 5: Levelised cost of energy (LCOE) for renewables 2010-2016

Source: IRENA (2018)

The combinatorial approach can be part of a dynamic process in which countries start from the most feasible point on the policy instrument spectrum, given their current context, and gradually move towards phasing out fossil fuel subsidies over the medium to long term. This not only reduces fiscal pressure on government budgets (compared to a fully subsidised model), but also averts political risks by allowing businesses and households to slowly adapt to the new environment where energy carriers are priced at their full economic costs. The position on the policy instrument spectrum is a function of the countries' institutional setting, status of energy price reform, fiscal situation and public acceptance, among others.

Given the pre-existing fossil fuel subsidies in the region, most hydrocarbon economies of MENA lie on the left hand side of the spectrum currently. The change in the weights of instrument specifically removing fossil fuel subsides needs to be done in a careful and gradual manner due to its side effects. First, price reforms needs to be part of a comprehensive strategy that not only concerns with removing subsides but also is aware of its side effects (impact on low-income households and on the wider economy) and timing and speed of implementation. The pace and scope of reforms need to be adjusted according to the countries' administrative and institutional capacities (IMF, 2017). Second, compensatory measures are required to mitigate the side effects after removal of fossil fuel subsides. Third, fossil fuel price reforms need to be accepted by public and this signifies the importance of communication and transparency. An automatic price adjustment approach in which price gap (the amount of subsidies provided by government for fossil fuels) is reduced at each period by a pre-determined percentage can be effective.

The combinatorial approach is compatible with current energy price reform policies in the resource-rich MENA economies. In fact, the fiscal tightening from the prolonged 2014 downturn in oil prices has already led to widespread planned energy price reforms, alongside expenditure cuts (see Fattouh et al., 2016). The UAE was the first to announce comprehensive fuel subsidy cuts in mid-2015, by linking domestic prices for gasoline and diesel to international spot market prices. Saudi Arabia hiked fuel prices for transport, power generation fuels and petrochemicals feedstock, followed by hikes for electricity and water, in early 2016. Oman, Bahrain and Qatar all announced fuel price hikes in a flurry (MEES, 2016d). Iran carried out fuel subsidy reform much earlier, in 2010, but underestimated its costs and the impact on consumer price inflation (Lilliestam and Patt, 2015). Price hikes were carried out in a very short period of time leading to increases of up to 150 % in some countries, generating backlash from consumers. Consequently, some countries began rethinking the manner of reforms, instead opting for periodic (monthly) adjustments (Qatar, Oman) and targeting of poorer consumers (Kuwait, Saudi Arabia) through considering price differentiation by consumption volumes, and rationing of quantities rather than providing price subsidies. Iran's 2016 budget envisaged a reduction in the number of consumers receiving cash handouts and the revival of a fuel 'smartcard' scheme for selling gasoline at different consumption slabs (MEES, 2016e; 2016f; 2016g). Kuwait was the last MENA country to announce subsidy reforms, announcing a plan for an 83 % rise in some petrol prices – the first rise in 50 years - from 1 September 2016.[24]

An important feature of the combinatorial approach is that it takes not only the economic factors but also political issues related to subsidies into account. Thus, the pace of price

[24] 'Kuwait announces 'ultra' petrol price rise of 83% - to 55 cents a litre' *The Guardian*, 2 August 2016. https://www.theguardian.com/world/2016/aug/02/kuwait-announces-petrol-price-hike-of-83-to-55-cents-a-litre

reform can be adjusted for each individual resource-rich country based on its own context. As opposed to a fully subsidised programme which transfers the whole cost of renewable deployment to the government budget, the combinatorial approach partially relies on government and partially on the market. In a similar way, contrary to a fully market-based model which transfers the political risks to government but economic risk to market agents, the combinatorial approach distributes the risk between market players, government and consumers. The combinatorial approach provides a practical way forward for the hydrocarbon economies to increase the share of renewables in their power generation mix.

3. Removing barriers to renewable deployment

Creating investment incentives through the combinatorial approach, is necessary but not sufficient for renewable promotion as the barriers to deployment also need to be removed. Despite differences among MENA resource-rich countries, they share similarities in their energy sector structure and governance; hence, common factors contribute to the low levels of renewable investment in these economies. We identify these barriers to be: grid connection and management, institutional challenges and risk and uncertainties.

3.1 Grid connection and management

A key component of energy transformation in the MENA is the availability of grid infrastructure that enables reliable electricity transmission from production to consumption areas. In the absence of adequate grid capacity and resiliency, renewable energies may face frequent curtailment due to network and reliability constraints. Grid inadequacy is a challenge for renewables deployment even in OECD countries such as the UK[25].

Furthermore, the connection cost model is important for renewable investment (shallow versus deep connection fees) –i.e., whether the grid company is responsible for the costs of grid connection and reinforcement, or the renewable project developer, and, if grid connection involves some costs then whether the investor can recover these through tariffs. Since renewable projects are more dependent on geographical location than conventional generation, many jurisdictions around of the world charge shallow connection charges meaning that renewable developer is only responsible for the cost of connection to the nearest grid point and cost of grid reinforcement is socialised among network users. Such an approach ensures that constraints relating to site selection are minimised. However, with the increase in the penetration of renewables, the amount of socialised costs will rise under shallow connection charge model and this can be problematic.

Additionally, renewables investors need guaranteed access to the transmission/distribution grid under clear, transparent and non-discriminatory conditions. Given the electricity market structure in the MENA region and the form of renewable subsidies, priority access and priority dispatch[26] may be necessary in engendering the competitiveness of renewables. Over time as market structure evolves and subsidies become market based, propriety dispatch can be removed to allow for a level playing filed for all resources. The implication of priority dispatch is that conventional generators have to reduce their generation levels in cases of

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[25] https://www.theguardian.com/business/2015/may/10/uk-electricity-grid-renewable-energy-solar-trade-association.

[26] In the fully liberalised electricity markets in which the payment to renewable generators is linked to the wholesale market, priority dispatch is not needed as renewable resources have natural priority because of their low marginal cost.

over-generation and/or transmission congestion (RCREEE/AFEX, 2015). In a competitive electricity market, curtailment (if needed) can be done in an economic way: generators can bid for the amount they are willing to receive in order to reduce their production.

Priority access ensures that renewable generators are able to sell and transmit their electricity according to the connection rules at all times, whenever the source becomes available. Therefore, in a competitive market, it allows for the maximum use of installations connected to the grid.

Transparency of regulation on grid access for renewables is specifically important for MENA countries because of the relatively integrated power sector structure in the region. In a highly integrated market, where the same actor handles both generation and transmission, incentives might arise to exclude generating competitors by denying grid access.

One approach to address this issue is to specify grid access details in national-level regulations and grid codes, and to avoid case-by-case negotiations. Only a few MENA countries have specified grid access details in their regulations, and Algeria and Jordan include the most preferential grid access conditions for renewable projects (see Table 7). Saudi Arabia and Abu Dhabi have detailed grid codes but do not specify any special conditions for renewable projects (RCREEE/AFEX, 2015).

Furthermore, grid requires sufficient capacity and resiliency in order to withstand uptake of intermittent resources and this will not be achieved without significant investment. Grid investment, on the other hands, requires a suitable and stable regulatory and policy environment with appropriate incentives and long-term horizons. The inadequacy of domestic grid infrastructure can hinder penetration of renewables.

In addition to domestic infrastructure, countries also need to increase their regional interconnections to improve their balancing capability, flexibility and security of supply. The GCC interconnection (GCCI) grid links Saudi Arabia, Qatar, Bahrain, Kuwait, Oman and the UAE. More than 10 contracts worth over 1 Bn US$ were awarded in the first phase linking Saudi Arabia with Kuwait, Bahrain and Qatar. Another initiative, the Seven Countries Interconnection Project launched in the 1990s aims to interconnect the grids of Libya, Egypt, Jordan, Syria, Iraq, Turkey and Lebanon. Within the region, an HVDC (high-voltage, direct current) line is planned between Saudi and Egypt. However, electricity transfers among GCCI grid users have reportedly been small-scale and mainly during times of outages.[27] An important reason for the lack of electricity trade is the prevailing view of the interconnector as a backup rather than an opportunity for optimisation of the electricity system.[28] The penetration of renewables is expected to provide new opportunities for regional cooperation and trade in this regard. However, major efforts are required towards building trust for this sort of cooperation, as well as adding necessary infrastructure or reinforcing the grid where needed.[29]

Table 7: Grid Access for Renewables in Selected MENA Countries, 2015

				Technical Guidelines Adopted to Connect:		
	Guaranteed grid access	**Priority access**	**Priority dispatch**	**Small scale PV systems to low**	**Utility scale PV systems to medium**	**Wind parks to medium**

[27] Oman's state electricity and water firm wants to prioritise the development of a spot market by 2019, with trials of electricity trading through the GCCI grid in 2016.

[28] While the GCC interconnection facilitates the infrastructure for electricity trade and cooperation among the six countries, it has mainly been utilised for emergency transfers of electricity to meet peak loads or to shore up lost capacity from plant outages to help avert partial blackouts (KAPSARC, 2016).

[29] For instance, the Saudi electricity sector needs $133Bn of investments in generation, transmission and distribution (MEES, 2016h).

				voltage grid	and HV grid	and HV grid
Saudi Arabia	No	No	No	No	No	No
Kuwait	No	No	No	No	No	No
UAE	No	No	No	No	No	No
Qatar	No	No	No	No	No	No
Algeria	Executive decree 06-428 (2006), 06-429 (2006), and order of 2008	No	Yes, once a renewable energy system is connected	No	Under preparation	Under preparation
Oman	No	No	No	Yes	n/a	n/a
Bahrain	No	No	No	No	No	No
Jordan	Non-discriminatory guaranteed access foreseen by Law No. 13 (2012) on Renewable Energy and Energy Efficiency, Article 8C	No	No	Yes	Yes	Yes
Iran*	Yes	N/A	N/A	Yes	Yes	Yes

[Source: (RCREEE/AFEX, 2015) * SUNA (2013)]

3.2 Institutional challenges

The successful implementation of renewable policy requires necessary institutional capacity, including administrative, economic and political. The type of institutions required depends on the specific policy and its complexity, as this indicates the degree to which a policy instrument is considered as legitimate, acceptable (commitment and long-term support from government and public) and can be adopted. At the same time, the enhancement of institutional capacity must not lead to excessive administrative and regulatory burdens as they themselves can become impediments to renewable deployment. For example, if obtaining relevant permits becomes complex and lengthy it increases transaction cost and discourages investors from entering into renewable sector. Effective institutions need to reduce the administrative burden of procurement, selection of contract holders, granting contracts, site selection, construction and environmental permits and grid access to the minimum. While dedicated renewable energy agencies or departments are necessary to enable coordination amongst stakeholders, independent regulators are critical to ensuring transparency and engendering stability in the implementation of policies.

Studies suggest that the MENA countries' institutional feasibility should include the existence of renewable energy ministries and regulators, their resources, competencies, laws, existing strategies and activities in renewable energy (DIE, 2012). As Table 8 shows for selected resource-rich (and non-resource-rich) MENA countries, most countries have a dedicated renewable policy agency. However, current institutional frameworks for energy in the MENA countries are largely dominated by the oil and gas sector and renewables have yet to be integrated within these. The implication of this is that oil/gas sector has a strong influence over the future development of electricity sector. Currently, the MENA countries' power sectors consist of mainly large powerful state-owned companies[30] overseeing generation, purchase and supply of power based on traditional business models which can be disrupted by renewables deployment. In the absence of regulations that strengthen the position of the renewable within the energy mix and address the concerns of traditional utilities, state utilities not only do not have incentive to facilitate growth of renewables but also may act as a barrier.

Although electricity reform legislation has been enacted in nearly all resource-rich MENA countries, institutions to implement them are lagging behind. Issues such as regulatory instability, lack of comprehensive legislation, inadequate operational standards for power

[30] For instance, ADWEC in UAE and Saudi Electricity Company in Saudi Arabia.

systems with intermittent renewables, incomplete regulatory frameworks for ancillary services, grid access, balancing rules and balancing responsibilities are concerns for investors in renewables facilities. The lack of regulatory independence is also a major impediment, as governments often overturn regulatory decisions and in many cases tariffs for procurement of renewables are set inflexibly. Finally, the lack of transparency and predictability in support schemes for renewable deployment highlight the extent of institutional challenges.

Table 8: Institutions for Renewables Deployment

	Electricity regulatory agency	RE Policy Maker (Dedicated Agency/Department)
Saudi Arabia	Electricity and Co-generation Regulatory Authority (ECRA)	King Abdullah City for Atomic and Renewable Energy (KACARE)
Iran	Ministry of Energy	Renewable Energy Organisation of Iran (SUNA) in collaboration with Ministry of Energy
Kuwait	None	None
UAE	Abu Dhabi Regulation and Supervision Bureau	Clean Energy and Climate Change Department at Ministry of Energy
Algeria	Commission de Régulation de l'Electricité et du Gaz (CREG)	Renewable Energy and Energy Conservation Directorate at the Ministry of Energy and Mines
Qatar	None	Qatar General Water and Electricity Corporation (KAHRAMAA)
Jordan	Energy and Minerals Regulatory Commission	Renewable Energy Department at the Ministry of Energy and Mineral Resources
Morocco	None	Energy and Renewable Energies at the Ministry of Energy, Mines, Water and Environment; Agency for the Development of Renewable Energy and Energy Efficiency
Egypt	Egyptian Electric Utility and Consumer Protection Regulatory Agency	New and Renewable Energy Authority

[Source: RCREEE/AFEX (2015); Authors]

3.3 Risks and uncertainties

Economic environments for investors always contain risks and uncertainty and renewable energy industry is no exception. Renewable investors face a range of risks including political risk, policy and regulatory risks, technology, currency and liquidity risk, and power off-taker risk (IRENA, 2016b). These not only affect the path of technological evolution but more importantly the cost of capital with direct implications for renewable competiveness and addressing them require access to effective risk mitigation instruments.

Political risks are related to political events which negatively impact the value of investment including war, civil disturbance, sabotage, expropriation and non-honouring of contracts. Policy and regulatory risks are related to changes in investment incentives (for example, removal of renewable subsidies), network codes, grid connection costs model, and permitting processes among others. In resource-rich MENA countries, renewable investors face uncertainty both where there is no specific renewable policy as well as after policy incentives are designed and implemented. Pre-implementation uncertainties include not knowing if, when, or what type of policy will be implemented to incentivise renewables. Post-implementation uncertainties are related to stability, transparency, trust and insurance for long-term support. Developers also face technology risk, related to nascent renewable technologies which lack a proven track record of operation in the MENA. The local workforce may lack the skills needed to operate and maintain power systems with renewable technologies. This risk becomes more pronounced knowing that a segment of the skilled workers in these economies tend to be expatriates.

The currency risk pertains to the volatility of domestic currency value with respect to foreign currencies. This is particularly important as most renewable power producers' costs are in hard currency (e.g., dollar or euro because of loans), whereas their revenue is in local currency (e.g., feed in tariff paid in domestic currency). Local currency depreciation leads to a mismatch between cost and revenue and can negatively impact the financial health of renewable energy companies. In the GCC countries, traditionally, national currencies were pegged to the US dollar due high reliance on import thus exchange rate was considered less of an issue. However, with drop in oil price and consequently revenue, keeping the value of national currency fixed becomes increasing difficult for many of hydrocarbon countries. Furthermore, in countries such as Egypt – which offered higher feed-in-tariffs than many other countries in the region ($0.13/kWh) meaning that investors were willing to take on currency risks, the imposition of capital controls in 2015 meant that investors could not repatriate their profits, constituting a major disincentive to investment. In addition to the currency risk, renewable energy companies are exposed to the risk of insufficient liquidity if there is a mismatch between the time of revenue receipts and cost payments.

Finally, the credit and/or default risk of the power off-taker is an important concern for renewable energy developers. This is especially exacerbated when the market structure is such that there is only one off-taker (e.g., public utility company) and power producers have no choice but to contract with the single buyer and bear the credit risk. In India, one of the fastest-growing markets for solar power, some developers are hesitant to sign Power Purchase Agreements (PPAs) with state-owned distribution utilities due to their low credit ratings.[31] Around 40% of allocated projects have reportedly been delayed/cancelled over the last two years.[32] The evolution away from the current market models to structures that diversify offtakers can eliminate counter-party risk. In some MENA countries (for example the GCC), considerable fiscal buffers at the time of high oil price implied that the government

[31] Developers are subject to a penalty or bid bond if they fail to follow through on projects after winning the auction. Often, firms prefer to pay the penalty rather than entering into PPAs with state distribution utilities.

[32] See 'India's cutthroat solar auctions – behind the hype', PV Tech, 22 December 2015. http://www.pv-tech.org/features/indias-cutthroat-solar-auctions-behind-the-hype

can ultimately indemnify the single buyer (state power company) but this may no longer exist with a prolonged low oil price.

The premium on the cost of capital resulting from aforementioned risks can prevent renewable investors from entering the renewable energy industry altogether. Effective financial de-risk instruments provided by public financial institutions along with appropriate government policies are crucial to channel capital into the renewable industry. Some MENA countries have attempted to set up separate renewable energy funds to underwrite new projects – for instance, the UAE, Morocco and Jordan. Algeria's renewable fund is financed through 1% of oil revenues allocated to it (RCREEE/AFEX, 2015). Such funds are under consideration in Saudi Arabia, Bahrain and Kuwait as well. However, given limited public finance, government guarantees are also an effective way of leveraging private capital. Guarantee instruments can cover many of the renewable energy investment risks and thus make them attractive to investors. Financial guarantees have long been used to back fossil fuel investment, but their use in the renewable energy industry remains limited because of financial institutions' lack of experience in the renewables industry as well as low demand for these instruments (IRENA, 2016b).

4. Power sector reform and renewable deployment

The structure of the power sector directly affects the deployment of renewables as it is the platform upon which incentive mechanisms for renewables should be designed. In countries with non-liberalised power sectors, electricity services are provided through a vertically integrated monopoly (VIM) which owns and operate all elements across the supply chain: generation, transmission, distribution and retail supply. The state-owned monopoly plans for investments (and operation) of all installed facilities.

Although most MENA countries had vertically-integrated electricity sectors until the late 1990s/early 2000s, legislation has led to the beginnings of a transition away from this model, but progress has been slow. The reform laws of Iran (1999), Saudi Arabia (2005) and Algeria (2002) envision wholesale markets; the UAE's (Abu Dhabi) reform law (1998) envisages disaggregated single buyers with bilateral trading and third party access, whereas the reform laws of Kuwait (2008; 2010) and Qatar are limited to Independent Power Producers (IPPs) in generation, and unbundling (for Qatar) (Dyllick-Brenzinger and Finger, 2013).

Therefore, electricity markets in the region have different degrees of liberalisation, some of which are more suited to renewable deployment. In principle, based on the level of liberalisation, electricity market structures can be presented as five distinct models which range from a VIM to a fully competitive wholesale and retail electricity market. Figure 6 presents these models and associated set of feasible renewable policy instruments that can be implemented under each market structure. The first structure after a VIM is the single buyer model. At this stage, the monopoly over generation is formally lifted and IPPs are allowed to enter the market and generate electricity. Therefore, as opposed to VIM where incentives for renewables deployment can only be given to the monopoly, private investors are incentivised under the single buyer model. Private investment enables the usage of tendering in addition to other support schemes under VIM.

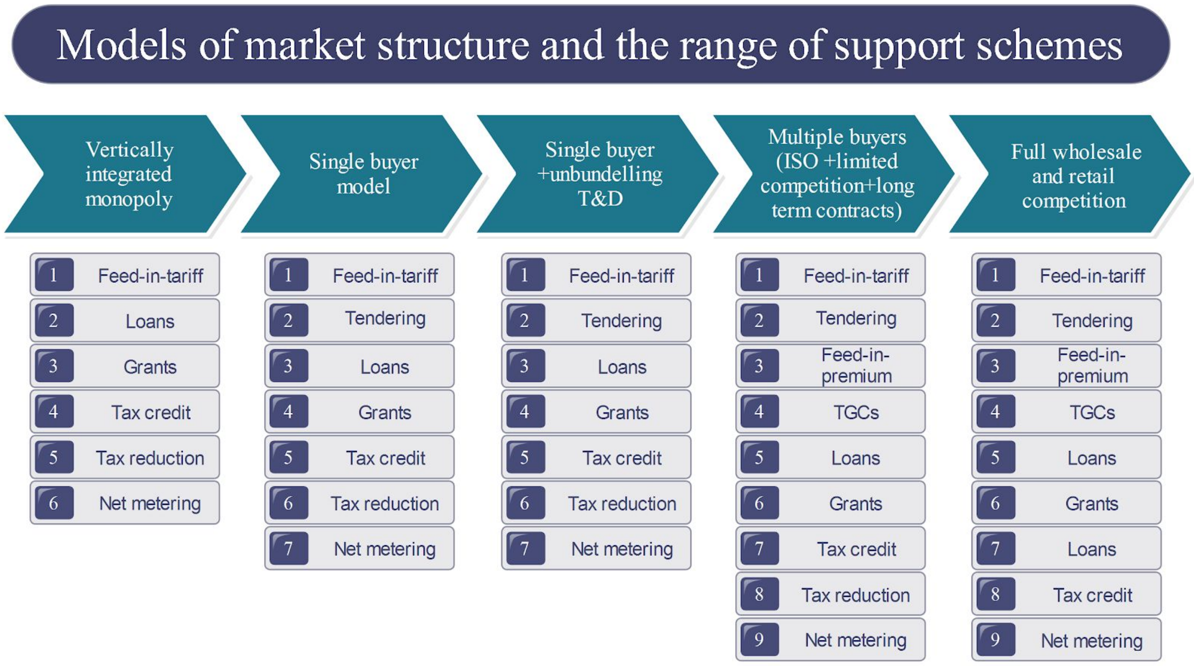

Figure 6: Models of electricity market structure and the range of feasible renewable support schemes at each stage

[Source: Authors]

The challenge of a bundled single buyer is that the coexistence of a huge integrated monopoly (single buyer or public utility) alongside private generators may hamper renewable advancement. Firstly, from an investment perspective, renewable penetration disrupts the business model of the incumbent monopoly, because the promotion of private renewable plants and on-site generation transfers assets away from the utility company to its consumers and private investors. Since utilities generate a return on the equity or assets they own, this is a direct threat to their earnings. Thus, provision of incentives to private investors and end-users for installation of renewables tends to not be supported by vertically integrated single buyers. Secondly, from an operational standpoint, the vertically integrated single buyer may prioritise its own generation assets for dispatching when demand is weak. The inefficiency generated from this behaviour benefits the monopoly at the cost of smaller private generators and consumers.

Therefore, in order to avoid the abuse of monopoly power, countries need to gradually move to the third model, which is an unbundled single buyer. In this step, generation is unbundled from transmission and distribution (T&D). The unbundling can initially be in the form of separating the monopoly’s accounts, but should at some point transition to full unbundling, or separation of ownership. In this way, the single buyer would be the grid company operating the transmission network (and distribution network if it is not separated) and does not own any generation asset. The grid company is subject to regulation for non-discriminatory grid access and cost efficiency improvement to alleviate monopoly power and remove perverse incentives.

Apart from the efficiency issues with a monopsonistic market structure, transactions with a single buyer always include credit and default risk on the part of the off-taker. Multiple buyers in the market not only reduce this risk but can also improve efficiency. The buyers can be regional transmission companies, suppliers of electricity to the end-users and/or large electricity consumers. The grid operator can be an independent system operator (ISO) or the largest owner of the transmission network (if there are several transmission companies), in which case it is called the transmission system operator (TSO). In recent, the issue of security of supply and decarbonisation has led to emergence of hybrid market structure in which the market governed by limited competition and long-term contracts (Roques and Finon, 2017). Such market structure now exist in Latin America and some other countries that have retreated from full liberalisation. .

The fifth model includes fully competitive wholesale and retail electricity markets. The design of wholesale market varies in countries with liberalised power sectors, but typically includes a day-ahead market, a market for bilateral contracts, and a balancing market. Countries can adopt new schemes such as feed-in-premiums and TGCs in addition to instruments used in a non-liberalised electricity market. An advantage of new schemes is that the investor of a renewable facility needs to recover its costs partly through the market, and partly through direct subsidies, spreading costs between the government budget and the consumer. The disadvantage is that it exposes investors to market price volatility.

Figure 7 depicts prevalent MENA power sector structures, which have two characteristics: first, they are all variants of the single buyer model, with the government retaining a dominant role. And second, the models differ on the level at which competition between economic actors is brought to bear (Dyllick-Brenzinger and Finger, 2013). Most countries have opted for auction-based competition in the tendering process for IPPs (or Integrated Water and Power Producers - IWPPs) in generation (the only segment with private actors) based on long-term Power Purchase Agreements. Iran is the only country where competition is introduced through bid-based auctions in the day-ahead and/or spot market for generation, with the purchase price of electricity for the single buyer in the pool determined by the interaction of competing generators.[33]

[33] The Iranian pool is said to resemble original electricity pool of England and Wales.

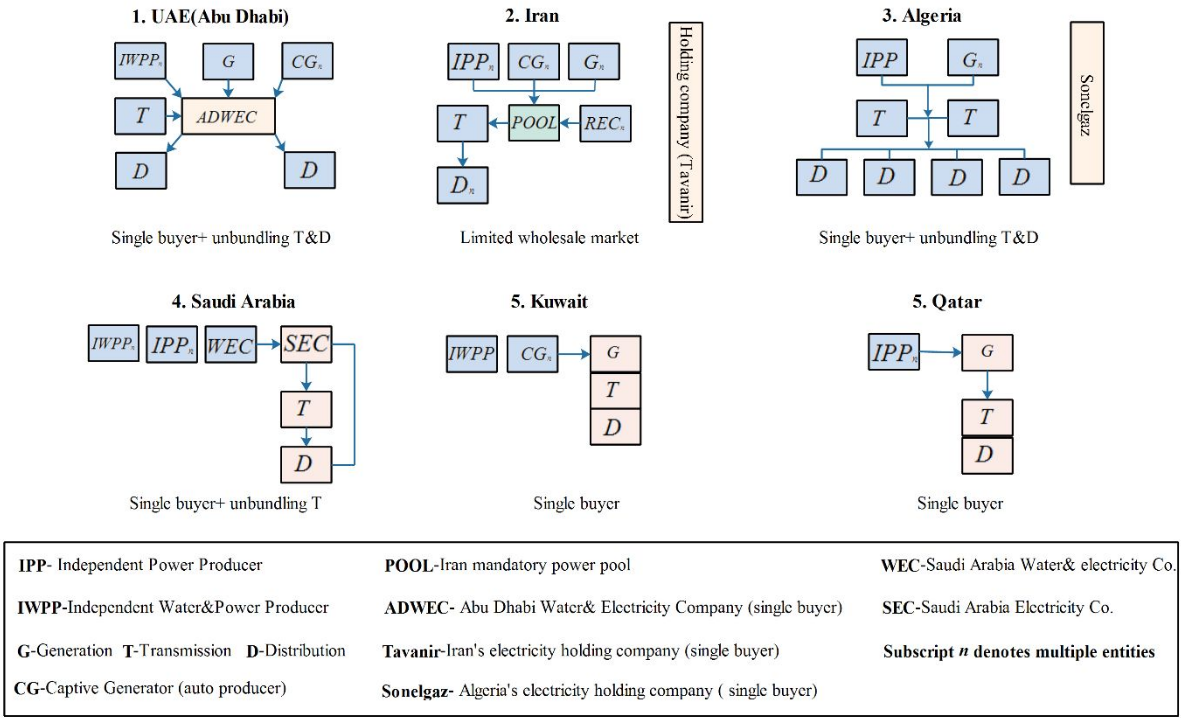

Figure 7: MENA Power Sector Models

[Source: Authors]

The simultaneous operation of renewables and traditional generation within competitive wholesale markets can lead to market breakdown and a distortion of electricity price signals, especially when renewables have out-of-market payments. This is because electricity prices in liberalized wholesale markets are set according to the system marginal cos or short-term marginal cost of the last (and, following the merit order, most expensive) plant that is required to be brought onto the system in order to meet demand (Keay et al, 2013; Sen, 2014). Conversely, renewable generators have very high capital costs but almost zero marginal cost of operation potentially leading to a wholesale electricity price which does not perform its intended function - i.e., provide an incentive for investment and efficient operation. This is a major challenge in developed economies and shows the importance of designing electricity markets fit for renewables.

The tension between liberalisation and decarbonisation has arisen partly because renewables were imposed upon a market designed for conventional fossil fuel electricity. MENA countries, by contrast, have the opportunity to design their electricity markets around the incorporation of renewables at the outset and tap into years of experience gained through trial-and-error in advanced economies. These countries can adopt market structures that avoid issues related to the perverse incentives of integrated monopolies and counter-part risk of single buyer, and also the market breakdown under fully liberalised electricity systems. The hybrid market structure where short-term competition is combined with long-term contracts is proved to be the way forward for developing countries.

5. Conclusions

Despite enormous renewable energy potential in resource-rich MENA countries, their share in electricity generation is among the lowest in the world, lagging behind similar high-income and low-income economies. This paper contends that while the main obstacles to renewables deployment are institutional challenges, grid inadequacy and risk and uncertainties, the solutions for spurring investment lie on a policy instrument spectrum in which a full market-based approach and a full renewable subsidies model (in addition to existing fossil fuel subsides) are two polar cases. The market approach requires the complete removal of fossil fuel subsidies, whereas a renewable subsidies programme requires long-term support and commitment on the part of government. Furthermore, the market approach promotes competition in the energy sector and relies entirely on price signals, whereas a fully subsidised renewable program encourages investment by offering various forms of direct and indirect financial incentives. Implementing the market-oriented approach is politically challenging given the political structure in these countries, while adopting a fully subsidised renewable programme is economically problematic given high fossil fuel subsides and tight fiscal budgets following the oil price decline.

Therefore, there is a trade-off between the two dimensions across the policy instrument spectrum implying that the two polar solutions themselves are not easily and fully implementable. We propose a combinatorial approach in which incentive for investment is provided partially through the market and partially through government subsidies. The combinatorial approach can be part of a dynamic process where governments start from the most feasible point on the proposed policy instrument spectrum and gradually move towards market-based incentive provision over the medium to long-term where energy subsidies are eventually phased out. The dynamic combinatorial approach not only reduces fiscal pressure on government budgets (compared to a fully subsidised model), but also averts political risks by allowing businesses and households to slowly adapt to the new environment, where energy carriers are priced at their full economic costs. This approach is also compatible with the current partial energy price reforms in the region.

Although the provision of investment incentives is necessary for renewable deployment they are insufficient on their own, as barriers to deployment need to be removed. Resource-rich countries need to ensure that the necessary institutional capacity exists to deliver renewables, generators have access to a reliable and flexible grid and ensure appropriate risk mitigation instruments are available to deal with inherent uncertainties. The presence of these barriers can led to underinvestment not just in renewables but also conventional generations that are essential to backup renewables.

The other important consideration is to reconcile market liberalisation with renewable integration. The experience of developed economies show that full market liberalisation does not go well with renewables deployment because of the impact that renewable integration has on the electricity price prices. The paper asserts that while many MENA economies have moved away from vertically integrated structures, most retain variants of the single-buyer model which in some cases is accompanied by the unbundling of generation and network segments. To avoid the perverse incentives seen in integrated monopolies and reduce credit and default risk posed by a single power off taker, an appropriate market structure needs to be adopted. The suitable market structure for the region is likely to be a hybrid one in which sport market and long-term contract co-exist and at the same time power offtakers are diversified.

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