

Robin Mills · Li-Chen Sim  
Editors

Low Carbon Energy  
in the Middle East  
and North Africa

palgrave  
macmillan

# Low Carbon Energy in the Middle East and North Africa: Panacea or Placebo?

*Li-Chen Sim and Robin Mills*

## INTRODUCTION

A seismic transformation of the global energy system is currently underway. It involves a shift away from fossil fuels, which account for 85% of our primary energy consumption, toward a low carbon energy system. Not only is this process underway but it appears to have reached a ‘critical inflection point’<sup>1</sup> where the technical performance and market penetration of solar and wind, in particular, may be rendering the transition almost irreversible. Two key trends are driving this transformation.

The first is the increasing use of low carbon sources of energy to generate power. By the end of 2019, for instance, 172 countries or

---

L.-C. Sim (✉)  
Abu Dhabi, United Arab Emirates  
e-mail: li-chen.sim@ku.ac.ae

R. Mills  
Qamar Energy, Dubai, United Arab Emirates  
e-mail: robin@qamarenergy.com

© The Author(s), under exclusive license to Springer Nature  
Switzerland AG 2021

R. Mills and L.-C. Sim (eds.), *Low Carbon Energy in the Middle East  
and North Africa*, International Political Economy Series,  
[https://doi.org/10.1007/978-3-030-59554-8\\_1](https://doi.org/10.1007/978-3-030-59554-8_1)

four times the number in 2005 had adopted at least one type of renewable energy target, including those in the Middle East and North Africa or MENA (see Table 1.1). Electricity generation from renewables has grown substantially; it supplied 27.3% of global power production in 2019 up from 18% in 2000.<sup>2</sup> Its share is expected to rise to 38% by 2030 according to the International Renewable Energy Agency and to over 50% by 2035 as projected by McKinsey.<sup>3</sup> Anthropogenic climate change, negative externalities of fossil fuel energy, falling prices of equipment for renewable energy production, international funding for renewable projects, and electrification of transport, industry, work processes, buildings, and households underpin the global momentum in favor of low carbon energy.

The second trend is stagnant oil demand growth. This is driven in the short term by the COVID-19 pandemic and associated economic fallout; and in the longer term by increasing energy efficiency, uptake of electric and hybrid passenger vehicles, the rise of a 'sharing' economy, falling prices of renewable energy, the limits of China's export-led growth model, and the possible introduction of a carbon tax regime. Oil will continue to play a major role in the global energy mix but most likely at sustained prices far lower than \$100 in a 'new normal' scenario of lower-for-longer prices.<sup>4</sup> This is because reduced oil demand will be coupled by abundant oil supply from relative newcomers like Brazil and Guyana as well as from stalwarts like Norway and Canada, while established oil producers such as Saudi Arabia, Iraq, and the UAE seek to monetize hydrocarbon resources lest they become 'stranded' assets.

As a major stakeholder in the current energy system, the MENA region will be greatly impacted by the transition to a low carbon world. While energy is the *sine qua non* of any state's economy, 'this is more pronounced in the MENA region than perhaps anywhere else in the world, as energy is central to political power, economic development, and foreign relations.'<sup>5</sup> Challenges abound but so do opportunities. Changes include geopolitical re-alignments<sup>6</sup> but also shifts in state-society relations and the distribution of influence among groups in society. This introduction will outline the main issues addressed by chapters in this volume and in so doing highlight their contributions to the extant literature.

**Table 1.1** Renewable energy power targets in selected MENA countries

Country	Overall Target	Electricity	Solar	Wind	Hydropower	Others
Bahrain	5% by 2025 10% by 2035	710 MW by 2030	200 MW by 2025 400 MW by 2035	50 MW by 2025 300 MW by 2035		5 MW by 2025 (bio) 10 MW by 2035 (bio)
Egypt	20% by 2022 37–42% by 2035		17.3 GW by 2035 (PV) 11 GW by 2035 (CSP)	7.2 GW by 2022 21 GW by 2035	2.8 GW by 2020	
Iran			5 GW by 2020 (solar and wind)			
Iraq	10% by 2020		2.24 GW by 2020			
Jordan	20% by 2020 30% by 2030	1.8 GW by 2020 3.22 GW by 2025	1 GW by 2020 2.5 GW by 2025	1.2 GW by 2020		
Kuwait	15% by 2030		3.5 GW by 2030 (PV) 1.1 GW by 2030 (CSP)	3.1 GW by 2030		50 MW by 2025 (bio)
Lebanon	12% by 2020 30% by 2030 100% by 2050			400–500 MW by 2020		
Morocco	42% by 2020 52% by 2030	6 GW by 2020 11 GW by 2030	2 GW by 2020 4.56 GW by 2030	2 GW by 2020 4.2 GW by 2030	2 GW by 2020	

(continued)

Table 1.1 (continued)

Country	Overall Target	Electricity	Solar	Wind	Hydropower	Others
Palestine	10% by 2020 100% by 2050		45 MW by 2020 (PV) 20 MW by 2020 (CSP)	44 MW by 2020		21 MW by 2020 (bio)
Qatar	2% by 2020 20% by 2030	500 MW by 2030	400 MW by 2030	50 MW by 2030		50 MW by 2030 (bio)
Saudi Arabia	30% by 2030	27.3 GW by 2023 58.7 GW by 2040	20 GW by 2023 (PV), 40 GW by 2030 (PV) 300 MW by 2023 (CSP), 2.7 GW by 2030 (CSP)	7 GW by 2023 16 GW by 2030		13 GW by 2040 (geothermal, bio, wind)
Turkey	65% by 2023		5 GW by 2023 (PV)	20 GW by 2023	34 GW by 2023	1 GW by 2023 (biomass) 1 GW by 2023 (geothermal)
UAE	44% by 2050					

Source: Renewables 2020 Global Status Reports, REN21

## MENA AND THE GLOBAL ENERGY SYSTEM

The MENA region contains the world's largest reserves of oil and gas (see Table 1.2). More significantly, its oil resources are predominantly in large, conventional, high-quality reservoirs with well-developed infrastructure and close to export routes, resulting in much lower production costs than the big but costly resources of US shale/tight hydrocarbons, Canadian oil sands, or Venezuelan extra-heavy oil. As a result, MENA is also dominant in exports of oil and liquefied natural gas.

The MENA region has also become a significant energy consumer in its own right (see Table 1.2), although comprising only 5.9% of world population and 4.2% of global gross domestic product (GDP) in 2018.<sup>7</sup> Its share of global oil consumption increased from 9.1 to 12.2% between 2000 and 2019 while its share of global gas consumption rose from 10.1 to 18% over the same period.<sup>8</sup> This has been driven by a number of factors including the paucity of other traditional energy sources like hydropower and coal; the hot, arid climate with a high requirement for air-conditioning and desalination; the oil-driven economic boom of 2003–2014; policies of energy-intensive industrialization (oil refining, petrochemicals, aluminum, steel, cement, ceramics); and low, subsidized prices for energy which have encouraged inefficient and wasteful consumption.

This hydrocarbon bounty is distributed unevenly across the region. Some states, such as the six that comprise the Gulf Cooperation Council

Table 1.2 Energy in MENA by the numbers

Indicator	Global share (%), 2019
Oil reserves	51.9
Gas reserves	42.0
Oil production	35.1
Gas production	21.4
Oil exports	45.4
LNG exports	30.8
Pipeline gas exports	8.8
Oil consumption	12.2
Gas consumption	18.0
Carbon dioxide emissions	8.6
Electricity generation	6.9

Source: BP Review of World Energy 2020

(GCC), and Libya, have small populations and large resources<sup>9</sup>; others like Iraq, Iran, Algeria, Yemen, Syria, and Egypt have significant resources but also relatively large populations. And then there are Lebanon, Jordan, the State of Palestine, Morocco, Turkey, and Tunisia, that have very little or no hydrocarbon production. Yet, even the oil and gas importers of the region are linked to their hydrocarbon-exporting neighbors by flows of labor, trade, remittances, foreign aid, and investment.<sup>10</sup> For example, just over 50 and 80% of banking assets in Lebanon and Jordan, respectively, are held by GCC-based banks and around half of all greenfield foreign direct investment in Egypt and Jordan originate from the GCC.<sup>11</sup> Hochberg and Moore highlight, within this volume, that companies and sovereign wealth funds based in the Gulf states participate actively in renewable energy projects in Egypt and Morocco. In Jordan, Dubai-based Yellow Door has designed, developed, and operated photovoltaic solar plants that supply electricity to supermarkets, malls, hospitals, and apparel manufacturers.

### LOW CARBON ENERGY IN MENA

Countries in MENA remain almost entirely dependent on hydrocarbons for electricity, with low carbon sources accounting for only 11.1% of electricity generation, the lowest share among all regions in the world (Fig. 1.1). Demand-side explanations include the pre-existing fossil fuel-based infrastructure and stakeholder networks and corporate, cultural, political, and urban idiosyncrasies that favor hydrocarbon consumption. The supply-side of the equation includes relative resource endowments; concerns about the grid such as higher than average distribution losses and scale of power theft and non-payment issues; business and regulatory environment; and limited returns from investments due to subsidized electricity rates.<sup>12</sup>

Reflecting on this, Al-Sulayman in his chapter here posits a link between large hydrocarbon rents and the relatively belated uptake of renewable energy in the GCC states, compared to other countries in MENA. Furthermore, the type of fossil fuel on which rents are based is relevant: Qatar has not prioritized the development of renewables or of climate mitigation policies partly because of its abundant low-cost gas, which is the least polluting of all fossil fuels.<sup>13</sup> The variation in commissioning and installing low carbon energy facilities across MENA

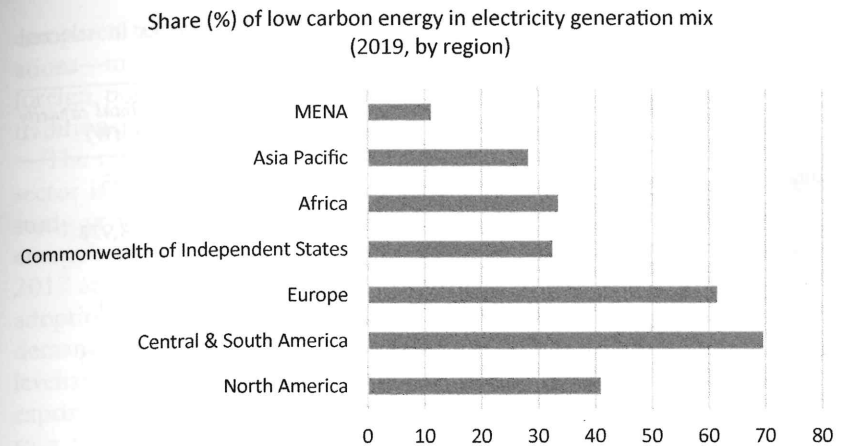


Fig. 1.1 Share of low carbon energy (including hydro) in Electricity Generation Mix (Source BP Review of World Energy, 2020)

is also a function of institutional capacity and coherence. In their chapters on Saudi Arabia and Lebanon, Al-Sulayman and Obeid highlight, respectively, the impact of bureaucratic infighting and political rivalry among domestic stakeholders that have impeded the progress of renewable energy; similarly, Mills notes the impact of political dysfunction and corruption in preventing progress in Iraq; in contrast, Sim notes that the UAE, which was successful in uniting stakeholders through crafting and managing coalitions, fared better in implementing nuclear power than Egypt, Jordan, and Turkey. Mahdavi and Uddin, in Chapter 9, offer another explanation of what determines the different pace of low carbon energy adoption, namely, the longer political time horizons of leaders coupled with the cost of energy imports.

The use of hydroelectricity is limited to Iran, Iraq, Turkey, Egypt, and Morocco; that of nuclear in Iran and by the end of 2020 in the United Arab Emirates; while solar and wind energy is making headway across most of MENA (Table 1.3). The choice of low carbon power generation technology, however, is not merely a technocratic decision informed by objective analyses of technology costs and country-specific factors such as grid size, solar irradiance, wind speed, or rainfall.<sup>14</sup> Moore's chapter is a reminder that energy choice is also shaped by historical narratives, in

**Table 1.3** Actual installed capacity of low carbon power sources in selected MENA countries

	Solar PV	Solar CSP	Wind	Hydro	Others	Total capacity (MW)
Bahrain	6.35 (90.3%)		0.68 (9.7%)			7.03
Iran	367 (2.6%)		302 (2.2%)	13,292 (95.1%)	12 (^) 915 (6.5%)	13,973
Iraq	37 (1.5%)			2514 (98.5%)		2311
Kuwait	43.3 (40.9%)	50.0 (47.3)	12.4 (11.7%)			105.74
Oman	8.3 (100.0%)					8.3
Qatar	5.1 (11.8%)				38 (88.2%)	43.1
Saudi Arabia	344.4 (86.7)	50 (12.6%)	2.8 (0.7%)			397.2
UAE	1783 (94.6%)	100 (5.3%)	0.85 (^)		1.0 (^)	1884.9
Egypt	1647 (27.6%)	21 (0.4%)	1375 (23%)	2851 (47.7%)	79 (1.1%)	5,973
Jordan	998.1 (71.3%)		373.5 (26.7%)	16.2 (1.2%)	13 (0.9%)	1400.9
Lebanon	56.4 (17.5%)		3 (0.9%)	253 (78.7%)	9 (2.8%)	321.4
Palestine	43 (99.1%)				0.38 (0.9%)	43.4
Morocco	206 (5.5%)	530 (14.2%)	1220 (32.7%)	1770 (47.5)	2	3728
Turkey	5995 (13.6%)		7591 (17.2%)	28,503 (64.6%)	2049 (4.6%)	44,138

By volume (in megawatts or MW) and as a share (in %) of total low carbon power, end 2019

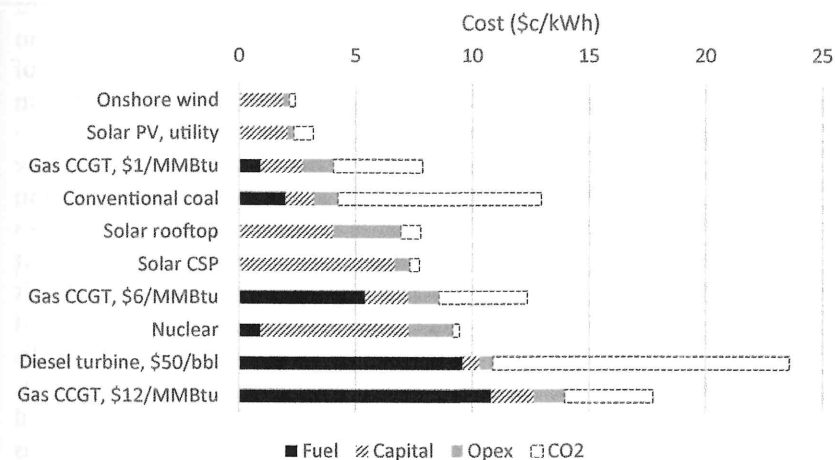
Note ^ denotes a share below 0.1%

Source IRENA Renewable Capacity Statistics 2020 dataset

this case by Morocco's self-identification as a low carbon consumer originally of hydropower and more recently of solar power. Mills discusses the influence of political lobbies in driving the development of nuclear and hydroelectric power in Iran rather than wind and solar. Additionally, Hochberg's analysis of the poor economic case for nuclear power in Egypt

compared to gas-fired plants underlines the role of geopolitical considerations—in this case building a relationship with Russia; this represents foreign policy hedging in the face of an unclear commitment from its traditional aid benefactor, the US.

The relatively minimal role of low carbon sources in MENA's power sector is likely to change substantially in the coming decades. A recent study projected that in the Middle East excluding Turkey, low carbon energy's share in the power mix could rise from 3.6 to 29.4% between 2017 and 2035.<sup>15</sup> It is clear that economic considerations incentivize the adoption of renewable energy in MENA on the back of strong electricity demand (Fig. 1.2). These include sharp declines of 82% in the global levelized cost of electricity of utility-scale solar photovoltaics since 2010, exposure to high fossil fuel import bills (for instance, for Jordan and to a lesser degree the UAE), and the costs of foregone crude oil and petrochemical exports due to wasteful domestic consumption (e.g., in Saudi Arabia).<sup>16</sup> The 'financeability' of renewable energy projects varies across MENA<sup>17</sup> but is generally not a major problem, as many of the contributors note, with the exception of sanctions-hobbled Iran. Yet, as Krane, Bayulgen, Moore, and Obeid highlight in their chapters in



**Fig. 1.2** Power generation costs (LCOE) under typical Middle Eastern conditions (Source Mills, Under a Cloud, 2020)

this book, non-financial considerations such as prestige, regime legitimacy, and sovereignty are equally significant drivers of low carbon energy adoption.

### THE GEOPOLITICS OF LOW CARBON ENERGY IN MENA

Oil has shaped international conflict for decades. According to one estimate, 25–50% of interstate wars between 1973 and 2012 had oil-related linkages.<sup>18</sup> In contrast, it is generally thought that a low carbon energy world is likely to reap a peace dividend in geopolitics.<sup>19</sup> This is partly because national energy security will be less contested; the limited number of countries endowed with hydrocarbon resources is trumped by indigenous production of readily-available low carbon energy. Trade in electricity is also assumed to be more interdependent and reciprocal than trade in oil, which in turn decreases the likelihood of interstate war.

Within MENA, Morocco and Jordan are consistently touted as winners in a low carbon world, given their credible potential to produce, consume, and export renewable electricity<sup>20</sup>; this could render them regional leaders. Despite their declared 100% renewable power target, Lebanon and the State of Palestine are highly unlikely to be in the same league as their regional peers largely due to political dysfunction and other reasons outlined by Obeid in her contribution. As for the oil-exporting states in the Gulf, they are typically identified as losers given the massive loss of revenues due to ‘stranded’ hydrocarbon assets and the slow progress in developing a non-oil export-oriented sector.<sup>21</sup>

Nevertheless, a strong case can be made that in the run-up to a low carbon world, some ‘losers’ will be able to adapt. Mahdavi and Uddin highlight in their chapter that the UAE is ranked among the countries best prepared for the energy transition in MENA given its credible project execution toward a 44% share of installed low carbon power by 2050. It was also the destination of nearly one-quarter of planned and committed investments in renewable power projects in MENA in 2019.<sup>22</sup> UAE-based private firms are also active investors in renewable energy in MENA, as noted earlier. In addition, the UAE has complemented its traditional petro-diplomacy with clean energy diplomacy by investing in overseas projects through Masdar, an Abu Dhabi-based parastatal, and through collaboration between the International Renewable Energy Agency and the Abu Dhabi Fund for Development.<sup>23</sup> Interestingly, however, the

UAE has not sought an active profile at UN climate change negotiations—an issue taken up by Luomi in her contribution in this volume. Her analysis of the disconnect between climate change and energy policies in Saudi Arabia also casts doubt on a proposal that the G20, of which the kingdom is a member, should take the lead in the energy transition.<sup>24</sup>

In the medium term during the period of transition to a low carbon world, it is not inconceivable that economic stress and struggles over remaining hydrocarbon resources, rents, and power may lead to more violent confrontations instead of a peace dividend.<sup>25</sup> Two scenarios are especially relevant. The first is the recovery of Iraq’s oil industry and its success in wresting market share from Saudi customers in Asia; this will have implications for hegemony in the Persian Gulf and for influence within the Organization of the Petroleum Exporting Countries+.<sup>26</sup> The second concerns the relative ascendancy of major gas producers Qatar and Iran (assuming the easing of sanctions) as the global demand for gas increases in the run-up to a low carbon world. This is because gas-fired power plants are easily paired with solar and wind energy for system balancing purposes. Likewise, geopolitics may trip up Morocco and Jordan; these include a renewed intensity in the simmering conflicts with Algeria and with Israel, respectively.

Low carbon power also raises the issue of the geopolitics of electricity trading. MENA countries that have successfully developed large amounts of low carbon power may seek to export surpluses at certain times. They may also rely on dispatchable capacity in other countries to reduce their need for balancing variable renewables. And time differences across the region can be exploited. Iraq’s Ministry of Electricity, which already buys power from Iran, recently signed an electricity purchase agreement of up to 2 gigawatts with the GCC Interconnection Authority. Iraq shall receive power supplied by GCC countries (which have a pre-existing interconnection grid) from transmission lines from Kuwait. Egypt has also shown interest in a linking its national grid with Saudi Arabia’s to meet peak demand with imports.

However, political rivalry has stymied robust intra-GCC exchanges. Consequently, only small volumes of trading take place among Gulf states on an emergency basis or during scheduled outages. Large-scale electricity exports from MENA to Europe are also unlikely in the medium term, although Morocco currently exports small volumes to Spain. From the Middle East, transmission lines would have to cross unstable areas in Syria, Iraq, or Lebanon. From North Africa, the distance is shorter and easier

but the investment climate is mostly unfriendly, and all the North African countries have been prioritizing meeting their own demand. Europe would also, for reasons of local employment and security of supply, not wish to depend too heavily on its Mediterranean neighbors.

Low carbon energy projects have also broadened MENA's outreach beyond the region through interactions with new, non-oil, foreign stakeholders. Power developers and financiers from Asia (for example, Marubeni from Japan, KEPCO from South Korea, Jinko Solar and Silk Road Fund from China) and Europe (EDF from France, Abengoa from Spain, Rosatom from Russia, the European Bank for Reconstruction and Development) jostle with those from the region (the jointly-owned APICORP, Acwa Power from Saudi Arabia, Masdar from Abu Dhabi, Gulf Investment Corporation from Kuwait, and local banks). The Middle East therefore continues to be a 'penetrated system' subject to exceptional external influence, although the degree of local agency has grown significantly from when the observation was made in the 1980s.<sup>27</sup>

#### LOW CARBON ENERGY AND STATE-SOCIETY RELATIONS IN MENA

The dominance of the state in MENA is ubiquitous, be it in the hydrocarbon sector, the 'private' sector, domestic consumption, banking, media, or politics. The region's electricity market is no different. Historically, a designated state-owned or controlled monopoly generated, purchased, and transmitted electricity. For instance, in Kuwait the monopoly is the Ministry of Electricity and Water, in Iran it is Tavanir, a holding company. Since the early 2000s, independent power producers have been introduced in most regional countries, breaking the model of the vertically integrated, state-owned monopoly utility. However, privatization of distribution has remained very limited and true electricity markets do not exist; the 'single buyer' model persists and a state monopoly remains in charge of transmission. In a possible case of path dependency, MENA countries have preferred to introduce large-scale, centralized renewable power projects in contrast to the decentralized and distributed model pioneered in Europe. These have typically been awarded by tender by the state-owned utility, ministry, or energy regulator, with a decades-long offtake guarantee. Nuclear power projects replicate this centralized model.

For Al-Sulayman in Chapter 4, rentier states in the Gulf have expanded their traditional dominance to include the renewable energy sector, partly because of the latter's promise of job creation (the latter being a hot button issue in MENA).<sup>28</sup> The significant share by Acwa Power in the region's renewable energy projects seems an apt metaphor; it is a privately-owned Saudi company that now counts the kingdom's Public Investment Fund as a major shareholder. Bayulgen concurs that the Turkish state has been increasingly centralized and strengthened by the simultaneous pursuit of low carbon and fossil fuel energies. A less pessimistic view is expressed by Mahdavi and Uddin in Chapter 9. For them, the decline of hydrocarbon rents will necessitate the shift to taxation—VAT, tourism taxes, and municipality fees have already been introduced—and with it, a renegotiation by the state in favor of greater institutionalized societal influence over public expenditure. The impact of low carbon energy on the evolution of the state in the UAE is also a theme explored in the chapter by Krane; the deployment of coal, the most polluting fossil fuel, in Dubai's energy mix appears to run counter to the low carbon narrative in the neighboring emirate of Abu Dhabi which includes a 'gold standard' non-proliferation civilian nuclear program, yet both emirates are also regional leaders in large, centralized solar projects.

Social pressure and environmental concerns among domestic constituents play an insignificant role in shaping the MENA region's low carbon energy agenda. There were episodic protests against coal in Turkey a decade ago but, as Bayulgen explains, coal—because it provides cheap baseload power and employment—continues to be central in supporting economic modernization in Turkey. Moore and Sim note that there have also been protests around solar siting and gas stations in Morocco and plans for nuclear energy in Jordan, respectively; these grievances were, however, more to do with concerns about lack of consultation with local communities or compensation or government corruption than with objections to low carbon energy per se. Hydropower and its relation to water has been a complex local and regional problem in Iran, Iraq, and Egypt. Domestic conflicts over siting of solar and wind projects are likely to proliferate in tandem with their share in renewable energy targets<sup>29</sup>; their relatively low power density compared to fossil fuel plants means they will be more numerous and visible as sites of contestation particularly in North Africa, with a larger unsettled population than the Gulf.



The lack of sustained social activism in favor of low carbon energy and the limited integration of climate policies into economic development plans discussed in Luomi's chapter have implications for the energy transition in MENA. They suggest a continuation of the top-down pattern in state-society interactions and the perpetuation of the primacy of hydrocarbon-based interests and networks domestically and in foreign policy. The transition toward a low carbon future is likely to be gradual and incremental so as not to imperil existing energy stakeholders, with low carbon power included as an 'add-on' instead of the centerpiece of a new energy policy.

### SCOPE OF THE BOOK

Before proceeding to the rest of the chapters, a few comments about scope of the book are necessary. First, throughout the book, the term 'low carbon' will refer to the deployment of non-hydrocarbon energy sources such as solar, wind, hydropower, and nuclear energy as part of the overall fuel mix. They emit no (during the operational phase) or low levels of carbon dioxide and other greenhouse gases (on a whole life-cycle basis) compared to fossil fuels. Energy efficiency measures, carbon capture and storage, a circular economy, electric vehicles and the use of hydrogen among others also inform the path toward a low carbon global energy system, but they are beyond the scope of this book. While the issue of low carbon energy waste—end-of-life wind turbine blades or solar panels or radioactive waste—is an important one, its salience is still some way off. This is because the average life span of solar panels and wind turbines average 20–25 years while that of nuclear plants built today is over 60 years.

Second, the objects of this volume are the countries within MENA. They share common characteristics such as the dominance of the state in economic and social patterns of interaction; and the outsize role of energy in underwriting political, economic, and social stability, as well as foreign relations. They also differ in many ways such as in terms of population size, resource endowment, governance, and integration into global economy. Consequently, seven country- or area-specific chapters at the beginning of the book are complemented by three chapters that deal with themes relevant across the region. The contributors are all experts in their respective fields and are a mix of energy practitioners and academics; each chapter was also rigorously peer-reviewed by distinguished specialists.

Third, the focus of this volume is the evolving impact of domestic and external stakeholders—such as the oil and gas industry, financiers, foreign governments, state-owned utilities, Ministries, power developers, and grassroots organizations—on the uptake of low carbon energy. The degree to which low carbon energy targets, policies, and actors have been institutionalized, mainstreamed, and embedded into development plans is also a central tenet of enquiry since this 'locks in' changes in energy policy and the role of the state. After all, and to paraphrase Milton Friedman, energy is always and everywhere a political phenomenon.

### NOTES

1. Rahmatallah Poudineh, Anupama Sen, and Bassam Fattouh, "Advancing Renewable Energy in Resource-Rich Economies of the MENA," *Renewable Energy* 123 (2018), <http://dx.doi.org/10.1016/j.renene.2018.02.015>.
2. REN21, *Renewables 2020: Global Status Report* (Paris: REN21 Secretariat, 2020), Table 10, p. 48, [https://www.ren21.net/wp-content/uploads/2019/05/gsr\\_2020\\_full\\_report\\_en.pdf](https://www.ren21.net/wp-content/uploads/2019/05/gsr_2020_full_report_en.pdf).
3. IRENA, *Transforming the Energy System—And Holding the Line on the Rise of Global Temperatures* (Abu Dhabi: International Renewable Energy Agency, 2019); McKinsey, *Global Energy Perspective 2019: Reference Case* (McKinsey, 2019), [https://www.mckinsey.com/~/media/McKinsey/Industries/Oil%20and%20Gas/Our%20Insights/Global%20Energy%20Perspective%202019/McKinsey-Energy-Insights-Global-Energy-Perspective-2019\\_Reference-Case-Summary.ashx](https://www.mckinsey.com/~/media/McKinsey/Industries/Oil%20and%20Gas/Our%20Insights/Global%20Energy%20Perspective%202019/McKinsey-Energy-Insights-Global-Energy-Perspective-2019_Reference-Case-Summary.ashx).
4. Spencer Dale and Bassam Fattouh, *Peak Oil Demand and Long-Run Oil Prices* (Oxford: Oxford Institute of Energy Studies, 2019), <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/01/Peak-Oil-Demand-and-Long-Run-Oil-Prices-Insight-25.pdf>.
5. David Ramin Jalilvand and Kirsten Westphal, eds., *The Political and Economic Challenges of Energy in the Middle East and North Africa* (Abingdon, Oxon: Routledge, 2018).
6. Manfred Hafner and Simone Tagliapietra, eds., *The Geopolitics of the Global Energy Transition* (Cham, Switzerland: Springer, 2020).
7. WB, *World Bank Open Data* (Washington, DC: n.d.).
8. BP, *BP Statistical Review of World Energy 2020* (2020), <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf>.
9. The Gulf Cooperation Council was formed in 1981 and comprise six members, namely, Saudi Arabia, Kuwait, Bahrain, Oman, United Arab Emirates, and Qatar.

10. Kamiar Mohaddes and Mehdi Raissi, "The US Oil Supply Revolution and the Global Economy," *Empirical Economics* 57 (2018), <http://dx.doi.org/10.1007/s00181-018-1505-9>; Adam Hanieh, *Capitalism and Class in the Gulf Arab States* (London: Palgrave Macmillan, 2011).
11. Adam Hanieh, *Money, Markets, and Monarchies: The Gulf Cooperation Council and the Political Economy of the Contemporary Middle East* (Cambridge: Cambridge University Press, 2018); MENA-OECD, *Fdi in Fragile and Conflict Affected Economies in the Middle East and North Africa: Trends and Policies* (Paris: OECD, 2018), <http://www.oecd.org/mena/competitiveness/ERTF-Jeddah-2018-Background-note-FDI.pdf>.
12. See, for example, Benjamin K. Sovacool and Steve Griffiths, "The Cultural Barriers to a Low-Carbon Future: A Review of Six Mobility and Energy Transitions across 28 Countries," *Renewable and Sustainable Energy Reviews* 119 (2020), <http://dx.doi.org/10.1016/j.rser.2019.109569>; OIES, *MENA Energy Pricing Reforms* (Oxford: Oxford Institute for Energy Studies, 2017), <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/04/OEF-108.pdf>; Poudineh, Sen, and Fattouh.
13. Mari Luomi, *The Gulf Monarchies and Climate Change: Abu Dhabi and Qatar in an Era of Natural Unsustainability* (London: Hurst, 2012).
14. Hisham M. Akhonbay, ed., *The Economics of Renewable Energy in the Gulf* (Abingdon: Routledge, 2019).
15. Robin Mills, *Under a Cloud: The Future of Middle East Gas Demand* (New York: Center on Global Energy Policy, Columbia University, 2020), [https://energypolicy.columbia.edu/sites/default/files/file-uploads/MiddleEastGas\\_CGEP-Report\\_042920.pdf](https://energypolicy.columbia.edu/sites/default/files/file-uploads/MiddleEastGas_CGEP-Report_042920.pdf).
16. IRENA, *Renewable Power Generation Costs 2019* (Abu Dhabi: International Renewable Energy Agency, 2020), [https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA\\_Power\\_Generation\\_Costs\\_2019.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Power_Generation_Costs_2019.pdf); Andrea Gamba, *New Energy Sources for Jordan: Macroeconomic Impact and Policy Considerations* (Paris: International Monetary Fund, 2015), <https://www.imf.org/external/pubs/ft/wp/2015/wp15115.pdf>; IRENA, *Renewable Energy Market Analysis: GCC 2019* (Abu Dhabi: International Renewable Energy Agency, 2019).
17. Joel Krupa and Rahmatallah Poudineh, *Financing Renewable Electricity in the Resource-Rich Countries of the Middle East and North Africa: A Review* (Oxford: Oxford Institute of Energy Studies, 2017), <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/02/Financing-renewable-electricity-in-the-resource-rich-countries-of-the-Middle-East-and-North-Africa-A-review-EL-22.pdf>.
18. Jeff Colgan, *Petro-Aggression* (Cambridge: Cambridge University Press, 2013).
19. See, for instance, Andreas Goldthau, Martin Keim, and Kirsten Westphal, "The Geopolitics of Energy Transformation," *SWP Comment*, 2018; n.d.,

- A New World: The Geopolitics of the Energy Transformation* (Abu Dhabi: Global Commission on the Geopolitics of the Energy Transformation, 2019), [http://geopoliticsofrenewables.org/assets/geopolitics/Reports/wp-content/uploads/2019/01/Global\\_commission\\_renewable\\_energy\\_2019.pdf](http://geopoliticsofrenewables.org/assets/geopolitics/Reports/wp-content/uploads/2019/01/Global_commission_renewable_energy_2019.pdf).
20. Indra Overland et al., "The Gegaloo Index: Geopolitical Gains and Losses After Energy Transition," *Energy Strategy Reviews* 26 (2019), <https://doi.org/10.1016/j.esr.2019.100406>; Stratfor, *How Renewable Energy Will Change Geopolitics* (Stratfor, 2018), <https://worldview.stratfor.com/article/how-renewable-energy-will-change-geopolitics>.
  21. A New World, n.d., p. 29; Manal Shehabi, "Slowing the Pump? Why GCC Economies Have a Diversified Base but Remain Overly Hydrocarbon-Dependent," in *Economic Diversification in MENA*, ed. Anupama Sen et al. (Oxford: Oxford Institute of Energy Studies, 2018).
  22. Personal e-mail communication between APICORP and co-author Sim, Li-Chen, 12 April 2020.
  23. Courtney Weatherby and Brian Eyler, *UAE Energy Diplomacy: Exporting Renewable Energy to the South* (Washington, DC: Stimson Center, 2018), <https://www.stimson.org/content/uae-energy-diplomacy>.
  24. Andreas Goldthau, "The G20 Must Govern the Shift to Low-Carbon Energy," *Nature* 546 (2017), <https://www.nature.com/news/the-g20-must-govern-the-shift-to-low-carbon-energy-1.22099>.
  25. Kirsten Westphal and Susanne Dröge, "Global Energy Markets in Transition: Implications for Geopolitics, Economy and Environment," in *Global Trends 2015: Prospects for World Society*, ed. Tobias Debiel, Michèle Roth, and Cornelia Ulbert (Bonn: Stiftung Entwicklung und Frieden, 2015).
  26. Li-Chen Sim, "Global Energy Markets and the Persian Gulf," in *Routledge Handbook of Persian Gulf Politics*, ed. Mehran Kamrava (Abingdon: Routledge, 2020).
  27. Carl Brown, *International Politics and the Middle East: Old Rules, Dangerous Game* (London: I.B. Tauris, 1984).
  28. I-Tsung Tsai, "Political Economy of Energy Policy Reforms in the Gulf Cooperation Council: Implications of Paradigm Change in the Rentier Social Contract," *Energy Research & Social Science* 41 (2018).
  29. Lasse Eisgruber, "The Resource Curse: Analysis of the Applicability to the Large-Scale Export of Electricity from Renewable Resources," *Energy Policy* 57 (2013); Samantha Gross, *Renewables, Land Use, and Local Opposition in the United States* (Washington, DC: Brookings, 2020), <https://www.brookings.edu/research/renewables-land-use-and-local-opposition-in-the-united-states/>.