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WORKING PAPERS

MATERIAL FACTORS FOR THE MENA REGION: ENERGY TRENDS

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ABSTRACT

This report analyses the key energy factors and trends shaping the Middle East and North Africa (MENA) region's energy landscape. The unsustainable increase in energy demand, driven by population and economic growth, is exerting considerable pressure on governments in the region to institute significant policy changes and demand-side measures as well as energy mix diversification (with a current energy mix that is heavily dependent on fossil fuels – mainly oil and natural gas). Should the increase in energy consumption rates persist in the future, many countries will see their export capacities (and eventually revenues) reduced as more energy is destined for domestic consumption. The US shale revolution is also having an impact on oil and gas prices. Low oil and gas prices as well as growing role of LNG in world gas markets have an impact on the MENA region's export markets, including effects on the chemical and petrochemical industry. In order for the countries in the region to fulfil their economic growth aspirations and move quickly to a more sustainable energy system, efforts should be intensified to diversify their energy mixes, especially through developing and deploying renewable energy on a wider scale.

INTRODUCTION

Despite the divergent energy contexts found among the countries of the Middle East and North Africa (MENA) – in terms of energy mix, dependence on foreign resources, demand profiles and penetration of renewables – several trends continue to shape the energy landscape across the region, with potentially far-reaching economic implications. Such trends include increasing energy demands, shale gas abundance, the increasing role of gas in the energy mix and the growing liquefied natural gas (LNG) trade, as well as the energy transition that is taking place, albeit slowly, driven by renewable energy.

Currently unsustainable increases in energy demand (more than 5 percent per annum growth in most MENA countries), for electricity in particular, are likely to put more pressure on fossil fuels. This will continue to limit export capacities and eventually result in lost revenues. Fossil fuels (oil and gas) dominate the energy mix,[2] especially in exporting countries, with their share ranging from 80 percent to almost 100 percent in some countries. Whilst their importance in the energy mix is still expected to persist in the future, the share of fossil fuels, oil in particular, might

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2 The term "energy mix" describes the specific combination of various energy sources that are consumed in a country/region.

shrink proportionally due to energy mix diversification through alternative sources. Countries in the region will have to adapt their energy policy choices in order to keep up with their economic development aspirations, should the current energy situation and the pace of demand growth persist into the future. The key equation to be solved involves successfully decoupling energy demand and economic growth.

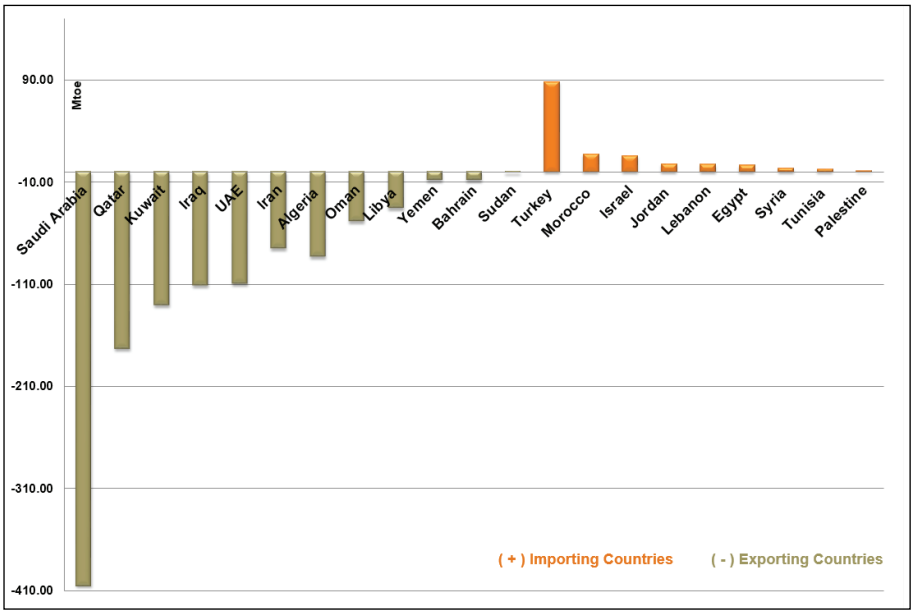
MENA countries face serious energy policy challenges, especially in the light of low oil prices, below 50 dollars a barrel, resulting in an urgent need to diversify their energy sources. The abundance of shale gas and the growing LNG trade are also having an impact on oil and gas prices and shifting the geopolitics of gas markets.

The energy transition (the shift from an energy system which relies primarily on non-renewable energy sources to a more efficient, lower-carbon energy mix) will play a considerable role in the region's economies. Despite the slow uptake of renewables, especially in energy exporting countries, the outlook remains promising, particularly in view of plans and programmes put in place by various countries in the region. Once deployed on a larger scale, renewables will lead to important energy savings and generate other socio-economic benefits. The transition can be expected to have a positive impact both on oil and gas exporting countries, by helping to maintain export capacities and eventually guaranteeing government revenue streams, and on energy importing countries, by reducing dependence on foreign energy sources by exploiting locally available, renewable energy sources. This, in turn, could contribute to economic development and thus stability in the region.

1. ENERGY OVERVIEW IN THE MENA REGION: UNSUSTAINABLE GROWTH IN ENERGY DEMAND

The MENA region, which includes some of the world's largest fossil fuel-producing countries, has been an important player in the supply of energy (mainly oil and natural gas) worldwide. The region as a whole exported 1,074 million tonnes of oil equivalent (Mtoe) in 2014, roughly equivalent to half of its total production. Overall, the countries in this region can be classified into two main categories: net energy importers and net energy exporters (see Figure 1). With the exception of Algeria and Libya, all southern and eastern Mediterranean countries are currently net energy importers. In particular, the dependence rate on foreign resources in Jordan, Lebanon and Morocco is more than 90 percent. Conversely, all of the Gulf Cooperation Council (GCC) countries, plus Iran and Iraq, are energy exporting countries, in addition to the aforementioned Algeria and Libya.

Figure 1 | Net energy importing vs. exporting countries, MENA region, 2014 (Mtoe)

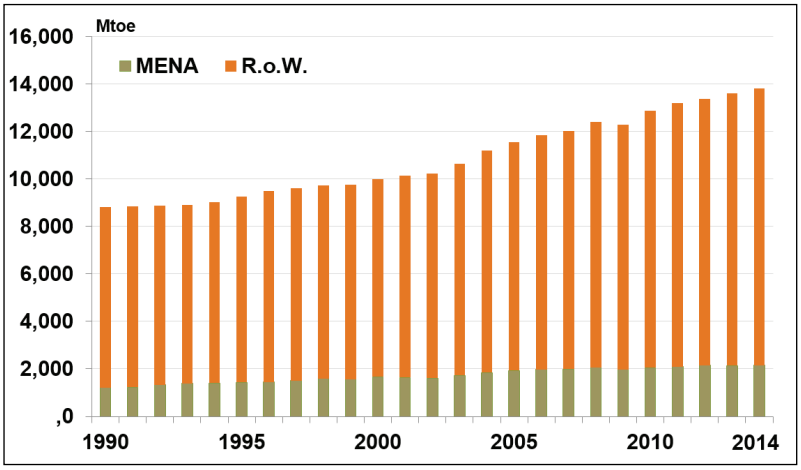


Source: OME (2015), IEA (2016b).

1.1 RESOURCES, RESERVES AND PRODUCTION

As far as energy production is concerned (Figure 2), the region's production (mainly oil and gas) accounted for around 16 percent (2,148 Mtoe) of total world energy production in 2014 (IEA 2016a). Whereas world energy production has increased on average by 1.9 percent during the 1990–2014 period, the region has witnessed relatively higher production levels, with an average annual growth rate of 2.4 percent during the same period. Saudi Arabia alone accounted for 29 percent of the entire region's production in 2014, followed by Iran (15 percent), Qatar (10 percent), the United Arab Emirates (UAE) (9 percent), Kuwait and Iraq (8 percent each), and the others accounting for the remaining 21 percent.

Figure 2 | Energy production evolution, MENA region and the rest of the world (RoW), 1990–2014 (Mtoe)

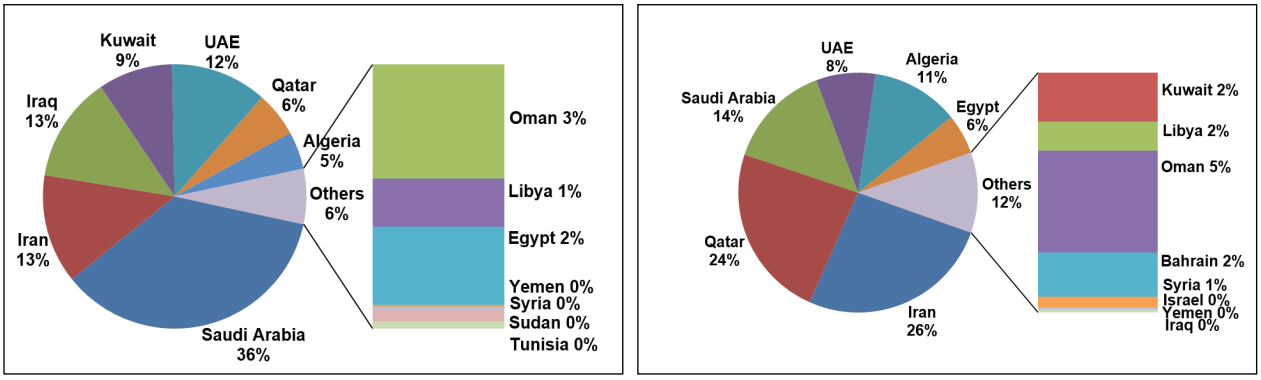


Source: OME (2015), IEA (2016b).

Crude oil production (Figure 3, left) in the region has seen continuous growth. The region's production accounted for around 37 percent (34.4 billion barrels of oil) of total world oil production in 2016. A share of 36 percent has been maintained over the years, albeit with an annual increase of 1.9 percent on average of production during the 1990–2016 period in absolute terms. Saudi Arabia has led the region in terms of production, with 36 percent of total production at the regional level (representing 13 percent of world oil production, with more than 12 million barrels of oil per day), followed by Iraq (13 percent), Iran (13 percent) and the UAE (12 percent), with the remainder shared among the other countries, mainly Qatar, Algeria, Oman, Egypt and Libya.

The region's share of world gas production (Figure 3, right) has grown as production volumes have increased on average by 6.1 percent annually during the 1990–2016 period. The region's production accounted for around 22 percent (about 772 billion cubic metres) of total world gas production in 2016. At the regional level, Iran and Qatar accounted for the largest share, with 50 percent of the regional gas production, followed by Saudi Arabia (14 percent), Algeria (11 percent), the UAE (8 percent) and Egypt (6 percent), with the remainder split mainly between Oman, Libya, Bahrain and Kuwait.

Figure 3 | Share of crude oil production (left) and natural gas production (right) in MENA countries, 2016



Source: OME analysis based on BP (2017).

The region is endowed with vast reserves of oil and natural gas. This positions the region favourably to play an important role in global energy supply. According to BP energy statistics (BP 2017), the region is host to 51.5 percent (879 billion barrels of oil) of global proven oil reserves as of 2016. Saudi Arabia stands as the leading country in the region in terms of reserves, accounting for 16 percent (267 billion barrels of oil) of global proven oil reserves as of 2016. At the regional level, reserves are concentrated in the following countries: Saudi Arabia (30 percent), Iran (18 percent), Iraq (17 percent), Kuwait (12 percent), UAE (11 percent), Libya (6 percent) and Qatar (3 percent).

As for natural gas, the region hosts 47 percent (87 trillion cubic metres) of global proven gas reserves as of 2016. Iran and Qatar are the leading countries in the region in terms of both reserves and production levels of natural gas. Together they account for 31 percent (57.8 trillion cubic metres) of global proven gas reserves as 2016. At the regional level, reserves are concentrated in the following countries: Iran (38 percent), Qatar (28 percent), Saudi Arabia (10 percent), UAE (7 percent), Algeria (5 percent) and Iraq (4 percent), followed by Libya, Egypt and Kuwait (2 percent each) (BP 2017).

The MENA region contains around 12.5 billion tonnes of coal reserves, representing about 1.1 percent of the world's total as of 2016. The majority of these coal reserves (lignite) are located in Turkey. Coal production reached around 72 million tonnes in 2016 (99 percent of which is in Turkey) (BP 2017).

As for exploration in the region, there remains potential overall for further increases in reserves (mainly oil and gas) in the future. Most areas in the southern Mediterranean, for example, especially offshore, are either under-explored or unexplored. Unconventional hydrocarbon resources development activities are still in the early stages in the region. In the Mediterranean region, for example, current activities continue to focus on resource assessment and exploration (OME 2015).

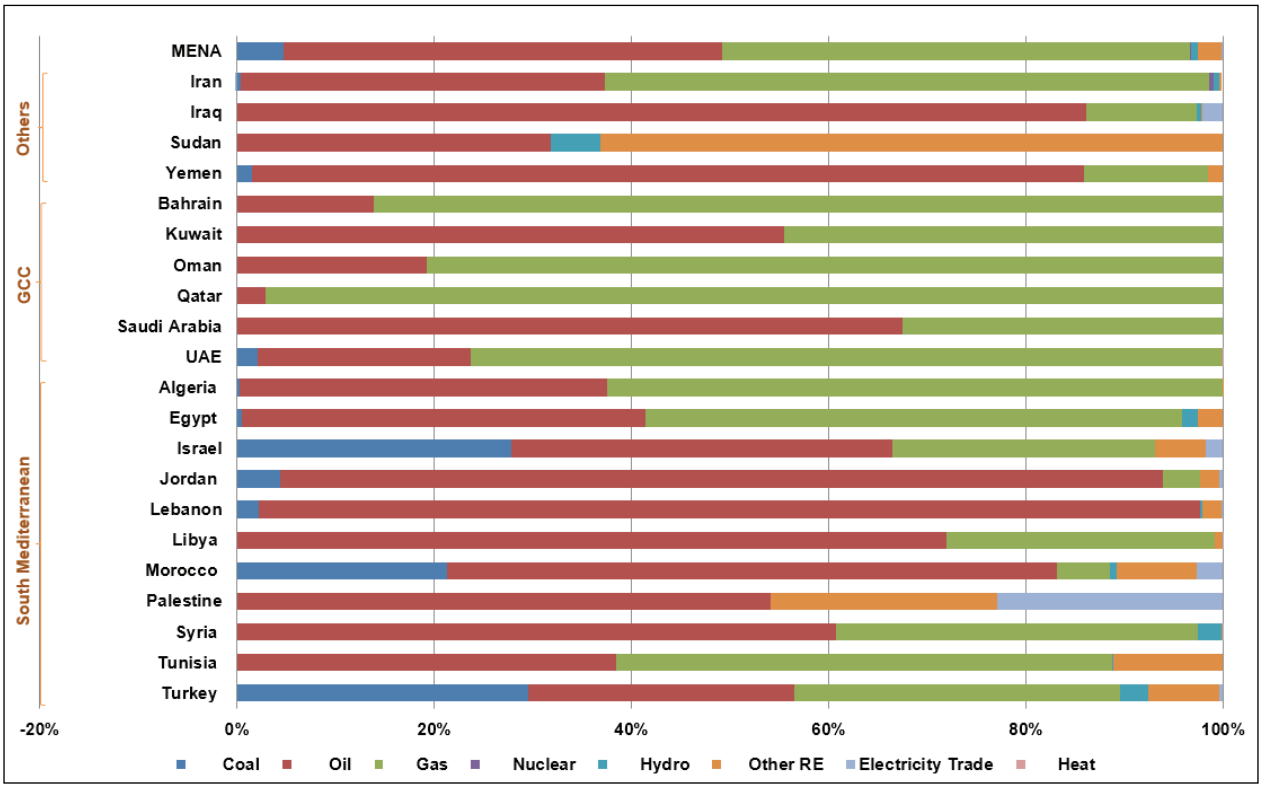
1.2 ENERGY MIX IN THE MENA REGION

The energy mix in the MENA countries (Figure 4) is heavily dependent on fossil fuels, particularly oil (45 percent) and natural gas (47 percent), with a minor share of coal (5 percent), whose production is concentrated in Turkey and whose role is also important in Israel's and Morocco's energy mix, particularly for power generation. This is also true for the energy exporting countries in general, with very low penetration of renewable energy sources in the energy mix. Renewables accounted for around 3 percent of the total energy demand in the whole region in 2014.

The share of oil in the energy mix has been shrinking. Its share moved from 60 percent of total energy demand in 1990 to 45 percent in 2014. In relative terms, oil (more than 50 percent of total primary energy supply, or TPES) is predominant in Saudi Arabia, Kuwait, Morocco, Syria, Libya, Jordan, Lebanon, Iraq and Yemen. Its overall share in the energy mix, in the electricity sector in particular, has been declining, however, as new sources (mainly renewables and natural gas) are substituted for oil-based power generation.

With the exception of Iran, nuclear energy is non-existent in the energy mix in the region, but the political decision to invest in nuclear energy remains an option for the future. Some countries, including the UAE (soon to commission its first nuclear plant, Barakah), Saudi Arabia, Egypt, Jordan and Turkey, already have plans to develop nuclear power, while others (i.e. Algeria, Morocco and Tunisia) are also considering introducing nuclear energy into their energy mix. The nuclear option has been advanced on several grounds: meeting the rising electricity demand, maintaining export levels to guarantee a sustained stream of revenues, energy security concerns (diversification) and moving towards a low-carbon economy. The nuclear option seems to be perceived as offering other benefits as well, especially in the Gulf countries, as it is seen as "a contingency plan – a nuclear defense doctrine – against Iran's nuclear program and uranium enrichment capability" (Nakhle 2016). Regardless of motivation, the nuclear option is gaining momentum and is likely to be adopted by some countries in the region. However, given the high up-front investment costs compared with other power generating technologies, the nuclear option might not be feasible in all countries, especially those with government funding constraints such as Egypt, Jordan and Morocco, and even in oil-rich states whilst oil prices remain below 50 dollars per barrel, placing further pressure on public finances (Nakhle 2016).

Figure 4 | The energy mix in MENA countries, 2014



Source: OME (2015), IEA (2016b).
Note: Each fuel's contribution is expressed in percentage terms.

Renewables have been developed mostly in energy importing countries. Historically, hydropower has been the most dominant source of renewable energy in the countries where the capacity exists – even if its contribution has remained constant over the years. The development of other renewable energy sources, mainly wind and solar, has made significant progress, reaching more than 25 Mtoe across the region in 2014.

Natural gas has gained importance across the region, surpassing oil as the primary source of energy and accounting for 47 percent of total energy demand in 2014. It accounted for the largest share of TPES in Bahrain, Qatar, Oman, UAE, Algeria, Egypt and Iran. The share of natural gas use is increasing, especially in power generation, due primarily to the abundant world supply as a result of the shale gas revolution in the USA and the growing LNG trade globally.

1.3 ENERGY DEMAND IN THE MENA REGION

The rapid increase in energy demand, for electricity in particular, is arguably the most notable trend in the region. Driven by economic development and industrialization, population growth and the increasing need for water desalination, the skyrocketing energy demand has pushed countries to revisit their energy strategies. Most of the countries will have to adjust their policies to cope with this unsustainable growth in demand for energy, which might pose serious problems by reducing export levels of hydrocarbons and thus putting constraints on governments' budgets,

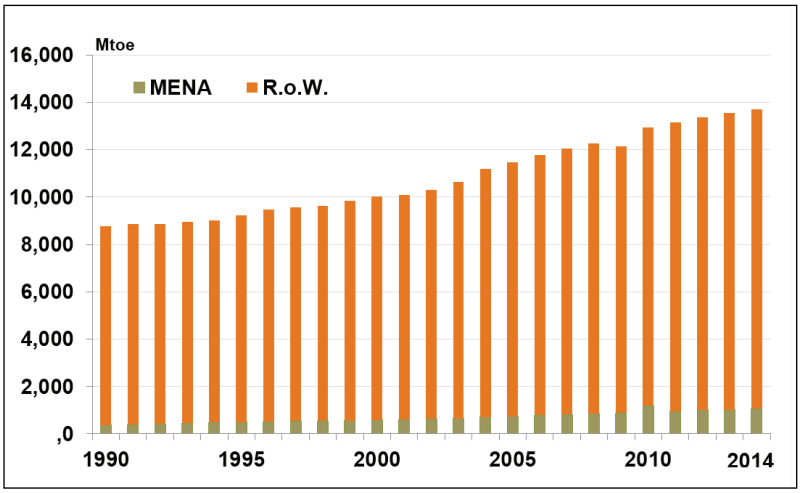
and eventually impact economic growth in the region.

Accounting for around 29 percent (more than 622 Mtoe) of total energy production in the region, Saudi Arabia led the region in energy exports, with more than 405 Mtoe (65 percent of domestic energy production) in 2014 (OME 2015, IEA 2016a). Relatively speaking, Qatar and Kuwait exported around 80 percent of their domestic energy production, and Iraq almost 70 percent.

However, energy export trends are expected to change drastically in the near future if energy consumption continues at its present rate (TPES increasing annually by 4.5 percent), thereby leading to reductions in export capacities in order to meet increasing domestic energy demands.

The MENA countries accounted for around 8 percent (1,047 Mtoe) of world TPES in 2014 (Figure 5), whereas this share was only 5 percent of TPES in 1990, with 511 Mtoe. Whereas global energy demand has been increasing by around 1.9 percent on average annually, the increase was much larger in the MENA countries – 4.5 percent annually – during the 1990–2014 period. Two countries (Saudi Arabia, 214 Mtoe and Iran, 237 Mtoe) accounted for the largest share, with 42 percent of TPES in the region, followed by Turkey (11 percent), Egypt (8 percent) and Algeria (6 percent), with the rest accounting for the remaining share of 23 percent.

Figure 5 | Total primary energy supply evolution for MENA region and the rest of the world (RoW), 1990–2014 (Mtoe)



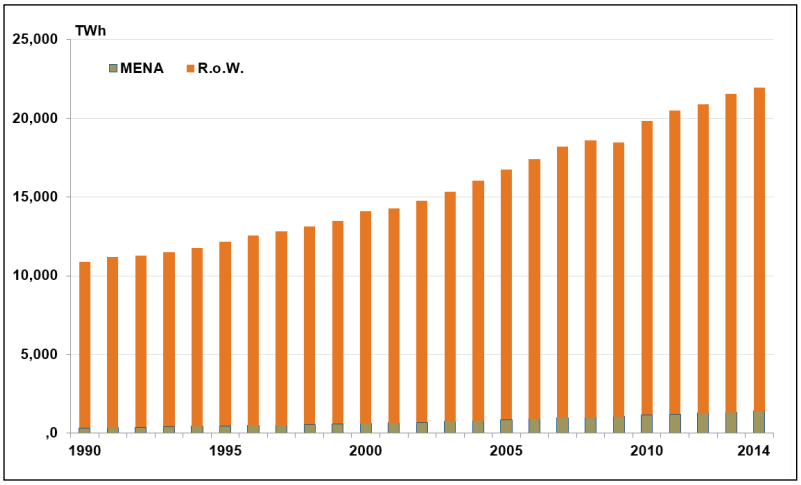
Source: OME (2015), IEA (2016b).

By sub-region, the GCC countries seem to have the highest energy demand growth rates. For instance, Qatar and Oman witnessed the fastest growth in energy demand, with annual average rates of 8.3 and 7.6 percent respectively during the 1990–2014 period.

Much of this energy demand can be observed at the electricity sector level, where very high electricity demand growth rates are recorded. Significant growth rates in electricity demand were seen in Oman, Qatar and UAE, with 10.4, 11.5 and 10.4 percent respectively during the 1990–2014 period. All other countries had rates ranging between 5 and 10 percent annually.

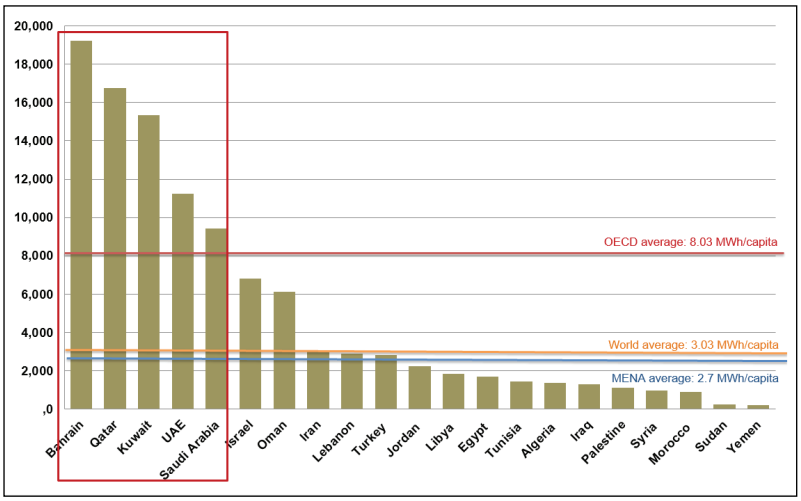
The MENA countries accounted for around 6.5 percent (1,423 terawatt hours, TWh) of world total electricity consumption in 2014 (Figure 6), while their share in 1990 was only 3.2 percent (or 344 TWh). Whereas global electricity demand has been increasing by around 3.8 percent on average annually, the increase was much larger in the MENA countries, with 7.8 percent annually during the 1990–2014 period. In 2014, Saudi Arabia accounted for the largest share of electricity consumption, with 20.4 percent (291 TWh) of total electricity consumption in the region, followed by Iran with 16.5 percent (234 TWh), and then Turkey with 15 percent (220 TWh), Egypt with 11 percent (152 TWh) and the UAE with 7 percent (102 TWh).

Figure 6 | Evolution of total electricity consumption for MENA region and the rest of the world (RoW), 1990–2014 (TWh)



Source: OME (2015), IEA (2016b).

Figure 7 | Per capita electricity consumption of MENA countries compared with OECD average and world average, 2014 (KWh)



Source: OME (2015), IEA (2016b).

On a per capita basis (Figure 7), electricity consumption rates vary significantly across the region. On a regional level, electricity consumption stood at an average of 2.7 megawatt hours (MWh) per

capita in 2014, slightly lower than the world's average. However, some countries in the region have the highest per capita rates in the world, mainly the GCC countries. Bahrain has the highest rate of electricity consumption per capita (19.2 MWh), more than double the average rate for OECD countries[3] and six times higher than the world average. Qatar, Kuwait, UAE and Saudi Arabia are also above the average rate for OECD countries. The lowest per capita consumption rates in the region are in Palestine, Syria, Morocco, Sudan and Yemen.

The demand for electricity in the region is expected to increase due mainly to economic development and population growth. The gap in electricity consumption on a per capita basis between the countries might narrow somewhat. For example, countries with very low per capita consumption rates might see their rates go up (especially in the light of increased energy access and the exploitation of locally available resources, mainly renewables), and energy efficiency measures might be deployed in countries with higher rates. Nevertheless, the gap is likely to remain high across the region.

Therefore, the increasing demand for energy is likely to have far-reaching implications for economies of the region. Some countries, including Saudi Arabia, Qatar, Kuwait and Iraq, export more than half of their energy production. However, these countries might see their export capacities shrink should the current energy demand trends be maintained. In GCC countries, for example, rising energy demand, driven by huge development projects in the domestic, service and infrastructure sectors (Qader 2009), as well as growth in industrial consumption, mainly the steel, aluminium and petrochemical industries (Hart 2010), is expected to put pressure on government budgets and reduce hydrocarbon export potential, thereby resulting in a loss of foreign exchange revenues (Ebinger et al. 2011). In this respect, the UAE and Kuwait have already become net importers of natural gas, and other GCC countries (e.g. Oman) have seen their gas exports constrained by rapidly increasing domestic energy demand. In order to meet growing natural gas needs, Bahrain plans to increase imports of natural gas (EIA 2016). Saudi Arabia is also expected to become a net energy importer in the near future, if current consumption patterns remain the same (Al-Shalabi et al. 2014).

Given these dynamics, especially the skyrocketing energy demand, countries in the region are revisiting their energy strategies in order to ensure that they support economic growth. In addition to adopting some demand-side management measures, especially energy efficiency, energy mix diversification, mainly through renewables, is gaining momentum and being put forward as an alternative to meet the growing energy demand. The role of natural gas is also gaining momentum, and it together with renewables will constitute the major energy sources in the power sector.

Two major changes, some would even say revolutions, have taken place in world gas markets in the past decade: booming unconventional gas production and the widespread LNG trade.

3 Organisation for Economic Co-operation and Development (OECD) members include the world's most advanced countries as well as emerging countries such as Mexico, Chile and Turkey.

2. THE UNCONVENTIONAL GAS REVOLUTION

The so-called unconventional gas revolution began more than a decade ago with low-cost coalbed methane, followed by the productive tight gas development and the emergence of shale gas. These developments have revolutionized gas supply in the USA, such that unconventional gas production has overtaken conventional gas production. This quick growth has had a significant impact on gas markets and thus attracted worldwide attention.

The intensive use of advanced technology has made it possible to unlock vast tracts of unconventional gas deposits. Three technologies have supported the rise in unconventional gas production, namely hydraulic fracturing, horizontal drilling and micro-seismic monitoring. The first steps towards development of the current technologies that allow for the successful commercial exploitation of shale gas resources were taken in the late 1990s by Mitchell Energy in the Barnett Shale.

Unconventional gas production volumes continued to rise with the development of technological advances during the 1990s. In the 2000s, increased production from those resources offset the decline in conventional gas production and drastically reversed the decreasing trend in total US domestic natural gas output.

US shale gas production was 5 percent of total US gas production in 2004, 10 percent in 2007 and 60 percent in 2016. According to the US Energy Information Administration (EIA), shale gas production is expected to continue to increase in the future.

This development has turned the USA from a gas importer in 2007 to a gas exporter in 2016. As a result, the USA no longer needs to import gas from the MENA region. The US shale revolution, combined with the rapid expansion of LNG capacity worldwide, has already started to reshape the regional and global natural gas market. These developments have put pressure on the price of natural gas in all major gas markets. This has implications also for the price of natural gas liquids (separated from natural gas in processing plants) that are used as feedstock in the petrochemical industry. This means that the shale gas revolution is not only a challenge to the MENA region in gas export markets, but will also be a threat to the expansion of the chemical and petrochemical industry in the region, which is export oriented.

While the amount is thought to be large, estimates of shale gas resources outside the USA are severely hindered by the lack of field data. A comprehensive assessment of shale gas potential covering the regions outside the USA was published by the EIA in 2011 and 2013. These reports show that some countries in the MENA region (for instance, Algeria and Libya) have large-scale shale gas resources (Table 1). However, shale geology know-how is still in its infancy in the region, and shale gas resources have not yet been quantified on a national basis for most countries. For instance, it is acknowledged that potentially productive shales exist in most of the countries in the Middle East, yet they are not included in the aforementioned reports as they lay outside the scope of the study.

Many prospective shales, particularly those in Europe, have turned out to be more geologically complicated than expected. This has implications for the technical and economic viability of their exploitation, and thus the willingness of companies to invest in their development.

Table 1 | Technically recoverable shale gas resources in the MENA region (billion cubic metres, bcm)

	EIA 2011			EIA 2013				2016
	Gas-in-place	Technically recoverable resource	Assumed recovery rate (%)	Gas-in-place	Technically recoverable resource	Assumed recovery rate (%)	Diff. TRR 2011–2013 (%)	Proven reserves
Algeria	22,993	6,513	28.33	96,816	20,020	20.68	207	4,504.0
Libya	32,480	8,212	25.28	26,675	3,455	12.95	-58	1,504.9
Morocco	3,058	510	16.67	2,690	566	21.05	11	1.4
Tunisia	1,727	510	29.51	3,228	651	20.18	28	65.1
Egypt				15,150	2,832	18.69	*	1,846.3
Jordan				991	198	20.00	*	6.0
Total MENA	60,259	15,744		14,5549	27,722		76	7,927.8

Source: OME, EIA (2011), EIA (2013), BP (2017), Oil & Gas Journal.
Note: * Not investigated in the EIA 2011 report.

Despite the initial excitement, the European shale gas boom has not materialized in the way many people predicted. While opportunities appear to be abundant, there are still plenty of challenges to be overcome and the region will be hard pressed to replicate the success of the USA.

Some of the challenges are technical in nature and are related to different material factors, whilst others are inherently political, legal or economic. The latter challenges include a difficult and uncertain fiscal, legislative and regulatory climate; a cumbersome bureaucracy with lengthy permitting procedures; public opposition or lack of public acceptance; and opposition by local citizens to shale gas projects. Mounting concerns about the environmental effects of shale gas in general and hydraulic fracturing in particular have helped mobilize public opposition and slowed the development of shale gas activities in Europe and parts of North Africa. These concerns are primarily related to four issues: water management, possible climate impacts, seismic activity, and risks to human health and other activities.

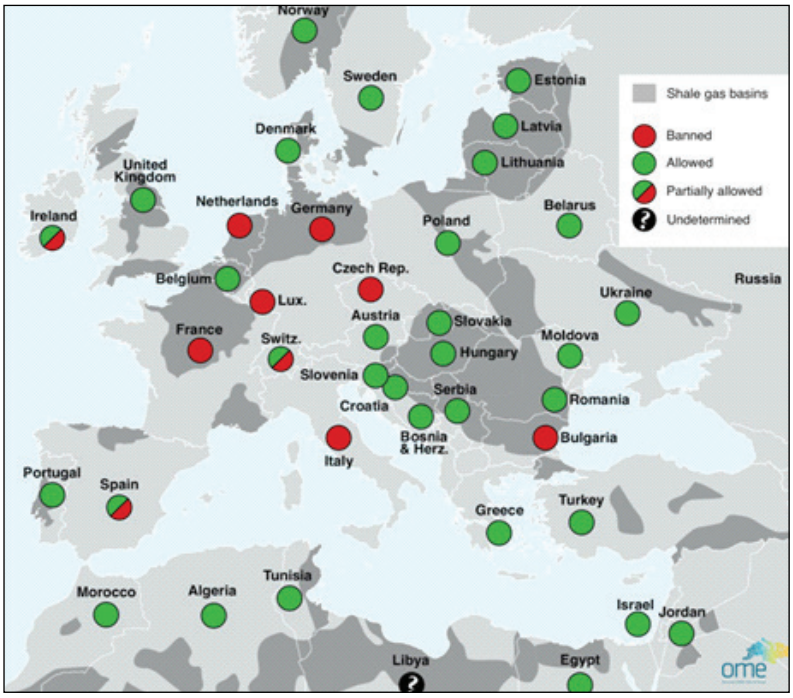
While some governments are supportive of the exploitation of shale gas, others have banned its development and/or the use of fracking technology (Figure 8).

France was the first country in Europe to explicitly outlaw hydraulic fracturing and shale gas extraction in July 2011. Many others followed, either imposing moratoriums or forbidding activities using fracking. And in some countries, such as Tunisia and Algeria, the idea of shale gas exploitation has been met with immense public criticism and demonstrations.

Partly as a result of all this, even in the most pro-shale countries no commercial production has yet been achieved. Most, if not all, experts argue today that shale gas will not be produced commercially and in significant volumes in the short to medium term in Europe. Prospects for its full utilization may only be realistic in the long term.

LNG, however, is expected not only to play an increasingly important role in filling the future gas supply gap but also to help improve supply security by providing flexibility and diversification through multiple supply options.

Figure 8 | Shale gas basins and regulations in the Euro-Mediterranean



Source: OME, IEA, KPMG, press reports.

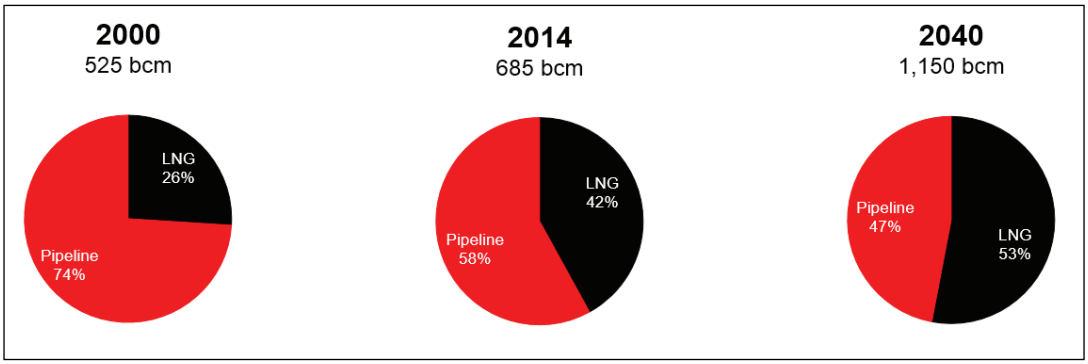
3. THE LNG REVOLUTION

The rise of shale gas production in the USA has shifted the market outlook from scarcity to abundance and driven the USA into the LNG export business. Cheniere Energy Inc. started exporting from its Sabine Pass LNG facility in Louisiana in February 2016. As of September 2017, more than 150 cargoes (over 17 bcm), have been shipped to international markets, from Asia to Latin America to Europe. The USA is now projected to become one of the top three LNG exporters in the world in the next few years, according to industry experts.

We are currently witnessing a paradigm shift in LNG markets. LNG is arguably the fastest growing segment in the global energy business (Figure 9). In addition, LNG has recently become a global commodity business. This has not happened overnight. Technological innovation has contributed to the LNG revolution. The modularization of liquefaction plant facilities and the emergence of small-scale floating storage regasification units (FSRUs) have played an important role in the growth of the LNG trade. Since FSRUs are quick and relatively cheap to install, new markets have opened up. First deployed in the US Gulf of Mexico in 2005, FSRUs have now become a standard industry technology.

Largely due to the development of FSRUs, the global LNG trade started to gain momentum in the past decade. According to the lEA, a more flexible global gas market, coupled with a doubling of trade in LNG, supports an expanded role for natural gas in the global mix. By 2040, more than half of the world's gas trade will be via LNG rather than pipeline, according to the IEA.

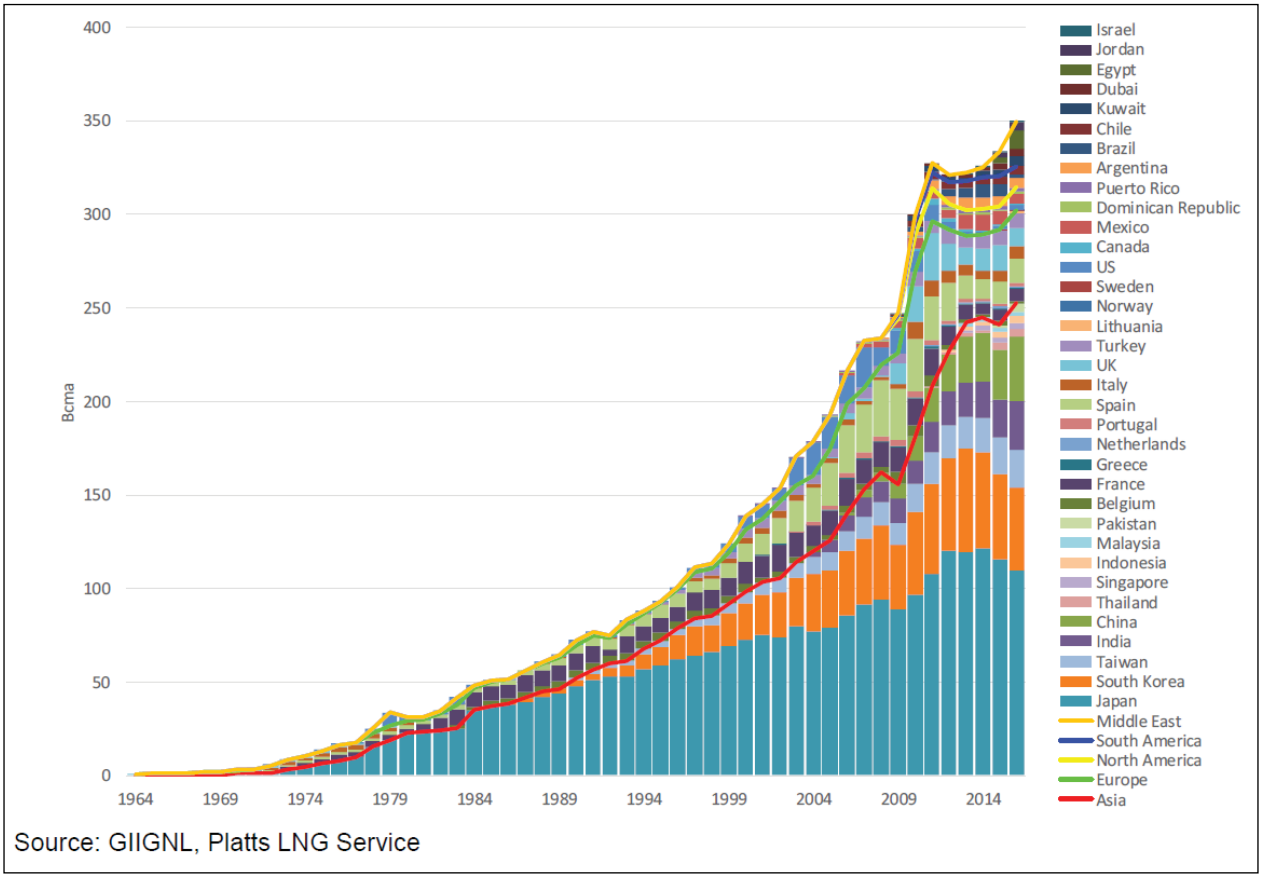
Figure 9 | Share of LNG in global gas trade



Source: IEA (2016c).

The volume and diversity of LNG trade flows have increased rapidly with the appearance of new exporting and importing countries. From the first LNG shipment from Algeria to the UK in 1964, LNG has been gaining importance in gas trade. The number of LNG importing countries (Figure 10) has grown from one in 1964 to fifteen in 2005 and thirty-nine in 2017. In this period, more and more countries in the region have become LNG importers. Other countries, such as Morocco, may also join this group in the future.

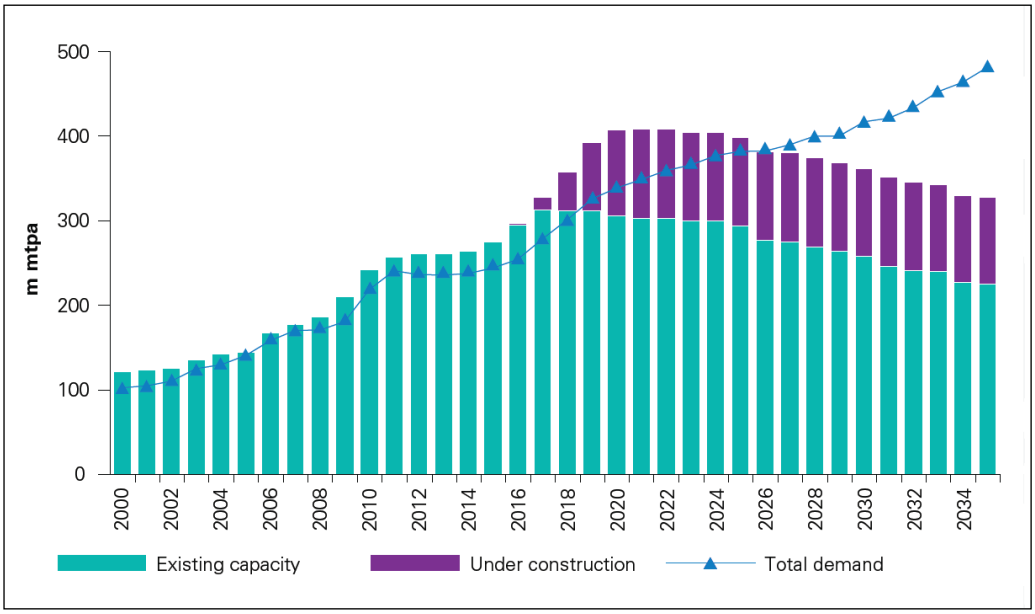
Figure 10 | LNG importing countries, 1964–2014



Source: Rogers (2017: 4).

The number of LNG exporting countries has also risen tremendously, from one in 1964 to over twenty in 2017. Booming gas production and high gas prices have motivated many countries to expand their LNG export capacities or to become gas exporters by building LNG plants. In the MENA region, Qatar (the largest LNG exporter in the world), Algeria, Oman, UAE, Egypt and Yemen are among the LNG exporting countries. Due to ongoing conflict and instability, LNG exports from Yemen have stopped. An emerging problem, however, is that the LNG export rush has created excess supply, which may be extended as far as 2025 (Figure 11).

Figure 11 | LNG supply–demand balance, 2000–2034 (million metric ton per annum, mmtpa)



Source: Hemmingsen (2017: 5).
Note: Production capacity includes capacity decommissioned, operational and under construction as of Q2 2016; total trade includes under development and existing demand.

The shift in the LNG market, from a period of undersupply and high prices in 2011–14 to a glut of new supply today and in the near future, has begun to change the dynamic in LNG markets. First, oversupply, the substantial volume of uncontracted LNG and the decline in the price of oil have brought down natural gas prices in all regions. Second, ample availability of LNG has allowed buyers to improve their competitive positions, allowing them to put pressure on the pricing and marketing of LNG.

Buyers no longer want price indices to be tied exclusively to the oil price, which is why global pricing formulas have shifted away from oil indexation, from more than three-quarters for contracts signed before 2010, towards more gas-to-gas linkages (around 50 percent) in newer contracts. The inclusion of fixed destination clauses in LNG contracts declined from 60 percent in 2014 to less than 40 percent in 2016. If this trend continues, it will likely result in a fight for market share among exporters, particularly in Europe. EU competition law, for instance, is considering the prohibition of market segmentation by means of destination clauses in gas contracts. More importantly, there has been an increase in spot trade and shorter-term contracts. Spot and short-term trades represented around 30 percent of overall trade in 2016. In addition, buyers are now

pushing to renegotiate or exercise price redetermination clauses. All these developments mean that LNG is becoming a deeper, more liquid and more commoditized market.

4. ROLE OF RENEWABLE ENERGY IN THE REGION

Meeting the growing energy demand, particularly for electricity, is a real challenge that all MENA countries are facing. In addition to population and economic growth, low energy prices are also responsible in some countries for driving energy demand. So, energy pricing reforms (around subsidies) remain a key priority to move toward more transparent and effective energy markets. In addition to energy efficiency measures, alternative energy sources, and in particular the deployment of renewable energy technologies on a wider scale, could partly address this challenge. This section sheds light on the potential of renewable energy sources in the region, their status and deployment, national plans for deploying renewables and the potential impact renewables could have on the entire region, while also putting forward some recommendations for deploying renewables in the region.

4.1 POTENTIAL OF RENEWABLE ENERGY SOURCES IN THE REGION

The region is well suited to the development of renewable energy technologies for different applications. As far as solar energy technologies are concerned, most of the countries lay in the so-called Sunbelt, with global horizontal irradiance (GHI) values ranging from 1,600 kilowatt-hour per square meter per year (kWh/m²/y) in coastal areas of the Mediterranean to 2,600 kWh/m²/y in the desert, and direct normal irradiance (DNI) varying from 1,800 kWh/m²/y to more than 2,800 kWh/m²/y. This is one of the best endowed areas of the world with respect to solar energy for both solar photovoltaic (PV) and concentrating solar power (CSP) applications (Al-Shalabi et al. 2014). The potential for wind energy is also very high in several countries of the Mediterranean such as Morocco, Egypt and Turkey, as well as Iran, with more moderate – but still interesting – potential in GCC countries and Iraq.

4.2 RENEWABLE ENERGY STATUS AND DEPLOYMENT PERSPECTIVES

The region is endowed with significant potential renewable energy sources, the exploitation of which could engender important socio-economic benefits in addition to increased energy security. Nevertheless, the pace of deployment has been very slow in most countries, with the exception of a few such as Egypt, Tunisia, Turkey, Morocco, Jordan and Israel.

However, there are several obstacles to overcome in the deployment of renewables in the MENA countries, including weak grid infrastructure, regulatory barriers, access to finance and, most important, subsidies to conventional energy. In the GCC countries, for example, the low penetration of renewable energy technologies could be attributed to "institutional inertia faced with new markets, clarity in institutional roles and responsibilities, and lack of dedicated policies and regulations" (Ferroukhi et al. 2016: 73).

Subsidies constitute a major challenge for countries in the region. In addition to providing support for basic consumption products and goods, subsidies to conventional energy, in particular, are

among the main barriers to the deployment of renewable energy in the region. Two countries, Iran and Saudi Arabia, account for more than 66 percent of total fossil fuel subsidies in the region, with more than 52 billion dollars and more than 48 billion dollars, respectively. In relative terms, Iran still leads the region with 13.5 percent as a share of GDP, followed by Libya (11 percent), Algeria (8.2 percent), Saudi Arabia (7.4 percent) and Kuwait (5 percent) (IEA 2016).

Nevertheless, several countries have introduced subsidy reforms to move towards a gradual phase-out. In January 2016, Algeria increased prices of gasoline by 34 percent and diesel by 37 percent while also increasing the prices of electricity and gas. In addition to increasing electricity prices, Bahrain has recently increased the price of regular gasoline and premium gasoline by 60 and 56 percent respectively. In Iran, the cabinet approved the removal of gasoline quotas for public and private passenger vehicles in May 2016. Kuwait also announced in January 2016 that it would repeal subsidies for gasoline and electricity, but is still studying the feasibility of further subsidy reforms. In May 2016, Oman started adjusting the prices of gasoline and diesel based on global market prices. Qatar also started adjusting prices of gasoline and diesel according to global market prices at the beginning of 2016, while also increasing the price of gasoline. In 2015, Saudi Arabia increased the price of gasoline and electricity. In April 2016, Tunisia announced it would index fuel prices to global market prices (IEA 2016). Therefore, moving towards energy prices that reflect market energy costs would eventually help to limit the rapid growth in energy demand and make renewables a real alternative to conventional energy sources, as well as lessen the government's budgetary burden.

Renewables' role in the energy mix (about 32.60 Mtoe – equivalent to about 3 percent of TPES – in the whole region) has been very minor in most MENA countries, especially in hydrocarbons exporting countries.[4] Hydropower is still the main renewable energy in the MENA region, accounting for 7.36 Mtoe in 2014. The development of other renewable energy sources, mainly wind and solar, has progressed significantly, reaching more than 25.23 Mtoe for the whole MENA region in 2014.

The deployment and significance of renewable energy is particularly notable in the power sector, accounting for about 6.3 percent (102 TWh; hydro production was about 84 TWh) of total electricity production in 2014.[5] Turkey leads the region, with a share of 21 percent (Turkey alone accounts for more than half of the electricity production from renewable energy sources), followed by Syria (17 percent), Morocco (14 percent), Egypt, (8 percent), Palestine (8 percent) and Tunisia (7 percent), while the rest of the countries' shares range from 5 to less than 1 percent.[6]

As far as installed electric capacity is concerned, more than 11 gigawatts (GW) of non-hydro installed capacity were in place as of 2016 (Figure 12), distributed among the following: wind (7.5

4 Renewable energy accounted for an estimated 19.3 percent of final energy consumption in 2015 in the world. Whereas traditional biomass (used primarily in cooking and heating in remote and rural areas in the developing countries) accounted for around 9.1 percent, modern renewables – including hydropower (3.6 percent), biomass, geothermal and solar heat together (4.2 percent), and wind, solar, biomass and geothermal power together (1.6 percent), as well as biofuels for transport (0.8 percent) – accounted for 10.2 percent (REN21 2017).

5 At the global level, renewable electricity provided around 24.5 percent (with hydro accounting for the largest share, with 16.6 percent of total production) of total global electricity production in 2016 (REN21 2017).

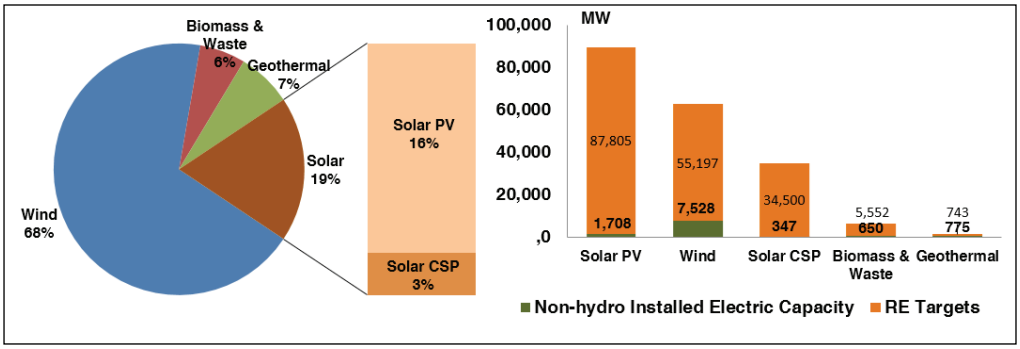
6 OME database.

GW), solar PV (1.7 GW), geothermal (0.775 GW), biomass and waste (0.650 GW) and solar CSP (0.347 GW) (OME 2015, IRENA 2017). Hydropower capacity alone totalled about 49 GW in 2016.

As a comparison, non-hydropower renewable energy capacity reached 921 GW at the global level in 2016 – with China alone hosting around 258 GW, or 28 percent of global installed capacity.[7] Hydropower was more than 1,000 GW.

In the southern and eastern Mediterranean countries, Turkey, Egypt, Morocco and Tunisia lead the renewable energy market in the region, with a cumulative installed capacity of 7,373 MW, 809 MW, 1,004 MW and 282 MW respectively. In the GCC, the UAE leads the region with 139 MW, followed by Saudi Arabia (48 MW), then Qatar (44 MW) and Kuwait (41 MW) and last Oman with just 1 MW. Among the other countries, Sudan has a 200 MW installed capacity, followed by Iran (160 MW), Mauritania (69 MW), Yemen (30 MW) and then Iraq (17 MW) (OME 2015, IRENA 2017).

Figure 12 | Share of electric installed capacity from renewable energy sources (excluding hydro) in 2016 (left) and comparison of the non-hydro installed electric capacity against the announced renewable energy targets by technology (right)



Source: OME (2015), Ferroukhi et al. (2016), IRENA (2017).

Several considerations have played an important role in advancing the deployment of renewables worldwide. In addition to environmental concerns, the prioritization of which may vary from country to country, renewables have been promoted based on a variety of other factors. The relatively higher renewables penetration rates in some of the MENA countries could be mainly a response to energy security concerns and a desire to reduce dependence on foreign energy imports, exploit locally available resources and develop a local value chain industry.

As discussed previously, there are several obstacles to the development of renewables in the region. Nevertheless, almost all MENA countries have established ambitious plans and objectives for the development and deployment of renewable energy, either in the energy mix or in electricity production, albeit with different rates of implementation. In particular, government-backed tenders have resulted in some of the most cost-effective projects at the global level for solar and wind, with record low prices in Morocco and the UAE (Menichetti and El Gharras 2017).

7 By technology, in 2016 wind power accounted for the largest share with ≈53 percent, followed by solar PV with ≈33 percent, bio-power capacity with 12 percent, and the remaining ≈2 percent split between geothermal and concentrating solar thermal power (CSP). The top six countries, in terms of renewable power installed capacity (in GW), are: China (258), USA (145), Germany (98), Japan (51), India (46) and Italy (33).

An enabling environment is key to the wider development and deployment of renewable energy technologies, which can attract investments to the sector. Almost all countries in the world provide a mix of policy support mechanisms, including a legislative, regulatory and institutional framework, as well as financing tools to attract investments to the sector.[8] The MENA countries are no exception, and the implementation of their renewable energy plans would have a significant impact on the region's economies.

From a technology perspective, most of the plans put more emphasis on solar (especially solar PV) and onshore wind, with relatively lower percentages for biomass and waste as well as geothermal. Many projects are either in construction or planned for the near future. Table 2 lists the targets announced by each country and the time frame for their implementation.

Table 2 | Plans of installed non-hydro electricity capacity (GW) by country

Category by installed capacity target scale	Country	Target (GW)	Time frame (year)
Less than 5 GW	Bahrain	0.7	2030
	Israel	2.7	2020
	Jordan	1.8	2020
	Lebanon	1	2030
	Libya	2.2	2025
	Oman	2.4	2030
	Palestine	0.13	2020
	Qatar	1.8	2030
	Sudan	1.52	2031
	Syria	4.1	2030
	Tunisia	3.8	2030
	Yemen	0.710	2025
Between 5 and 15 GW	Egypt	8.2	2022
	Iran	7.5	2030
	Kuwait	11	2030
	Morocco	10	2030
More than 15 GW	Algeria	22	2030
	Saudi Arabia	29.3	2030
	Turkey	27	2023
	UAE	33.3	2030

Source: OME (2015), Ferroukhi et al. (2016), IRENA (2017).

Despite encouraging progress, substantial changes are needed in order for MENA countries to be able to exploit their renewable energy potential and position themselves as sustainable energy champions. The main transformations required should occur at the following levels (Menichetti and El Gharras 2017):

i) *Setting mandatory renewable energy targets within a stated deadline*: Compulsory targets, supported by a roadmap or national energy plan, would give clear signals to markets, investors

8 As of 2016, 176 countries had set up renewable energy targets, most of which focus on renewable energy in the power sector (REN21 2017).

and the population regarding the actual engagement of the government in pursuing sustainability goals, thus creating positive dynamics.

ii) *Establishing an institutional framework with clear allocation of roles and responsibilities to allow for a transparent market*: It is important that clear roles and responsibilities are allocated to the entities in charge, thus avoiding overlaps and increasing the transparency of the system; the establishment of a (renewable) energy agency would be an important step forward for pushing renewable energy development.

iii) *Defining fair rules to guarantee market access to independent power producers*: A dynamic market can only be created by establishing clear rules for accessing the market and providing long-term certainty to private operators through long-term price guarantees.

iv) *Adoption of policy support measures for renewable energy projects based on the project scale, the degree of maturity of the technology and the type of application (electricity vs. other use)*: Regardless of the specific policy support scheme adopted, it is important to ensure that incentives progressively decrease over time in order to move rapidly towards market competitiveness.

v) *Gradual phase-out of subsidies to conventional energy technologies*: A progressive adjustment of energy prices, including incorporating the externalities from energy production and the removal of subsidies, is needed to ensure a more level playing field for renewables. Of course, such a process should be implemented smoothly, taking into account local socio-economic constraints.

vi) *Accurate market design and overall assessment of the impact of increasing renewable energy share on the grid*: Massive penetration of renewable electricity requires a deep reorientation of infrastructure policy. This transition will require considerable investments for grid reinforcement, intelligent grids, electricity transmission, energy storage, distributed energy systems and novel transport methods, together with improvements in energy efficiency, for both the supply and the demand side.

vii) *Access to finance, especially access to lower cost of finance, would be required for a wider-scale deployment of renewable energy technologies*: In addition to international financial institutions providing, in particular, concessional loans, the involvement of commercial banks would be more likely to push sustainable and long-term developments.

4.3 POTENTIAL IMPACT OF DEPLOYING RENEWABLE ENERGY IN THE REGION

Implementing national renewable energy plans and objectives and further exploiting the renewable energy sources with which the region is endowed could have a significant impact on the whole region in terms of energy savings, especially freeing up oil and gas for export, energy security, reducing CO2 emissions, job creation, industrialization and energy access. Furthermore, the implementation of large-scale energy projects could favour international partnerships that could project the MENA countries into global energy markets. In addition, decentralized energy through the use of renewable energy technologies could improve energy access, especially in remote areas which are not yet served by the grid.

CONCLUSIONS

Several key trends characterize the MENA energy context and are likely to shape the energy future of the region. These include: (i) the increasing demand for energy, and for electricity in particular; (ii) the predominance of fossil fuels (mainly oil and gas) in the energy mix; (iii) the continued importance of the region's fossil fuel reserves (oil and gas) in world energy markets; (iv) the increasing risk of reduced oil and gas export capacities due to increased local demand; (v) the expanding role of renewables (especially wind and solar PV) in the electricity sector; (vi) improvements in the energy security and independence of some countries in the region, mainly due to an increased share of renewables in national energy mixes; and (vii) the increasing role of natural gas in the energy mix as a result of the shale gas revolution in the USA and the growing LNG trade.

Key points and trends shaping the energy landscape of the region include the following:

Unsustainable energy demand growth rates have been observed in almost all countries. Total primary energy demand has increased by about 4.5 percent on average annually between 1990 and 2014 (compared with the world average of 1.9 percent). Electricity demand, in particular, is unsustainable in the region, with an average annual growth rate of 7.8 percent between 1990 and 2014, compared with a world average growth rate of 3.2 percent. On a per capita basis, levels of electricity consumption differ greatly across the region, with some countries having the highest rates and others the lowest ones in the world. This increasing energy demand, especially for electricity, is likely to persist and will be further driven by economic development, population growth (an additional 133 million inhabitants by 2030, and 213 million by 2040), electrification and, in some countries, significant infrastructure projects, thereby putting upward pressure on energy demand. Should the current trends in energy consumption persist in the region, this would limit many countries' export capacities, which would in turn have a negative impact on their economies, especially those that are heavily dependent on energy exports. However, this rapid growth in demand could be slowed should demand-side management measures, including energy efficiency, be put in place and should pricing reforms be accelerated.

Fossil fuels dominate the energy mix (mainly oil and natural gas, with a minor share of coal and a very low share of renewables) in the region, especially in energy exporting countries. With its abundance of fossil fuel reserves (51.2 percent of global oil proven reserves and 47 percent of world natural gas proven reserves), the region plays an important role in global energy dynamics, markets and flows, accounting for 16 percent (half of which is exported) of total world energy production in 2014. Energy production has increased by 2.4 percent on average annually between 1990 and 2014. The region accounted for 37 percent of global crude oil production and 22 percent of global gas supply in 2016.

In terms of each type of fuel's role in power generation, the share of both coal and oil is declining in almost all countries. The share of natural gas and renewables is growing, however, and they will dominate future investments in power generation. Nuclear energy is non-existent in the energy mix (with the exception of Iran and soon the UAE). However, a few countries (Egypt, Jordan, Turkey, Morocco, Saudi Arabia) in the region are planning to introduce nuclear to their electricity

generation mix in the future. Therefore, whereas the future of nuclear power is still uncertain in many countries in the region, one thing which is sure is the growing importance of renewables and natural gas in their energy mix.

The so-called unconventional gas revolution is having a significant impact on gas markets. The development and intensive use of advanced technology has unlocked vast tracts of unconventional gas deposits. While the amounts are thought to be large, estimates of the shale gas resources outside the USA are severely restricted by the lack of field data. Some countries in the MENA region (for instance, Algeria and Libya) have large-scale shale gas resources. However, shale geology know-how is still in its infancy in the region, and shale gas resources have not yet been quantified on a national basis for most countries. LNG is expected not only to play an increasingly important role in filling the future energy supply gap but also to help improve supply security by providing flexibility and diversification through multiple supply options.

The rise of shale gas production in the USA has shifted the market outlook from scarcity to abundance and driven the USA into the LNG export business. A paradigm shift is taking place in LNG markets. LNG is arguably the fastest growing segment in the global energy business. In addition, LNG has recently become a global commodity business as natural gas plays an important role in the global mix. The volume and diversity of LNG trade flows have increased rapidly with the appearance of new exporting and importing countries. Booming gas production and gas prices have motivated many countries to expand their LNG export capacities or to become gas exporters by building LNG plants, thus creating excess supply. The shift in the LNG market, from a period of undersupply and high prices in 2011–14 to a glut of new supply today and in the near future, has begun to change the dynamics in LNG markets, with natural gas prices decreasing in all regions and the improved competitive position of buyers putting pressure on pricing and marketing of LNG. Thus, LNG is becoming a deeper, more liquid and more commoditized market.

The region is characterized by very sharp differences in degree of energy dependence, with some countries exporting more than half of their domestic production and others dependent on foreign sources for more than 90 percent of their energy. Many countries will be able to lessen their dependence mainly by exploiting locally available resources of renewable energy. Energy cooperation is key for energy security. The potential for regional electricity trade is particularly important, given the great complementarities of supply and demand profiles across the region. With the exception of a few countries (mainly in the southern Mediterranean), despite the abundant availability of renewable resources and the potential socio-economic benefits, renewables' penetration is still low in the region. Many obstacles would need to be overcome for their large-scale development and deployment in the region. Nevertheless, the outlook seems promising, with several ambitious renewable energy plans being set up by the countries in the region whose deployment will benefit the whole region in terms of energy security, energy savings, reduced CO2 emissions, employment and the creation of local industry.

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Middle East and North Africa Regional Architecture: Mapping geopolitical shifts, regional order and domestic transformations (MENARA) is a research project that aims to shed light on domestic dynamics and bottom-up perspectives in the Middle East and North Africa amid increasingly volatile and uncertain times.

MENARA maps the driving variables and forces behind these dynamics and poses a single all-encompassing research question: Will the geopolitical future of the region be marked by either centrifugal or centripetal dynamics or a combination of both? In answering this question, the project is articulated around three levels of analysis (domestic, regional and global) and outlines future scenarios for 2025 and 2050. Its final objective is to provide EU Member States policy makers with valuable insights.

MENARA is carried out by a consortium of leading research institutions in the field of international relations, identity and religion politics, history, political sociology, demography, energy, economy, military and environmental studies.

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