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Arab Region Progress in Sustainable Energy

Global Tracking Framework Regional Report

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UNITED NATIONS
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Executive Summary

This report provides an overview of the progress made by the Arab region in recent years and decades in the area of sustainable energy management and universal energy access. As the Arab region depletes its energy savings and water resources and pollutes its air faster than any other region in the world, this report urges policymakers to draw lessons early enough to manage the resources the region has carefully and sustainably nurtured. The report focuses on three key pillars that underlie both the Sustainable Energy for All (SE4ALL) initiative and the United Nations Sustainable Development Goals (SDGs) that came into effect in January 2015: scaling access to modern energy through electrification and access to modern clean cooking fuels and technologies (CFTs); doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix.

This present report was developed by the United Nations Economic and Social Commission for Western Asia (UN ESCWA) drawing on data from the Global Tracking Framework Report (GTF) which is globally co-led by the World Bank/Energy Sector Management Assistance Programme (ESMAP) and the International Energy Agency (IEA) with input from more than 20 organizations around the world including the United Nations Regional Commissions, and which aims to track progress in sustainable energy globally through the collection and analysis of quantifiable, internationally comparable energy-related indicators.

One of the key messages of this report is that progress in sustainable energy can no longer be seen as separate from, and conditions progress in, other socioeconomic development goals in the Arab region. The fragile natural resource balance in many parts of the region, coupled with rapid and rising economic expectations by the region's young and increasingly educated populations, means that managing the natural assets of Arab countries takes centre stage in ensuring that future generations can lead stable and successful lives. Energy is crucially interconnected with a whole range of other factors for developmental success – from its close link to the security of water and food supplies, to key development goals such as universalizing access to modern health services and education, gender equality and women empowerment, the creation of sustainable living spaces, technology innovation and critical progress in regional mitigation of, and adaptation to climate change.

Energy use in the Arab region – business as usual is not an option

The Arab region is in the midst of a transition from being a major supplier of energy to international world markets towards an increasingly important demand market in its own right. This transition raises considerable challenges but also opportunities for the coming decades. The key message for policymakers and civil societies alike is that the current business-as-usual scenario in the areas of energy and wider natural resource management in the Arab region is, in many cases, unsustainable. Proactive policy is

critical to ensuring the region's long-term resilience and stability in view of growing populations and economies, rising living standards and expectations and the finite nature of the region's unequally distributed natural resource wealth. Most parts of the region – excluding the Arab Least Developed Countries (LDCs) – have been making significant progress to near-universal access to energy, a key developmental attainment. Nevertheless, the region lacks sustainable resource management – in particular in the areas of energy efficiency – and relies overwhelmingly on fossil fuels for virtually all its energy needs.

The Arab region's rapidly growing domestic energy demand challenges its traditional energy policy. With a historically small domestic energy market, it has long been perceived as a marginal energy consumer, with limited priorities set on policies such as energy-efficiency improvements and the diversification of Arab countries' domestic energy mix away from fossil fuels. Past policy priorities in the area of energy were legitimately placed on energy access, the result of which has been the highest rates of modern energy access of any developing region (see Chapter 2). Today, high rates of population growth, increasing rates of urbanization, economic and industrial expansion and rising standards of living are all expected to contribute to the progressive shift in the global geography of energy consumption towards industrializing and urbanizing regions in South-East Asia and parts of Africa, Latin America and the Middle East.[1]

The Arab region's growing energy needs are not only a challenge in their own right, but affect other factors essential for long-term socioeconomic development, in particular water and food security. The water-energy-food nexus presents special challenges in the Arab region, given the large inequalities in access to resources, the scarcity of water and – in many parts of the region – of arable land. The highly interrelated nature of these three factors reflects the need for more sustainable planning in the way natural resources are used. The same factors driving energy demand will also increase demand for water and food, as population grows, living standards and mobility increase and societies move towards more sophisticated technologies.

While climate change has never played a significant role in Arab countries' discourse on energy use, the Arab region is one of the most vulnerable regions to climate change. Water shortages and hazards to food security posed by climate change jeopardize the livelihoods of large segments of the population.[2] The publication of the Stern Review in 2007,[3] the Intergovernmental Panel on Climate change (IPCC) report of 2007[4] and the World Development Report of 2010[5] have left little doubt as to the urgency of climate action needed today. The Arabian Peninsula is already one of the most water-stressed regions in the world, making its long-term water and food security highly vulnerable to climate change.[6]

The Arab region's growing rates of urbanization are feeding into the growing importance of integrated policies that manage natural resources more sustainably. A total of 56% of the Arab region's population already live in cities, and the United Nations projects that, by 2050, this proportion will increase to over 68%.[7] War, political instability, and consequent displacement and migration, particularly in low- and lower-middle-income countries, further accelerate pressure on urban living space and resources.[8]

Access to electricity is now near-universal in most parts of the Arab region

Universal access to modern energy services is one of the fundamental pillars of human

welfare and, as such, a critical factor in modern socioeconomic development. Most of the SDGs relate in one way or another to the objective of achieving universal energy access, including the reduction of poverty, education for all, decent work opportunities, economic growth and reduced inequalities. Clean and secure energy access is also a critical factor in improving livelihoods for women globally, through its countless positive effects on female health and safety, positively affecting key developmental factors such as maternal health, reduced child deaths, access of girls and women to education and hence significant long-term effects on gender balance and social development overall.

High rates of access to modern energy in the Gulf Cooperation Council, the Mashreq and North Africa

The Arab region as a whole has been doing extraordinarily well with enabling its citizens to have universal access to energy. Key reasons include considerable government efforts to supply modern fuels, electricity and cooking technologies to their populations. In wide parts of the region, access to electricity and liquid fuels has gone hand in hand with economic development policies. Some of these are programmes targeting rural electrification, liquified petroleum gas (LPG) subsidies and programmes aimed at introducing LPG as the cooking fuel of choice to replace kerosene and traditional biomass, including in the countryside. Price regulation and subsidies for fuels and electricity have formed an intrinsic part of the region's overall energy policy over the past 50 or more years; low-cost energy has been widely perceived as a public good as much as subsidized bread and sugar. As a result, access to electricity and clean cooking fuels and technologies (CFTs) in the Gulf Cooperation Council (GCC) economies and most parts of the Mashreq countries and North Africa is now nearly universal. Latest data over the tracking period reconfirm existing trends in electricity access in the Arab region. The Arab region's electrification rate increased slightly, from 89% in 2012 to 90.4% in 2014, up from 82% in 2000 and 76% in 1990.[9]

Historically, high urbanization rates have helped many Arab countries to increase access to modern energy. Fast-rising urbanization rates were accompanied by the gradual improvement of urban–rural networks in parts of the Mashreq and North Africa during the 1960s, 1970s and 1980s. By 1990, most Arab countries already had relatively comprehensive access to electricity, with rates ranging from around 50% in Morocco to over 90% in Algeria, Iraq, Jordan, Lebanon, Syrian Arab Republic and Tunisia. By then, more than half the Arab region's population was already living in urban areas; more than two-thirds in the GCC, Iraq and Jordan. Only the Arab LDCs - Mauritania, Sudan and Yemen - lag significantly in this area.[10] Today, more than two-thirds of the Arab region's population live in urban areas, the GCC economies Bahrain, Kuwait, Qatar and the UAE having urbanization rates of almost 100%.[11]

Similar to electricity, access to clean CFTs in the Arab region is relatively high. Overall, the share of the Arab region's population using CFTs has been rising continuously throughout the 2000s and stood at 88% in 2014, with intraregional differences ranging from close to 100% access in the GCC economies and the Mashreq, to less than 40% in the Arab LDCs – Mauritania, Sudan and Yemen.

Significant gaps in access to modern energy remain in the Arab Least Developed Countries

Despite very positive developments in electricity access in North Africa, the Mashreq and the GCC since the 1990s, some significant gaps in access to energy remain in the Arab

region. A total of around 36 million Arabs did not have any access to electricity in 2014, primarily in the Arab LDCs with small numbers of people without electricity access in North Africa and the Mashreq. The situation of those left behind is exacerbated by the geographical concentration of lack of access to energy, which is typically linked to other deprivations such as insufficient access to secure water and food resources, education and health care, and parallel environmental destruction. Mauritania, Sudan and Yemen represent the greatest number of people with no access to electricity and limited access to CFTs in the Arab region.

Sudan and Yemen continue to face a large gap in access to modern energy. Together, they account for some 29 million people – around 81% of the Arab region's electricity access deficit. Electrification rates in 2014 range from 72% in Yemen to a low 39% in Mauritania, with rural electrification rates in Mauritania standing at merely 2%[12]. These numbers include significant progress since the 1990s; in Mauritania alone, overall electricity access has doubled since 2000, particularly in urban areas, but with limited progress over the tracking period 2012–2014. Despite these improvements, the vast gap in access in these countries remains a major obstacle to further socioeconomic development. Nearly two-thirds of people without access to electricity in the Arab region live in Sudan and one-fifth in Yemen.

A considerable urban–rural divide remains in the Arab region, where urban access to electricity and CFTs is substantially higher in countries with incomplete coverage than in rural areas. Overall, access to electricity is close to universal in cities across the Arab region, but remains fixed at approximately 80% in rural areas. This issue is particularly precarious in the Arab LDCs, where almost 80% of urban dwellers have some access to electricity. In Mauritania, only 2% of people living in rural areas have access to electricity and 32% in Sudan[13]. Other geographic factors can also play a role in accessing electricity. In Yemen, electricity access remains highly location-dependent, with urban and rural areas in the former North being substantially better serviced than the mostly rural areas of the former South, although the war in Yemen since 2015 has arguably turned access to electricity into a problem throughout the country.

A frequently forgotten aspect of access to electricity is the quality and reliability thereof. While access in many countries may be close to universal, according to recent data, many countries experience service disruptions and power outages, the frequency of which differs significantly from country to country. Access to electricity may mean a few hours of service per day, or it may imply 24/7 coverage. Egypt, Iraq, Lebanon, Palestine and Yemen have been experiencing the most power outages, a situation we believe is inadequately reflected in available public data. Political disinterest in collecting and disseminating such data, coupled with a lack of institutional capacity, are important factors contributing to the insufficiency of reliable data. In addition, political conflict has severely affected data-collection capabilities of a number of countries, including Iraq, Libya, Mauritania, Sudan, Syrian Arab Republic and Yemen. It is thus prudent to assume that actual disruptions in these countries are significantly under-reported in the available data.

Conflict and political instability are major obstacles to sustainable development, in many cases reversing past progress in areas such as energy access. The years since 2010 have seen the escalation of an unprecedented number of political crises and conflicts in the Arab region, from Egypt, Libya and Tunisia to Iraq, Sudan, Syrian Arab Republic and Yemen. The effects of

conflict are profound for many of the region's economies and people. Devastating long-term effects of the destruction mount as conflicts extend to many years. Vast areas of land, infrastructure and entire cities are lost, along with the livelihoods of millions of people. In Syrian Arab Republic alone, conflict and political instability have left severe and lasting damage to the country's ability to supply its population with energy. The destruction of oil and gas fields caused an estimated US$ 8.4 billion in losses in early 2016. Losses to electricity, water and sewerage installations amounted to US$ 8.2 billion.[14]

Political conflict also undermines sustainable management of resources such as energy and water. This is, on the one hand, because central government control often deteriorates throughout the conflict. On the other hand, conflicts, as well as subsequent ceasefires, increase the focus on policies that promise tangible benefits to specific constituencies in the short term, over and above long-term planning and the enforcement of sustainable production and consumption patterns. The effects of poor resource management can be devastating in the long run, making conflict today a heavy heritage for future generations beyond the acute cost in human life and the loss of infrastructure.

Reductions in energy intensity lag behind those in other regions

Reductions in energy intensity in the Arab region have been lagging significantly behind those in other regions. Between 2000 and 2014, global energy intensity fell by around 1% annually, 2% per year since 2010, while the average intensity in Arab countries rose by around 1% during the 2000s and has since been largely stagnant. Over the long term, the Arab region's energy intensity has been rising with some variation, from around 4.4 MJ/2011 PPP US$ (megajoules per 2011 purchasing power parity dollar) in 1990 to 4.9 MJ/2011 PPP US$ in 2014, a regional net increase of 12%, which is in contrast to a trend in falling energy-intensity rates everywhere else in the world. While the Arab region has historically not been one of the most energy-intensive regions in the world, it has been the only one to achieve no fall in its energy intensity over the past 25 years, implying that more energy is needed today than 25 years ago to produce a unit of economic output. Today's average energy-intensity rate in the Arab region is close to the rates of Europe, North America and Central Asia, where countries have over the past 25 years reduced their own energy intensity rates by more than one-third.

The absence of any long-term downward trend in energy intensity is indicative of the very slow progress of raising the efficiency of energy use systematically in the Arab region and at national level. This result is highly problematic, even more so as energy efficiency is one of the few low-hanging fruits among policies aimed at reducing the long-term cost of energy to these highly energy-dependent economies.

Net energy exporting countries in the GCC and North Africa drive the regional trend in rising energy intensity. A closer look at the sub regional level reveals the overall much higher energy-intensity rates in the GCC economies from around the early 2000s compared with any other subgroup of States within the Arab region. Energy intensity in this subgroup continues to rise. Overall, they account for more than 60% of the Arab region's total primary energy supply (TPES), thus being a major driving force behind aggregate regional energy dynamics. Most of the aggregate growth in energy intensity in Arab oil-exporting countries stems from the industrial and residential sectors, with some

growth in energy intensity in the agricultural sector, along with the national agricultural programmes of countries such as Saudi Arabia, aimed at producing more food domestically.

North African countries are the second group of economies that have seen an overall increase in energy intensity since the 1990s, albeit with some variation in the early 2000s, which seemed to show an initial decline in intensity levels. The slight increase in energy intensity in the sub region stems largely from Algeria and Libya, both oil and gas exporters, with Libya clearly being a regional outlier in its significant increase in energy intensity during the 2000s and again since the onset of political instability in 2011–2012. Net energy importers Morocco and Tunisia have seen fairly low and falling energy-intensity rates. The energy intensity of North Africa's agriculture, transport and service sectors has fallen slightly, albeit only marginally compared with the 1990s and with significant variation across years.

Many of the barriers to energy-efficiency improvements in the Arab region are well known and documented. Final user motivation to invest in energy-efficiency improvements across sectors depends on end-user energy prices and their energy spending compared to other costs.[15] While the relatively high ratio of energy inputs to production costs in the highly energy-intensive industries of the GCC economies, as well as medium-size energy producers such as Algeria, should, in principle, offer considerable incentives for producers to improve the efficiency of their energy use, the extremely low price of input fuel and feedstock from domestic production of oil and natural gas have historically provided weak market incentives for producers. To a degree, this is also true for Arab countries that have seen significant increases in their reliance on imported fuels – natural gas, for instance – which continue with very low prices across the region (see Chapter 5 for a more detailed discussion).

Measures that help increase economies' energy efficiency over time, particularly on the regulatory side, have in many parts of the Arab region been sketchy and piecemeal.[16] Building codes, efficiency standards and labelling have in the past been low-priority items in policymaking, although they have increasingly found their way onto regional governments' agendas, the benefits of which will probably only start to accrue in the coming decade. With low electricity prices for domestic consumers, market incentives for property developers to invest in, and for property owners to upgrade, the energy performance of new and existing buildings has in parallel been low. In lower-middle income countries and the Arab LDCs, information about energy-efficiency savings and access to financial markets to finance initial investments, are virtually non-existent. Even in high-income countries in the Arab regions, policy focus and hands-on reform efforts differ markedly between countries, with historical priority being given to fast-rising development and quick improvements in living standards. The revision of building codes and technical standards has been a relatively recent development. Some of these initiatives appear to be driven by a governmental desire to demonstrate commitment to some form of energy saving in view of rising import bills; others by the gradual realization that a business-as-usual scenario will hurt even the most energy-rich economies, whose energy needs are expected to grow further in the future. Enforcement and scoping of regulations that have been passed in more recent years are a parallel issue for many countries.

Typical market structure of the energy industry in the Arab region further affects incentives for energy efficiency. In many Arab countries, public companies fulfil the duty of providing citizens with affordable electricity, as well as water. In practice, this model entails many inbuilt factors that hinder a gradual, market-based absorption of energy conservation, because State utilities implicitly absorb operating and accident risks without formal

risk-pooling and insurance premiums; do not typically require any or a high-enough return on capital; have high billing arrears or non-payment rates; and rely on subsidized input fuels such that their entire cost structure is artificially low. Lacking consumer choice through market competition further reduces incentives for public utilities to invest in more energy-efficient technology or indeed switch fuel. Regulated utility prices that fail to recover operating costs[17] are, on the other hand, frequent standards in the Arab region, in turn obstructing utilities' ability to invest in the maintenance and upgrading of their generation- and transmission-related infrastructure – a dilemma that has also been partly blamed for the poor quality of electricity service in some countries affected by frequent blackouts (see Chapter 5 for a thorough discussion of energy prices and their impact on energy price dynamics).

Modern renewable energy remains a largely untapped resource in the Arab region

Renewable energy plays only a marginal role in the Arab region's energy consumption. No other world region plays such a small role in renewable energy, reflecting the Arab region's globally unparalleled reliance on non-renewable sources. In 2014, renewable energy, including biomass, accounted for some 4% of the region's final energy consumption. This is despite considerable potential for renewable energy, in particular modern technologies such as wind and solar power, given the region's favourable geography and climate conditions.[18] Enhanced policies and market frameworks would have the potential to be 30% higher in the Middle East and Africa by 2021, according to the accelerated case of the International Energy Agency (IEA) in its medium-term outlook for global renewable energy markets.[19]

Historically, renewable energy has found it difficult to compete with fossil fuels in the Arab region for a number of commercial and non-commercial reasons. In most parts of the region, conventional fossil fuels have, for many decades, underpinned the systematic expansion of modern energy access and higher living standards, leading to near-universal access rates of electricity and clean cooking fuels, and comparably low rates of regional reliance on biomass. Both oil and gas producers, and importers of energy, look back at a long-standing history of energy being supplied by the State, usually at fixed prices, paving the way for the accumulation of the massive subsidies that many Arab governments began to accrue during the 2000s. This historical experience closely ties a relatively high degree of socioeconomic development to the availability of abundant, low-cost fossil-fuel-based energy resources, which many citizens in the Arab region have regarded until today as one of the key areas where sustained government intervention is required. More structurally, renewable energy deployment has been slowed by a combination of factors, some of which are more generic and some more specific to the Arab region:

- **Cost barriers.** Like many developing regions, Arab countries found the cost of modern renewable energy technologies such as solar and wind power expensive, relative to existing energy sources until the more recent sharp fall in technology costs in the 2000s. Countries such as Kuwait studied the economics of solar power for use in their power sector as early as the 1970s, but found them to be uncompetitive for reasons of cost.[20] Rapidly falling costs for technologies such as wind and solar power since the late 2000s have slowly begun to reverse this cost disadvantage. The lack of financial market instruments and experience in funding renewable-energy projects at utility scale and micro-level further complicate deployment (see Chapter 5 for a thorough discussion).

- **Market barriers.** Domestic energy and utility markets in the Arab region are highly regulated environments whose particular design has by and large obstructed the entry of new energy technologies – whether potentially cost-effective or not. Key market features, with some intra-regional variation, include the supply of low-cost fossil fuels, either subsidized or at around marginal production cost, to industries and utilities, often at a fraction of their international market value; the parallel regulation of utility tariffs, typically highly subsidized, that in turn deprive utilities of profit-making, and hence the means to invest in new energy projects. Renewable-energy technologies struggle under such market conditions, unless top-down government policy makes room for politically backed-up projects, in the absence of clear market incentives.
- **Technological barriers.** As in other developing country contexts, the prospect of integrating large quantities of variable renewable energy provides challenges in the Arab region. This affects wind power, in particular, whose production profiles are considerably more difficult to predict than, for instance, those of solar power in a region enjoying reliable daytime sunshine for most times of the year. It also affects the viability of decentralized feed-in options, such as the mass rollout of rooftop solar panels in both urban and rural areas to feed surplus production back into the grid. Key renewable energy technologies such as wind and solar power – with the exception of higher-cost concentrated solar power (CSP) technology – are intermittent sources of energy, and have long been seen as an insufficient alternative to -available fossil fuels for the large additional power needs of many of the faster-moving economies.
- **Political will and policy priority.** Political will and policy priority remain critical to driving progress in renewable-energy deployment in the Arab region, given the distorted market signals discussed above. Renewable energy has historically had less lobby in the Arab region, where energy security has been largely upheld by domestically and regionally produced, low-cost fossil fuels, than in classical energy-import markets for which renewables presented the additional benefit of reducing foreign imports. Until now, many large and medium-size fossil-fuel producers see renewable energy as a potential future option, more than as a present priority. At the off-grid level, where renewable technologies such as rooftop solar power are already cost-competitive with the conventional alternative of diesel generators in the long run, the political will to translate these savings into action is missing, particularly in the LDCs.

The contribution of renewable energy towards the domestic energy mix remains highly concentrated in a few Arab countries, primarily those that have continued to use large quantities of biomass since the 1960s. Egypt, Morocco and Sudan together account for over two-thirds of the Arab region's renewable-energy consumption. Sudan alone consumes almost half the region's renewable energy, owing to the continued use of biomass for large shares of the country's energy supply in the absence of more modern energy sources and electricity being available to large parts of the population. Compared to the region's total energy needs, modern non-hydropower renewable-energy technologies such as wind and solar power remain, with very few exceptions such as Morocco and the UAE, a marginal and always very recent source of energy to the region as a whole. In subregional terms, renewable-energy consumption is highest in the Arab LDCs, followed by North Africa, with smaller volumes consumed in the Mashreq, and almost none in the GCC economies, where, despite the recent inroads of solar power, renewable energies continue to account for relatively small amounts of the region's power mix.

The continued use of biomass – particularly traditional biomass – in Arab LDCs raises a number of development concerns, for various reasons. Biomass is not by definition a modern fuel. The efficiency of biomass – whether modern or traditional, does not compare with renewable energy technologies such as solar, wind or hydropower. While modern biomass such as charcoal presents a considerable improvement relative to traditional biomass sources, its efficiency remains low and its sourcing is, in many cases, not sustainably managed. Biomass in most forms offers households no access to electricity. Traditional biomass use in particular results in considerable negative health impacts from the high concentrations of particulate matter and carbon monoxide, among other pollutants.[21] More efficient modern bioenergy in the form of solids, liquids and gases is not yet widespread in the Arab region, where biomass consumption typically remains a feature of the poor in the absence of better alternatives. In Mauritania, one of the largest biomass consumers in the Arab region, natural forest areas decreased by 30% between 1990 and 2000 alone.[22] Deforestation often results in the gradual decline of fuelwood available to local communities, raising serious concerns over the sustainability of biomass supply and, in many cases, its highly destructive impact on nature, the environment and, eventually, rural communities. Systematic biofuel production, which is not yet taking place in the Arab region, also raises concern over the use of water resources and food security, given high land and irrigation requirements.[23] More modern uses of biomass, such as in waste-to-energy plants raise separate issues that remain unresolved in the Arab region, including the parallel lack of recycling practices and emission and pollution controls, the effective implementation of which would increase the cost of such technologies significantly.

Solar and wind power emerge as new sunrise technologies

The trend towards renewable-energy consumption in the Arab region is nevertheless moving away from biomass towards modern renewable technologies. Where renewable-energy consumption grew over the period 2012–2014, it did so primarily on the basis of technologies such as solar and wind power and, to a lesser extent, hydropower. The single largest increments in renewable-energy consumption over the past 25 years were recorded in wind power, the consumption of which rose nearly 1,000% over the period 2000–2010, particularly in North Africa, with the installation of large windfarms in Morocco and Tunisia, and in the Mashreq countries during the 1990s and 2000s. Solar-power consumption increased strongly as well, albeit from very low rates to start with: up 55% across the region during the 2000s, and 20% over the period 2012–2014 alone, especially in the GCC economies. In the Arab LDCs, the largest single increment in consumption of renewables came from hydropower.

A few Arab countries account for virtually all of the region's newly installed renewable-powered electricity-generation capacity. The largest electricity-generation capacity additions in renewable energy in the Arab region over the tracking period 2012–2014 took place in Morocco (with some 547 MW new capacity installed during 2013 and 2014) and the UAE (113 MW new generation capacity) primarily from CSP. In the coming decade, both countries aim to significantly increase their renewable-energy generation capacity further, to a total of 2,000 MW installed wind and another 2,000 MW solar capacity in Morocco by 2020 (around 42% of total generation capacity), to be further doubled by 2030 (to account for 52% of total generation capacity); and 5,000 MW or 25% of Dubai's electricity generation by 2030 in the UAE. Other countries in the region have even larger renewable-energy plans, with the highest

capacity target currently in Saudi Arabia, which aims for 9,500 MW renewable-energy-based power generation capacity by 2030; Egypt with total capacity targets of 9,500 MW (wind and solar power) or 20% of total electricity generation by 2022; and Algeria with combined capacity targets of 4,375 MW by 2020 and 21,600 MW or 37% of installed electricity generation capacity by 2030, including wind, solar, biomass and geothermal power.

While the Arab region's recent trend in solar- and wind-power energy deployment is currently driven by a few countries, more dedicated policies to establish these technologies could substantially increase the level of deployment over the coming decades. This includes allowing markets to establish a business case for alternative technologies. In a market that remains more than any other region dominated by fossil fuels, this will require a more systematic reform to open up utility sectors, but also work on enabling factors for small-scale applications such as off-grid use, through mechanisms such as transparent pricing and access to finance.

Key challenges for progress in sustainable energy in the Arab region

Efficient natural resource governance and policy play a pivotal role in driving the Arab region's energy transition. Existing market mechanisms provide insufficient incentives for a change in production and consumption patterns in the Arab region. The challenge is compounded by the absence of a culture of conserving natural resources, needed to spur required policy changes. On the positive side, however, sustainable-energy and natural-resource management are integrated within national development strategies. This offers significant social and economic opportunities, including the creation of valuable jobs for the Arab region's educated youth. Over the longer term, this integration also offers a tangible improvement in the quality of life for some 343[24] million people living in the Arab region. Future efficiency savings resulting from near-term policy changes can provide significant reductions in the rate of growth in energy demand and near-term financial savings as well. Over the longer term, such changes can provide significant savings to national economies and the reduction of deadweight loss to economies through resource waste.

Initiating proactive policymaking

Proactive policy is a key enabling factor in the Arab region's transition towards a more sustainable use of its natural resources, including energy. Energy markets present various imperfections that reduce the ability of economies to change their way of producing and consuming energy in a sustainable way. These include lack of information, the considerable time lag between changes in policy, the initial cost of switching, for instance, technology, and economic benefits to individuals and companies in the medium and long term. Every year, Arab economies spend tremendous amounts of financial resources to support – and potentially lose – greater economic resources from entrenched, wasteful consumption and production patterns, through untargeted consumer subsidies and missing price signals to the market, missing energy-efficiency regulation and unresolved problems such as incomplete or unreliable access to electricity. Redirecting these resources to cleaner, more efficient and, in the long term, more cost-effective technologies, holds potentially vast benefits for citizens, governments and the wider economy.

A more proactive policy approach towards sustainable energy in the Arab region could involve the following steps:

- **Strengthening the link between sustainable energy and environmental management to social and economic development goals.** This

includes a more rational use of the region's valuable fossil-fuel resources but also the exploitation of the economic potential of energy alternatives, in particular renewable energy, and the reconsideration of legislative settings that encourage or discourage wasteful consumption and production patterns. Mainstreaming the notion that sustainable-energy and natural-resource use is in the interests of economic development also includes emphasis on long- and medium-term benefits for society, such as clean air and water, the protection of land, coastal waters and the natural biosphere, and the parallel creation of jobs and innovative industries that provide opportunities for bright citizens to contribute toward their country's future prosperity. Water, in particular, deserves much higher priority on public agendas; in a region as water-stressed as the Arabian Peninsula, the Mashreq and Africa, subsidizing wasteful water use is simply not an option in the long term, a consideration which carefully directed public discourse should help to ingrain in populations as governments take meaningful policy action against waste.

- **Using innovative policy approaches.** The deployment of renewable energy in the Arab region in recent years illustrates this positive learning curve in Arab countries that have registered positive progress in the deployment of renewables. Some countries have opened the utility sector to private co-investors for new power and desalination projects, against the background of the region's longstanding history of public utility provision at subsidized cost. Public–private partnerships in this context are becoming an increasingly attractive solution for Arab countries aiming to attract private finance for sustainable-energy projects whilst retaining a public hand in energy projects. What such policies do or not do is change the more structural organization of utility markets, in particular the lack of competitive elements of the sector opening up to competition and liberalizing utility tariffs in order to strengthen utility producers that invest in more efficient and cost-effective technology.
- **Ensuring that new policies, plans and targets are stringent and, where voluntary compliance is concerned, mandatory.** This is of particular importance in contexts where various economic interests are involved, such as in regulatory efforts to improve energy efficiency. Inherent difficulties in formulating regulatory requirements involve a number of considerations. These include the availability of components such as: technology, applications, a market for building materials, national know-how, the availability of financial products to fund supplementary costs to individuals, businesses and industries, and the overall economic feasibility of certain measures. The downside of this complex array of factors to consider can be policies whose rigidity besets their own objectives: for instance, all voluntary efficiency codes. Excessive use of exceptions to regulations can furthermore erode regulatory frameworks over time, particularly in large-scale sectors such as building and transport.
- **Effective government communication and strategy-making.** Ultimately, the most effective way of promoting a positive energy transition is the creation of complementary policies between different government bodies that integrate individual policy changes such as in areas of regulation with a wider policy strategy that targets the most efficient use and management of natural resources such as energy, water and food. A strategic national plan for economic growth and development, in which the use of energy and other natural resources and the environment play a major role, can help contextualize and popularize individual policies that, individually, might

generate discontent from some parties. Such policies are those which promote energy efficiency and renewable energy in the national interest, embracing new legislation and regulation from different ministries in coordination with each other, including by: identifying the full cost of a business-as-usual scenario; consulting rather than just informing; and by using quantifiable goals and targets that help the public understand progress.

Building institutional capacity, transparency and accountability

Institution- and capacity-building within existing institutions is a critical component of sustainable energy-policy management targeting long-term development. The complexity of energy-related policies and regulations targeting energy efficiency throughout different sectors without undermining growth, of changing market dynamics and implementing policies that require large changes to existing market structures, such as increased private-sector access and the reform of energy-pricing, require effective institutions with sufficient access to information and data, skilled human resources knowledge of their own area of work, and the political mandate to design, implement and monitor policies.

Key requirements to strengthen institutional capacity across Arab countries include:

- **Clear institutional mandates.** Clear policy-mandating is critical to ensuring institutions can actually do their work, including evaluating current policy, providing policy recommendations and implementing and monitoring policies. In practice, this implies a need for more streamlining, institutional restructuring and clear messaging and communication within government and between governmental bodies.
- **Credible institutions.** Sustainable-energy development policies rest on the availability of credible institutions more than many others, due to the inherent lag between initial costs to individuals and businesses and the eventual accrual of benefits to society and the economy in the long term. Experience in the area of energy-subsidy reform has revealed the central role played by credible institutions in determining the success or failure of relevant government reform across the Arab region. This highlights the need for governments to look at sustainable-energy policy not only as a solitary task, but one that needs to be integrated within wider political work at the level of the public institutions themselves.
- **Professionalization of the public sector.** Key assets to building credible institutions are human resources. Advancing sustainable development in areas such as energy, water and the environment will hence require much more dedicated effort in education, training and the creation of skilled bureaucracies that are able to advise policymaking, and implement policies successfully.
- **Reinforced local governance and the role of cities**. A number of sustainable energy initiatives are suitable for development at the local level, aiming particularly at managing urban spaces and decentralized solutions in lower-income countries such as in the off-grid sector. Rooftop solar panel programmes, feed-in tariffs (FIT), urban and rural public transport, infrastructure development and building standards are all areas where local governments could – and often do – build capacity and implement policies. Governments can make greater use of these opportunities by encouraging municipalities and regional governments to drive national progress in sustainable energy at the local level.
- **Greater use of existing competence.** Key to making greater use of existing competence is the strengthening of communication channels between government institutions, financial institutions and public and private companies. Bringing in the private sector to work towards energy-related development

goals can be critical in advancing this process and reducing the burden of top-down decision-making in favour of cleaner, more modern and more efficient energy technologies from market incentives.

- **Strengthened civil society institutions.** Civil society can be an important catalyst for changing government regulations aimed at improving environmental sustainability and consumer welfare significantly. Many seemingly unpopular legislative decisions, such as changes to energy prices and upgraded efficiency legislation would likely find valuable supporters in civil- society institutions that are able to communicate costs and benefits of the business-as-usual scenario to their constituencies far more credibly than government institutions.

Restructuring domestic energy and water-pricing

The Arab region's slowly changing pricing environment for energy may yet prove to be one of the most important structural drivers of a gradual improvement in energy efficiency. Energy subsidies, particularly if universal in nature, also distort consumer incentives, leading to the overconsumption of energy, energy waste and eventually deadweight loss to the economy. This problem is more distinct in the Arab region, because of the lowest costs of energy – and therefore highest rates of subsidization – are to be found in the region's upper-middle and high-income countries, in particular the GCC and other oil- and gas-exporting countries. While providing citizens with low-cost access to essential utility supplies, the State also subsidizes round-the-clock air conditioning, inefficient power-plant transmission networks and the construction of poorly insulated buildings that will contribute towards the region's energy consumption through the building stock for many more decades.

In lower-middle-income countries and the Arab LDCs, the social cost of this status quo is problematic from a developmental point of view. The cost of energy subsidies relative to other sectors can quickly become enormous – as happened during the high oil prices of the period 2010–2014 – and crowd out fiscal resources for investment in pro-poor sectors such as education and health or the maintenance and systematic expansion of energy-related infrastructure and services. Relative to other spending, price subsidies also give rise to black-market trade, including within countries, between urban–rural areas and inter-State fuel smuggling. Unsurprisingly perhaps, most substantive progress in energy-efficiency regulation and interest in new energy technology, such as renewable energy, has been made in countries that charge comparably high energy prices, such as Jordan, Morocco and Tunisia.[25]

Arab countries' energy-pricing reform efforts still end where additional market restructuring, such as the liberalization of utility markets per se, would be required. This is because in most Arab countries, utility and energy provision generally remains an essential task of State and public companies. A slow opening towards private-sector entrants into utility provision has begun tentatively in Jordan, Tunisia and the UAE. So far, private engagement remains are mostly build-operate-transfer (BOT) style agreements that limit competition to the early stages of project development, rather than to generation and distribution – the two most competitive elements inside power generation. The aspect of wider energy-market regulation and liberalization remains one of the most important areas for further development in the Arab region. While the Arab region is today still far from liberalized energy and utility markets, where customers choose an utility provider or petrol station over cost, reform over the coming decades may eventually benefit different parties: States that still face large outlays for energy-company subsidies; utility companies that will then have an incentive to reduce costs and

invest in the most cost-effective technology; and customers, who will have greater choice and, potentially lower costs than cost-reflective prices in non-competitive energy markets.

Preparing financial markets

Access to finance is a key factor in determining market uptake of more sustainable energy technologies. For many energy markets in and outside the Arab region, economic incentives are at the core of the opportunity for, but also barriers to, the adoption of more efficient energy and renewable energy technologies; disincentives to invest in more sustainable production techniques, and to change long-established consumption patterns also affect progress in other areas of sustainable development, such as the protection of water resources and food security. Supporting a sustainable energy transition is particularly difficult if current market incentives are being considered, given the various imperfections of energy markets in and outside the Arab region, including distortions by pricing signals to producers and consumers, lacking regulatory environments, missing information for consumers and the problem of pricing long-term sustainability of resources into today's energy prices.

Financial sector shortcomings add to the problem of popularizing clean energy technologies, in particular in the case of renewable energy and energy efficiency. Typical financial sector barriers to project funding – not only in the Arab region – include, in addition to, low-capital market development, high capital costs and perceived higher national risk for investors for the nationally small market for renewable energy and energy-efficient technologies. The problem is amplified in low - and middle-income countries and at the level of energy access, where microcredits often remain beyond the reach of small households.

A number of financing solutions have been demonstrated to drive clean-energy deployment in the Arab region, however, illustrating the diversity of options that can work in different circumstances. These include microcredits for small-scale applications, especially in the off-grid segment; international sources of funding, with an increase in initiatives linked to clean-energy development in developing countries; and locally oriented, national policies specific to each individual country.

Strengthening information quality and awareness-creation

Access to information plays a pivotal role in government and business decisions to invest in and favour one technology over another and in guiding final consumer behaviour. The Arab region's current market structures for natural resources – energy, water and the environment – are highly distorted through one-sided government intervention, pricing structures that do not reflect the true cost of natural resources to society and the economy as a whole and, on the other hand, a decade-long public discourse that has focused heavily on the role fossil fuels play in countries' socioeconomic development, with little emphasis on issues such as natural-resource waste, environmental pollution and the degradation of the environment that hosts and feeds over 340 million people in the Arab region. Overdue progress in improving information access in the Arab region will rely on a number of factors, including:

- **Data collection and dissemination.** Where policies are aimed to change behaviour and long-held consumption and production patterns, information becomes much more important. At the most basic level, this is a call for proactive efforts to improve governments' ability to collect, monitor and disseminate qualitative and quantitative data. These encompass social indicators, population and household-income statistics and survey material, as well as consumption and production patterns of different types

of energy including gender disaggregated data on energy use, secure energy access and environmental indicators including the protection of precious land and water resources, protection and loss of species, urban and ambient air pollution, waste disposal and water usage and withdrawal.

- **Information-sharing between institutions.** Government bodies such as ministries and municipalities also need data and relevant information on a wide range of interrelated factors, both at national and subnational level. Policies aiming to increase access to energy and to raise the rate of energy efficiency in the economy and deployment of renewable energy often entail a complex mix of changing market regulations, investment models and other incentive structures to secure project finance and change consumer behaviour. Assessing the potential impact of changes to regulations and policy design on different market segments requires information that is rarely publicly available, nor does any single institution typically collect and monitor data about all factors involved. This renders effective channels of communication and transparent information-sharing between institutions a key enabling factor for good governance and policymaking.
- **Communicating with final consumers.** A critical pillar of changing energy consumption and production patterns is access to information about energy by final energy consumers. While the tenets of this assertion appear fairly self-evident, detailed data, including survey data on household energy-consumption patterns, user profiles and detailed measures taken by government entities and utilities to manage supply and demand, are not systematically available in many Arab countries. Nor is information about domestic energy consumption and measures to improve consumption habits such as household energy-efficiency improvements, available and comprehensible to most households. Both energy efficiency and renewable energy, for example in the form of small-scale rooftop solar installations, can present significant economic savings potential to small households. Popularizing this potential for household savings requires, in addition to regulatory measures and the potential introduction of government-supported loan and payment structures for such projects, the more active communication and explanation of such opportunities to households, given the lack of such information available to large parts of the public in most Arab countries.
- **Re-prioritizing sustainable energy use and environmental consciousness in the public discourse.** On a broader policy level, environmental reporting and public information have low priority in reporting through public institutions, research in universities and think-tanks, and in public media. This includes core messages: for instance, issues in wasteful consumption of energy and water, the degradation of environmental resources such as groundwater levels and coastal waters, and food security. All these themes feature little in the public discourse of most parts of the Arab region, which represents a lost opportunity to sensitivize people to their own consumption behaviour. Young people in the Arab region are overwhelmingly connected to online information and social media, making these forums important for the spread of greater environmental awareness and social support for policies aimed at increasing the sustainable use of natural resources in the long term.
- **Media and academic freedom.** Lack of freedom of science, research and media in many countries also means weak civil society, in addition to weak institutions. A paradoxical situation: some governments lack institutional and human capacity to promote sustainable planning, but also keep civil society from taking over this role. Critical media, backed by qualitative research at local universities and think-tanks could play an important role in driving local solutions to local problems,

such as more targeted investment in public infrastructure or the implementation of low-emission zones in cities. Critical and empowered media are also important to check on the effectiveness of local implementation of existing and new laws and regulations, helping eventually to build trust in the capacity of institutions to implement new laws which benefit the population.

- **Depoliticizing data.** A key problem in many parts of the Arab region is the politicization of data and knowledge, even in innocuous areas such as basic-population and energy-consumption indicators. This provides for an exceptionally difficult context for any effective policy progress. Lack of available publicly – and often even inter-institutionally – data and information makes informed policymaking and a rational public and market response to growing problems such as economic deadweight loss extremely difficult. It also harms governments' ability to justify policies that produce no immediate ad hoc results, for instance regulatory changes aiming for longer-term energy efficiency or, for consumers, an initially costly reduction in energy price subsidies. In the longer term, achieving sustainable development goals, including in the area of energy, will require a degree of greater freedom of science, research, data dissemination and media reporting.
- **Empowering civil society to present their interests.** Where institutional data and information collection and dissemination capacity is limited, civil society groups can play an important role in helping governments to assess society's preferences. Many governments' intrinsic fears of bottom-up interest groups being politically harmful, rather than beneficial elements as part of a country's socioeconomic development path, obstruct this valuable resource from carrying out gradual consumer market-driven change, sometimes against their own best interests. Environmental awareness, green lobby groups, and general consumer interest groups pushing for more adequate, market-driven regulation of public services, building-stock quality and minimum energy-efficiency standards for consumer goods such as electric appliances can play a very important role, not only in monitoring progress, but also in becoming third-party "watchdogs" that can make important contributions to raising awareness in society – and, hence, acceptance of, and support for, policies otherwise deemed costly and unpopular.

One of the most critical aspects for policymakers in energy planning is the reconciliation of increased popular pressure for quick, tangible benefits on the one hand and the design of energy markets that are sustainable in the long-term on the other. The challenge for policymakers is significant, as is the dilemma many Arab economies face in the need to bridge the seemingly competing demands of securing high and rising living standards today, and of building lasting wealth that helps sustain these living standards and their underlying resource base in the future. Non-tangible problems, such as air pollution and the long-term threat of climate change, are new concepts to the region; the associated policy challenge is no less here than in other parts of the world. The close interrelationship between energy and other elements critical for long-term sustainable development, such as water, food and climate change raise the stakes for the delivery of solutions that manage to do both – benefit the region's people in the short-term, while ensuring the consumption and production of the region's precious natural resources are secured for its future generations as well.

Sustainable-energy development is not a priority that is more relevant to any one Arab country rather than another nor a choice between high growth and low growth. As populations grow and living standards rise, so does energy demand across the Arab region: managing natural resources – energy, but also water – is the only way to ensure inclusive growth that will provide all people with economic opportunities in the future.

The senseless destruction of today's natural wealth under the umbrella of "business-as-usual" while populations grow and economies expand is in this context not a realistic choice, no matter what income group or status of fossil-fuel resource endowments a country holds. Arab LDCs perhaps more than all others epitomize the way the management of limited natural resources is a precondition and not an impediment to lasting economic progress.

Conventions used in this report

In this report, the Arab region has been divided into four subregions, to help facilitate subregional analysis along the very different types of economies within the region.

This report aims to track progress in sustainable energy through the collection and analysis of quantifiable, internationally

Table 1. Subregional groups and countries in the Arab region

Country	Population (million)	Population density (people per km² of land area)	Population in largest city (million)	GDP per capita, PPP (current international $)
North Africa				
Algeria	40	17	3	14,688
Libya	6	4	1	..
Morocco	34	77	4	7,841
Tunisia	11	72	2	11,467
Mashreq				
Egypt	92	92	19	10,913
Iraq	..	84	7	15,395
Jordan	8	86	1	10,902
Lebanon	6	572	2	13,936
Syrian Arab Republic	19	101	4	..
Palestine	4	735	1	5,020
GCC				
Bahrain	1	1786	0.4	46,586
Kuwait	4	218	3	74,645
Oman	4	15	1	39,971
Qatar	2	193	1	141,543
Saudi Arabia	32	15	6	53,539
United Arab Emirates	9	110	2	69,971
Arab LDCs				
Mauritania	4	4	1	..
Sudan	40	22	5	4,388
Yemen	27	51	3	2,821

Sources: World Bank (2017b).

comparable energy-related indicators. The present report was developed by the UN Economic and Social Commission for Western Asia (UN ESCWA) drawing on data from GTF 2017. It explores progress in the development of sustainable energy and synthesizes regional, subregional and country-level reports in the Arab region, according to the three SE4ALL pillars of sustainable-energy development: energy access, energy efficiency, and renewable energy.

This report proceeds as follows: Chapters 2, 3 and 4 present progress made in the three pillar areas under the SE4ALL framework. Chapter 5 discusses some of the policy challenges the Arab region faces in making further progress in the area of sustainability across different pillars. The Appendix provides further background to the historical and methodological context of the SE4ALL GTF, with an explanation of indicators chosen to track progress in and outside the Arab region.

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Acronyms and Abbreviations

ADER	Agence de développement de l'électrification rurale
ADFD	Abu Dhabi Fund for Development
APAUS	Agence de promotion de l'accès universel aux services
AUPTDE	Arab Union of Producers, Transporters and Distributors of Electricity
bbl	barrel
BOOT	Build, own, operate and transfer
BOT	Build-operate-transfer
CAFE	Corporate average fleet economy
CAGR	Compound annual growth rate
CDM	Clean Development Mechanism
CFLs	Compact florescent lamps
CFTs	Clean cooking fuels and technologies
CH_4	Methane
CIF	Climate Investment Funds (World Bank)
CNG	Compressed natural gas
CO_2	Carbon dioxide
CCP	Combined-cycle power
COP21	2015 Paris Climate Conference
CSP	Concentrated solar power
EAD	Environment Agency Abu Dhabi
EETC	Egyptian Electricity Transmission Company
EF	EU energy facility
EJ	Exajoule
ERA	Egyptian Electric Utility & Consumer Protection Agency
ERUDI	Projet d'électrification rurale décentralisée interrégionale en Mauritanie
ESCWA	Economic and Social Commission for Western Asia (United Nations)
ESMAP	Energy Sector Management Assistance Programme (World Bank)
EU	European Union
FAO	Food and Agriculture Organization (United Nations)
FIT	Feed-in tariff
GACA	General Authority of Civil Aviation (Saudi Arabia)
GCC	Gulf Cooperation Council
GCR	Greater Cairo Region
GDP	Gross domestic product
GDP PPP	Gross domestic product based on purchasing power parity
GDF	Gaz de France
GEF	Global Environment Facility
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GNI	Gross National Income
GRET	Groupe de Recherche et d'Echange Technologique
Gt	Gigaton
GTF	Global Tracking Framework
GW	Gigawatt
GWh	Gigawatt hours
IDPs	Internally displaced persons
IEA	International Energy Agency
IFC	International Finance Corporation
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
KAPSARC	King Abdullah Petroleum Studies and Research Centre
ktoe	Kilo tons of oil equivalent
toe	Tons of oil equivalent
kWh	Kilowatt-hour

LDC	Least Developed Country (United Nations)
LEED	Leadership in Energy and Environmental Design
LDVs	Light duty vehicles
LNG	Liquified natural gas
LPG	Liquefied petroleum gas
m^3	Cubic metre
MPA	Marine protected areas
MENA	Middle East North Africa
MESIA	Middle East Solar Industry Association
MJ	Megajoule
MJ/2011 PPP US$	Megajoules per 2011 purchasing power parity dollar
MMBtu	Million British Thermal Units
MW	Megawatt
MWh	Megawatt hour
N_2O	Nitrous oxides
NGO	Non-governmental organizations
ODS	Ozone-depleting substances
OECD	Organisation for Economic Co-operation and Development
PERG	Programme d'électrification rurale global
PERUB	Programme d'électrification rurale dans la région du Brakna
PM	Fine particulate matter
PPA	Power purchase agreement
PP	Percentage points
PPP	Purchasing-power parity
PV	Photovoltaic(s)
RCREEE	Regional Centre for Renewable Energy and Energy Efficiency
RE	Renewable Energy
REN21	Renewable Energy Policy Network for the 21st Century
RISE	Regulatory Indicators for Sustainable Energy
SDG	Sudanese pound
SDG	Sustainable Development Goal (United Nations)
SEEC	Saudi Energy Efficiency Centre
SEEP	Saudi Energy Efficiency Programme
SE4ALL	Sustainable Energy for All
SIDS	Small Island Developing States
SMEs	Small and Medium Businesses
SSIs	Small-scale Industries
STE	Solar thermal electricity
TFEC	Total final energy consumption
TJ	Terajoule
TPES	Total primary energy supply
UAE	United Arab Emirates
UN	United Nations
UNAMID	African Union-United Nations Hybrid Operation in Darfur
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN HABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
US$	US dollar
W	Watt
WACC	Weighted average cost of capital
WEO	World Energy Outlook
WHO	World Health Organization
µg/m^3	Micrograms per cubic metre

Heavy traffic jam in Amman, capital city of Jordand. © tenkl | Shutterstock.com

1. Energy and Development in the Arab Region

Overview

The Arab region is a large and diverse region that shares a rich geography known for its natural-resource wealth as well as its climate vulnerability. It is also on the verge of an important region-wide transition with vast implications for its long-term socioeconomic modus operandi – the transition from being one of the world's largest producers and net exporters of fossil-fuel-based energy, towards one of the world's main growth markets for energy demand. Managing the dual goals of socioeconomic growth and sustainable energy development and natural-resource management will hence become an ever-growing challenge for the region and its vastly different economies.

This chapter explores some of the characteristics of the region at the interception of energy, economic development and wider natural-resource management. It observes five key regional challenges:

1. **Natural resources, including fossil fuels, are unequally distributed in the Arab region, as are income levels and associated levels of socioeconomic development.** Income levels reflect to a large extent differences in natural resource endowments and subsequent levels of State income, but also the management of these resources. This relates directly to the quality of governance and institutions, as discussed in greater depth in Chapter 5.
2. **Energy consumption is rising fast in Arab economies, a trend that challenges the region's traditional energy policy.** Having historically been a marginal consumer and key regional exporter of energy to world markets, the Arab region is now faced with growing pressures for more comprehensive, sustainable energy and natural-resource planning that reflects the needs of both present and future generations.
3. **The Arab region's growing energy needs are not only a challenge in their own right, they affect other factors essential for long-term socioeconomic development, in particular water and food security.** The water-energy-food nexus presents special challenges in the Arab region, given the very large inequalities in access to resources, the scarcity of water and – in many parts of the region – of arable land. This makes more effective policymaking with a focus on greater sustainability of natural-resource use all the more critical to long-term growth and the stability of regional socioeconomic development.
4. **While climate change has never played a significant role in Arab countries' discourse on energy use, the Arab region is one of the regions of the world most vulnerable to climate change.** Water shortages and hazards to food security posed by climate change jeopardize the livelihoods of large segments of the population. If left unmanaged, climate-relevant factors such as a continuing lack of adaptive measures, the protection of land and water resources, and complacency in seeking more sustainable ways of using and producing energy, could entail a high economic and social cost.

5. **The Arab region's growing rates of urbanization are feeding into the growing importance of integrated policies that manage natural resources more sustainably.** Cities add further pressure to the water-energy-food nexus, as they comprise higher water, food and energy consumption patterns within a smaller space, coupled with environmental degradation and urban air pollution. The Arab region's urban population is expected to more than double again by 2050, further increasing pressure on existing living spaces and natural resources.

Progress in the three pillars presented in Chapters 2, 3 and 4 will be a critical contributing factor to managing the multi-faceted challenges faced by Arab countries over the coming years and decades. As populations and economies grow, so do their overwhelmingly young people's expectations for economic opportunities and improving living standards, for which the availability of an ever-increasing pool of natural resources will be of pivotal importance.

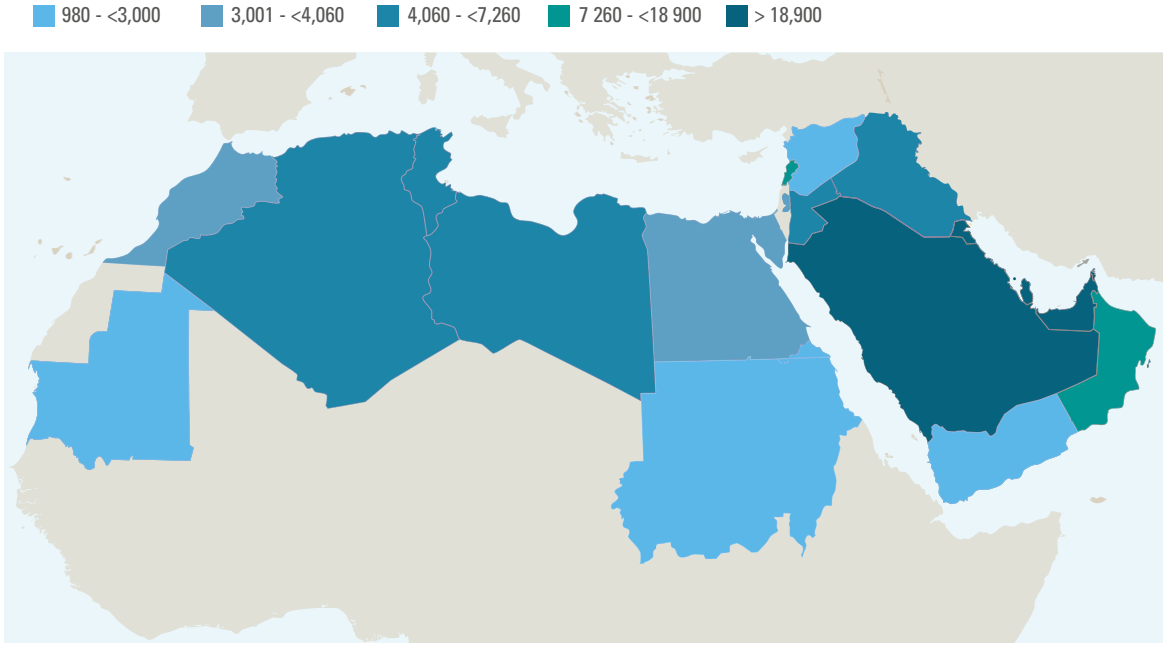
Natural resources and income ranges are distributed unequally in the Arab region

The Arab region is a large and diverse region that shares a rich geography known for its natural resource wealth as well as its climate vulnerability. It comprises 19 countries, stretching from Morocco and Mauritania on the Atlantic coast of North Africa, across Egypt, Syrian Arab Republic, Jordan and Palestine in the Levant, or Mashreq, to Iraq, the GCC economies and Yemen on the Arabian Peninsula.[26] It represents 10% of the world's land area and is home to some 343 million people[27]. In 2014, the region accounted for some 5% of the world's total primary energy supply (TPES), though less than 5% of the world's carbon dioxide (CO_2) emissions and some 5% of the world's GDP, the generation of which remains highly concentrated in the GCC and to a lesser extent the Levant and North Africa.[28] The Arab region is also a region of extremes in terms of its natural resources and at the same time of extreme aridity with most of its land being desert. Water scarcity and food security represent major challenges for the region's sustainable development.

Natural resources, including fossil fuels, are unequally distributed in the Arab region, as are income levels and associated levels of socioeconomic development. Countries including Iraq, Kuwait, Saudi Arabia and the United Arab Emirates (UAE) are large oil producers with sufficient reserves to continue production at current rates for another 70[29] years at least. Strategically, these countries' primary interest is in the stability of demand markets for their fossil fuels in the long-term future. Medium -and smaller- size producers such as Algeria, Egypt, Syrian Arab Republic and Yemen face smaller reserves and production outlooks, making the maximization of profits from fossil-fuel exports in the short term and the diversification of their economies in the medium term far more urgent than for larger producers. Jordan, Morocco, Palestine and Tunisia have historically been net importers of energy, which have been most directly affected by rising energy prices on international commodity markets during the 2000s and as such have been facing urgent pressure to relieve themselves of their historical reliance on fossil-fuel imports.

Income levels reflect, to a large extent, differences in natural resource endowments

Map 1. Gross National Income per capita, Atlas Method (current US$, 2014)



Notes: Syria: 2007 data; Libya: 2011 data.
Source: United Nations ESCWA based on World Bank (2017b) data.

and subsequent levels of state income, but also the management of these resources. Arab economies include some of the world's wealthiest nations on a per capita basis: small but oil-rich Gulf economies such as Kuwait, Qatar and the UAE, whose economies remain to a large extent tied to fossil fuels and related energy-intensive industries; middle-income countries with highly divergent levels of economic diversification in countries such as Algeria, Egypt, Jordan, Morocco and Tunisia; to LDCs – Mauritania, Sudan and Yemen – which count among the poorest and least developed economies in the world, despite – in the case of Yemen – substantial fossil-fuel endowments. Sudan has only recently joined this group following the secession of the South in 2011, where most of the former unified republic's oil wealth is based. The per capita Gross National Income (GNI) of Qatar in 2014 dollars – the region's wealthiest State on a per capita basis – was 60 times that of Yemen, one of the poorest countries in the region on a per capita basis (Map 1).

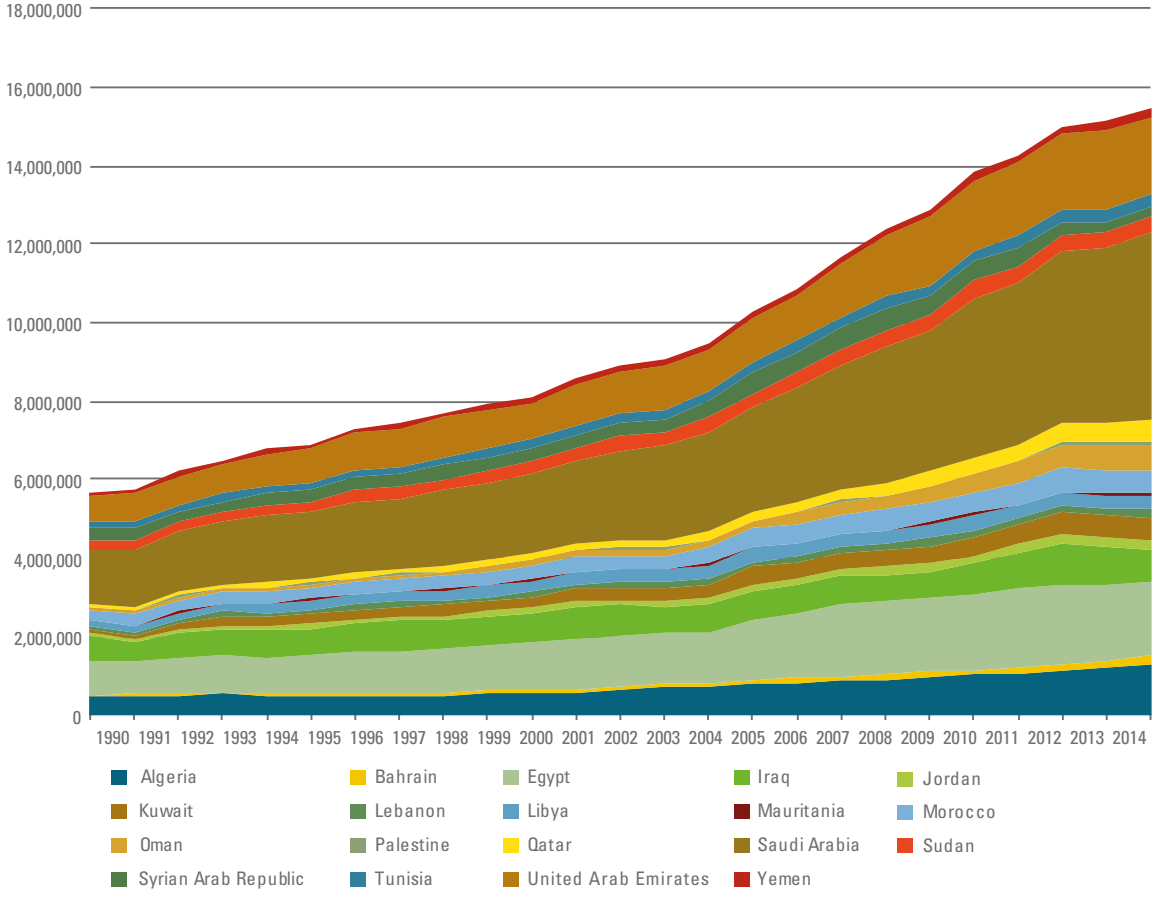
The Arab region is on the verge of an important region-wide transition with vast implications for its long-term socioeconomic modus operandi – the transition from being one of the world's largest producers and net exporters of fossil-fuel-based energy, to being one of the world's main growth markets for energy demand. As regional economies move on to accommodate more economic growth, ever-growing populations and rising living standards for all parts of their societies, their energy needs are expected to increase significantly in the future. Nevertheless, the Arab region is still at the very beginning of its transformation towards a more sustainable way of using its rich natural resources, while protecting itself from its own long-term vulnerabilities: declining mineral resources, fiscal pressures from volatile energy markets, region-wide water scarcity that is likely to become more acute and the threat of the negative implications of climate change on precious local and regional land and maritime

resources and food security. At the same time, some 36 million Arabs still lack basic access to electricity and an even greater number to clean cooking fuels – a situation that will impose particular challenges for the Arab region's LDCs for decades to come (see Chapter 2).

Fossil fuels form an integral part of the Arab region's modern socioeconomic development trajectory, reflecting its large oil and natural gas resources that have defined its status as a key supplier of oil to world markets. The Arab region as a whole accounts for some 30% of the world's oil and around 16% of global natural gas production, holding some of the world's largest regional reserves of crude oil and natural gas (Table 2).

Some three-quarters of the region's oil production are exported and traded on international markets, reflecting its historically small domestic energy demand relative to the size of its energy resources and the important role played by oil industries in many Arab oil-producing economies. Fossil fuels also dominate the region's domestic energy mix, with oil and natural gas accounting for around 95% of the region's own energy needs (see Chapter 4).

Figure 1. Historical energy consumption in the Arab region by country (TJ), 1990–2014



Source: World Bank (2017a).

Table 2. Energy balances in the Arab region, 2014

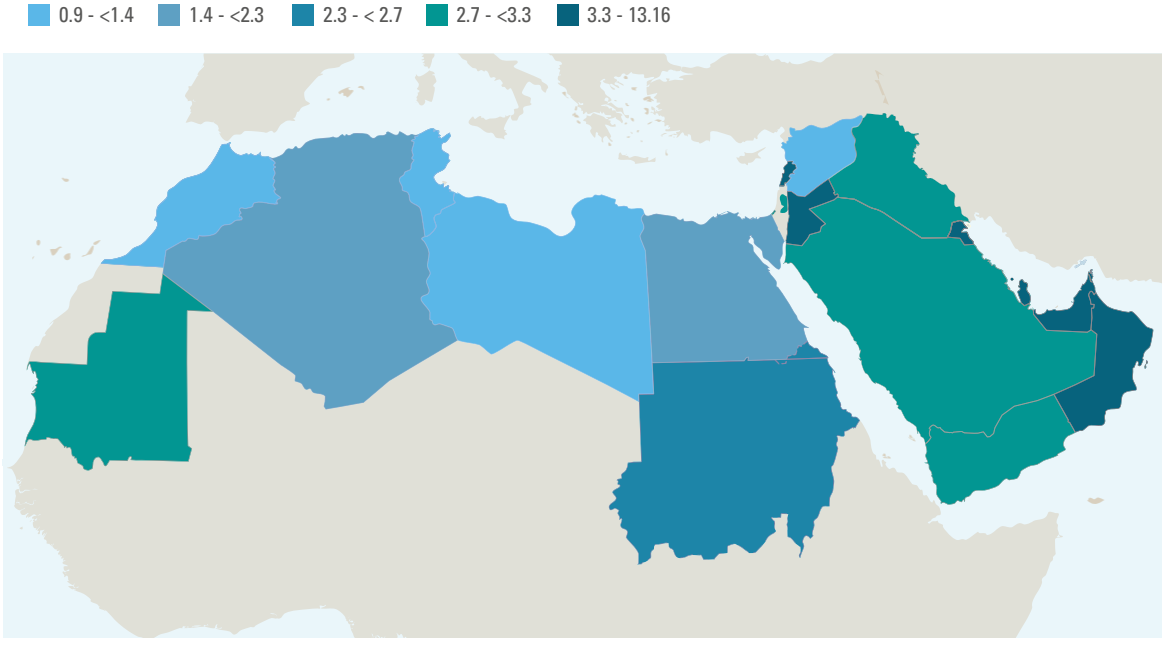
	Crude oil production (ktoe)	Natural gas production (ktoe)	Net energy exports (ktoe)	Share in world oil production	Share in world natural gas production
North Africa					
Algeria	72,976	70,193	-89,745	2%	2%
Libya	25,949	10,167	-16,385	1%	0%
Morocco	5	85	19,526	0%	0%
Tunisia	2,902	2,576	4,154	0%	0%
Mashreq					
Egypt	31,175	46,108	-4,415	1%	2%
Iraq	157,171	5,518	-111,282	4%	0%
Jordan	1	97	8,373	0%	0%
Lebanon	0	0	7,608	0%	0%
Syrian Arab Republic	1,401	3,970	5,431	0%	0%
Palestine	n/a	n/a	n/a	n/a	n/a
GCC					
Bahrain	10,681	12,195	-8,356	0%	0%
Kuwait	154,092	12,273	-131,143	4%	0%
Oman	47,403	27,085	-48,536	1%	1%
Qatar	77,589	142,345	-173,815	2%	5%
Saudi Arabia	552,903	69,516	-603,474	13%	2%
United Arab Emirates	156,080	43,887	-109,554	4%	1%
Arab LDCs					
Mauritania	n/a	n/a	n/a	n/a	n/a
Sudan	6,108	0	0	0%	0%
Yemen	7,546	8,391	-8,439	0%	0%
Total	1,303,980	454,407	-1,260,052	30%	16%

Note: ktoe = kiloton of oil equivalent.
Source: Based on IEA data from World Energy Balances © and World Energy Statistics © OECD/IEA 2016: www.iea.org/statistics.
Licence: www.iea.org/t&c, modified by UN ECSWA.

Regional energy consumption is rising fast in Arab economies

The Arab region's rapidly growing domestic energy demand challenges the region's traditional energy policy. With a historically small domestic energy market, the Arab region has long been perceived as a marginal energy consumer, with limited priorities set on policies such as energy-efficiency improvements and the diversification of Arab countries' domestic energy mix away from fossil fuels. Past policy priorities in the area of energy were legitimately placed on access to energy, the result of which has been the highest rates of modern energy access of any developing region (see Chapter 2). Today, high rates of population growth, increasing rates of urbanization, economic and industrial expansion and rising living standards are

Map 2. Population annual growth (per cent, 2000-2014)



Source: United Nations ESCWA based on World Bank (2017b) data.

all expected to contribute to the progressive shift in the global geography of energy consumption towards industrializing and urbanizing regions in South-East Asia and parts of Africa, Latin America and the Middle East. [30]

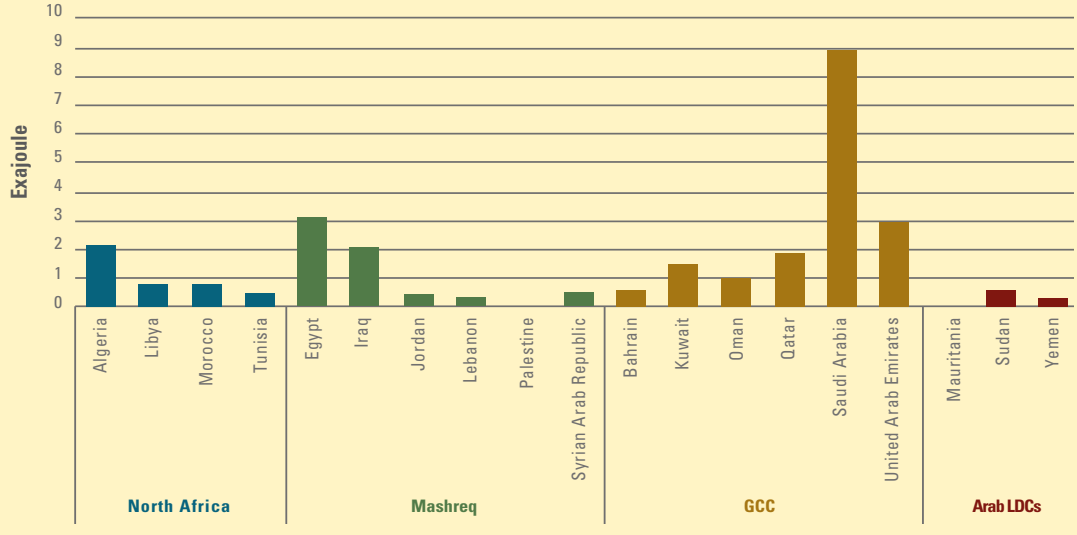
The ongoing transition of the Arab region from a key global exporter of energy into an increasingly dynamic energy market in its own right will entail growing pressures for more comprehensive, sustainable energy planning. The gradual shift from oil to natural gas in many parts of the utility and industrial sectors in the Arab region during the 1990s and 2000s, coupled with more limited gas resources and production than in the case of oil, is likely to lead to further growth in the need for energy imports. This trend includes countries formerly known only as energy exporters, including Egypt, Kuwait, Oman and the UAE. Policies aimed at demand management, efficiency savings in the energy sector and the greater use of indigenous energy alternatives, including renewable energy, to bring down demand provide an alternative option. Increasing pressure on living space and interrelated resources, such as energy, water and food, will also make inclusive policies that help protect and conserve countries' natural assets ever more important to the long-term stability of Arab countries' socioeconomic development models.

Rising energy consumption also affects water and food security

The Arab region's growing energy needs are not only a challenge in their own right, but affect other factors essential for long-term socioeconomic development, in particular water and food security. The water-energy-food nexus presents special challenges in the Arab region, given the large inequalities in access to resources, the scarcity of water and – in many parts of the region – arable land. The highly

Box 1. Regional fast-moving energy markets

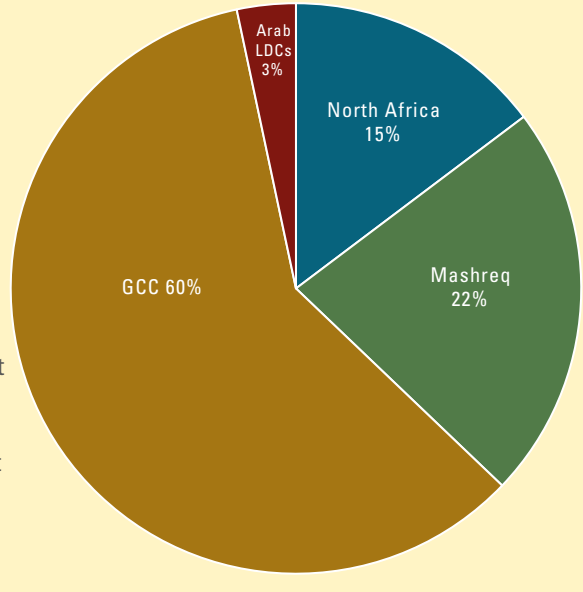
Figure 2. Total primary energy supply in the Arab region, 2014



*Data gaps: Mauritania, Palestine,
Source: World Bank (2017a).

In the recent past, three countries have dominated the regional energy picture: Saudi Arabia, Egypt and the UAE (Figure 2). Providing 32%, 11% and 10% respectively, and over half the final energy supply in the Arab region in total, these countries are critical drivers of regional energy trends. At subregional level, the GCC economies account for 60% of the Arab region's total primary energy supply, followed by the Mashreq with 22% and North Africa with 15%. Arab LDCs supply only 3% of the region's TPES (Figure 3). While Arab LDCs are only small energy consumers, they will account for the majority of new access to electricity and CFTs over the coming years. By contrast, the Gulf economies, followed by the Mashreq and North Africa, are key markets for both improvements in energy efficiency and the deployment of clean renewable energy. They are also critical drivers of regional contributions towards internationally negotiated energy-related development targets, in particular climate change mitigation. Only 8 out of 19 Arab countries are net importers of energy: Jordan, Lebanon, Mauritania, Morocco, Palestine, Syrian Arab Republic, Sudan and Tunisia (see Table 2). Combined, they account for a mere 13% of final energy demand in the Arab region, leaving Arab energy exporters as the most important driving force of regional energy-demand dynamics.

Figure 3. Share by subgroup of economies in the Arab region's total primary energy supply



Source: World Bank (2017a).

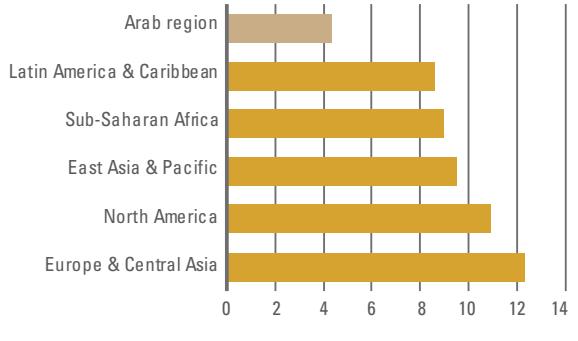
interrelated nature of these three factors reflects the need for more sustainable planning in the way natural resources are used. Water is used throughout the entire agri-food chain, from agricultural production to fishing and forestry. In parallel, the agri-food chain consumes about 30% of total energy globally, as energy is required to produce, transport and distribute food and to extract, pump, collect and distribute water. The same factors driving energy demand in the Arab region will also increase demand for water and food, as populations grow, living standards rise and mobility increases and societies move towards more sophisticated technologies.

The lack of freshwater reserves in parts of the Arab region has led a growing number of countries to increase their use of seawater desalination, which, in turn, further increases domestic demand for energy. In the GCC, 80% of drinking water is supplied from desalination plants, while only 20% comes from finite groundwater resources.[31] Desalination is energy-intensive and environmentally problematical, as saltwater contributes to the increased salinity of coastal waters, further reducing the capacity of the natural carbon-uptake capacity of waters such as the Arabian Gulf, while affecting the biodiversity of local fishery grounds. Water is also used by industries such as upstream oil and gas production in order to produce primary energy, although its withdrawal rates are small compared to those of the agricultural sector.

Water scarcity in the Arab region raises a whole set of long-term concerns about the sustainability of current modes of extracting as much water and natural resources as possible from the region's fragile biosphere; these considerations are not currently factored into the cost of water and energy for final consumers. The Arab region is one of the most water-stressed parts of the world and its internal renewable freshwater resources are falling rapidly alongside issues such as growing populations and rising living standards. The availability of freshwater reserves in the Arab region dropped from 921 m^3 per capita per year in 2002 to 727 m^3 per capita per year by 2012. Almost 75% of the Arab population lives under the water-scarcity level and nearly half lives under an extreme water-scarcity level of 500 m^3 per capita per year.[32] On the other hand, water prices are very low and do not capture the value of this resource throughout the region, reflecting neither dropping groundwater levels, nor realistic costs for desalination, not to mention the resulting long-term effects of environmental destruction. Similar to primary energy and electricity, the virtual absence of appropriate pricing signals leads to a lack of incentives for the conservation and reuse of water throughout virtually the entire Arab region.[33]

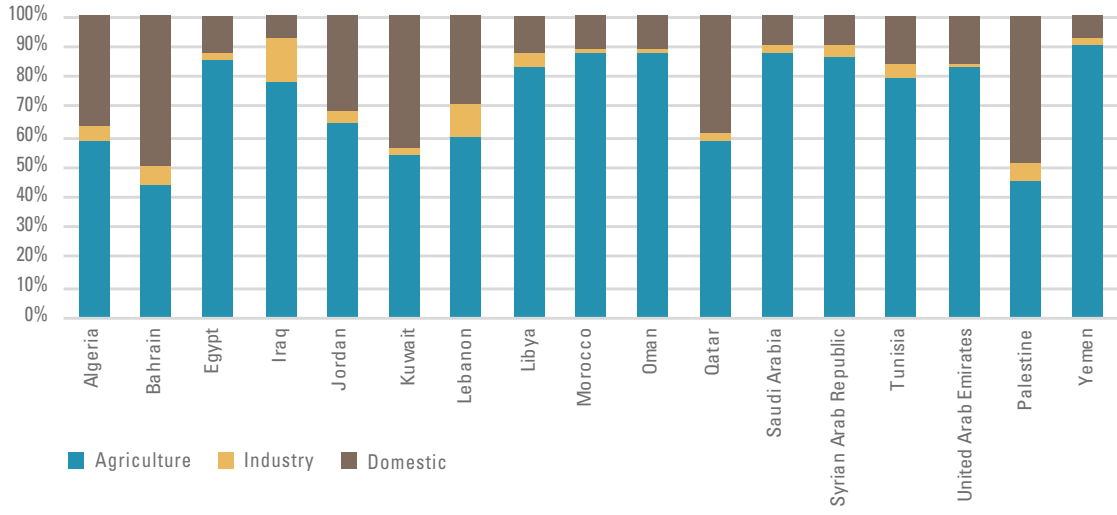
Failure to capture and signal the value of scarce resources – water and energy – in the Arab region will significantly increase the cost of dealing with its consequences in the near-term future. Unsustainable production and consumption patterns for water and energy are a critical concern in a region so exposed to the negative consequences of unmitigated climate change, in combination with pressing needs to supply ever-growing populations with rising living standards. Food security is already a significant cause of concern for a number of arid Arab countries such as those located on the Arabian Peninsula. While technologies present a vast opportunity to improve the lives of people around the globe, they also increase the interlinkages between consumption patterns for water, food and energy.

Figure 4. Arable land (% of land area)



Source: World Bank (2017b).

Figure 5. Annual freshwater withdrawals (% of total freshwater withdrawal)



Source: World Bank (2017b).

Box 2. Water scarcity in the Arab region

Water scarcity is a serious concern in the Arab region. Arab countries cover 10% of the world's area but receive only 2.1% of its average annual precipitation. The region's annual internal renewable water resources amount to only 6% of its average annual precipitation, against a world average of 38%. Most of the region is arid or semi-arid (desert), receiving less than 250 mm of rainfall annually.[35] Many Arab countries draw heavily on their groundwater resources – both renewable and non-renewable – to meet their citizens' rising water demand, particularly for residential consumption and agricultural irrigation. Water continues to be heavily subsidized in most Arab countries and is in many cases seen culturally as a good that should in principle be free of charge to all citizens. The lack of price incentives hence fails to send appropriate signals to markets, resulting in a lack of incentives to conserve and re-use water; the lack of government capacity to regulate and monitor water use results in very limited water management in a number of Arab countries.

Figure 6. Renewable internal freshwater resources per capita (m^3)

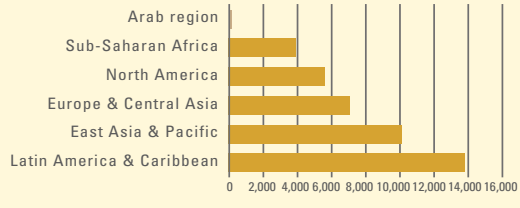
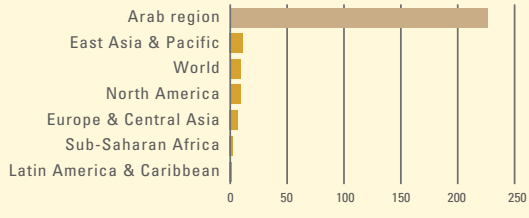


Figure 7. Total annual freshwater withdrawal, (% of internal resources)



Source: World Bank (2017b).

The overexploitation of groundwater resources beyond their natural replenishment rates has, in a number of Arab countries, resulted in the rapid depletion of aquifer reserves and in the salinization and deterioration of water quality due to seawater intrusion. This is in addition to other threats to groundwater resources from

pollution, from agricultural, industrial and domestic activities. Water salinization has, in turn, dried natural springs and degraded or destroyed their surrounding habitats and ecosystems, diminishing these areas' historical and cultural value.

Examples of the negative consequences of excessive groundwater extraction are evident throughout the Arab region. In the UAE, intensive groundwater abstraction in the eastern coastal plains increased water salinity, leading to abandoned irrigation wells and dying date plantations. In Yemen, excessive groundwater withdrawal for extensive irrigated agriculture has led to seawater intrusion in several coastal areas, especially the Abyan Delta along the Gulf of Aden, the Tihama area and Wadi Mawr. The south Algerian oases, natural springs in Bahrain, most of the oases of the Egyptian Western Desert, the Al Kufrah oasis in Libya, the Al Ahsa oasis in Saudi Arabia and the natural springs used to irrigate Tozeur and Kebili in southern Tunisia have all been lost through excessive pumping and sinking groundwater levels.

This highlights the need for significant steps towards better managing these regionally precious resources, most likely through a combination of robust pricing mechanisms that incentivize water conservation and reuse, and through functioning regulatory measures that rationalize water-production patterns in the near term.

Source: Adapted from UNDP (2013), pp. 17–18.

In the Arab region, the proportion of agriculture in total water withdrawal lies at over 80% of total freshwater resources, a trend driven by the highly water-intensive agricultural sectors of arid agri-producers such as Egypt, Iraq, Morocco, Syrian Arab Republic and Yemen.[34] The very high levels of freshwater withdrawals from agriculture of the 80% of total freshwater resources in Oman, Saudi Arabia and the UAE (see Figure 5), with a relatively small domestic agricultural sector raises further questions over the environmental long-term sustainability of highly irrigated agricultural projects in those countries – especially as the Arabian Peninsula is already one of the most water-stressed regions in the world.

The Arab region is highly vulnerable to climate change

While climate change has never played a significant role in Arab countries' discourse on energy use, the Arab region is one of the most vulnerable to climate change. Water shortages and hazards to food security posed by climate change jeopardize the livelihoods of large segments of the population.[36] The publication of the Stern Review in 2006,[37] the IPCC report of 2007[38] and the World Development Report of 2010[39] have left little doubt as to the urgency of climate action needed today. The Arabian Peninsula is already one of the most water-stressed regions in the world, making its long-term water and food security highly vulnerable to climate change.[40] Agriculture in North Africa, the Mashreq and the Arab LDCs is likely to suffer major losses due to high temperatures, droughts, floods, soil degradation and extreme weather events. The United Nations Food and Agriculture Organization (FAO) estimates that, in Egypt alone, climate change could decrease the national production of rice by 11% and of soybeans by 28% by 2050, compared with their production under current conditions.[41]

The severity and pace of climate change are becoming more acute, including in the Arab region. Current global surface temperatures are already now about 0.6 °C higher than the average for the last century. This increase is consistent with model predictions of the

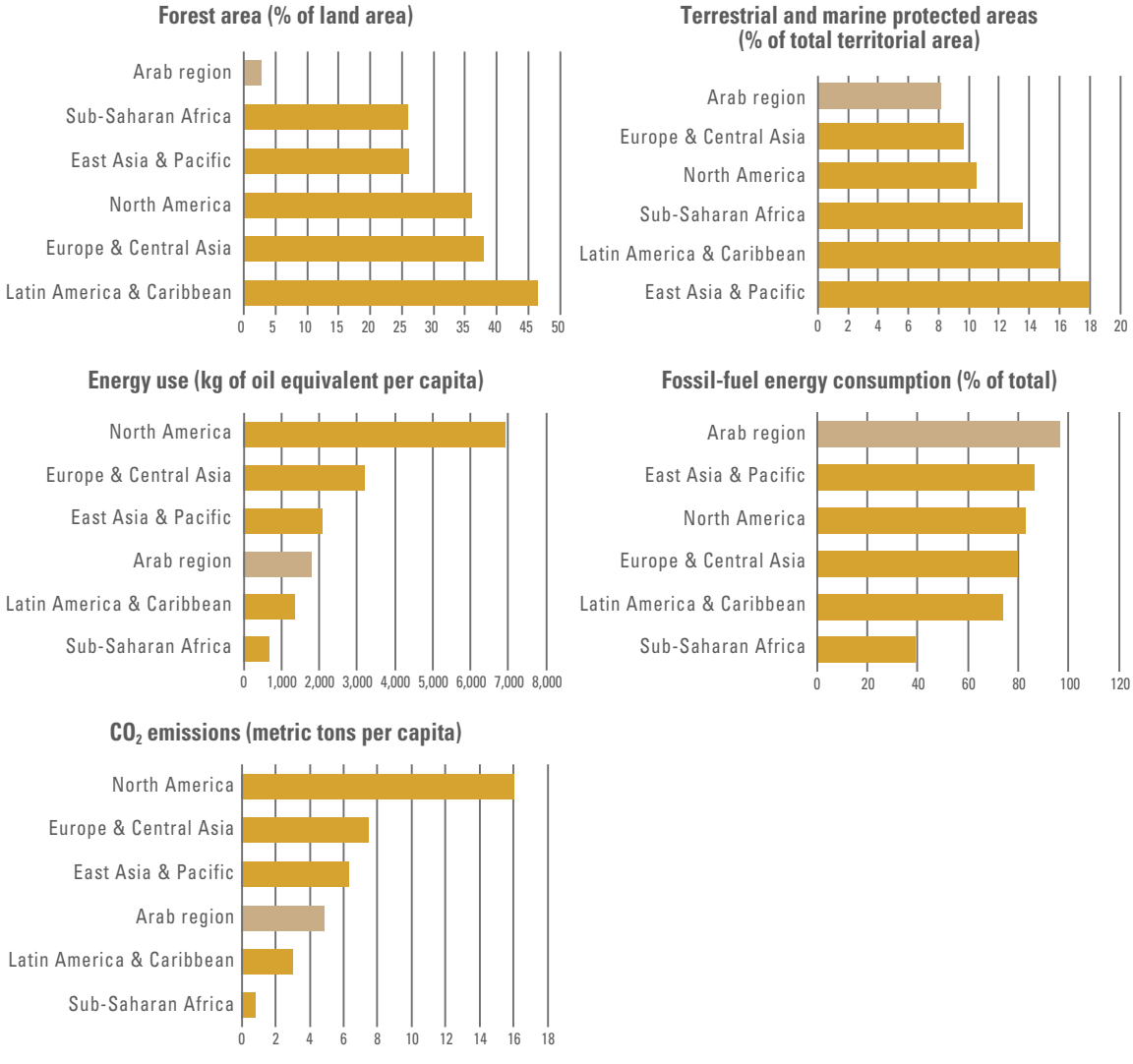
effects of rising atmospheric concentrations of CO_2 and other greenhouse gases (GHGs), which are a result of human activity.[42] UN ESCWA climate projections for the Arab region suggest a consistent warming trend with a general increase in the frequency of warm days and longer summer periods across the Arab region by mid-century, along with more variable precipitation trends, including drier conditions that will become more dominant in North Africa and stronger spatial variability of extreme precipitation and temperature extremes throughout the region.[43] FAO concludes with regards to the Arab region:

> "In the entire Near East and North Africa region, rangelands and livestock are likely to be affected by climate change as they are located mostly in marginal areas. These changes will have an impact on nomadic systems and on livestock pests and diseases. Increases in the outbreak of epidemics are also possible. Soil moisture depletion will likely affect the productivity of major forestry species and lead to declines and extinctions of sensitive species, increased fire risks, and changes in the spread patterns of pests and diseases. The resulting changes in habitats will induce changes in wildlife populations. The combined effects of human actions, nature, and climate change could lead to further degradation and desertification in many parts of the region. (…)
>
> These warming trends will continue if emissions of anthropogenic GHGs continue to follow a business-as-usual scenario, with global atmospheric surface temperatures predicted to rise by at least 4 °C by 2100. Moreover, the hydrological cycle will most likely become stronger because of increased rates of evaporation from land and sea surfaces. As a result, rainfall may increase in the tropics and at higher latitudes, but decrease over large continental interiors. Areas of the world, such as the Near East and North Africa, that are already facing critical water scarcity, are expected to become drier and hotter."[44]

Natural resources that can contribute toward a region's ability to mitigate and adopt to climate change are not abundant in the Arab region: forests and protected land and marine resources, in addition to the aforementioned critical factor in the energy–agri-food chain–water. United Nations data indicate that only about 7% of the surface area of the Arab region was covered by forests in 2011, with a loss of around 106,948 km^2 of forest, or around 13% of total forest resources since 2000, most of them in Sudan, followed by Lebanon.[45] The GCC economies and Egypt have less than 1% of their landmass covered by forest.[46] Most of these countries have, in turn, significantly increased protected terrestrial and marine areas, although to a varying extent; only about 5% of the total landmass of the UAE, but over 11% of land and marine resources in Egypt and about 30% in Saudi Arabia were under protection in 2012. Other countries with more forest and water resources are performing less well than some of the Gulf countries; in Lebanon – the Arab region's second largest forest resources after Iraq, Jordan and Sudan, which hold valuable river and coastal waters – less than 0.5% of total land and marine resources are under protection.[47]

Marine protection is of particular value because of the immense importance of coastal areas for fishing, recreation and biodiversity and as natural storage grounds for CO2 as part of the mitigation of climate change. The lack of attention paid to coastal areas is of particular concern for the Arab region: approximately 28,000 km^2 in total – a scant 3.8% of marine territorial waters in the region – were protected in 2010. The growth in protected marine areas over the 10-year period after 2000 was almost zero.[48] The Arab region and the wider Middle East[49] are rich in natural biodiversity, including marine mammals, fish, some 513 km^2 of mangrove forests and well over 15,000 km^2 of coral reefs: these resources require protection.[50]

Figure 8. Climate change vulnerability: selected comparative regional indicators



Source: World Bank (2017b).

Box 3. Positive progress in environmental protection from the UAE

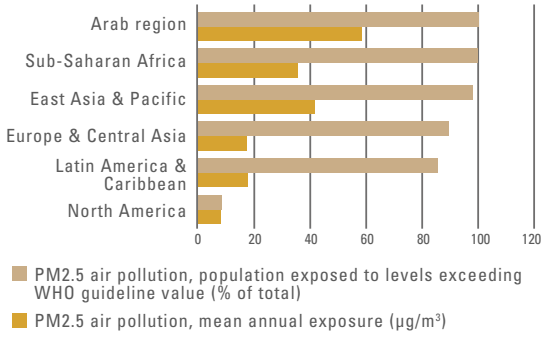
The Abu Dhabi Environment Agency's management of protected areas has shown positive results for a number of habitats and species. For example, the population of dugongs has stabilized due primarily to the establishment of marine protected areas (MPAs). By the end of 2013, 13.5% of the total land area of Abu Dhabi was MPAs, and 14.6% was terrestrial protected areas. The Agency's conservation plan strengthened the Arabian oryx gene pool after becoming extinct in the wild in the early 1970s; Abu Dhabi is now home to 3,000 Arabian oryx. It has also supported the conservation of falcons across the region and the world, by decoding the entire genetic make-up of peregrine and saker falcons.[51]

Greenhouse-gas emissions vary between countries in the Arab region, but the region's overall carbon footprint is undoubtedly rising. In total, the Arab region accounts for around 5% of global GHG emissions, with the three largest energy consumers – Egypt, Saudi Arabia and the UAE accounting for more than half the total emissions from the Arab region.[52] Saudi Arabia is one of the top 10 global emitting countries of CO_2, with a share of 1.4% of global emissions in 2014.[53] Arab economies' weighted average CO_2 emissions are at 4.85 tons per capita. Though still in a modest range (see Figure 8), the metric understates the importance of regional climate action given that Arab countries are some of the world's most vulnerable to climate change and that the Arab region's population is highly exposed to largely unmitigated air pollution. Both methane (CH_4) and nitrous oxide (N_2O) emissions in the energy sector more than doubled in the Arab region over the period 1990–2010.[54] On the other hand, the consumption of ozone-depleting substances (ODS) in ESCWA member States reached 3,582 ODP tons in 2013, with a decrease of 49% from 2007.[55]

Ambient air pollution remains a serious, though unappreciated, concern in the Arab region; policy responses have been lacking. Annual mean exposure to air pollution, measured by fine particulate matter (PM) air pollution (measured here in PM2.5) – generated by duststorms, motor vehicles and manufacturing – exceeds the WHO guideline value in the Arab region in 100% of cases (see Figure 9 and Figure 10). For the latest time range available, 2012–2014, the Saudi Arabian cities of Riyadh, Al Jubail and Dammam ranked among the world's 20 most polluted cities in terms of fine particle pollution. Riyadh and Al Jubail are the world's fourth and fifth most polluted cities, respectively.[56] The impacts of this issue are underappreciated: WHO data consistently show adverse health effects, including respiratory and cardiovascular system diseases, from PM exposure levels currently experienced by urban populations in both developed and developing countries.[57]

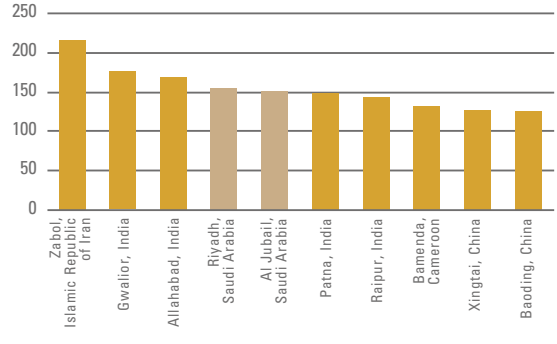
While some of the region's fine particle pollution is undoubtedly related to its dusty climate, Arab economies have also been complacent in addressing avoidable air pollution and emissions, including in high-income countries. This includes the virtual absence of practical policies aimed at protecting air quality, including minimum fuel emissions and economy standards, traffic management, fuel-quality standards and the

Figure 9. Air pollution, mean annual exposure (µg/m³)



Source: World Bank (2017b).

Figure 10. PM2.5 air pollution (annual mean, µg/m³) (WHO long-term guideline value = 10 µg/m³)



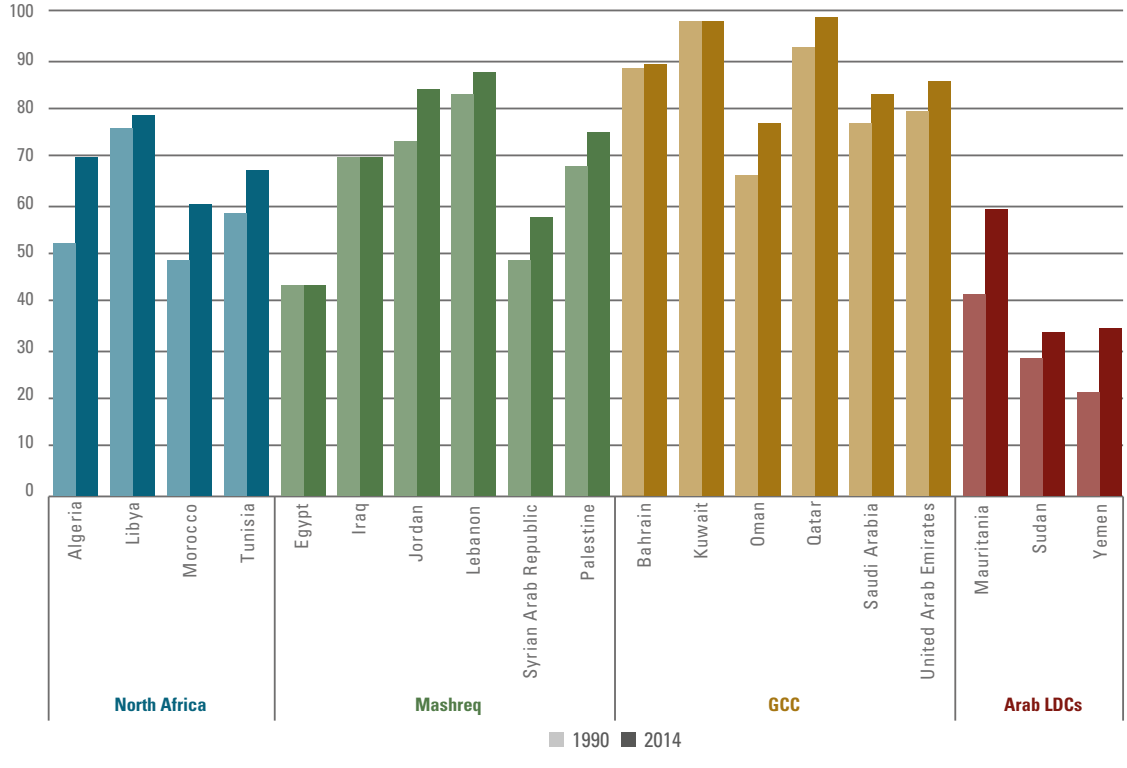
Source: WHO Ambient Air Pollution Database.

promotion of appropriate public transport for the Arab region's rapidly growing cities. Mainstreaming awareness of the highly negative social and economic costs of rising air pollution will be one area of major policy challenges in the Arab region, as general environmental conservation and protection still occupy only a small space in public policy beyond declarations of good intent.

Rapid rates of urbanization will continue to add pressure on regional resources

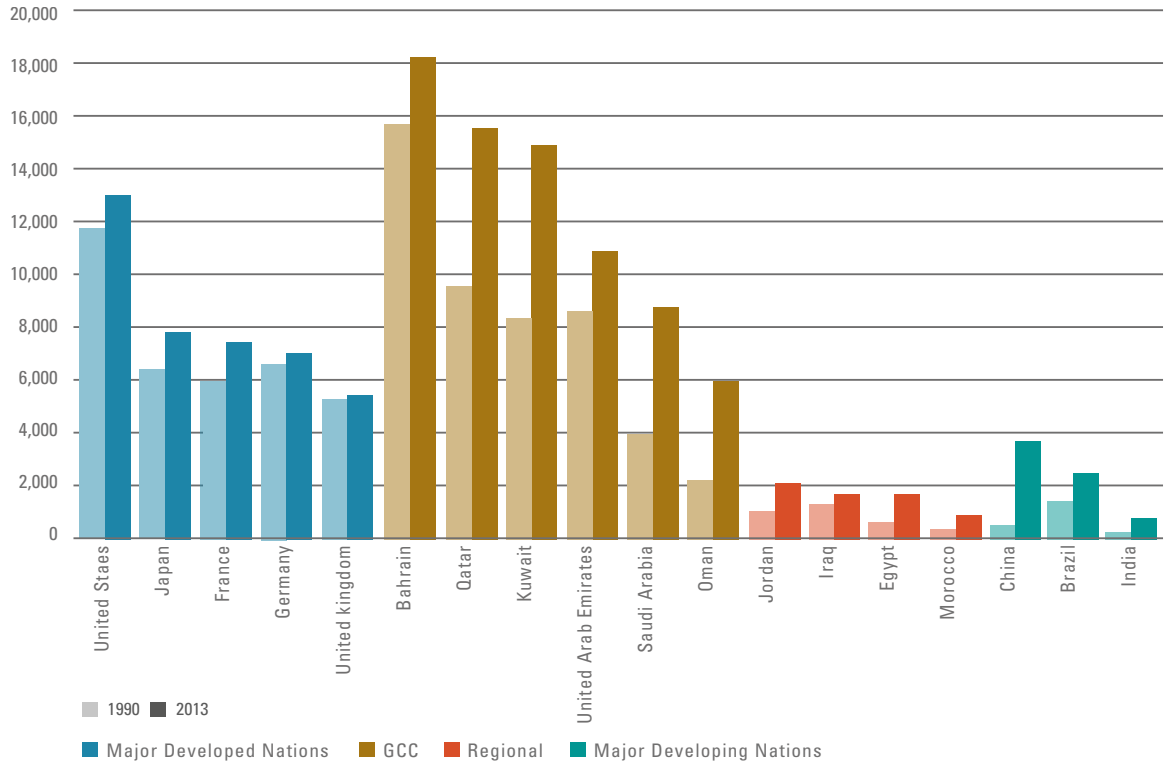
The Arab region's growing rates of urbanization are feeding into the growing importance of integrated policies that manage natural resources more sustainably. Cities add further pressure to the water-energy-food nexus, as they comprise higher water-food- and energy-consumption patterns within a smaller space, coupled with environmental degradation and urban air pollution.[58] In the Arab region, urbanization rates are growing, owing to greater socioeconomic opportunities in cities. The urban population in Arab countries grew by more than four times from 1970 to 2010 and will more than double again by 2050. A total of 56% of the Arab region's population already live in cities, and the United Nations projects that, by 2050, this proportion will increase to over 68%.[59] While, in the past, poverty was largely associated with rural areas, high growth rates in urbanization means that in countries such as Jordan and Tunisia, poverty is mostly urban by now.[60]

Figure 11. Urban population in the Arab region (% of total)



Source: World Bank (2017b).

Figure 12. Electric power consumption in the GCC and selected countries (kWh per capita)

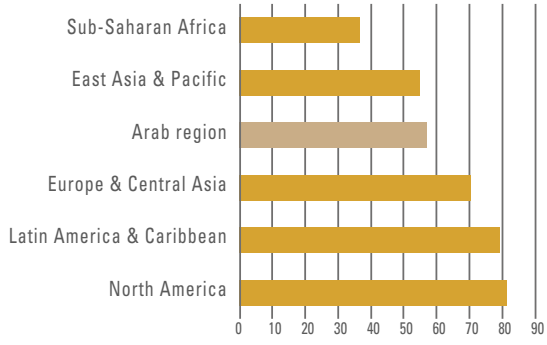


Source: World Bank (2017b).

The GCC economies are among the most urbanized countries in the world, a factor influencing their own policy decisions and priorities in the areas of energy, water and food relative to other parts of the region. Close to 100% in Bahrain, Kuwait, Qatar and the UAE live in cities (Figure 11), the particular architecture and demographic structure of which differentiates these essential city-States significantly from countries with larger, more dispersed and more rural populations. Consuming already over 60% of the Arab region's final energy, the GCC economies face many of the Arab region's challenges comprised on less space, with high reserve rates of fossil fuels but also a very high rate of depletion rates of energy and other scarce natural resources on the basis of net-adjusted savings. Climatic issues and very high per capita rates – and hence living standards – mean that energy plays a pivotal role in maintaining these countries' water and food security, adding pressure for sustainable resource management in the coming years and decades. The challenges these countries face becomes clear when comparing their per capita consumption of electricity with different regions and economies, leaving the GCC with some of the highest per capita consumption rates in the world (Figure 12).

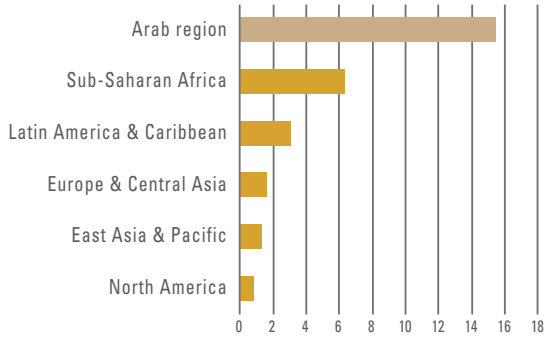
War, political instability, and consequent displacement and migration, particularly in low- and lower-middle-income countries, further accelerate pressure on urban living space and resources.[61] Data of the United Nations High Commissioner for Refugees (UNHCR) show the Arab region has in recent years been witnessing globally unprecedented numbers of refugees and displaced persons, mainly as a result of

Figure 13. Urban population (% of total)



Source: World Bank (2017b).

Figure 14. Adjusted savings: energy depletion (% of GNI)



Source: World Bank (2017b).

conflict in Iraq, Libya, Syrian Arab Republic, Sudan and Yemen.[62] Conflict and instability have led to the destruction of entire cities, with devastating effects on the livelihoods of millions of people, who will have to face yet more challenges with the eventual reintegration of returning refugees under insufficient funding for housing, infrastructure and social services.[63] The difficulties these countries will face far beyond the duration of acute armed conflict can barely be overstated and present the Arab region with major humanitarian and developmental challenges over the coming decade at least.

The unprecedented growth in informal housing at the peripheries of urban settlements throughout the Arab region adds further pressures on the water-energy-food nexus. The United Nations has noted that:

> "The encroachment of urban areas on agricultural lands often threatens already scarce water and natural resources and overburdens the existing urban infrastructure which, in many cases, is not able to accommodate the sharp increase in demand for services."[64]

A case study from Yemen, based on an extensive survey of household energy use from 2000 reveals the intensity of this challenge, which has meanwhile lost nothing of its acuteness in more recent years:

> "A key issue confronting Yemen is poverty, and the linkage with environmental degradation, and resource depletion – occurring in both rural and urban areas ... Foremost among the environmental concerns of the urban poor are health problems resulting from substandard living conditions that do not shield them from human excreta and other wastes and natural hazards. In most cities, it is not only the impact of urban environmental deterioration on the poor that is a concern. Poverty is itself a major factor in urban environmental degradation as the rural poor migrate to the cities in search of income-producing opportunities. The poor lack the financial resources to compete for serviced land and adequate housing in safe locations. In Sana'a the poor have no access to safe water. As a result, the poor are often forced to occupy illegal settlements on hazard-prone or environmentally sensitive land."[65]

Provisional, inadequate and poorly surveyed housing adds to the pressures on insufficient infrastructure, including electricity, water

and sewerage systems, public transport and social services. As conflict and displacement of people will result in the further expansion of informal settlements in the region, more urban areas will face increasing challenges of managing finite resources in a sustainable way – even more so where the gap between rich and poor widens further.

LampPost in Mauritania. © JAHMIL | Shutterstock.com

2. Energy Access

Overview

Universal access to modern energy services is one of the fundamental pillars of human welfare and as such is a critical factor in modern-day socioeconomic development. Most of the United Nations Sustainable Development Goals relate in one way or another to the objective of achieving universal energy access, the reduction of poverty, education for all, decent work opportunities, economic growth and reduced inequalities. Clean and secure energy access is also a critical factor in improving livelihoods for women globally, through its countless positive effects on female health and safety, maternal health, reduced child deaths, access of girls and women to education and hence significant long-term effects on gender balance and social development overall. This chapter summarizes key observations about modern energy access in the Arab region:

- **Access to electricity, as well as to clean cooking fuels and technologies is now near-universal in North Africa, the Mashreq and the Gulf Cooperation Council** – an impressive achievement, allowing the Arab region to stand out from other regions with a high share of developing economies.
- **A wide gap between the Arab Least Developed Countries – Mauritania, Sudan and Yemen – and the rest of the Arab region** – North Africa, the Mashreq and the GCC. The three Arab LDCs account for around 94% of the region's electricity access deficit.
- **Where access to electricity and CFTs is incomplete, it is characterized by a considerable urban-rural divide,** where urban access to electricity is substantially higher in countries with incomplete coverage than in rural areas. Lack of access is often restricted by geography: it is uneconomical, for example, to connect remote settlements and villages to the main grid, particularly in mountainous areas.
- **War and regional instability present the region with the separate challenge of supplying modern energy access** – among other essential services – to the rapidly increasing number of displaced persons in Arab countries.

Data presented in this chapter suggest that the Arab region has made significant progress in the area of modern energy access, but that important challenges remain. Besides universalizing electricity and CFT access in LDCs, the region as a whole faces the challenge of providing their young and rapidly growing populations with secure and affordable energy that underlies the rising living standards their populations expect, while, at the same time, ensuring the sustainability of current energy-supply patterns.

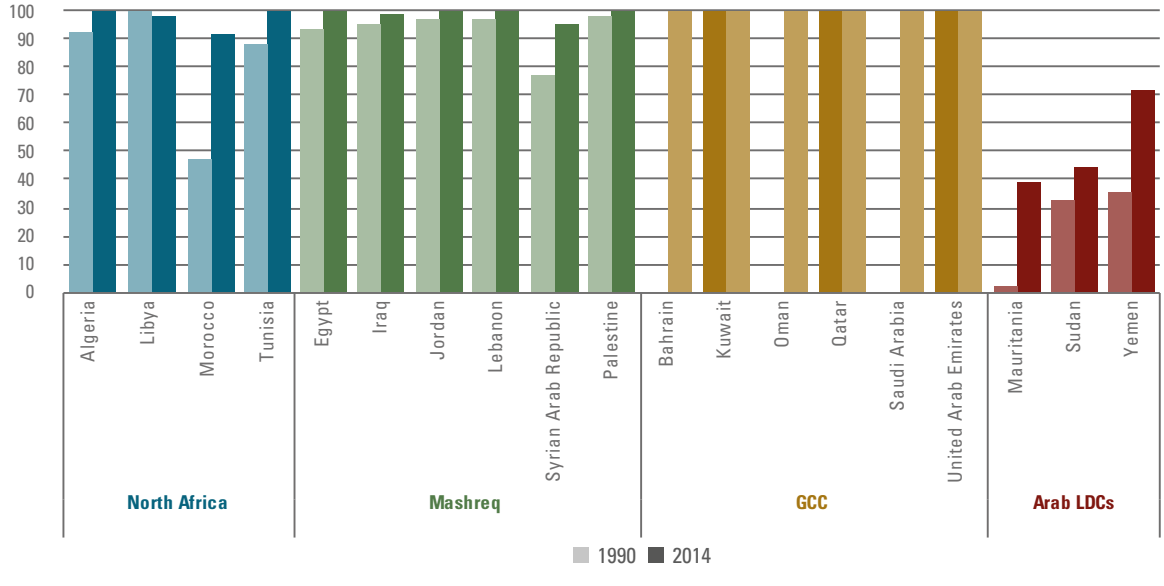
One of the key challenges the Arab region faces as a whole is whether primary energy and electricity should remain what has been effectively a "public good" supplied at low cost by the State to its citizens, or whether the region's emerging economies will need to redefine the way energy is used and supplied within their domestic market.

Electricity access is now near-universal in North Africa, the Mashreq and the GCC

The Arab region as a whole has been doing extremely well with facilitating universal energy access to its citizens. Key reasons include considerable government efforts to supply modern fuels and electricity and cooking technologies to their populations. In wide parts of the region, access to electricity and liquid fuels has gone hand in hand with economic development policies. These include programmes targeting rural electrification, LPG subsidies and programmes aimed at introducing LPG as the cooking fuel of choice to replace kerosene and traditional biomass, including in the countryside. Price regulation and subsidies for fuels and electricity have formed an intrinsic part of the region's overall energy policy over the past 50 or more years, with low-cost energy having been widely perceived as a public good, as much as subsidized bread and sugar. As a result, access to electricity and CFT technologies in the GCC economies and most parts of the Mashreq and North Africa is now nearly universal.

Historically high urbanization rates have helped many Arab countries to increase modern energy access. Fast-rising urbanization rates were accompanied by the gradual improvement of urban–rural networks in many parts of the Mashreq and parts of North Africa during the 1960s, 1970s and 1980s. By 1990, most ESCWA countries already had relatively comprehensive access to electricity, with rates ranging from around 50% in Morocco, to over 90% in Algeria, Iraq, Jordan, Lebanon, Syrian Arab Republic and Tunisia. By then, more than half the ESCWA region's population was already living in urban areas; and more than two-thirds in the GCC, Iraq and Jordan. Only the Arab LDCs Mauritania, Sudan and Yemen lag significantly in this area.[66] Today, more than two-thirds of the Arab region's population live in urban areas: the small GCC economies

Figure 15. Share of population with electricity access in the Arab region, 1990 and 2014 (%)

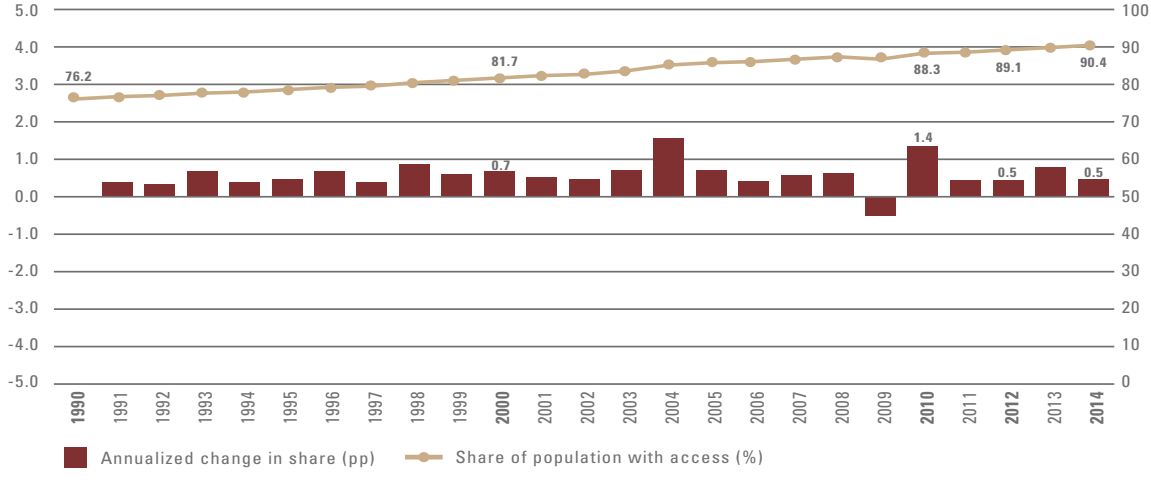


*Data gaps: Bahrain (1990), Oman (1990), Saudi Arabia (1990)
Source: World Bank (2017a).

– Bahrain, Kuwait, Qatar and the UAE – have urbanization rates close to 100%.[67]

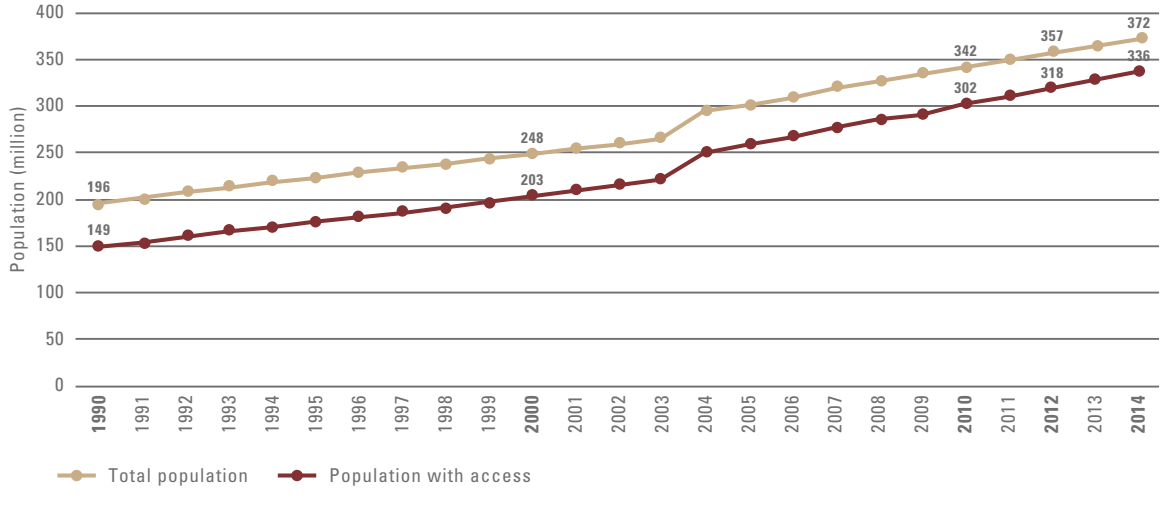
Latest data over the tracking period reconfirm existing trends in electricity access in the Arab region. The Arab region's electrification rate increased slightly, from 89% in 2012 to 90.4% in 2014, up from 82% in 2000 and 76% in 1990. The electrification rate in urban areas stayed largely static, with a slight improvement from 97% in 2012 to 97.3% in 2014. A slightly higher growth in electricity access rates has taken place in rural areas of about 7% (compound annual growth rate (CAGR) a year, from 78% in 2012 to 80.5% in 2014.

Figure 16. Share of population in the Arab region with access to electricity and annualized change in share 1990–2014



Source: World Bank (2017a).

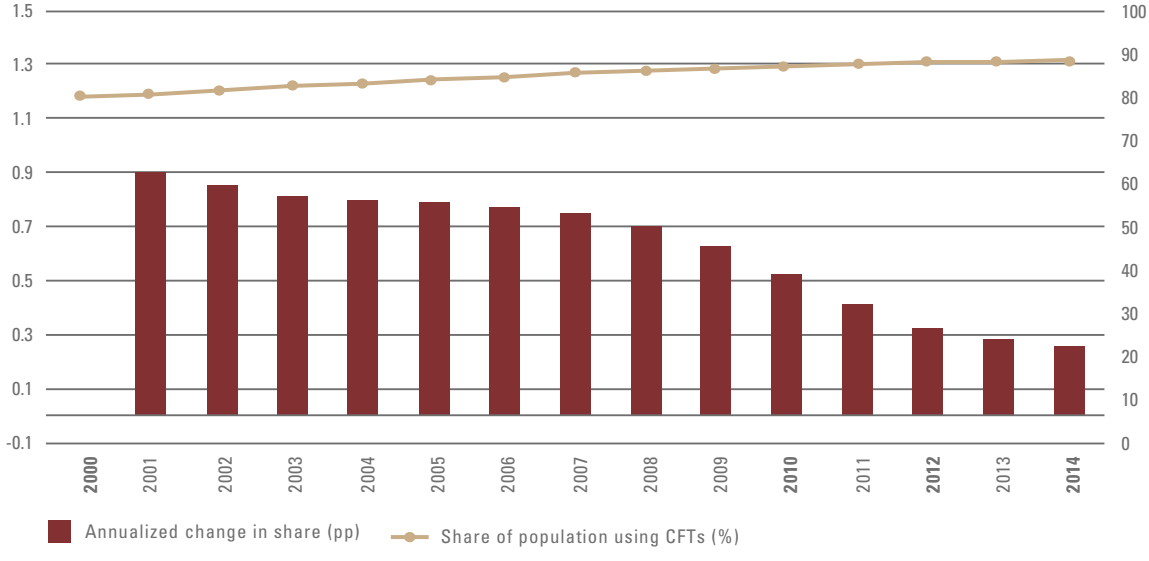
Figure 17. Number of people in the Arab region with access to electricity, 1990–2014



Source: World Bank (2017a).

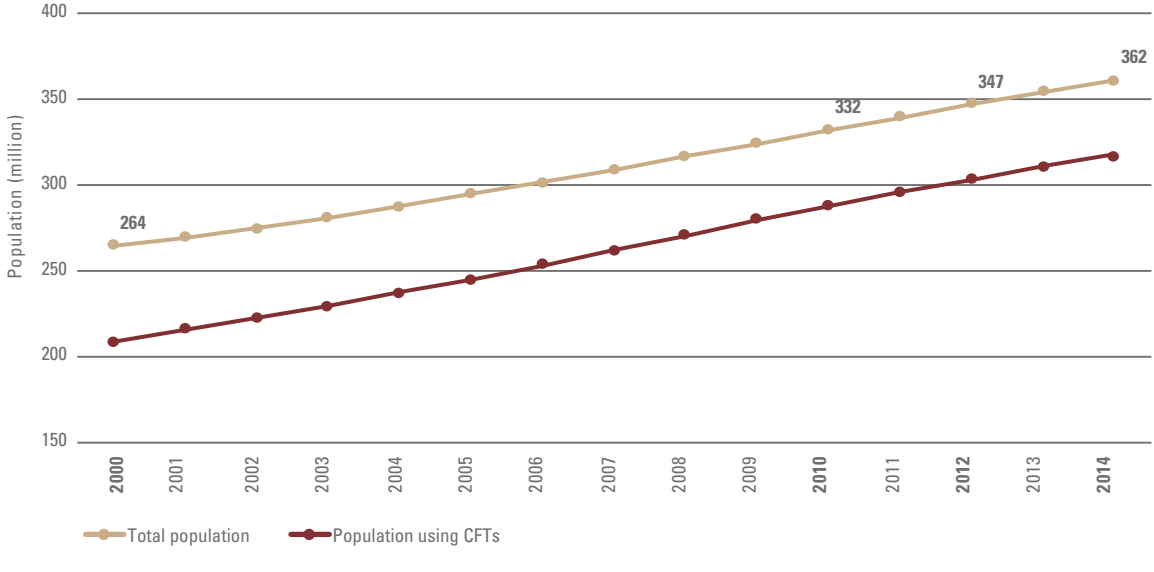
Similar to electricity, access to clean cooking fuels and technology in the Arab region is relatively high. Overall, the share of the Arab region's population using CFTs rose continuously since the 2000s and stood at 88% in 2014, with intraregional differences ranging from close to 100% access in the GCC economies and the Mashreq, to less than 40% in the Arab LDCs – Mauritania, Sudan and Yemen.

Figure 18. Share of population in the Arab region using CFTs and annualized change in share, 2000–2014



Source: World Bank (2017a) based on WHO data.

Figure 19. Number of people in the Arab region using CFTs, 2000–2014



Source: World Bank (2017a) based on WHO data.

Box 4. Experience in rural electrification in the Arab region

Morocco's Programme d'Électrification Rurale Global, which was launched in 1996, when rural electrification rates were estimated as low as 18%, catered specifically for a range of different village needs based on the long-term commercial viability of village-based electricity access. The programme identified villages lacking electricity access across the country, classifying them into different categories based on whether or not their connection to the main grid was financially viable. Areas that could not be connected cost-effectively to Morocco's main electricity grid were assessed for the viability of other, local solutions including PV generators, small hydro-turbines, wind turbines, diesel generators and hybrid systems, taking into consideration the potential village market size, geographical proximity and local geographical and climatic factors that would favour specific technologies. Over a period of 15 years, more than 35,000 villages, including some 1.9 million rural households, were electrified, driving up rural electrification rates to 97%by 2009.[68]

Jordan gained similarly positive results following its launch in 2002 of a rural PV electrification programme, aimed at improving both access to electricity and the quality of life for rural electricity users. The programme relied specifically on renewable energy resources in the light of experience gained from previous electrification works that supplied rural communities with diesel-powered self-generators. Diesel generators were found to be highly polluting and required frequent repair and maintenance, often in geographically remote areas where technical defaults led to frequent interruptions for long periods, resulting in high costs. Many rural communities welcomed the introduction of cleaner and supposedly low-maintenance PV generators which additionally required none of the running costs associated with diesel fuel.[69]

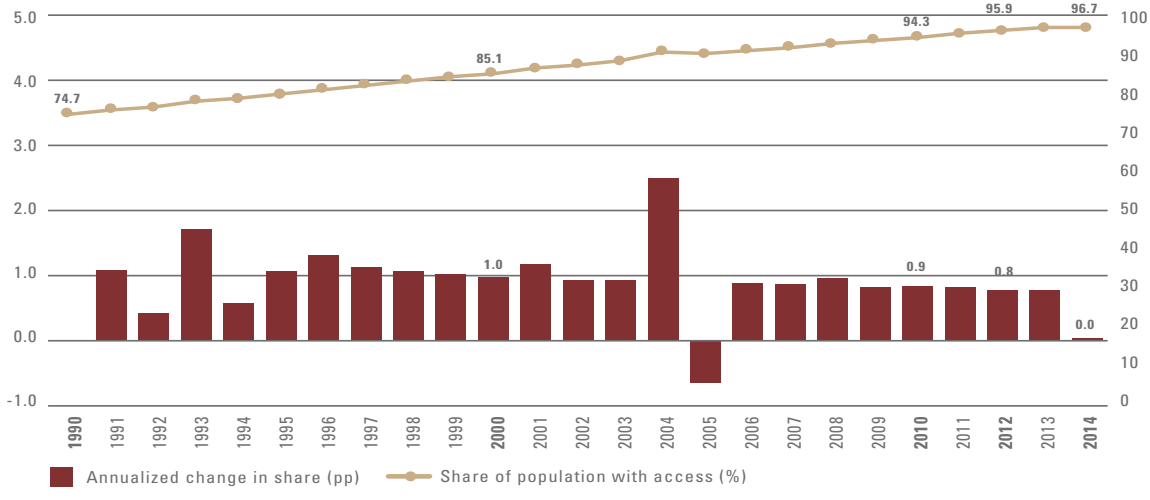
Algeria has long been using mini-grids to supply off-grid areas in rural and desert regions. Historically based on diesel generators, policy focus has in recent years turned to hybrid PV and wind generators to save fuel costs and harvest significant local renewable energy resource potential, while supplying off-grid areas with stable supplies of electricity.[70] These gains build upon experience initially gained during the 2000s, when the Algerian Government introduced solar-hybrid systems into existing diesel-fuelled generation systems in isolated areas, such as the southern provinces of Adrar, Illizi, Tindouf and Tamanrasset.[71]

In Mauritania, aid and development projects have been targeting mini-grid provision in rural areas for many years. Most mini-grids operate on the basis of diesel generators, but there has also been recent experience with renewables-based systems. The first renewable-energy-based mini-grids were tried out in the mid-1990s under the Alyzés programme (initiated by the United Nations Development Programme (UNDP)/Global Environment Facility (GEF), wind turbines. Non-governmental organizations (NGOs) and national agencies (Agence de promotion de l'accès universel aux services (APAUS) and Agence de développement de l'électrification rurale (ADER) have been promoting the development of renewable-energy-based mini-grids on a similar model, but based on solar energy. A joint project (Programme d'électrification rurale dans la région du Brakna (PERUB) of the Groupe de recherche et d'échange technologique (GRET) and APAUS, funded by the European Union (EU) Energy Facility (EF), installed 24 solar-based projects between 2008 and 2011; then 24 solar platforms were installed as part of a joint UNDP/United States Agency for International Development (USAID)/APAUS project; six solar platforms by APAUS and 100 additional solar platforms between 2011 and 2015 under the ERUDI (Electrification rurale décentralisée interrégionale) project in Mauritania. While this series of primarily aid-driven development initiatives has shown success in providing rural access to electricity, they remain ad hoc projects that still need to be scaled up into systematic policies, requiring sustainable infrastructure and financial mechanisms to be in place in the coming years.[72]

Source: El-Katiri (2014b); UNDP (2014).

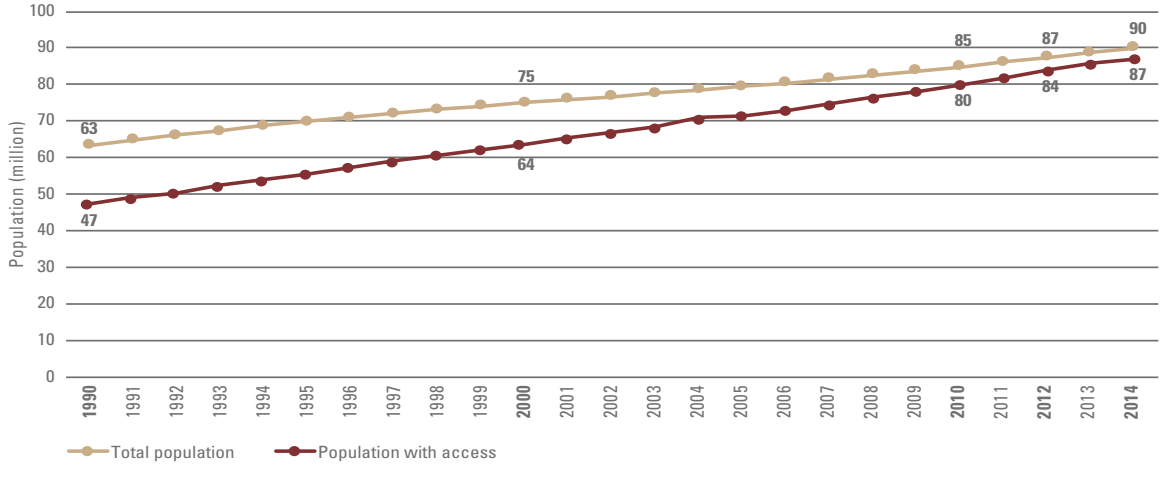
In the lower-middle-income countries in North Africa and the Mashreq, the period of large expansions in electrification was the 1990s. In North Africa, Morocco first launched its Programme d'Électrification Rurale Global (PERG) in 1996, when rural electrification rates were estimated as low as 18% – one of the last large remaining gaps in electricity access in the Arab region apart from the LDCs (Mauritania, Sudan and Yemen). The programme was designed to cater to a range of different geographic features and village needs. It has been widely regarded as being successful in bringing electricity access to more than 35,000 villages, including some 1.9 million rural households, over a period of just 15 years. Jordan gained similarly positive results with its solar photovoltaic (PV) rural electrification programme during the early 2000s (see Box 4).

Figure 20. Share of population in North Africa with access to electricity and annualized change in share, 1990–2014



Source: World Bank (2017a).

Figure 21. Number of people in North Africa with access to electricity, 1990–2014

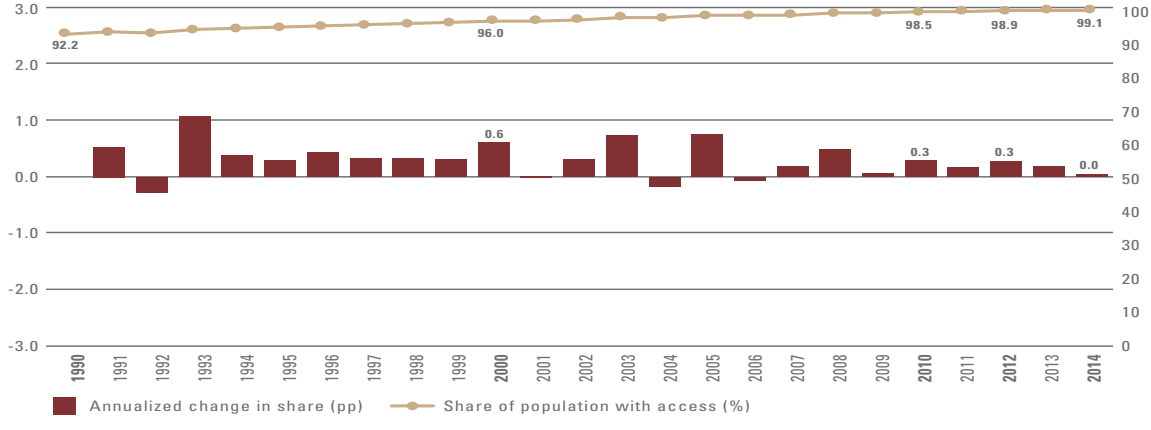


Source: World Bank (2017a).

Overall, North Africa's electricity access gap is clearly closing. Electricity access has been high across the region over the tracking period at rates close to 90%, with additional improvements which are likely not to have been captured by our data. A recent exception has been Libya, where conflict and political instability have severely affected the country's infrastructure and power generation capacity. Available data suggest some 60,000[73] Libyans lost access to electricity in the period 2012–2014, a number which may underestimate actual losses.

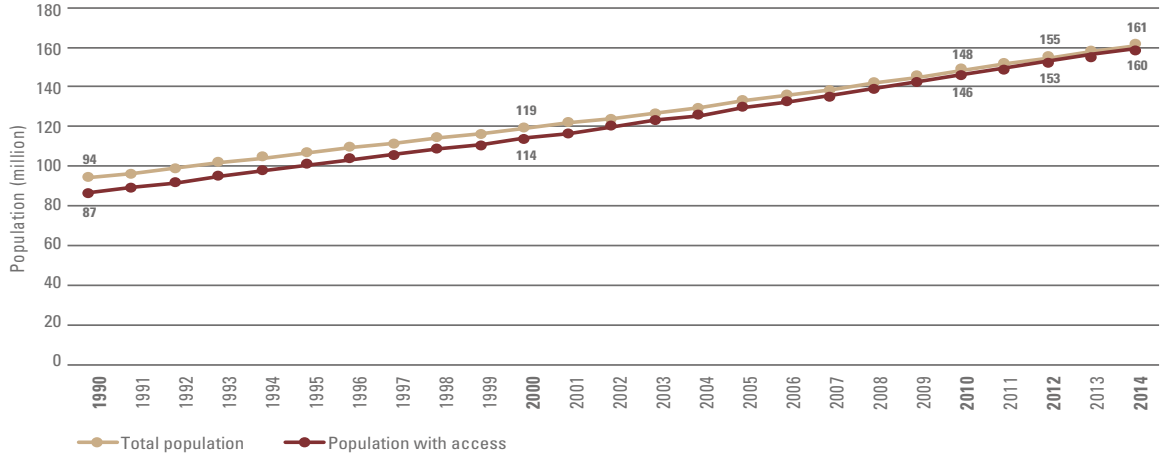
The Mashreq has been characterized by high electricity-access rates since the 1990s, with coverage close to universal in 2012–2014. Problems have intensified, however, in conflict-affected countries leading to a loss of service, or frequent disruptions in Iraq and Syria, numbers for which are likely to underestimate the extent of the problem incurred by large parts of the population. Palestine suffers from endemic power cuts and load-shedding, the result of its dependence on Israel from which it buys electricity, where conflict leads to shutdowns

Figure 22. Share of population in the Mashreq with access to electricity and annualized change in share, 1990–2014



Source: World Bank (2017a).

Figure 23. Number of people in the Mashreq with access to electricity, 1990–2014

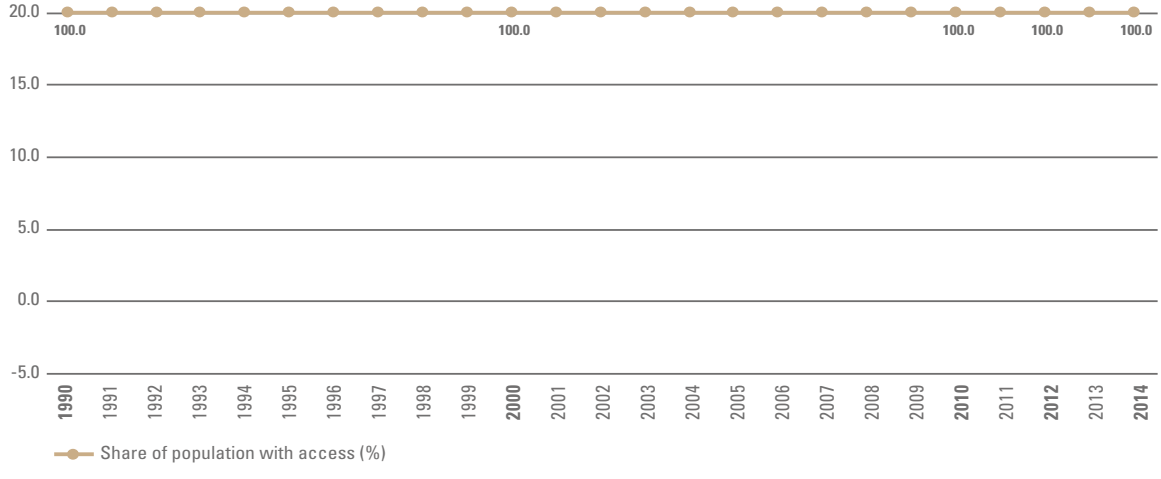


Source: World Bank (2017a).

in power supply, as well as the continued destruction of existing infrastructure in Gaza in particular. Non-payment and the subsequent problem of lack of financial resources for utilities to invest in maintaining and upgrading facilities, play an additionally important role throughout Mashreq countries. The inflow of more than a million Syrian refugees into Jordan and Lebanon since the outbreak of political turmoil and instability in neighbouring Syria in 2012 further exacerbated this situation through increased demand for already rationed electricity production and the subsequent need for load-shedding and increasing pressure on the country's ageing utility-sector infrastructure.[74]

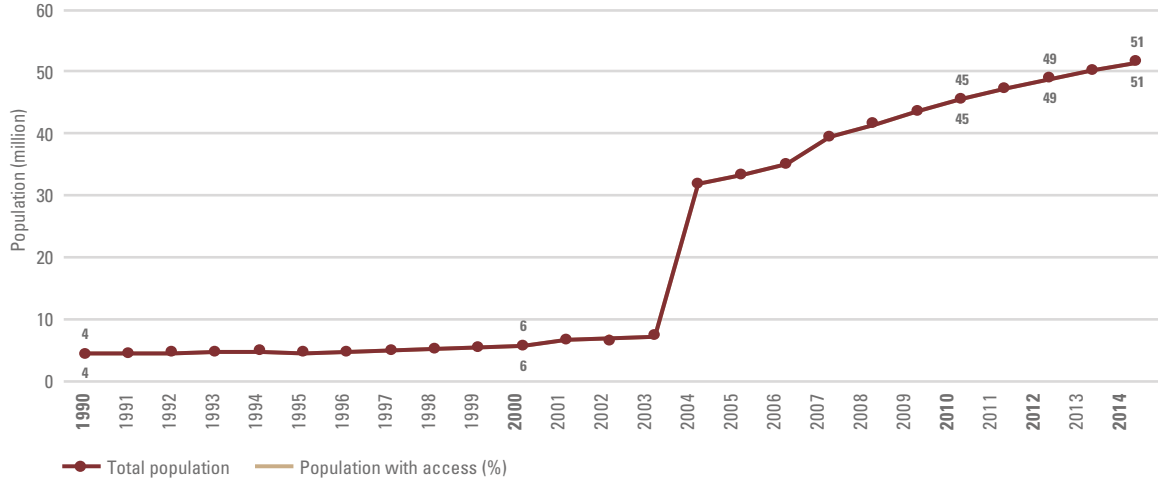
The GCC economies are today among the wealthiest nations in the Arab region and enjoy virtually universal electricity coverage. Small issues of coverage remain in remote

Figure 24. Share of population in the GCC with access to electricity and annualized change in share, 1990–2014



Source: World Bank (2017a).

Figure 25. Number of people in the GCC with access to electricity, 1990–2014



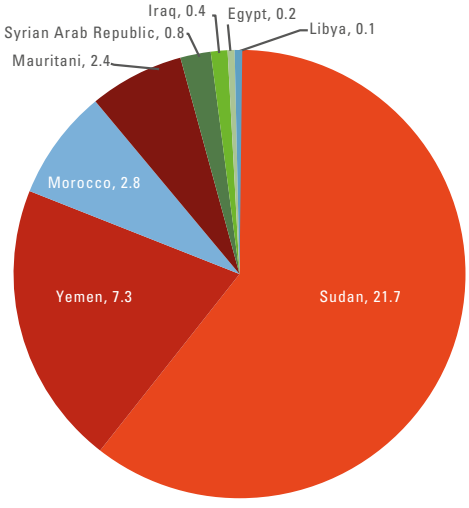
Source: World Bank (2017a).

and mountainous territory in countries such as Oman and Saudi Arabia, but the high rate of urbanization in the GCC's smaller members, coupled with small populations of merely a few million and very high per capita income rates mean electricity coverage here is universal.

Significant gaps in modern energy access remain in the Arab Least Developed Countries

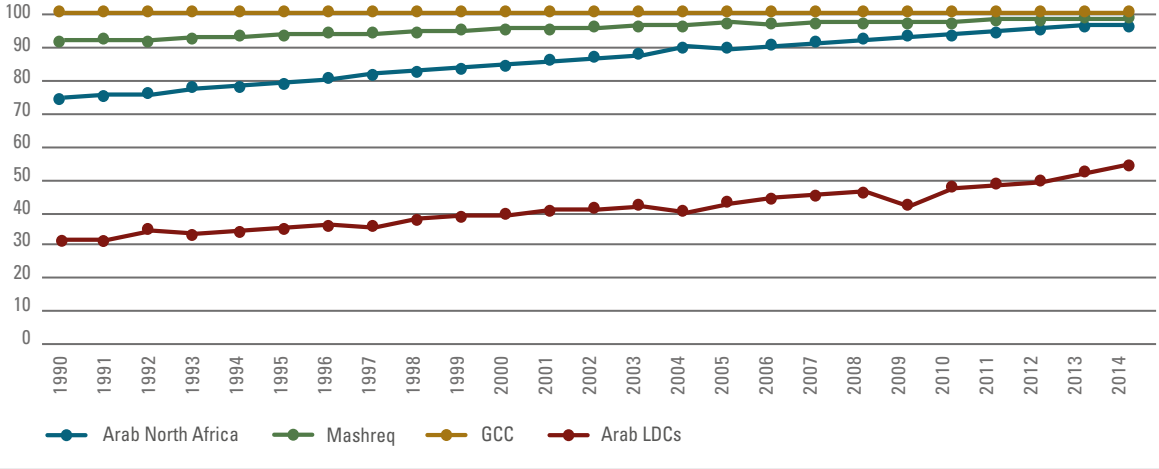
Despite positive developments in electricity access in North Africa, the Mashreq and the GCC since the 1990s, some significant gaps in energy access remain in the Arab region. Some 36 million Arabs did not have any access to electricity in 2014, primarily in the Arab LDCs, with small numbers of people without access to electricity in North Africa and the Mashreq. The situation of those deprived is exacerbated by the geographical concentration of lack of energy access, which is typically linked to other deprivations such as lack of access to secure water and food resources, education and health care and parallel environmental destruction. Mauritania, Sudan and Yemen represent the greatest number of people with no access to electricity and limited access to CFTs in the Arab region.

Figure 26. Population without access to electricity in the Arab region, 2014 (million people)



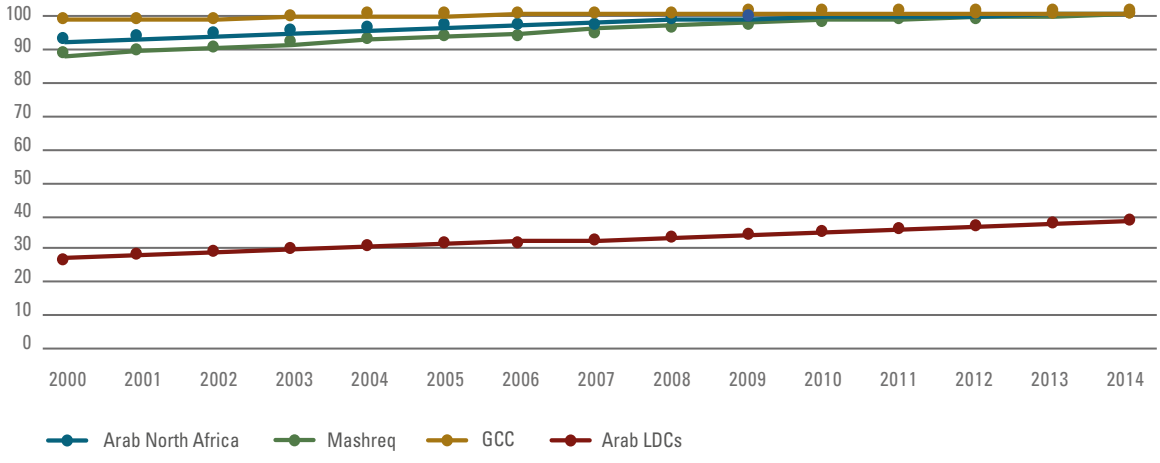
Source: World Bank (2017a).

Figure 27. Share of population in the Arab region by subregion with access to electricity, 1990–2014 (%)



Source: World Bank (2017a).

Figure 28. Share of population in the Arab region by subregion with access to CFTs, 2000–2014 (%)



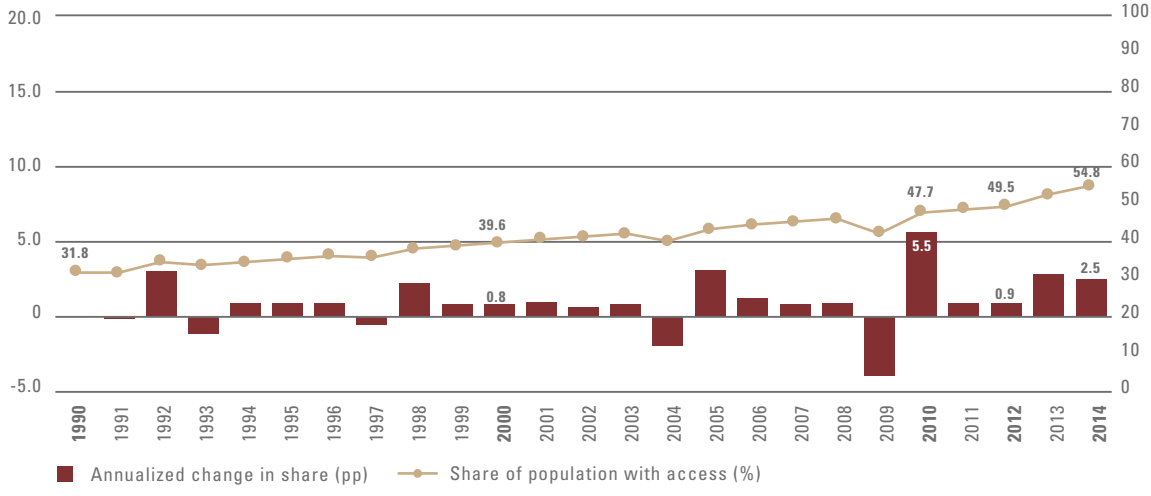
Source: World Bank (2017a) based on WHO data.

Sudan and Yemen continue to face a large gap in access to modern energy (Figure 26). Together, they account for some 29 million people, or almost 81% of the Arab region's electricity access deficit. Electrification rates in 2014 ranged from 72% in Yemen to a low 39% in Mauritania, with rural electrification rates in Mauritania standing at merely 2%[75]. These numbers include significant progress since the 1990s; in Mauritania alone, overall electricity access doubled after 2000, particularly in urban areas, but with limited progress over the tracking period 2012–2014. Despite these improvements, the vast gap in access in these countries remains a major obstacle to further socioeconomic development. Nearly two-thirds of people without electricity access in the Arab region live in Sudan, and another fifth in Yemen.

Furthermore, the gap between those with access to electricity, and those without, has actually been increasing over time in the Arab LDCs (Figure 30). This can be seen, on the one hand, as a reflection of the growing populations of the Arab LDCs – more than 40%[76] of their populations are under the age of 15 – combined with limited investment in parallel upgrading of infrastructure and power-generation capacity. It is also, however, a likely reflection of the widening divide between rich and poor: between those with access to education, health services, infrastructure and economic opportunities that so much characterizes the economies of the developing world, including Arab economies and those without that access. This split is even more pronounced across geographical factors, such as rural areas versus relatively well catered-for towns and cities, but also the divide between the urban rich and poor, and their access to medical services, including contraception. In other words, as populations grow, there are more people left behind today than 20 years ago, despite an overall positive trend in energy access.

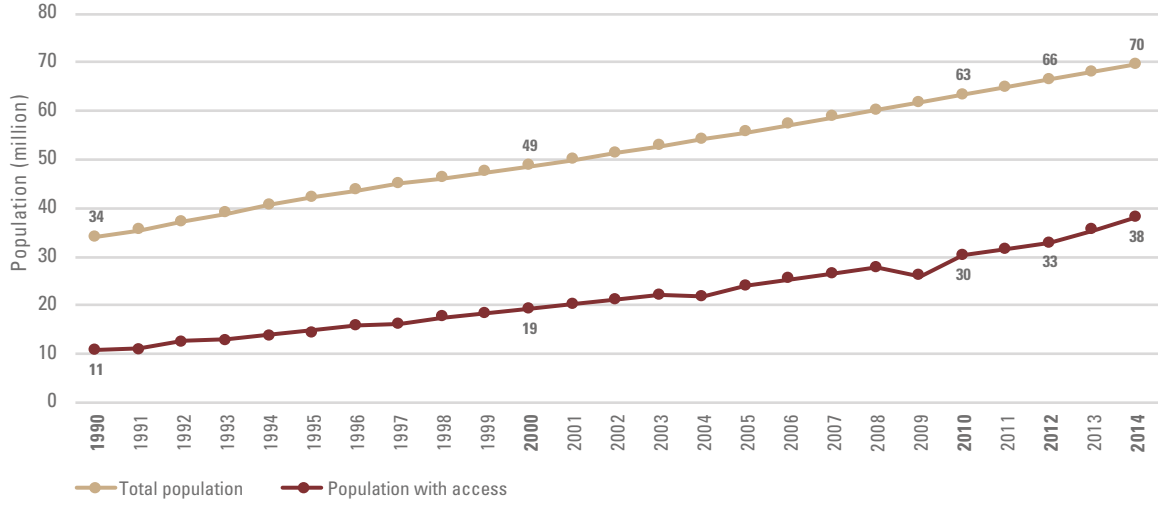
Through its multifaceted links to different fields of socioeconomic development, the lack of access to energy is a major stumbling block to national development efforts in the Arab LDCs. Because energy is required to operate basic services such as health care and education facilities, transport and access to the outside world, the Arab LDCs energy-access

Figure 29. Share of population in the Arab LDCs with access to electricity and annualized change in share, 1990–2014



Source: World Bank (2017a).

Figure 30. Number of people in the Arab LDCs with access to electricity, 1990–2014



Source: World Bank (2017a).

gap is of particular developmental concern. A UNDP report illustrates the severe effects of poor energy access in Yemen:

> "Energy-related constraints have seriously been affecting the performance, and sustainability of small and medium businesses (SMEs) and small-scale industries (SSIs) in Yemen. For instance, with the lack of access to electricity and fuel during political instability in 2011, a number of SMEs both shut down and large numbers of their employees, and workers were laid off. In addition, many other SMEs downscaled or suspended their operations. On the other hand, lack of access to electricity in rural areas has been further limiting the livelihood potentials of the poor. Without access to an adequate energy

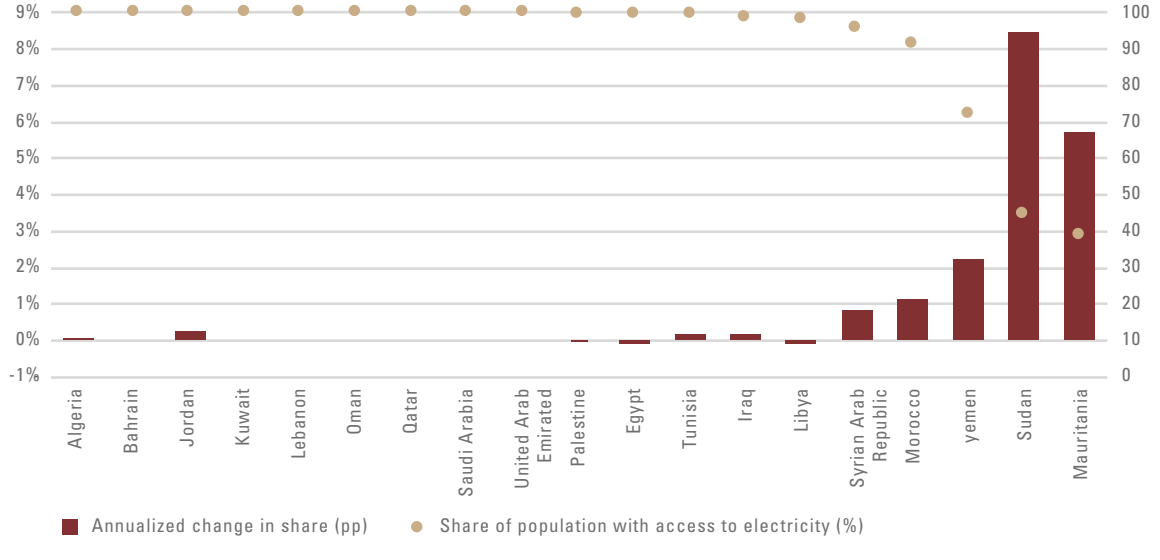
service, the poor, particularly in rural areas, have limited choices for income generation, improved education and health services."[77]

Access to CFTs remains similarly precarious in the Arab LDCs, in notable contrast to all other parts of the Arab region. Access is particularly precarious in Sudan, with merely 23%[78] of the population having access to CFTs. These being the most basic forms of modern energy, this sobering result shows the still vast intraregional differences in human development across the Arab region, with implications for health, education and the quality of nutrition in a vast number of households in the Arab LDCs – with women tending to carry the largest burden. Growth over the period in access to CFTs comes subsequently from the Arab LDCs, particularly in Mauritania and Sudan, where more than one million people in each country had access to CFTs between 2012 and 2014. Overall, more than 43 million people in the Arab region are estimated to lack access to even CFTs, most of them in Mauritania, Sudan and Yemen[79].

As in other parts of the developing world, lack of energy access and income poverty are closely interlinked in the Arab region. Least Developed Countries and locations with the highest concentration of low-income residents (often rural areas) face the most acute gap in modern energy access. The example of the Arab LDCs further illustrates the bi-directional linkage between energy access and poverty: income poverty prevents energy access, while the lack of modern energy services prevents people from escaping poverty by affecting their ability to produce and store food (because they do not have access to modern agricultural techniques, including water-pumping, or refrigeration), access to modern health and education facilities (through lack of access to lighting, medical equipment, safe local transport options) and general access to the outside world.

Mauritania has identified the lack of access to basic services, including energy, as a focus area in its efforts to improve its socioeconomic performance. About 56% of the population

Figure 31. Share of population with access to electricity (2014) and annualized growth (2012–2014)



Source: World Bank (2017a).

(approximately 30% of the urban population and 82% of the rural population) uses solid fuels (wood and charcoal) for cooking. The two main available improved stoves are the Ouaga Metallic Vita wood-burning stove with an efficiency greater than 45% and a cost of about US$ 4.11–8.22/unit, and the Multi 4-7-30 or "maslaha" wood-burning stove, which was introduced in the 1990s, with an efficiency of 30%–35%.[80] The first outreach and training programmes for improved cooking stoves, supported by the World Bank's Energy Sector Management Assistance Programme (ESMAP), targeted the neighbourhoods of Nouakchott in 1990, which included training for potential producers of the stoves.[81] More recently, the ProCEAO programme, funded by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the European Commission, implemented a project to distribute improved Vita cook stoves to approximately 5,000 households in the Guidimaka region by 2014.[82] Systematic evaluation of these pilot projects regarding their practicality for scaling up programmes based on such experience has yet to be carried out, however.

The socioeconomic and environmental cost of continued poor access to modern energy services has proved ultimately disastrous for Arab LDCs. Lack of access to energy reduces agricultural productivity and food security, accelerates land degradation and increases livelihood vulnerability in the face of expanding populations, climate-induced pressures such as droughts, extreme weather and poor water management. A case study from Yemen illustrates the detrimental effects of lacking natural resource management coupled with lacking access to modern energy sources:

> "In rural areas, high levels of poverty have often led to environmental degradation. Households are living at levels well below subsistence levels and use soil, forests and other resources at rates that exceed sustainable limits for recovery or renewal. The poor have no other option than to adopt short-term survival strategies which do not incorporate longer-term resource management considerations. If the poor have no alternative, they will continue to use land and water resources in ways that will threaten their future productivity."[83]

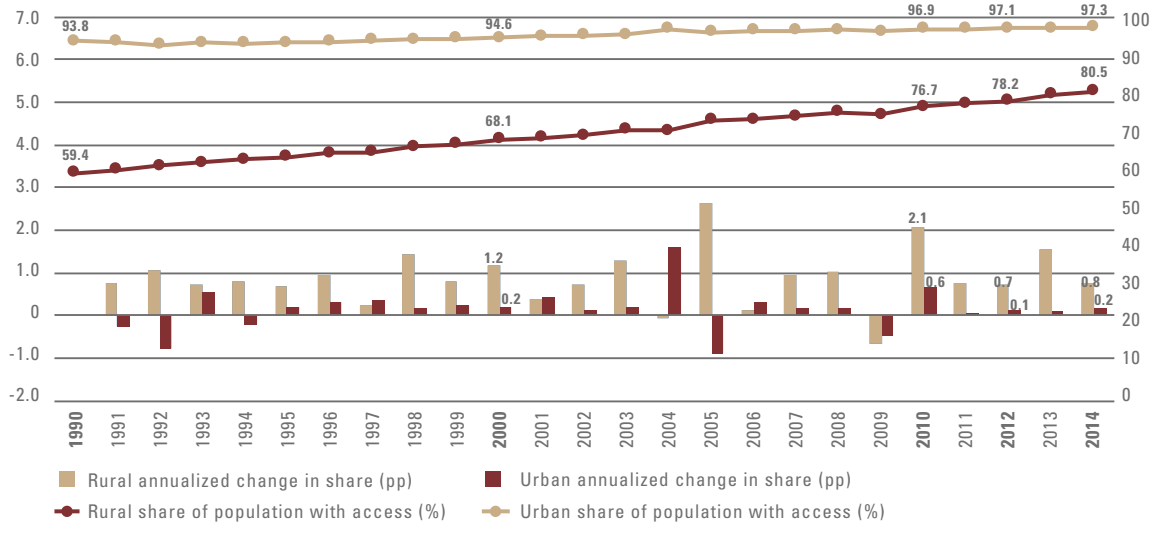
In addition to the detrimental effects on socioeconomic development, lacking and unequal access to resources, including essential services such as energy and water, pose the risk of driving conflict. The risk for conflict over natural resources has also been linked in the past to climate-related disasters and, ultimately, climate change itself.[84] Unequal access to resources, with the exclusion of entire provinces from modern energy, water, education and health services for more than 20 years, is seen by many as a key cause of political discontent and an obstacle to sustainable peace in Yemen.[85] Non-availability of basic energy services and the subsequent high value of fuel such as diesel for generators, also creates large economic niches for black-market smuggling, which, in turn, feeds funding for local armed groups.[86]

Lack of access to energy also reinforces the very causes that often stand behind the outbreak of conflict, particularly poverty and unequal opportunities. In Yemen, for instance, the shortage of liquid fuel in the absence of other forms of energy in many provinces has led in recent years to an average increase in fuel prices of 91%,[87] making basic access to energy even more difficult for those not privileged by income or other forms of access.

Urban–rural divide remains in some countries

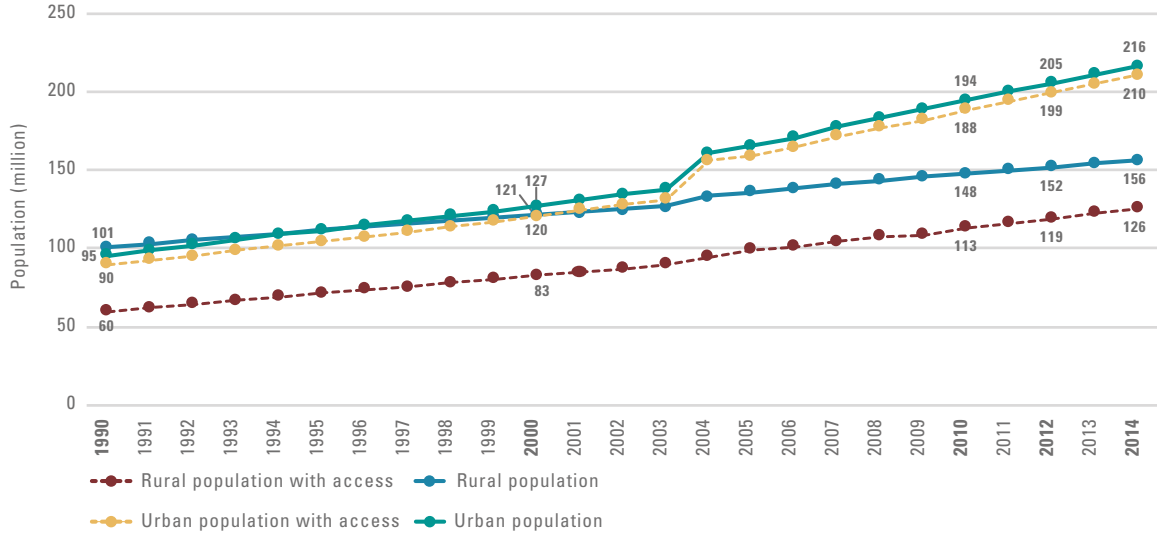
A considerable urban–rural divide remains in the Arab region, where urban access to electricity and CFTs is substantially higher

Figure 32. Share of rural and urban populations in the Arab region with access to electricity and annualized change in share, 1990–2014



Source: World Bank (2017a).

Figure 33. Number of rural and urban populations with access to electricity, 1990–2014



Source: World Bank (2017a).

in countries with incomplete coverage than in rural areas. Overall, access to electricity is nearly universal in cities across the Arab region but remains stationary at approximately 80% in rural areas. This issue is particularly precarious in the Arab LDCs, where almost 80% of urban dwellers have some access to electricity. In Mauritania, only 2% of people living in rural areas have electricity access, and 32% in Sudan.[88] Other geographic factors can also play a role in electricity access. In Yemen, electricity access remains highly location-dependent, with

urban and rural areas in the former North being substantially better serviced than the mostly rural areas of the former South, although the war in Yemen since 2015 has arguably turned electricity access into a problem throughout the country (see discussion below).

In all Arab LDCs, both urban and rural access improved slightly in recent years, although progress has been slow. Around one-third of rural areas in Sudan and two-thirds of rural areas in Yemen now have electricity access – in the case of Sudan a statistical improvement of almost 28% (simple growth) over a period of two years. By contrast, Mauritania's rural electrification rates appear to have actually fallen by around 42%, from 4% in 2012 to 2.3% in 2014. While statistical inaccuracies imply our data about modern energy access can only provide an indicative picture of the realities in LDCs, it appears clear that much more needs to be done to help rural populations in the Arab LDCs to access electricity, from a human-development point of view alone, not to mention the vast waste of talent and human and social capital of those 5 million urban and 27 million rural people in the Arab LDCs with no access to electricity.[89]

Electricity service quality remains a thorny issue in many Arab countries

A frequently forgotten aspect of electricity access is the quality and reliability of the access. While access in many countries may be close to universal according to recent data, many countries experience service disruptions and power outages, the frequency of which differs significantly across countries. Electricity access may mean a few hours of service per day or it may imply 24/7 coverage. Egypt, Iraq, Lebanon, Palestine and Yemen have been experiencing the most power outages, a situation we believe is inadequately reflected in available public data. Political disinterest in collecting and disseminating such data, together with insufficient institutional capacity, are important factors contributing to this lack of reliable data. In addition, political conflict has severely affected data-collection capabilities by a number of countries, including Iraq, Libya, Mauritania, Sudan, Syrian Arab Republic and Yemen. It is thus prudent to assume that actual disruptions in these countries are significantly under-reported in the available data.

Many rural off- and mini-grid systems are designed to supply only a few hours of electricity services per day. In most cases, the resulting service hours are incomplete, but contain an element of predictability: daylight hours in the case of PV systems for instance. Individual home units for self-generation such as rooftop PV panels with battery storage and diesel generators can help households produce electricity when needed: for instance, for lighting, watching TV and battery-charging for mobile phones. This form of access is a compromise between round-the-clock, always available access to electricity for some customers, especially in urban areas, and the alternative of no electricity access at all. On the other hand, interrupted electricity supply can disable reliance on electricity for certain essential uses, such as the refrigeration of medicines and life-saving electrical appliances used in rural health clinics. Hybrid systems that combine different technologies – for instance PV panels with a back-up diesel generator – can help overcome these challenges, but the cost for the end user is of course higher.

Unplanned service disruptions, however, are a challenge for electricity users, irrespective of the urban–rural divide or indeed income divide. Power cuts as a result of insufficient power-generation capacity and old and underserviced networks – often the result of decades of underinvestment in upgrading and maintenance and fuel shortages in utilities – typically affect all users, from small homes to businesses, industries and government

buildings. The reasons for such power disruptions can range from a dearth of funding for utility companies – often linked to highly regulated electricity prices that keep utilities from recovering costs and hence investing in new infrastructure – to insufficient planning and load control, large technical losses due to old transmission lines and electricity theft and simple under-capacity of the grid to service the market during peak times owing to rapidly increasing peak demand across many Arab countries. Poor electricity services can also trigger an increase in illegal connections to the grid, which further complicates load management and can cause short circuits.

The social and economic cost of recurring blackouts can be enormous. Lost hours of service are operating hours lost to businesses and industries. They potentially affect hospitals and clinics, leading to cases where no back-up generators are available and the failure of life-saving machinery and equipment. Longer and more frequent blackouts lead to the loss of stored food and medicine, damage to electrical appliances, including expensive and life-saving medical equipment, as well as production and economic value generated by businesses and industries.

Lebanon epitomizes the debilitating and – for the economy – highly costly results of unstable power provision. Decades of underinvestment in new electricity-production capacity, transmission and distribution infrastructure and underdeveloped long-term planning to diversify the country's energy sources have meant that Lebanon has been suffering from unstable power supplies for many years. The problems arise both in cities and in the countryside. Electricity shortages lead to regular load-shedding and power cuts across the country, a problem that has further intensified since the beginning of the neighbouring Syrian Arab Republic crisis, triggering the inflow of large numbers of Syrian refugees into Lebanon.[90] Because of the failure of the national electricity company (Electricité du Liban) to provide its customers with a regular power supply, a large market for self-generation has emerged in Lebanon, the additional cost of which is paid for by local industries, businesses and end users – and, through deadweight loss, by the wider economy.

The World Bank estimated that, by 2008, between 33% and 38% of electricity consumption in Lebanon was met by self-generation, with most generators relying on diesel fuel.[91] This, in turn, has contributed to the vast import bill for petroleum products in Lebanon in addition to the enormous health and environmental cost of the systematic use of diesel electricity generators throughout the country.

Other countries in the region suffer from interrupted electricity supply. In the summer of 2014, Egypt experienced one of its most serious energy crises in decades due to peak demand overtaking capacity, with power cuts occurring on a daily basis, each lasting one to two hours. Iraq faces similar challenges. Power cuts in the country last typically from 15 to 20 hours per day, a situation that has been the norm for years.[92] Estimates place the economic cost of power cuts in Iraq alone at around US$ 40 billion per year.[93] Palestine continues to experience significant deficits in energy access and reliability. Being dependent on Israel for the delivery of electricity and other energy services, Palestine suffers from economic infrastructure destruction and supply-chain disruption. The Israeli military operation against Gaza in July 2014 incurred serious humanitarian and economic costs, in a further escalation of an already dire situation due to the Israeli blockade since 2007.[94] A 2013 enterprise survey conducted by the World Bank reveals that access to electricity is the second most important obstacle to conducting business in the West Bank and Gaza after political instability. Surveyed firms reported an average of 8.7 outages in a typical month.[95]

In Yemen, socioeconomic progress in many provinces and the country's overall dire humanitarian situation has deteriorated further, due to poor electricity-service quality. In the context of Yemen, a UNDP study states:

> "Although the percentage of on-grid connected population is very low, electric power supply from the public network experiences is intermittent, with regular rolling blackouts as a result of recurring technical failures due to outdated infrastructure which has exceeded its lifespan, in addition to shortage of fuel, particularly diesel, as well as non-technical failures due to frequent tribal attacks. The cost of intermittent electric power is enormous, especially on household welfare, delivery of quality basic services as well as small and medium businesses and small-scale industries, upon which economic growth largely hinges."[96]

This, in combination with problems of replacement ability, can further worsen the humanitarian situation in conflict-torn countries considerably: for instance, Iraq, Palestine and Syrian Arab Republic. Frequent blackouts and service disruptions due to power shortages and technical outages also imply that customers pay for poor-quality service, which feeds into a negative spiral where cooperation by citizens, such as willingness to pay bills, may diminish and eventually fade, further weakening already unsatisfactory utility services, with long-term consequences.

Political conflict and instability present growing challenges to universalizing energy access in the region

Conflict and political instability are major obstacles to sustainable development, in many cases reversing past progress in areas such as energy access. The years since 2010 have seen the escalation of an unprecedented number of political crises and conflicts in the Arab region, from Egypt, Libya and Tunisia to Iraq, Sudan, Syrian Arab Republic and Yemen. The effects of conflict are profound for many of the region's economies and people. Devastating long-term effects of the destruction mount as conflicts extend to many years. Vast amounts of land, infrastructure and entire cities are lost, along with the livelihoods of millions of people.

Conflict and energy access

In Syrian Arab Republic, conflict and political instability have left severe and lasting damage to the country's ability to supply its population with energy. The destruction of oil and gas fields alone have caused an estimated US$ 8.4 billion in losses as of early 2016. Losses to electricity, water and sewerage installations were US$ 8.2 billion.[97] National electricity-generating capacity fell from 4,800 MW in 2011 to around 2,200 MW in 2016. In 2016, an estimated 11.8 million Syrians were in need of access to electricity. Damage to electricity-generation facilities and transmission and distribution networks, as well as fuel shortages, have resulted in blackouts for around 16 hours per day for those who still have access to electricity; people in rural areas undergo power outages up to 18 hours per day.[98] Despite the obvious hardships this causes, the disruptions are not captured in our indicators. The effect of the electricity deficit on the country's health sector and other essential services and productive activities has been devastating.[99] What is left of the Syrian grid is in dire need of critical servicing, modernization and standard maintenance. Efforts in this direction by external donors, in conjunction with the United Nations, have been held up either by the Government or by non-Government forces, as well as by major sanctions-related obstacles.[100] A recent report on the humanitarian situation in Syrian Arab Republic that illustrates the negative downward spiral in socioeconomic development factors as a result of conflict concludes:

> "The destruction of economic, social and human infrastructure has deprived Syrians across the country of the productive tools required to meet their basic needs, burdening households and leading to the creation of improvised solutions in the absence of State services. The deterioration of basic services continues to undermine the viability of productive sectors, feeding a vicious cycle of unemployment, diminishing resources and increased levels of poverty."[101]

Political conflict also undermines sustainable resource management such as energy and water. On the one hand, this is because central government control often deteriorates throughout the conflict. On the other hand, during times of conflict, as well as subsequent ceasefires, focus is increased on policies that promise tangible benefits to specific constituencies in the short term, over and above long-term planning and the enforcement of sustainable production and consumption patterns. The effects of poor resource management can be devastating in the long run, making conflict a heavy heritage for future generations beyond the serious loss of human life and infrastructure.

The example of Yemen illustrates the far-reaching, acute consequences of conflict on energy access and hence on other key sectors such as food security and public health. As a result of war and conflict, schools and hospitals have to close down due to lack of fuel supplies and financial resources.[102] Looking back at several years of conflict and war in Yemen, UNICEF reported in 2016:

> "Since March last year, restrictions on imports – and severe damage to the western port of Al-Hodeida, the main import hub for supplies into the country's north – hindered the rapid delivery of critical commodities to people in need. Parties to the conflict set up roadblocks and checkpoints challenging the access of humanitarian teams and the delivery of supplies. Yemen was cut off from its food pipeline. Fuel has been in very short supply, bringing services to a standstill and crippling the economy at a time when the needs of desperate families and children continue to increase."[103]

> "The escalation of the conflict in Yemen has left an estimated 14.1 million people, including 7.4 million children, in need of health care. These huge needs come at a time when the health system is on the brink of collapse. Nearly 600 health facilities have stopped working due to damages and shortages in supply, electricity, fuel and personnel ... UNICEF estimates that nearly 10,000 children under the age of five may have died in the past year from preventable diseases as a result of the decline in key health services such as immunization against vaccine-preventable diseases and the treatment of diarrhoea and pneumonia. This is in addition to nearly 40,000 children who die every year in Yemen before their fifth birthday."[104]

In turn, poor or no access to basic electricity can also become a causal factor contributing to the stirring-up of social discontent. In the Arab LDCs, vast discrepancies exist between provinces with regard to access to fuel and electricity, reinforcing the concentration of poverty and deprivation of local communities that, in turn, can become the subject of political grievances. In Mauritania, the areas most affected by poverty and lack of access to modern energy and services are the Aftout area, the Rkiz moughataa (Trarza) and Moudjeira moughataa (Tagant).[105] In the context of Yemen, the International Monetary Fund (IMF) in 2014 reported the following:

> "...recent increases in sabotage of oil pipelines and the electricity grid have led to severe shortages of fuel and electricity. These prompted large demonstrations

Box 5. The effect of South Sudan's secession on energy access in Sudan

The secession of South Sudan from the Republic of Sudan following a referendum in 2011 presents huge setbacks to the energy-supply situation in Sudan. Following the secession of the South in 2011, Sudan lost 75% of its oil reserves, 60% of its biomass energy resources and 25% of its hydropower potential. South Sudan is equally affected, because the majority of the country's lifeline oil-export infrastructure is located in the north. Only around 45% of Sudan's population and a mere 1% of the population of South Sudan have access to electricity. This new development poses a critical energy-supply situation for all primary sources due to a dwindling stock of energy resources on the one hand and increased population on the other hand for both States. As an LDC (ranked 166 out of 187 countries on the Human Development Index, 2014) and with 46.5% of its population living officially in poverty (and many more near the poverty line), Sudan's population is extremely vulnerable to energy-supply constraints.

Source: Adapted from UNDP et al. (2016), with input from UNDP et al. (2013).

and a limited reshuffle in the coalition cabinet in June 2014."[106]

Sudan represents one of the direst situations in the Arab region. The 2011 National Energy Assessment reported that about 73% of total electrical power is consumed in three states (Khartoum 45%, Geziera 18% and White Nile 10%), 16% is consumed by four states (4% each in Sinar, Red Sea, Kassala and Nile) and the remaining 11% is consumed by 12 states (>1% for each of Northern, Blue Nile, Kordofan and Darfur). Oil products also follow the same state disparities in Sudan; five states consume 82.8% of the total oil products (Khartoum 61%, Geziera 6%, Red Sea 5.4%, North Kordofan 5.4% and White Nile 5%); the other 13 states share the remaining 16.7% (less than 2% each). Darfur is among the poorest in terms of consumption of electricity and modern liquid fuels. With an estimated 1.3 million internally displaced people living in Darfur, in addition to the native population,[107] distances from the centre and poor transportation facilities result in modern energy services being unavailable and/or unaffordable to the majority of the state's population and have disastrous humanitarian and environmental effects.[108]

Energy access and refugees

The other side of conflict is the systematic displacement of millions of people, with highly detrimental effects on energy access and the environment. The Arab region has long been home to a vast number of immigrants and permanently displaced persons, a situation that has intensified to unprecedented levels since 2010. By 1 January 2014, UNHCR registered some 2.3 million Syrian refugees (a number that doubled between then and 2016),[109] 3 million internally displaced persons (IDPs) in Iraq in addition to some 250,952 Iraqi refugees in neighbouring countries[110] and some 180,000 Yemeni refugees and migrants.[111] The Arab region is also home to one of the longest-standing conflicts of the 20th century, between Israel and Palestine, with an estimated 5 million Palestinian refugees of whom some 1.5 million live permanently in refugee camps in Jordan, Lebanon, Syrian Arab Republic, the West Bank and Gaza.[112] Many Palestinian refugees in Syrian Arab Republic have now become refugees once more due to conflict in Syrian Arab Republic

itself.[113] In acute conflict locations, such as certain Syrian and Yemeni towns, the exit of large numbers of the population leads to what is expected to be a further brain drain, reducing the availability of technicians, engineers and other trained staff to maintain functioning energy supplies for those who stayed behind. These circumstances illustrate the extremely damaging effects of conflict, not only on affected Arab countries today, but also on their people over the medium and long term, even if they one day return to their destroyed homes.

A large proportion of displaced Arab people remain within neighbouring Arab countries, demonstrating how the negative socioeconomic ramifications of conflict in one country affect many others. The Mashreq countries alone hosted an estimated 5.8 to 7 million migrants and refugees by mid-2013, including around 1,305,145 Syrians registered by UNHCR as being refugees or in refugee-like situations in Egypt, Iraq, Jordan and Lebanon. The conflict-related displacement of several million Syrians since the outbreak of armed internal conflict in 2012 adds to the number of long-term migrants and displaced persons, including Iraqis, and the vast Palestinian community in neighbouring countries such as Jordan, Lebanon and Syrian Arab Republic.[114]

The proportion of migrants and refugees relative to the population of some countries is significant. In Jordan, migrants made up 40.2% of the population (48% including Syrian refugees recorded by UNHCR as of mid-2013), and 17.6% in Lebanon (or 26% including Syrian refugees recorded by UNHCR).[115] Already prior to the Syrian crisis, Jordan alone hosted 2,097,338 Palestinian and 55,509 Iraqi refugees, 20,286 of whom were assisted by UNHCR. To these numbers were added 605,157 registered refugees from Syrian Arab Republic by mid-2014. Lebanon, with 1,111,076 Syrian refugees registered with UNHCR, became the second largest host country in the world to refugees. Jordan and Lebanon host the highest proportion of refugees worldwide, with 257 and 114 refugees per 1,000 inhabitants respectively.[116] The situation of a large part of these refugees remains under-documented and their access to modern energy services, or lack thereof, must be regarded as being largely unconsidered in our data.

Mass migration imposes tremendous material and logistical challenges for host countries and communities, while it deprives millions of refugees of secure access to energy in addition to other essential services such as clean water, sewerage, food and health care. Energy services in refugee camps and informal settlements are often inferior, poorly planned and highly inefficient, leading to a reversion to traditional biomass, such as fuelwood, and diesel generators.[117] The effects for both human health and the environment from large refugee populations are significant, from the implications of inefficiently burnt biomass, together with common problems, including deforestation around refugee camps and the effect of polluting fuel fumes inhaled by women and children in particular. An FAO report from Lebanon exemplifies these challenges:

> "Due to the accelerating demand for fuel, woodlands and forests (by illegal cutting) by increasingly resource-poor Syrian refugees and the Lebanese host communities, natural resources are being overexploited – non-wood forest products are also exploited for daily subsidence by both Lebanese communities and refugees. In

addition, the arrival of additional livestock from Syrian Arab Republic is gradually causing overgrazing and degradation of vegetation cover on vulnerable rangelands. To meet the increasing demand of Lebanese host communities and Syrian refugees, water-pumping and depletion of aquifers are approaching critical levels for both domestic and agricultural use. The influx of the refugees and their search for water points is resulting in a dramatic increase of solid waste along the rivers and coastline, causing higher pollution levels in these ecosystems. The deterioration of water quality is affecting not only potable water, but also water used for irrigation. Furthermore, conflicts over the use of natural resources, between host communities and refugees, have become more and more severe, putting peace and security at risk."[118]

The intrinsically transient nature of refugee camps and informal settlements – even where these turn into quasi-permanent forms of accommodation, such as in the case of the large number of displaced Palestinians in neighbouring Arab countries – also implies that available humanitarian aid is typically poorly suited to financing longer-term energy solutions in protracted crises and recovery situations.[119]

Aerial view of big highway interchange with traffic in Dubai, UAE, at night.
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3. Energy Efficiency

Overview

Energy efficiency is one of the key pillars of inclusive sustainable growth. By helping countries maximize the productivity of energy, energy-efficiency policies and investments pay for themselves, eventually, because they allow economies to make better use of available energy resources, reducing waste and economic deadweight loss. Energy producers and net importers in the Arab region have also to gain from improvements in their energy-efficiency levels. A recent World Bank study estimates potential for savings from energy efficiency at 21% of projected total primary-energy supply in Middle East and North African countries by 2025.[120] Nearly three-quarters of these savings, or 219 of 300 million tons of oil equivalent, are from greater efficiency in end-use sectors, including industry, residential, commercial users, transport and public services.[121]

This chapter's analysis is based on the use of energy intensity as a proxy for energy efficiency. An analysis of GTF data suggests three broad observations:

1. Reductions in overall energy intensity in the Arab region have been lagging behind those in other regions. While it has historically not been one of the most energy-intensive regions in the world, it has been the only one to achieve no fall in its energy intensity over the past 25 years. This implies that more energy is needed today than 25 years ago to produce a unit of economic output. Today's average energy-intensity rate in the Arab region is close to the rate of Europe, North America and Central Asia, where countries have reduced their own energy intensity rates by more than one-third over the past 25 years.
2. Energy intensity has been improving since 2010 in a number of Arab countries, but the rate of progress needs to accelerate. Some of the most active countries in prioritizing energy efficiency in the Arab region are net importing countries, particularly Jordan, Morocco and Tunisia, but a number of net exporters of energy have also registered falling energy-intensity rates. In order to turn these positive developments in some countries into a regional trend, proactive energy-efficiency policy will need to be accorded much higher priority on political planning agendas.
3. Energy-efficiency trends vary considerably by country and economic sector. Taking the region's aggregate data, we see a moderate trend in more recent years towards falling energy-intensity levels in agriculture and transport, with declining intensity rates in industry in some economies. Transport remains by far the most energy-intensive sector in the Arab region, however, followed by industry and agriculture. Statistical constraints using energy intensity as a proxy for energy efficiency mean our understanding of country-level developments remain sketchy at best, but a clear message is that much scope exists for further efficiency improvements.

The current period of low oil prices offers many of these countries an opportunity to act, both through direct policies aiming at long-term energy-efficiency savings and through policies targeting those barriers that have obstructed progress in energy efficiency in the region for the past few decades, including weak market and energy-pricing incentives.

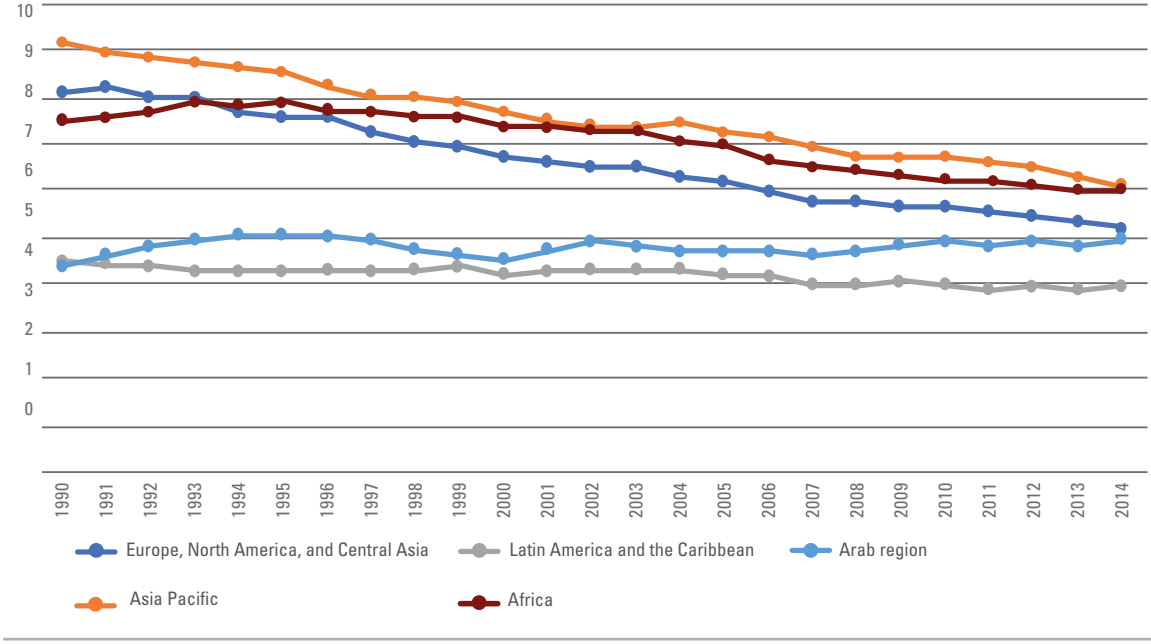
Reductions in energy intensity lag behind those in other regions

Reductions in energy intensity in the Arab region have been lagging significantly behind those in other regions. Between 2000 and 2014, global energy intensity fell by around 1% annually (2% per year since 2010), a pattern observed across world regions – irrespective of income and development levels – with the notable exception of the Arab region. Unlike the rest of the world, the Arab region as a whole has actually grown more energy-intensive in the past 25 years, implying more energy is needed today than 25 years ago to produce a unit of economic output. With an average annual growth in regional energy intensity of around 1% during the 2000s, the Arab region is now about as energy-intensive as Europe, North America and Central Asia, albeit with considerable intraregional variation.

Levels of energy intensity differ substantially across the region

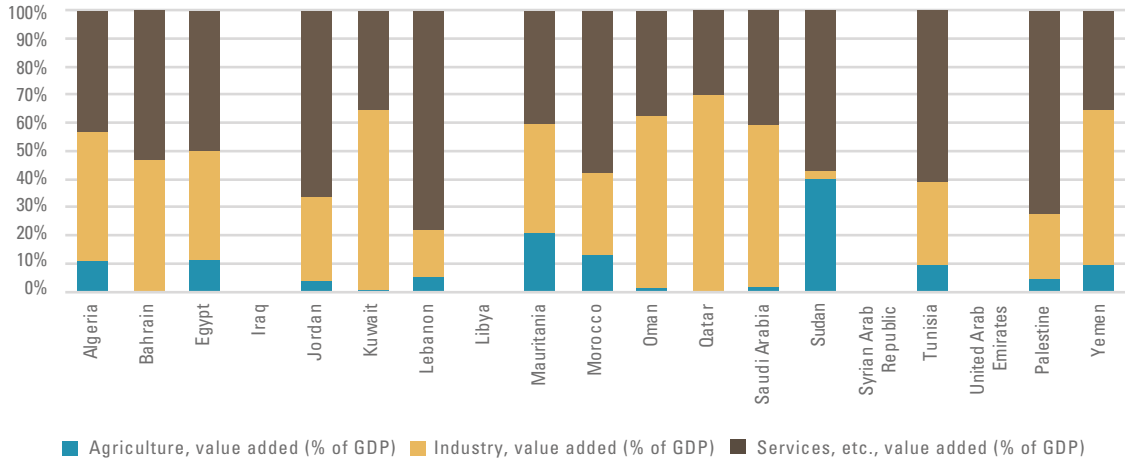
Energy intensity rates differ considerably across the Arab region. Many Arab economies are fossil-fuel exporters, with large-scale oil producers such as Algeria, the smaller GCC economies, Iraq, Libya and Saudi Arabia having based their historical industrial growth on fossil fuels and energy-intensive industries such as petrochemicals, steel, aluminium and fertilizer production, which increase the energy-intensity score used as a proxy for measuring energy efficiency in this report. The proportion of total manufacturing output of industries such as food, textiles, chemicals, mineral products and electrical machinery also differ vastly between countries such as Algeria, Egypt, Jordan, Morocco, Saudi Arabia or the UAE, as does the share of industry within their GDP in the first place (Figure 35).[122] Disturbances to the economic development of Iraq throughout the tracking period and to

Figure 34. Energy intensity trends by global region, 1990–2014 (MJ/gross domestic product based on purchasing power parity (GDP PPP), 2011 US$)



Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 35. Composition of GDP in different Arab countries, 2014 (% of GDP)

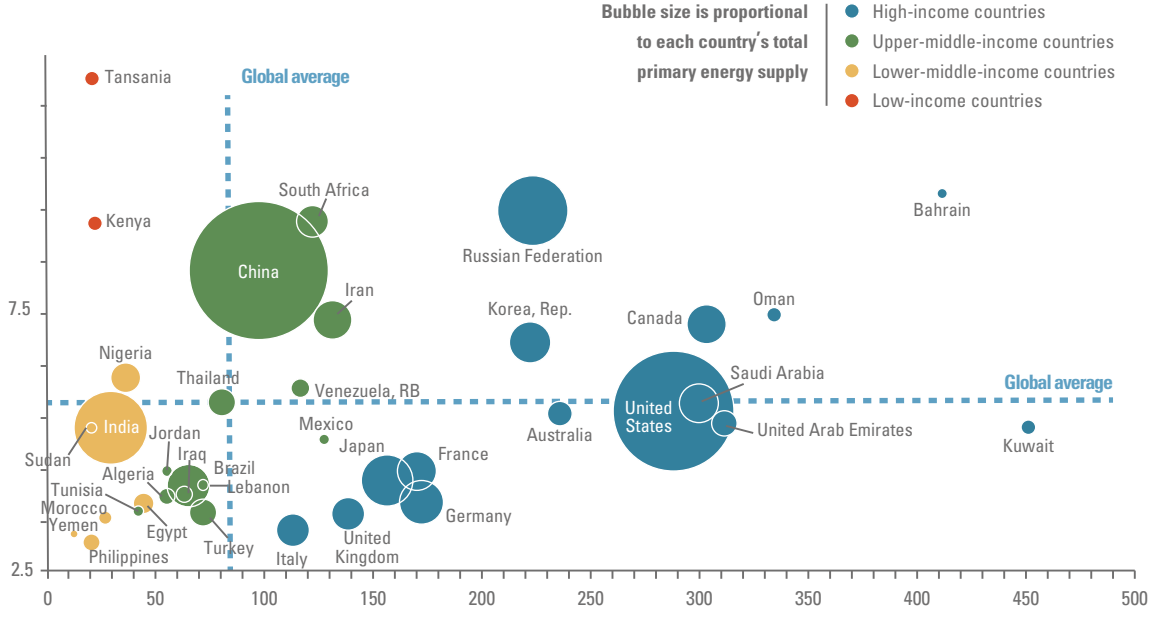


Note: Data gaps: Iraq, Libya, Syrian Arab Republic, United Arab Emirates. Some values do not add up.
Source: World Bank (2017b).

Libya recently have further aggravated the energy performance of this group of countries, leading to spikes that affect overall regional performance.

Plotting individual countries' energy-intensity levels against per capita consumption of energy illustrates this highly diverse picture of energy use in the Arab region, as well as the

Figure 36. Primary energy intensity vs. primary energy consumption per capita, selected countries, 2012

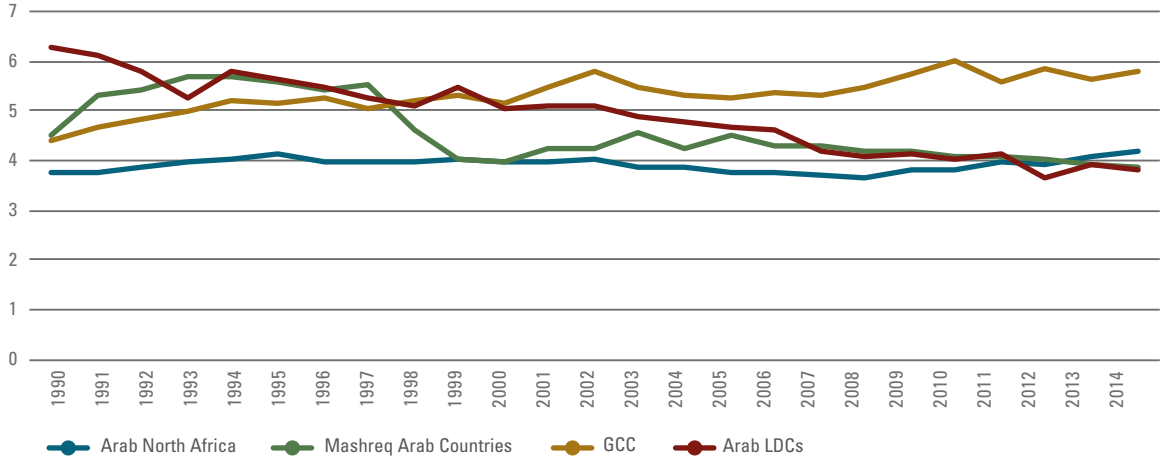


Note: The scale does not allow depiction of Qatar, which had per capita energy consumption in 2012 of over 770 GJ per person, and energy intensity of 6 MJ/2011 USD, just above the world average.
Sources: OECD/IEA, World Bank.

very large differences between some Arab oil exporters – in particular the GCC economies – and the rest of the Arab region. GCC economies Qatar, Oman, Saudi Arabia and the UAE, with their very high rate of energy consumption per unit of economic output, are among the most energy-intensive economies in the world (Figure 36).

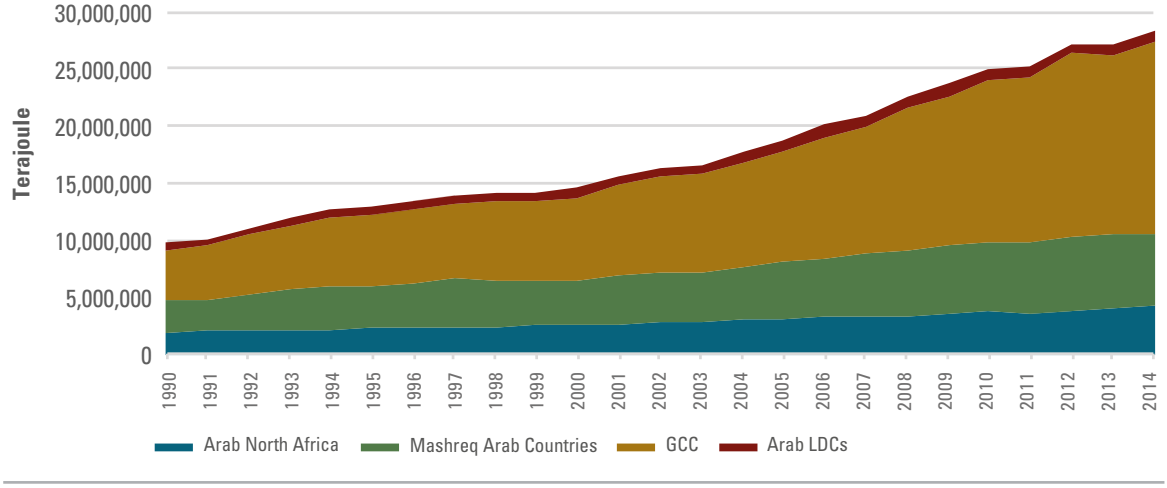
Energy net exporters in the GCC and North Africa drive the regional trend in rising energy intensity. A closer look at the subregional level reveals the overall much higher energy intensity rates in the GCC economies from around the early 2000s compared with any other subgroup of States within the Arab region. Energy intensity in this subgroup continues to rise. Overall, they account for over 60% of the Arab region's TPES and are thus a major driving force behind aggregate regional energy dynamics (Figure 38). Most of the aggregate growth in energy intensity in

Figure 37. Energy intensity in the Arab region by subregion, 1990–2014 (MJ/2011 PPP US$)



Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 38. Total primary energy supply in the Arab region by subregion, 1990–2014 (TJ)



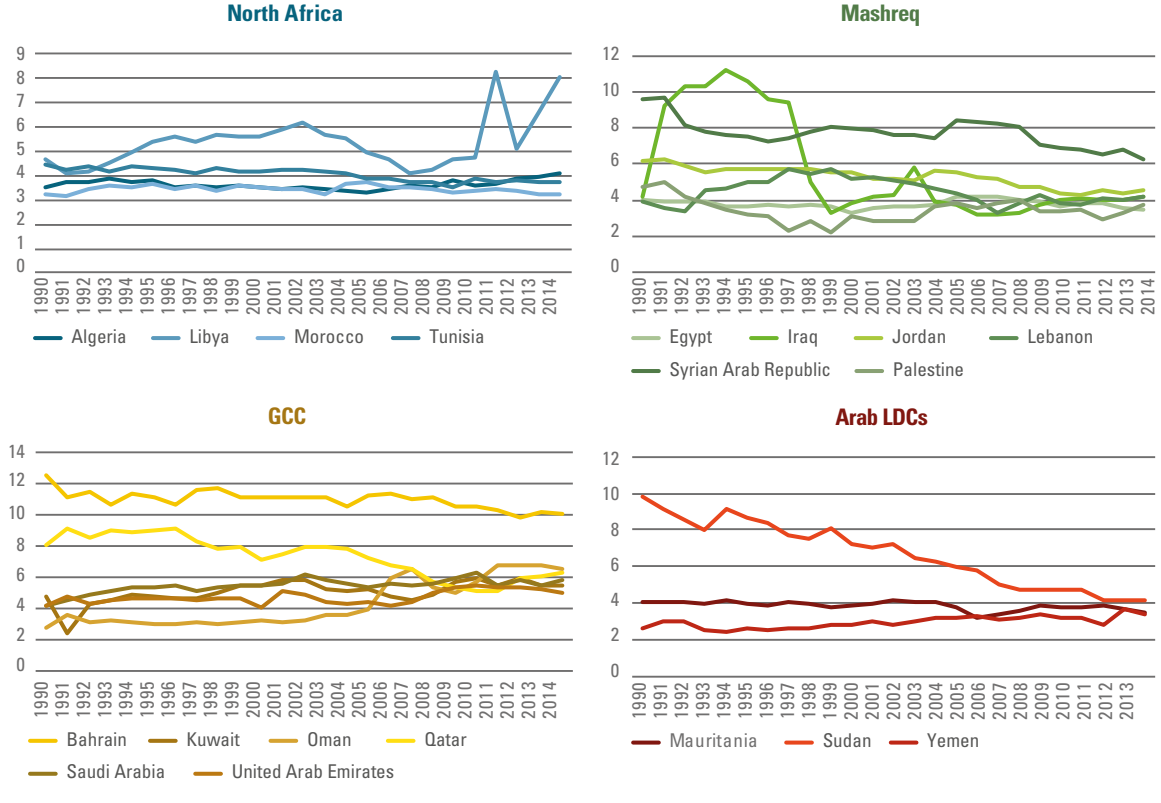
Source: World Bank (2017a).

Arab oil exporters stems from the industrial and residential sectors, with some growth in energy intensity in the agricultural sector along with countries such as Saudi Arabia, whose national agricultural programmes are aimed at producing more food domestically.

North African countries are the second group of economies that have seen an overall increase in energy intensity since the 1990s, albeit with some variation as the early 2000s seemed to show an initial decline in intensity levels (Figure 37). The slight increase in energy intensity in the subregion stems largely from Algeria and Libya – both oil and gas exporters – with Libya being clearly a regional outlier in its significant increase in energy intensity during the 2000s and again since the outbreak of political instability in 2011/2012. Net energy importers Morocco and Tunisia have seen fairly low and falling energy-intensity rates. The energy intensity of North Africa's agriculture, transport and service sectors has fallen slightly, albeit only marginally compared with the 1990s and with significant variation over the years.

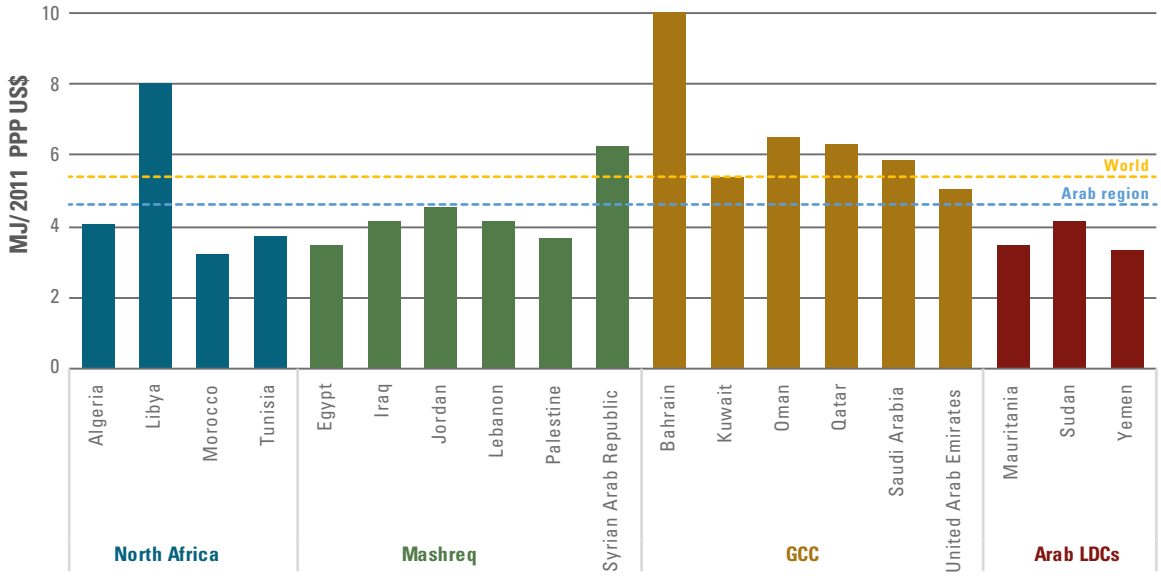
In contrast to the rest of the Arab region, the Mashreq economies and the Arab LDCs have observed a long-term trend of falling energy intensity since 1990. This is despite a subregional increase in the energy intensity of residential and agricultural primary energy supply in the Mashreq economies and more energy-intensive industrial production and service sectors in the Arab LDCs. Some of these trends can be linked back to region-wide factors such as rising incomes and living standards, and improved technology for use in agriculture. The Mashreq economies'

Figure 39. Energy intensity in the Arab region by subregion, 1990–2014 (MJ/2011 PPP US$)



Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 40. Energy intensity in the Arab region, 2014 (MJ/2011 PPP US$)



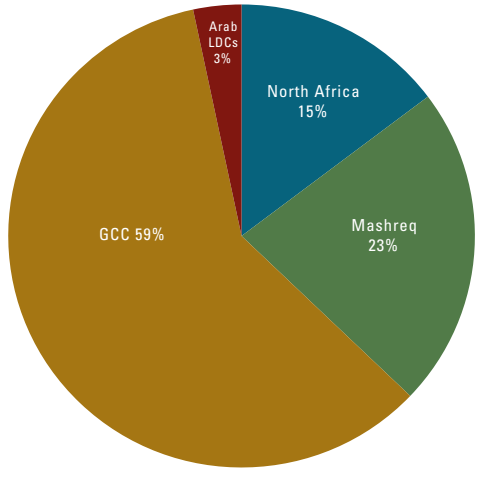
Source: World Bank (2017a) based on IEA and UN Statistics data.

industrial, service and transport sectors have, on the other hand, witnessed significant reductions in energy intensity, with an acceleration in more recent years. The two subregions' limited energy consumption, particularly the Arab LDCs, whose energy consumption is marginal relative to the rest of the Arab region, means that gains in energy-intensity reductions have not been able to reverse the region's aggregate performance in energy intensity.

GCC countries become the most energy-intensive in the Arab region

The GCC economies are among the most energy-intensive countries in the Arab region. While most parts of North Africa, the Mashreq and the Arab LDCs register comfortably below the region's average energy intensity of 5 MJ/2011 PPP US$, the GCC economies range above it, and pull aggregate regional energy intensity upwards. The weighted average of the GCC economies of 5.8 MJ/2011 PPP US$ indicates considerably higher energy-consumption rates in aggregate terms, per capita energy-consumption rates and significantly more energy-intensive industries than in the rest of the region. In 2014, Bahrain was with 10 MJ/2011 PPP US$ the most energy-intensive economy in the Arab region, using almost twice as much energy per unit of

Figure 41. Share by subgroup of economies in the Arab region's TPES



Source: World Bank (2017a) based on IEA and UN Statistics data.

economic output as the world average, and three times as much as the Arab region's least energy-intensive country, Morocco. Because the GCC countries account for close to two-thirds of regional primary-energy supply, they also account for, and influence, regional shifts in energy intensity over time. With relative energy-intensive economies and as the most important block of energy-consuming economies in the Arab region, shifting dynamics in the GCC will likely affect regional aggregate ratings and policy trends well into the future.

Structural factors play a critical role in accounting for the heightened energy consumption patterns in GCC economies. Industry accounts for a large share of domestic energy consumption in the GCC, 50% of total final energy consumption in Saudi Arabia and between 60% and 75% in Bahrain, Kuwait, Qatar and the UAE[123]. The GCC economies' key industries – refining, petrochemicals, steel, aluminium and other energy-intensive activities have contributed toward this relative large energy footprint of industrial activity in the Gulf. This combines with other factors that have driven consumption in transport and the residential sector. Very low market prices for energy – to both intermediary and final consumers – and lacking energy-efficiency requirements across different sectors have translated into very high energy requirements per unit of output of GDP, particularly in high-income economies, with a high proportion of energy-intensive industries relative to other economic sectors.

There is no clear regional or subregional trend in efforts to decrease energy-intensity rates. Bahrain's energy intensity, both in absolute terms and on a per capita basis, is among the highest in the world. GCC fossil-fuel exporters Bahrain and Qatar register some of the world's highest energy-intensity levels, but also some of the largest declines in energy-intensity rates from even higher levels during the 1990s within the Arab region. Oman and large oil producers Kuwait and Saudi Arabia, by contrast, saw increasing energy-intensity rates during the 1990s and 2000s. This very mixed picture suggests that GCC economies both push up regional rates in energy intensity and account for a large share in gradual energy-intensity reductions through structural industrial reform and efficiency savings. The gradual introduction of higher-performing technologies may in this context add to some efficiency gains made in recent years. These structural factors, however, must be seen as being tied largely to higher international, rather than regional, efficiency standards – whose gradual introduction in recent years is more likely to show results over the coming years.

Outside the GCC, the greatest fall in energy intensity has been seen in Egypt and Jordan. Both countries have in the past witnessed a gradual change to their economies' industrial base, with a trend away from manufacturing and industrial activities toward service-based industries, including tourism. This also means that falling energy-intensity levels are less likely to be the result of dedicated energy-efficiency improvements than the result of more structural reorientation of new economic activities. A substantial fall in energy intensity in the period since 2000 has also been witnessed in Lebanon, Sudan and Syrian Arab Republic, although this trend appears to have been reversing in more recent years. The lack of any clear pattern or definitive trend in energy intensity is a theme throughout the region and reflects the probably very high influence of exogenous factors on energy intensity, including changing trade patterns and the value of industrial products on domestic and international markets, changes to the value of GDP as a result of currency fluctuation, climatic factors and political stability. The largest rise in energy intensity outside the GCC has been registered in Libya, albeit with a note of caution as to the accuracy of available statistics, with a fast increase since 2010, thus preceding the outbreak of civil war in 2012.

Box 6. Interpreting regional data on energy efficiency and the use of energy intensity as a proxy

Tracking progress in energy efficiency across countries and regions is a difficult endeavour owing to the lack of standardized, comparable data and, in many cases, the lack of any quantifiable data to start with. Energy intensity was hence chosen within the GTF as a proxy variable to compare the productivity of energy within different economies. The standard way of calculating energy intensity is to divide a country's GDP by its total final energy consumption (TFEC). This is a highly imperfect way of measuring energy efficiency, but is the closest way to identifying the way energy is being used to generate growth inside economies. Some important considerations apply to the interpretation of regional data on energy intensity as a proxy for energy efficiency:

First, the underlying data used to calculate country-level energy intensity itself is highly imperfect and characterized by gaps. Several Arab countries publish no figures on basic indicators such as TFEC, value-added and energy-intensity data available at subsectoral level prior to 2000, others not prior to 2010. This includes relatively large energy consumers on a per capita and subsectoral level, as well as transitional economies such as Bahrain, Kuwait, Libya, Oman, Sudan, Syrian Arab Republic, the UAE and Yemen. Because the GCC economies account for close to 60% of the region's final energy consumption, their lack of data must be seen as having a particularly distorting effect on aggregate regional data. While these countries report aggregate numbers such as TFEC and GDP, limits to data availability mean that, even for some key economies in the region, we are unable to verify the extent to which different sectoral data feed into aggregates, or whether subsectors with missing data are simply incomplete.

Second, energy-intensity rates are influenced by a range of exogenous factors, making their interpretation as a par-by-par proxy problematic. The large share of commodity exports in a range of Arab economies' GDP and inherent world-market price fluctuations for commodities from crude oil to agricultural products, in addition to currency fluctuations, affect the value of many Arab economies' sectoral and aggregate GDP and thus its energy-intensity rates as the value of economic output inherently varies over time. This makes interannual fluctuations in energy intensity more difficult to interpret purely in terms of improved or declining energy efficiency. Energy intensity in conflict-torn countries typically increases sharply with the onset of conflict, and the decline in economic output despite unchanged rates of energy use (see discussion below). While we are treating energy intensity here as a proxy for energy efficiency, more thorough analysis would require better data that are currently not available.

Third, comparing energy intensities between countries with large oil sectors, such as Kuwait, Qatar, Saudi Arabia and the UAE with energy-importing countries involves a comparison between inherently different types of economies. In large oil-producing and exporting countries, the large share of fossil-fuel exports distorts the structure of GDP – in addition to its value as discussed above – and hence energy-intensity ratings. This being said, using only non-oil GDP in large oil-exporting countries would further increase the energy intensity of GDP in these countries, relative to other economies.[124]

As a result, measuring energy intensity in the Arab region must be seen as a highly difficult endeavour that calls for an urgent improvement in data quality and availability if individual countries wish to monitor and improve their energy efficiency performance over time. Our conclusions are thus tentative and we are aware that they may offer only a very rudimentary perspective of what remains a largely underdocumented, and poorly understood area of energy management in the Arab region.

Barriers in regional energy-intensity reductions

Many of the barriers to energy-efficiency improvements in the Arab region are well known and documented. Final user motivation to invest in energy-efficiency improvements across sectors depends on end-user energy prices and their energy spending compared to other costs.[125] While the relatively high ratio of energy inputs to production costs in the highly energy-intensive industries of the GCC economies as well as medium-size energy producers such as Algeria, should in principle, offer considerable incentives for producers to improve the efficiency of their energy use, the extremely low price of input fuel and feedstock from domestic production of oil and natural gas have historically provided weak market incentives for producers. To a degree, this is also true for Arab countries that have seen significant increases in their reliance on imported fuels, for instance natural gas, which continues to be priced at very low prices across the region (see Chapter 5 for a more detailed discussion).

Where economies and living standards have been growing, market incentives to conserve energy have been lagging significantly behind across the entire Arab region. Impressive progress in achieving near-universal access to modern energy services, coupled with rapid growth in populations, living standards and economic expansion and diversification has in many cases come hand-in-hand with universally applicable, low-priced energy and a lax regulatory environment that sets few, if any, requirements for the efficient use of energy. Incentives for end users – whether industrial, commercial or residential – are still largely absent from regional energy markets, given the very low cost of energy in most Arab countries that has characterized energy supply for many decades. In many countries, subsidized energy and water form an integral part of wider social expectations that link the provision of these goods at low cost to the few tangible benefits their citizens receive from their Governments. On the other hand, the largest spat between average income ranges and the cost of energy (and water) can be found in some of the wealthiest Arab countries, whose high per capita income rates combine with some of the world's lowest energy and utility tariffs.

Measures that help increase energy efficiency over time, particularly on the regulatory side, have in many parts of the Arab region been sketchy and piecemeal.[126] Building codes, efficiency standards and labelling have in the past been low-priority items in policymaking, even if they have increasingly found their way onto regional governments' agendas – the benefits of which should only start to accrue in the coming decade. With low electricity prices for domestic consumers, market incentives for property developers to invest in and for property owners to upgrade the energy performance of new and existing buildings has in contrast been low. In lower-middle-income countries and the Arab LDCs, information about energy-efficiency savings and access to financial markets to finance initial investments are virtually non-existent. Lacking institutional capacity to monitor and implement minimum efficiency standards makes compliance difficult in many cases, even where final consumers wish to invest in more efficient products, including in the Levant and North Africa (see Box 13 in Chapter 5 for an example of regulating air-conditioning units in North Africa).

Even in high-income countries in the Arab region, policy focus and hands-on reform efforts differ markedly between countries, with historical priority having been given to fast-rising development and quick improvements in living standards. Where building codes and technical standards have been revised, this has been a relatively recent development, and remains limited in scale and applicability in many cases. Some of these initiatives

appear to be driven by a government desire to demonstrate commitment to some form of energy savings in view of rising import bills; others by the gradual realization that business-as-usual will hurt even the most energy-rich economies whose energy needs are expected to grow further in the future. Missing price incentives reduce the effectiveness of such regulation to minimum compliance levels, where this is compulsory and monitored. This implies that much of the region's building stock that is currently being developed will linger in many Arab countries' energy balance for decades to come.

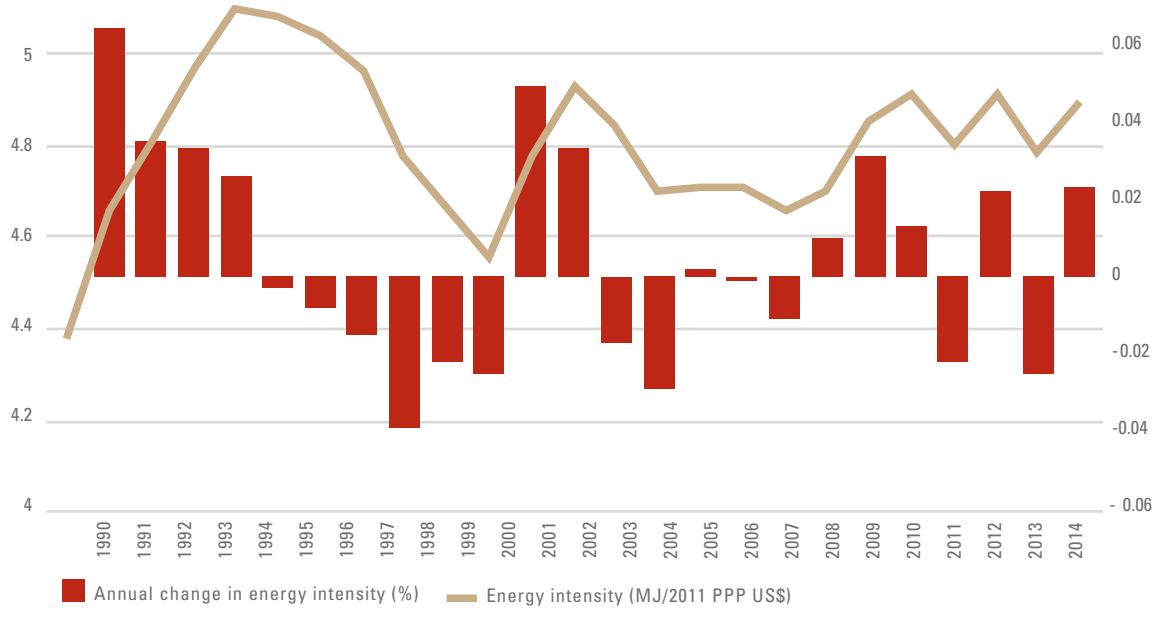
Typical market structure of the energy industry in the Arab region further affects incentives for energy efficiency. Utilities remain public companies that fulfil the duty of providing citizens with affordable electricity, as well as water supplies. In practice, this model entails many inherent factors that hinder a gradual, market-based absorption of energy conservation, because State utilities implicitly absorb operating and accident risks without formal risk-pooling and insurance premiums: they do not typically require any or a high-enough return on capital; have high billing arrears or non-payment rates; and rely on subsidized input fuels such that their entire cost structure is artificially low.[127] Lacking consumer choice through market competition further reduces incentives for public utilities to invest in more energy-efficient technology or, indeed, switch fuel. Regulated utility prices that fail to recover operating costs[128] are, on the other hand, frequently standard in the Arab region, in turn obstructing utilities' ability to invest in the maintenance and upgrading of their generation- and transmission-related infrastructure – a dilemma that has also been partly blamed for the poor quality of electricity service in some countries affected by frequent blackouts (See Chapter 5 for a thorough discussion of energy prices and their impact on energy price dynamics).[129]

Energy intensity has been improving since 2010, but the rate of progress needs to accelerate much more

The Arab region has been seeing rising rates of primary energy intensity for most parts of the 1990s and 2000s. Primary energy supply in the Arab region grew at a rate of 0.4% a year from 1990 to 2000, and 0.8% over the 2000s. Socioeconomic development, economic and industrial growth and rapidly expanding access to modern energy alongside high rates of population growth and rising living standards – particularly in the GCC economies – have been key factors driving this growth. This long-term trend is reflective of the lack of wider energy efficiency improvements in the Arab region throughout much of the 1990s and 2000s. Conflict and political instability in parts of the Mashreq and Arab LDCs on the other hand have raised energy intensity in a number of countries – the result of declining GDP relative to energy consumption – and the systematic destruction of infrastructure in countries such as Libya, Syrian Arab Republic and Yemen. Further caution needs to be applied to their energy-intensity performance data, owing to various data-collection constraints that make reliable assessment of these countries' macroeconomic indicators close to impossible. Falling oil prices are likely to further reduce government budgets far beyond 2014, with a negative effect on the ability of a number of Arab countries to invest systematically in energy efficiency over the coming years. The influx of large numbers of refugees into neighbouring Arab countries, particularly Jordan and Lebanon, means also that countries that remain stable have seen rising energy-consumption levels (by more people) relative to GDP and, hence, a spike in their overall energy intensity.

Since 2010, regional energy intensity growth has been declining for many years, down to zero growth from 2010 to 2012, and a further

Figure 42. Energy intensity in the Arab region

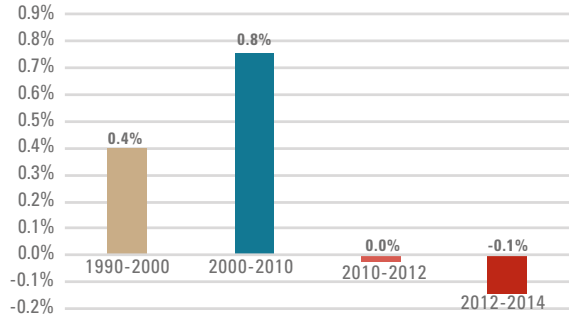


Source: World Bank (2017a) based on IEA and UN Statistics data.

deceleration in regional energy supply growth to a -0.1% per annum, although with high variability throughout the years. Caution has nevertheless to be applied when reading region-wide patterns from these data, for two main reasons. First, the region's growth rate in energy intensity – both on aggregate and on country level – has been fluctuating over the years, creating regional variability, which has turned negative in more recent years. It remains unclear to what degree this trend remains stable. Secondly, the aggregate for the Arab region is a weighted average of 19 different States, implying a number of outliers on both sides.

This regional decline has been driven by falling energy intensity in a variety of economies, with no immediately apparent pattern of type or size of economy or overall income levels. Key countries that have contributed toward this decline are the GCC economies Kuwait, Saudi Arabia and the UAE and non-GCC countries Egypt, Morocco, Syrian Arab Republic and Tunisia.[130] In contrast, Algeria, Lebanon, Oman,

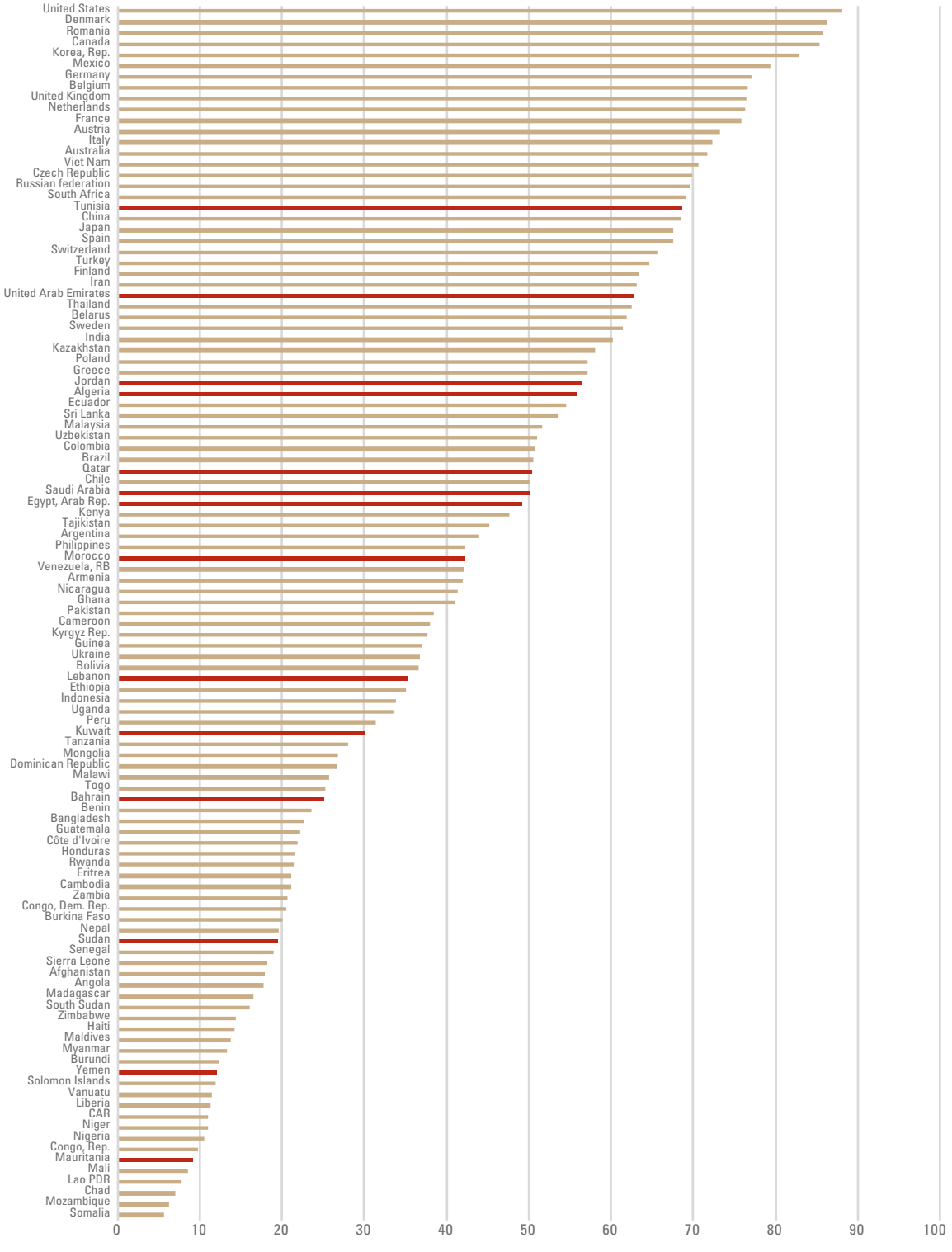
Figure 43. Annual change in energy intensity in the Arab region



Source: World Bank (2017a) based on IEA and UN Statistics data.

Qatar and Yemen have seen large increases in their energy-intensity rates of between 5% (Yemen) to 23% (Qatar) per year. The biggest outlier in the period 2010–2014 has been Libya, with a (likely conflict-related) surge in aggregate energy intensity of almost 70% per year – potentially driven by a large drop in GDP and the need to rely on inefficient diesel generators as centralized power networks collapsed.[131]

Figure 44. Distribution of energy-efficiency pillar scores under the World Bank's Regulatory Indicators for Sustainable Energy (RISE)



Source: World Bank (2017d).

A number of Arab countries have adopted energy-efficiency measures in more recent years, while many have in parallel included energy efficiency as a strategic policy objective in their national plans. Buildings, lighting and appliances are the most widespread targets of recently introduced national energy-efficiency regulations, a logical step given energy use in buildings, including through appliances such as air conditioning, are expected to be a key driver of future energy demand in the Arab region.[132] Most Arab countries have in recent years issued or upgraded minimum performance requirements for electric appliances, in addition to the encouragement of greater building efficiency. Countries such as Bahrain, Egypt, Jordan, Saudi Arabia and Sudan have started to subsidize or else incentivize the purchase of energy-efficient products, such as energy-efficient lightbulbs and other electrical products).[133]

The World Bank's Regulatory Indicators for Sustainable Energy (RISE) Index, which measures progress in regulatory indicators for sustainable energy, draws an overall positive picture on progress in Arab countries. The index lists six Arab countries to have made significant progress in regulatory progress aimed at sustainable energy consumption: Algeria, Egypt, Jordan, Morocco, Tunisia and the UAE (Figure 44).[134] Overall, the World Bank sees the Middle East and North Africa, together with East Asia, as the most advanced developing regions in terms of sustainable-energy policy environments, although it emphasizes that the policy environment for energy efficiency lags significantly behind that for renewable energy and energy access.[135]There are further plans across the region to introduce further energy-efficiency initiatives, as awareness grows, as well as pressure to manage energy demand. As more countries reform their domestic energy-pricing frameworks towards more market-based price levels, such investments might pay increasingly for a greater share of consumers – although the effect may be gradual. The coming years are likely to see more initiatives, in particular if financial resources are facilitated to less wealthy Arab countries.

Energy-efficiency improvements in fossil-fuel net importers

Some of the most active countries in prioritizing energy efficiency in the Arab region are net importing countries, particularly Jordan, Morocco and Tunisia. Tunisia has been one of the Arab region's earliest adopter of dedicated energy-efficiency programmes to reduce its dependence on fossil fuels that has continually increased since the early 2000s. Reinforcing energy efficiency was seen as necessary to help companies reduce their production costs and make them more competitive internationally, while also reducing the country's rapidly rising fossil-fuel import bill in view of rising world market prices and subsidized energy prices domestically. Despite a slowdown in progress in early 2012 due to the popular uprising and its aftermath, Tunisia continued its path of gradual reform to enhance energy efficiency during the tracking period through a combination of financial incentives, regulatory changes and cooperation with third parties, including the World Bank, under Tunisia's Energy Efficiency Programme.[136] Improvements in energy efficiency have meant the country's energy-intensity rates have continually declined since the early 2000s, with –1% contraction over the tracking period. Tunisia has in place some of the Arab region's most comprehensive energy-efficiency policies, including mandatory minimum energy-performance standards for office and residential buildings (building energy codes), minimum energy-performance standards for refrigerators and air-conditioning systems and mandatory energy audits for industrial establishments whose annual energy consumption exceeds 800 toe, as well as the establishment of the transport, tertiary and residential sectors with annual energy consumption exceeding 500 toe.[137]

Jordan and Morocco have similarly expanded their energy-efficiency frameworks in the

light of rising energy imports and the need to reduce the growth of energy demand. Jordan has implemented mandatory thermal insulation and energy-conservation building codes; Morocco launched new regulations for construction in 2015, having previously engaged in the mass roll-out of compact florescent lamps (CFLs) and solar water heaters during the 2000s.[138]

For some of the region's net importers of energy, a primary question is why their energy-intensity rates are not substantially smaller than those of some fossil-fuel producers and exporters. Algeria and Tunisia, for instance, have similar energy intensity, despite having substantially different economies: Algeria is a traditional oil and gas exporter, with few other industries; Tunisia has focused on tourism and services. Lebanon imports close to 100% of its primary energy needs but consumes more energy per output of GDP than oil and gas exporter Algeria, while having the most interrupted electricity services outside the Arab LDCs. In the Arab oil and gas exporters, one possible explanatory variable could be the high oil prices for much of the period between 2010 and mid-2014, which increased the value of fossil-fuel exporters' GDP relative to their national energy consumption – an independent variable from exports. All other factors aside, this variable could also imply rising energy intensity in fossil-fuel importers following the end of our tracking period in 2014, as oil prices and the value of GDP in Arab energy exporters declined, and assuming no further energy-efficiency savings.

Lebanon illustrates some of the long-term challenges in reducing energy waste in the Arab region's power sector. Lebanon has virtually no public transport and a large part of its electricity is produced by inefficient private generators owing to the insufficient capacity of the public utility. Many years of underinvestment in power plants' efficiency and transmission lines, high continued reliance on oil and fuel oil in power generation, coupled with high levels of electricity theft and the lack of policy on improving energy efficiency are some key factors involved. Underinvestment in the sector has been partly exacerbated by poorly implemented regulated electricity tariffs that did not allow the State utility to collect sufficient revenues, while consumers in Lebanon have faced a situation of parallel non-payment by some and overpayment by others. Unlike some of its neighbours, Lebanon has not yet switched systematically to natural gas as the primary source of fuel for its power plants, owing to unavailable access to feedstock. More than two decades of political indecision and underinvestment in power plants and transmission and distribution infrastructure mean electricity services are substandard, despite the country's status as a middle-income country. During the past few years and over the tracking period, Lebanon experienced a drastic slowdown in its economic activities, with over 70% of its GDP in 2014 being based on services. Frequent power cuts force many businesses and private households to rely on inefficient diesel generators as a back-up source of electricity during power cuts.[139] More recently, the inflow of refugees has added to the burden of Lebanon's already limited electricity-generation capacity, discussed in greater depth below.

Energy-efficiency improvements in fossil-fuel net exporting countries

Energy efficiency has grown in importance in Egypt in recent years owing to an inadequate supply of domestic oil and natural gas and the country's rising fiscal deficit. This includes a gradual reform of electricity markets that aims to strengthen the commercial orientation of the sector.[140] In June 2015, the Government passed the New Electricity Law, which, among other elements, allows for private-sector participation in the generation of electricity, sets out the framework for market liberalization through demonopolizing generation and distribution activities, and restructures the roles of the Egyptian Electric Utility & Consumer Protection Agency (ERA) and the Egyptian Electricity Transmission Company (EETC), redefining their competencies to ensure equality and freedom of competition. While not directly targeting energy efficiency through dedicated regulation, the law

clearly aims to improve the market conditions for the adoption by utilities of more energy-efficient choices and eventually consumers[141] and provide appropriate legal frameworks in private property rights protection legislation.

Several GCC economies have also registered falling energy-intensity rates – an indication of the gradual economic reorientation towards less energy-intensive industries, as well as increasing energy efficiency. For many of these countries, the rationale to reduce the energy footprint of their economies is driven by economic reasons: energy consumed domestically cannot be exported to international markets, revenues from which account for an overwhelming share of government revenue in the majority of Arab oil and gas producers. Countries such as Kuwait, Oman and the UAE, have in recent years demonstrated considerable focus on energy-efficiency improvements throughout their economies and have been working on subsequent strategies. Saudi Arabia, the GCC's largest energy market, has in recent years expanded its policies on energy efficiency significantly, including in areas such as standards for air-conditioning units, labelling for consumer appliances and fuel-economy standards for new personal vehicles.[142]

Qatar and the UAE both have comprehensive national energy strategies integrated into their economic long-term plans. Qatar's National Development Strategy 2011–2016 towards Qatar National Vision 2030 covers controls and incentives for water and conservation "in place of today's fragmented system of laws and regulations",[143] including new, green building standards.[144] The challenge here is undoubtedly the rigidity of ensuing legislation and enforcement thereof. In the UAE, Abu Dhabi's Economic Vision 2030 and Dubai's Integrated Energy Strategy 2030 are dedicated plans that include demand-and-supply policies and focus on the development of sustainable ways of providing energy to the next generation. Abu Dhabi's Estedama scheme is one of the GCC's first systems of classifying buildings by their level of efficiency, with separate requirements for public and private new constructions.

Saudi Arabia, the world's largest producer and exporter of crude oil and one of the world's top 10 oil consumers, has similarly begun to increase its efforts in raising energy efficiency.

Box 7. Institutional developments driving energy-efficiency policy in Saudi Arabia

The Saudi Energy Efficiency Centre (SEEC) was established in 2010 to develop the Kingdom's energy-efficiency policy. In 2012, this developed into an inter-agency effort through the launch of the Saudi Energy Efficiency Programme (SEEP), which outlined guiding principles with strong participatory governance among key implementation agencies focusing on the building, transport and industry sectors and covering around 90% of energy consumption in the country.

Today SEEP is a fully fledged programme with 12 teams and 150 professionals spread over 30 implementation and policy entities involving 84 initiatives at different stages of feasibility, design and execution. The approach adopted is to develop a baseline for setting policies, establishing performance relative to international benchmarks, prioritizing initiatives based on potential impact, achieving consensus and coordination among implementation agencies, establishing execution teams and the enabling policy environment and monitoring and evaluating progress with a view to providing feedback in the design of the overall approach. SEEP is expected to avoid energy consumption of about 1.5 million barrels of oil equivalent per day by 2030 or about a 20% reduction on what energy consumption might be without this programme.

Source: King Abdullah Petroleum Studies and Research Centre.

Figure 45. Comparison between Arab countries of selected RISE energy-efficiency indicators, 2015 (% RISE score)

Source: World Bank (2017d).

The National Energy Efficiency Plan, in place since 2003, introduced energy audits for buildings, conducted training, created energy-efficiency standards and labels for appliances, developed energy-efficiency codes for new buildings and started benchmarking building-energy performance.[145] In 2012, energy efficiency became more prominent through the launch of the Saudi Energy Efficiency Programme (see Box 7). A total of 84% of all grid electricity generation in Saudi Arabia is consumed by residential and commercial buildings, 65% of which is accounted for by air conditioning.[146] The IEA concludes that, prior to 2012, Saudi air conditioners were less efficient than those in India though by 2015 small-capacity air conditioners were expected to match the energy-efficiency rating of air conditioners in the United States.[147] How long existing technology stock will be allowed to hold back the sector's efficiency performance, will emerge as a separate question in the near future.

A closer look at survey results from the Arab region as part of the World Bank's Regulatory Indicators for Sustainable Energy provides some insights into the state of regional energy-efficiency procedures. RISE assesses countries' policy and regulatory support for each of the three pillars of sustainable energy – access to modern energy, energy efficiency, and renewable energy. It only measures the presence of factors which are generally under the control of policymakers, but cannot assess the effectiveness of a given factor: an important caveat when interpreting the data. Nevertheless, the indicators chosen have been shown to be effective in many countries in enabling investments in energy efficiency and can hence provide an idea of where countries stand relative to each other (Figure 45).

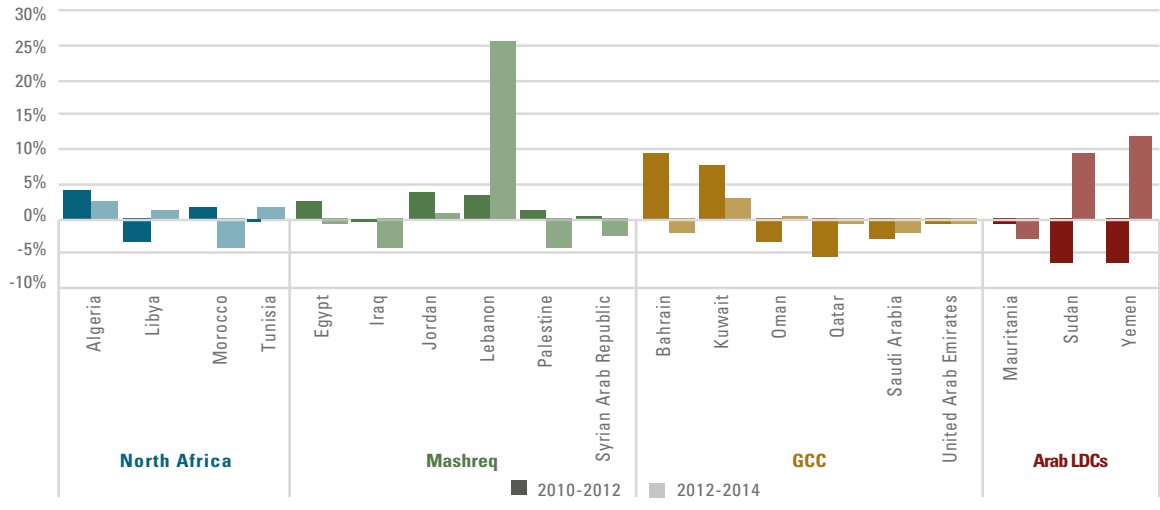
Conflict obstructs progress in sustainable-energy consumption

The short-term effects of conflict on progress in energy efficiency are extremely negative. Over the period 2012–2014, the largest spikes in energy intensity were registered in fragile countries, in particular Libya, Palestine and Yemen. This observation likely reflects the effect of conflict and political instability on planning and regulatory progress and stability and damage to infrastructure – including energy-related infrastructure such as pipelines, transmission lines and power plants – that in turn reiterate and even intensify resource waste. It is also a reflection of the fall in national GDP, as energy intensity is here calculated by dividing TPES by GDP (2011 PPP US$). An economy in conflict implies a substantial loss in GDP, but the country's energy-supply needs remain largely unchanged, rising energy intensity can be seen as proxy – imperfect as it may be – for the amount of energy and hence financial resources lost to society during times of conflict.

Conflict in neighbouring countries can also affect the propensity for necessary but potentially contentious reform of energy markets in politically stable countries. A key example is the reform of energy subsidies – an unpopular but potentially significant step to raise the level of energy efficiency of the Arab region's economies in the future. The Arab Spring and the escalation of popular protest in several Arab countries in this context undermined policy reform in the years 2012–2014, although fiscal pressures toward the end of 2014 resulted in a gradual policy reorientation back towards more market-based mechanisms of pricing energy. Political stalemate due to the lack of a formal government, as in Lebanon during 2014–2016, and other factors such as a high degree of factionalism inside government, further complicates decision-making in areas such as energy efficiency and renewable energy deployment – none of which are popular or easily communicable topics to the public and industry lobbies.

Conflict-affected countries Sudan and Yemen have seen rising energy-intensity rates for their economies over the tracking period.

Figure 46. Change in energy intensity in the Arab region, 2010–2014



Source: World Bank (2017a).

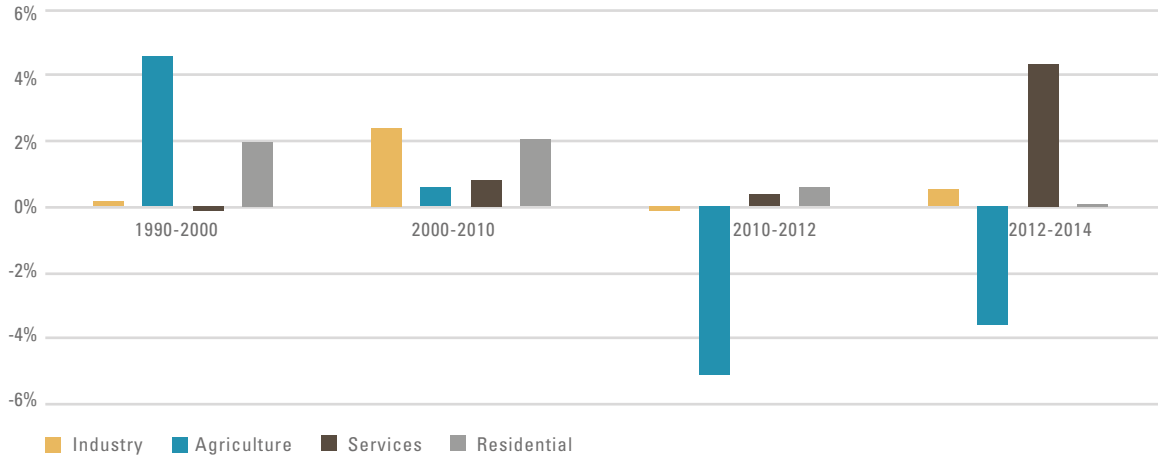
Their economies were characterized by a considerable degree of political stalemate and indecision: they illustrate the impact of instability and dysfunctional institutions on levels of energy waste and the efficiency of energy use. The systematic destruction of infrastructure in countries like Yemen and endemic underinvestment in key energy infrastructure, along with missing policy motivation for more efficient energy uses throughout the economy, all contribute to making conflict-torn countries more, rather than less, energy intensive.

Conflict and political instability are highly detrimental to effective, long-term development planning. Energy efficiency is a particularly affected area of national energy development, because it requires financial inputs in the short term from consumers and a highly skilled government sector to plan, support and enforce strategies aimed to deliver social, economic and environmental benefits in the medium to long term. The nature of conflict entails an intrinsic bias by both policymakers and their constituencies toward policies that promise quick, tangible gains, rather than higher costs and standards for technology. For LDCs that have been facing politically fragile situations over prolonged periods of time, conflict or the risk of an escalation thereof can deter necessary reforms for years and decades, thus contributing to policy stalemate with the continuation of overexploitation of countries' natural resources, while significant parts of the population continue to be neglected. Prolonged conflict also affects institutional capacity profoundly, rendering effective policy initiatives ever more difficult in practice as domestic conflict persists.

Energy-efficiency trends vary significantly in the economic sector

Sectoral developments play an important role as a structural cause of changing energy-intensity dynamics in the Arab region. A structural move away from energy-intensive industry towards more service-based industries can involve energy-intensity savings, not directly due to efficiency

Figure 47. Change in energy intensity by sector in the Arab region (compound annual growth rate)

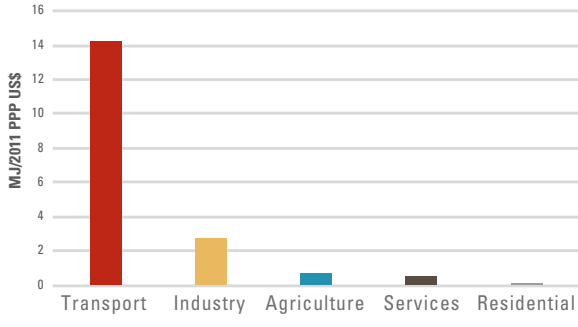


Source: World Bank (2017a) based on IEA and UN Statistics data.

savings, but because different sectors use energy differently. On the other hand, a shift away from one type of economic activity towards another necessarily means a trade-off between energy gains made and growing new sources of energy demand. For instance, reductions in the energy intensity of heavy industry – partly as a result of the changing composition of GDP in a number of Arab economies that are shifting increasingly towards service-based economic activities – often comes in line with increased energy intensity in precisely these new economy sectors. This includes the region's growing service and hospitality sector, which is overall much less energy-intensive than heavy industries, but whose consumption of energy and water rises along with further growth in the sector.

Taking the region's aggregate data, we can see a moderate trend in recent years towards falling energy-intensity levels in agriculture and transport, with declining intensity rates in industry in some of the region's economies (Figure 47). Transport is by far the most energy-intensive sector in the Arab region, followed by industry and – in some countries – agriculture (Figure 48).

Figure 48. Energy intensity by sector in the Arab region, 2014 (MJ/2011 PPP US$)

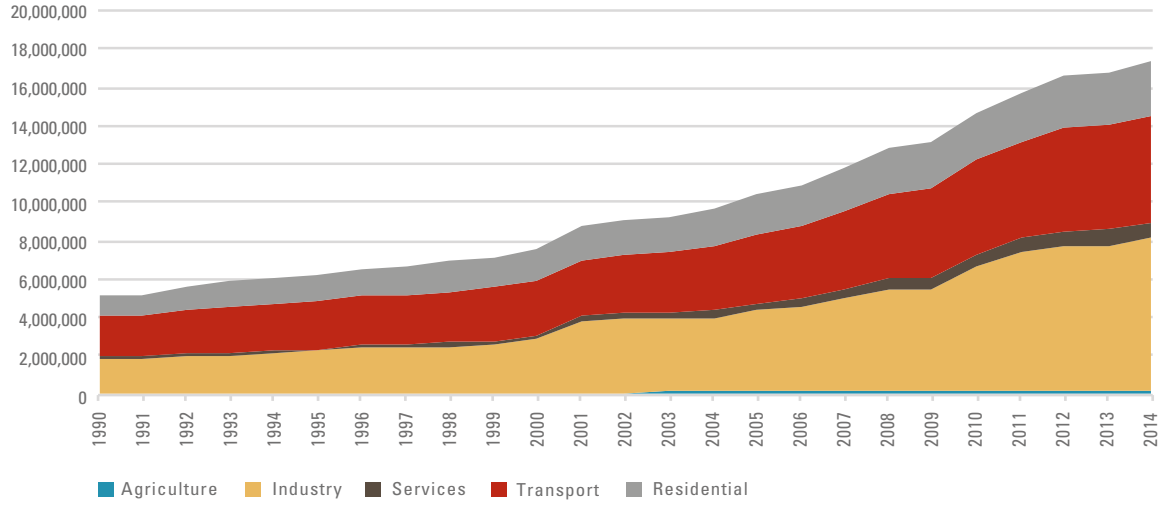


Source: World Bank (2017a) based on IEA and UN Statistics data.

Industries are slowly becoming less energy-intensive, but much more needs to be done

Industry is by far the most important energy-consuming sector in the Arab region. It accounts for 46% of regional final energy consumption, followed by transport with around 32% (Figure 50). Accounting together for 78% of total regional energy consumption, industries and transport clearly present key sectors to be targeted for energy-efficiency

Figure 49. Total final energy consumption by sector in the Arab region, 1990–2014 (TJ)

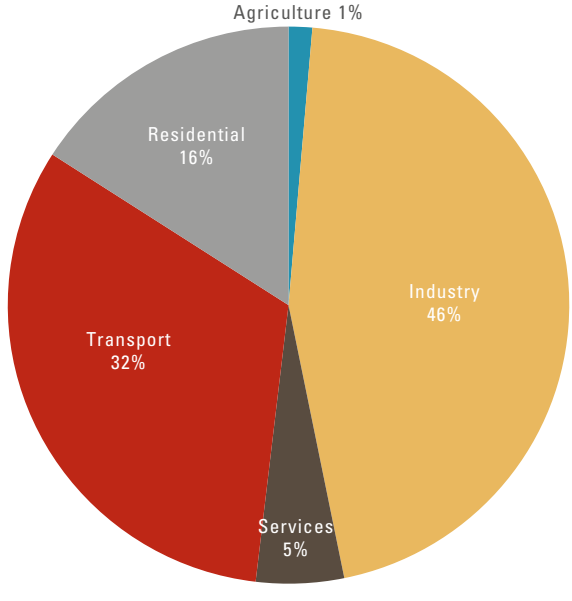


Source: World Bank (2017a).

improvements. Industry is also the most important energy consumer in many countries, in particular energy producers and exporters, whose industrial base has historically taken advantage of low-cost energy inputs and has, in many oil and gas producers, focused on energy-intensive activities. In the GCC economies, industry accounts for over half the final energy consumption owing to the highly energy-intensive nature of industries in the Gulf region, compared with 35% in the Mashreq, less than 30% in North Africa, and a mere 12% in the Arab LDCs. The GCC economies account for around 60% of the Arab region's energy consumption, making industry by far the most important energy-consuming sector in the region as a whole (see Figure 51).

The most important drivers behind the region's trend in industrial energy intensity in recent years are a few large industrial producers. Two-thirds of the Arab region's industrial output is produced by four countries: Egypt, Iraq, Saudi Arabia and the UAE. Substantial declines in energy intensity in the industrial sectors in these four countries has significantly contributed towards the region's overall reduced growth in industrial-energy intensity since 2010. By

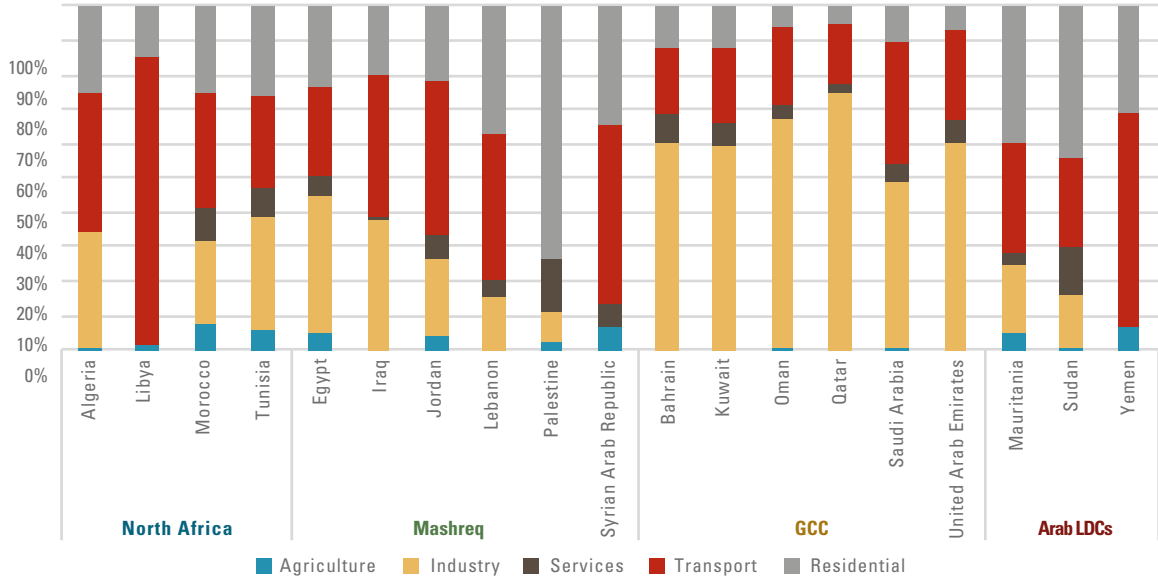
Figure 50. Total final energy consumption by sector in the Arab region, 2014



Source: World Bank (2017a).

contrast, industries have grown more energy-intensive over the same period of time in a number of Arab countries, both energy exporters and net importers, including Algeria, Lebanon,

Figure 51. Total final energy consumption by sector in the Arab region, 2014



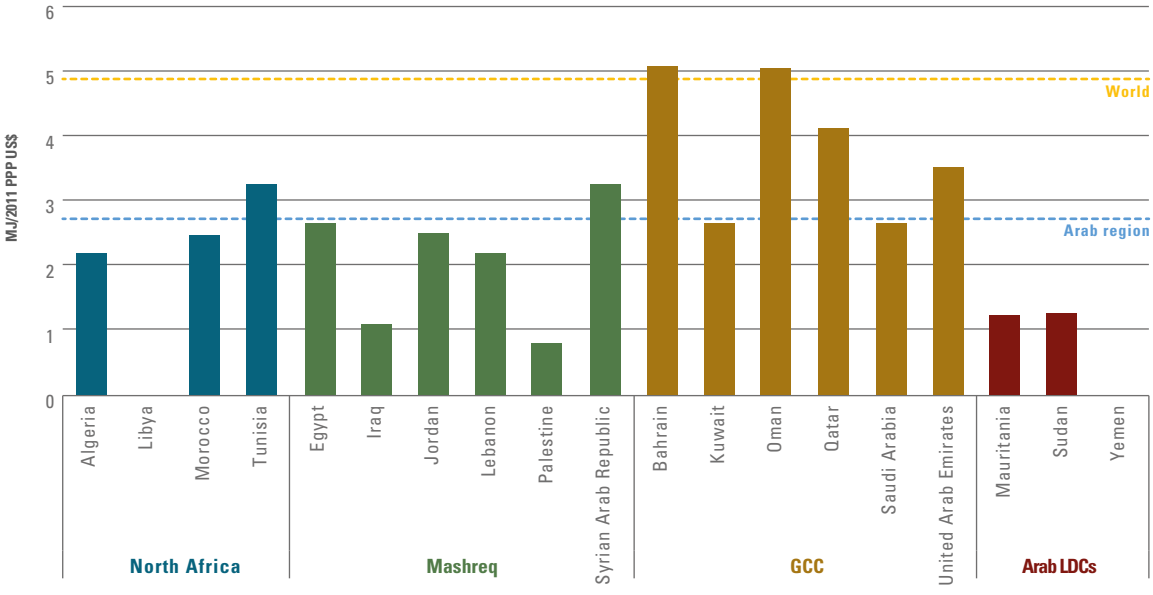
***Data gaps:** Algeria (services), Kuwait (agriculture), Libya (industry, services), Iraq (agriculture), Palestine (transport), Qatar (agriculture), Syrian Arab Republic (industry), UAE (agriculture), Yemen (industry, services).
Source: World Bank (2017a).

Oman, Qatar and Yemen. In net exporters of energy, an important part of the explanation of rising energy intensity may be found in the intrinsic exposure of many typical energy-intensive industries to fluctuating international market prices and hence fluctuating value of GDP generated relative to proportionally the same energy inputs.

The GCC economies have the most energy intensive industries in the Arab region. With a historical focus on industries such as steel, aluminium, petrochemicals and refining, industries in the GCC account for a much higher share of GDP than countries that have historically focused on agriculture, textiles or services, for instance in parts of North Africa and the Levant, but they also consume significantly more energy per unit of economic output than industries in other regions. Industries in Bahrain and Oman consume around twice as much energy per unit of GDP output as do industries in Jordan and Morocco (Figure 52). Energy intensity therefore remains only a partial indicator of energy efficiency per se, but also reflects differences in the structure of economic and industrial activity between different Arab countries.

A high degree of fluctuation in commodity prices on international markets for the output of energy-intensive industries further complicates the interpretation of industrial energy intensity. Rising prices for crude oil, refined products, natural gas and other energy-related commodities, such as fertilizers and petrochemicals, affect the value of GDP, hence the denominator based on which energy intensity is calculated. Rising prices for export commodities, as in the case of oil and natural gas over the period 2000 to mid-2014 imply a fall in energy intensity, all else (energy consumption) being equal. The reverse applies as export commodities fall. This could help explain fluctuations in the GCC and other oil and gas exporters, whose energy-intensive intermediate products are primarily exported to international markets. Individual countries' industry composition and its value added to GDP play an additional role in accounting for marked differences between individual GCC countries, with Kuwait's industrial-

Figure 52. Energy intensity of the industry sector in the Arab region, 2014 (MJ/2011 PPP US$)



***Data gaps:** Libya, Yemen.
Notes: Energy intensity of the industry sector measures final energy consumption of the industry sector over industry sector value added.
Source: World Bank (2017a) based on IEA and UN Statistics data.

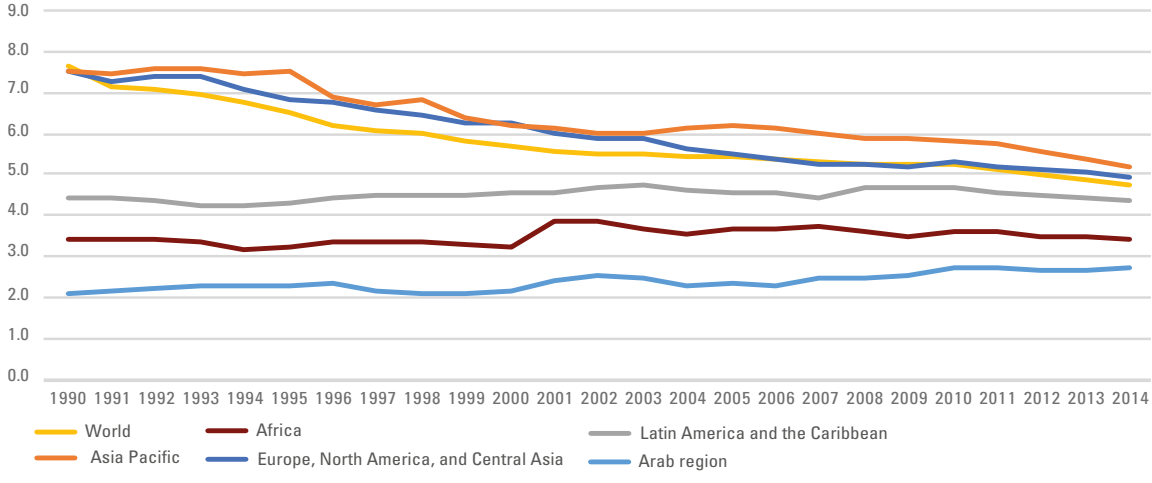
energy intensity, for instance, lying at half the rate of Bahrain and Oman.

Current production patterns also raise questions over the long-term horizon of many of these industries in at least part of the Arab region. Both Bahrain and Oman, for instance, are countries that face relatively short remaining production horizons for their oil and natural gas reserves, raising concern over their high reliance on energy-intensive industries without either significant improvements to their energy efficiency or a speedier reorientation towards economic sectors that offer higher added value relative to energy inputs. The same question, albeit at different time horizons, applies to large producers such as Saudi Arabia, whose industries are formidable consumers of the country's own energy production, and to other medium-size producers, including Algeria.

Incentives to invest in energy-efficiency measures for industries remain low in many Arab countries, owing to a continued lack of both regulatory and financial incentives. Historically low prices for energy have led to intrinsic modes of operation that are already well established, particularly in fossil-fuel producers, where entire industries have been built on their economies' competitive advantage in low-cost fuel inputs. In power generation and desalination, on the other hand, considerable efficiency savings have been realized through systematic fuel-switching from oil to natural gas and, within natural gas, to combined cycle gas turbine technology. Many Arab countries still shy away from specific regulatory requirements for industries over reasons of national economic value generation and overall sensitivity. Large energy consumers such as industries have thus been largely exempt from recent, nascent domestic energy price-reform steps in the Arab region (see Chapter 5), leaving many mandates and incentives for energy-efficiency improvements focused on households (electric appliance minimum efficiency standards, energy-efficient lighting), energy-labelling and, in some cases, building codes.[148] Energy audits have been introduced

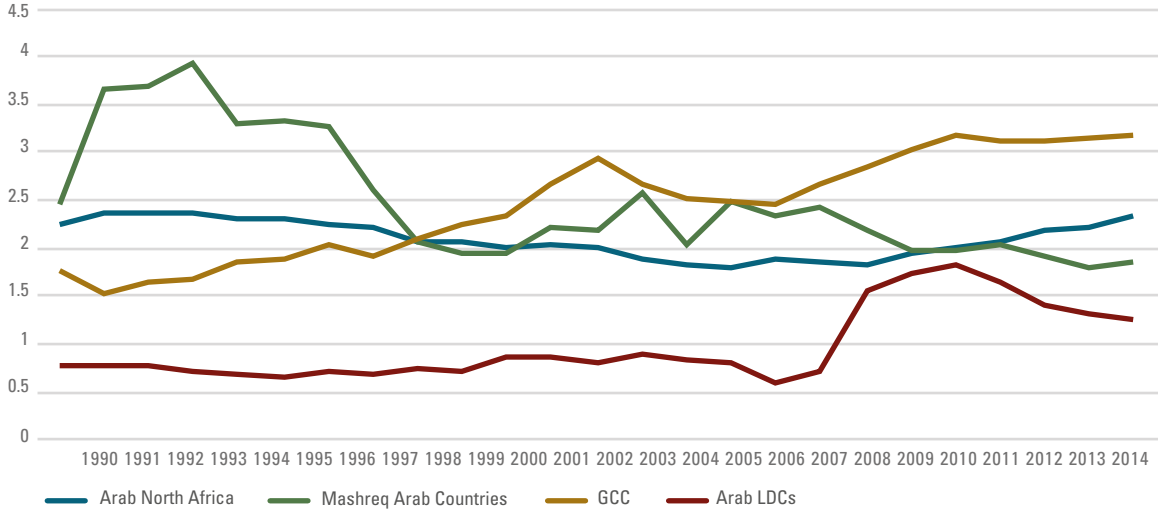
into industry regulation in several Arab countries,[149] but the effectiveness of such policies will need to be reviewed in the future, given the many cases of unclear institutional responsibility for monitoring and enforcing uptake, in addition to the absence of clarity about follow-up actions required and, in a number of cases, the voluntary nature of such audits in the first place. The absence of dedicated financial instruments such as subsidized or government-guaranteed loans for industrial-scale energy consumption to systematically switching technology poses further challenges to change in this sector (see Chapter 5).

Figure 53. Energy intensity of the industry sector (MJ/ 2011 PPP US$)



Data gaps: Bahrain (1990–2010); Kuwait (1990–2010); Lebanon (1990–1994); Libya (1990–2014); Oman (1990–2010); Palestine (1990–1994); Qatar (1990–2000); Sudan (1990–2008); Syrian Arab Republic (1990–2014); UAE (1990–2000); Yemen (1990–2014).
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 54. Energy intensity of the industry sector by subregion (MJ/2011 PPP US$)



Data gaps: Bahrain (1990–2010); Kuwait (1990–2010); Lebanon (1990–1994); Libya (1990–2014); Oman (1990–2010); Palestine (1990–1994); Qatar (1990–2000); Sudan (1990–2008); Syrian Arab Republic (1990–2014); UAE (1990–2000); Yemen (1990–2014).
Source: World Bank (2017a) based on IEA and UN Statistics data.

How efficiency measures are interlinked in the areas of both energy and water is evident from examples such as Saudi Arabia. The country's water demand per capita is the third highest globally – despite Saudi Arabia being one of the most arid countries in the world. Most of Saudi Arabia's groundwater is a non-renewable resource and its deep groundwater aquifers are expected to dry up over the next 15–25 years at current use trajectories.[150] Saudi Arabia is also home to around 17% of the world's desalination capacity, essential infrastructure as the country's freshwater resources are small and rapidly declining. Saudi Arabia's water production is energy-intensive, and demand for water is expected to rise further. Groundwater pumping alone is estimated to consume 5% of total electricity consumption in Saudi Arabia.[151] A case study at Saudi Aramco shows that water recovery and recycling could reduce water use at a natural gas plant by 45% and that, should this be extended to Aramco's natural gas production facilities, could save 23 million m^3 of water and 1.6 GWh of energy consumption at the facility, excluding additional savings through reduced energy inputs into water production (see Chapter 5 for further discussion).[152]

Falling energy intensity in transport signals the way ahead for the region

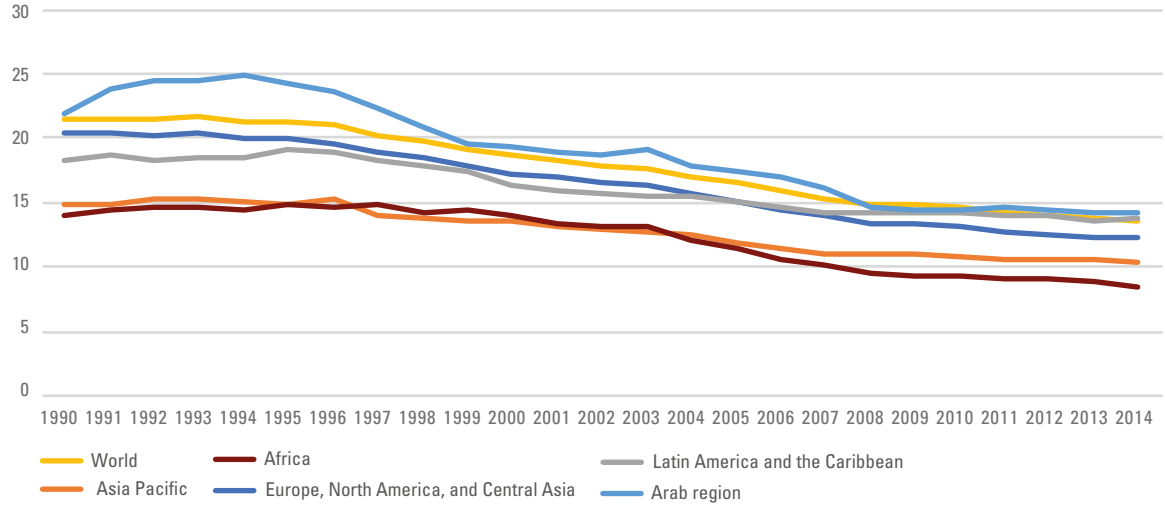
Transport is by far the most energy-intensive sector in the Arab region and on regional aggregate level is more fuel-intensive than any other region of the world (Figure 55). This level of fuel intensity of transport reflects on the one hand the increasing mobility of many Arab economies' populations, along with progress in a number of social development indicators, such as access to education and health care, and rising income levels. On the other hand, many Arab countries' socioeconomic development models have been built around the concept of cheap, personal transport, with a significant lag in the availability of public transport, including in high-income countries. Growing populations, coupled with lacking infrastructure, implies that the Arab region has very high rates of privately owned vehicles – the result of lack of alternatives as much as rising income levels and personal preference. UN HABITAT summarizes the situation of transport in 2010.[153]

> "Over the past two decades, the Arab region has witnessed phenomenal growth in motorization. In 2008, the total number of motor vehicles reached 26.7 million – having grown at an annual average rate of 4.2% between 1997 and 2008. The region features one of the highest ratios of vehicle ownership in the developing world. For instance, in Bahrain, Kuwait, Qatar, the UAE and Oman, the ratios of motor vehicles per 1,000 population are 509, 507, 724, 313, and 225 respectively. Factors behind this trend include the affluence occasioned by the region's oil-driven economic boom, strong preference for private cars, subsidized fuel, greater availability of car finance and lack of effective public transportation."

Public transport systems are inadequate in many Arab cities, suburbs and the countryside. Taxis are the principal, widespread means of public transport, in the absence of sufficient and qualitative bus networks, the very limited availability of trains and, in cities, trams and metros that are limited to only a few locations. At the beginning of the 2000s, for instance, less than 10% of commuters in Beirut and only around 14% in Amman were served by public transport.[154] Dubai's car-ownership ratio was 541 cars per 1,000 people at the beginning of the decade, compared with that of London: 345 per 1,000 and New York: 444 per 1,000, [155] while the first metro line has attracted millions of travellers since its opening in September 2009. In Amman, the number of privately owned cars reached 544,974 in 2009, growing at the rate of 10% per annum and accounting for 72% of the total number of vehicles.[156]

Where private vehicles are a necessity rather than a luxury good, the market necessarily prioritizes low-cost vehicles – often old vehicle stock – over newer, more expensive but more fuel-efficient ones. As a result, many

Figure 55. Energy intensity of the transport sector (MJ/2011 PPP US$)

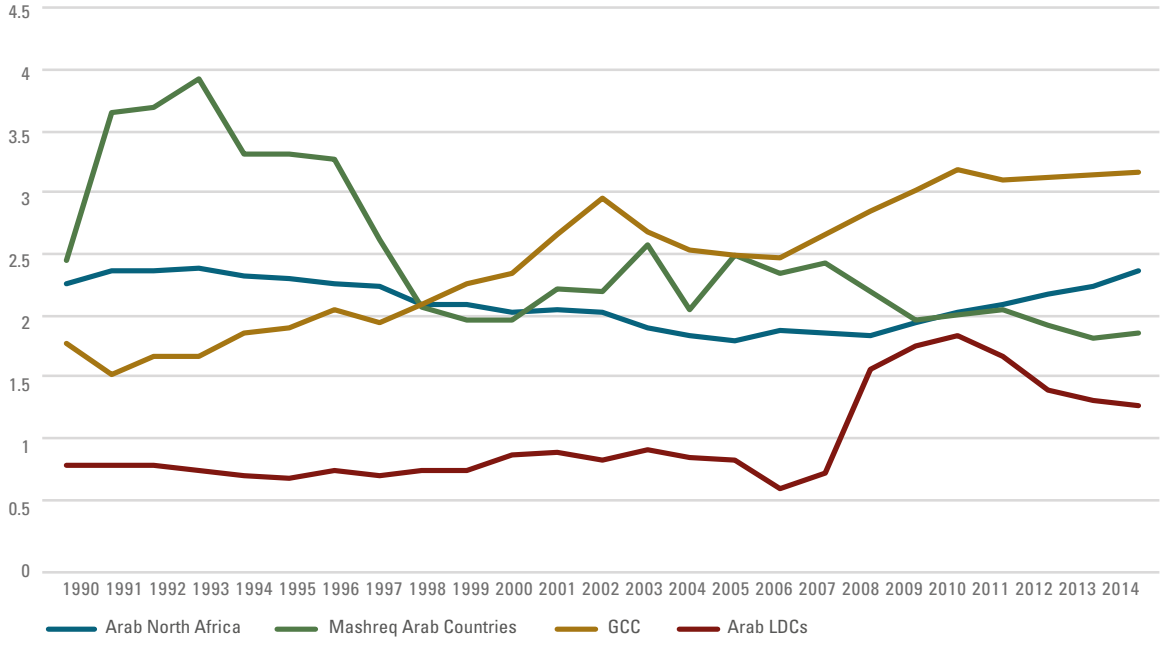


Data gaps: Palestine (1990–2014); Sudan (1990–2007).
Source: World Bank (2017a) based on IEA and UN Statistics data.

Arab cities suffer significantly from traffic congestion, in addition to very high rates of urban air pollution, which means that even massive investments in roadworks do not, in many cases, keep pace with increasing vehicle numbers. The result is often very large additional investments in road infrastructure at the same time, however, as a lack of funds and policy priority on public transport. Additional factors, discussed in more detail in Chapter 5, include the centralization of governance structure in the Arab region, which constrains the active role played in many cases by cities and their municipalities in improving their public infrastructure and the lack of environmental lobby groups that have pushed for the gradual improvement and public acceptance of available public- over private-transport options in other parts of the world.

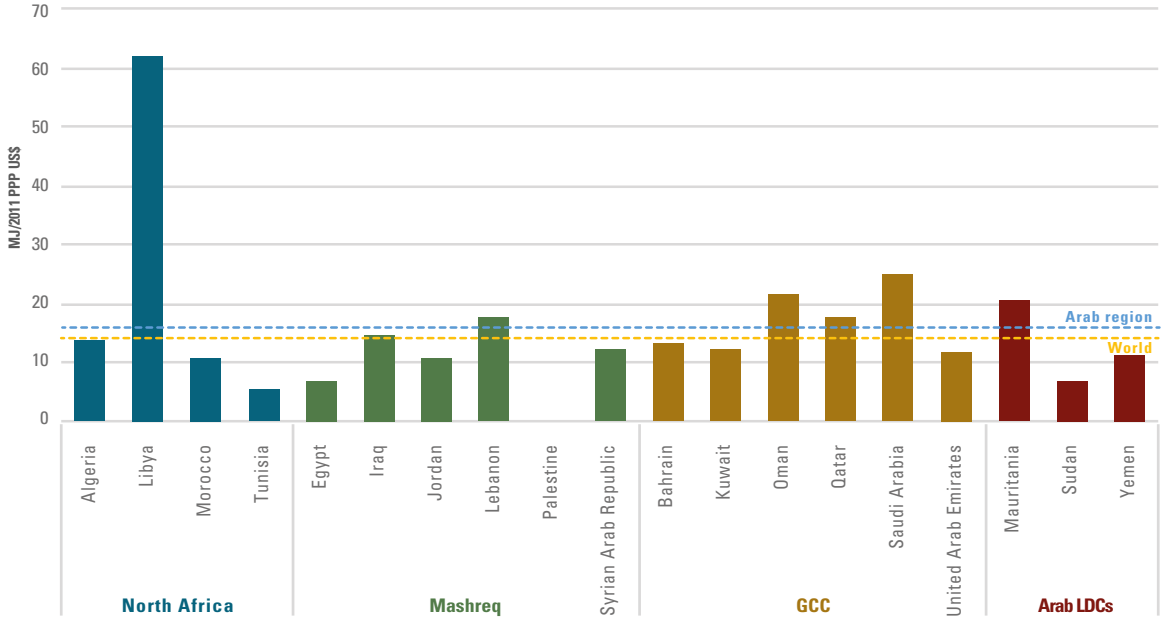
Three-quarters of the Arab region's energy used in transport is consumed in the GCC economies and Egypt, suggesting these countries are critical to bringing down the region's energy intensity in transport in the coming years. The GCC economies have by far the most energy-intensive transport sector in the region but have also seen the most dramatic fall in transport-sector energy intensity in the period since 1990. This fall, however, is not so much of explicit fuel-efficiency policies, which have only just begun to take hold, as of the progressive change in the region's vehicle stock, which is almost entirely imported from external markets. High purchasing power along with rising per capita income rates has facilitated the uptake of higher-quality vehicles from abroad; in parallel, however, there is greater demand for larger, more fuel-consuming 4x4 vehicles. With prices for transport fuels in many Arab countries being among the lowest in the world, individual vehicle owners' incentives to buy more efficient vehicles are barely existent. In lower- and middle-income countries, this means markets absorb the cheapest car stock available, whereas, in high income countries such as in the Gulf region, demand is overwhelmingly in favour of larger, more luxurious vehicles. This means that significant additional energy-efficiency potential exists in transportation, as more countries choose to implement overdue fuel-economy standards along with wider improvements in the quality and availability of public-vehicle stocks and public transport.

Figure 56. Energy intensity of the transport sector by subregion (MJ/2011 PPP US$)



Data gaps: Palestine (1990–2014); Sudan (1990–2007).
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 57. Energy intensity of the transport sector in the Arab region, 2014 (MJ/2011 PPP US$)



Data gaps: Palestine.
Notes: Energy intensity of the transport sector measures final energy consumption of the transport sector over transport sector value added.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Saudi Arabia, the Arab region's largest consumer of oil, introduced new efficiency standards for transport in November 2014. The country's vehicle stock rose by around 69% between 2002 and 2012, with an estimated 285 vehicles per 1,000 people; its vehicle reliance stands at more than double the average for the Middle East.[157] The regulatory change concerns new, light-duty vehicles (LDVs) and adjusted according to vehicle footprint, following the model of the US Corporate Average Fuel Economy (CAFE) standard structure. The country's new fuel economy targets follow the design of the US 2012–2016 fuel-economy standards closely, with a three- to four-year delay. As in the US programme, the fuel economy targets are adjusted according to vehicle footprint.[158] For Saudi Arabia, the effects of the new programme should be significant for new vehicle stock, as the average fuel efficiency of new LDVs in 2012 was 12.2 km per litre lower than in Australia, China, the European Union, India Mexico and the United States.[159] Average efficiency of new vehicles is now expected to improve by 28% by 2020.[160]

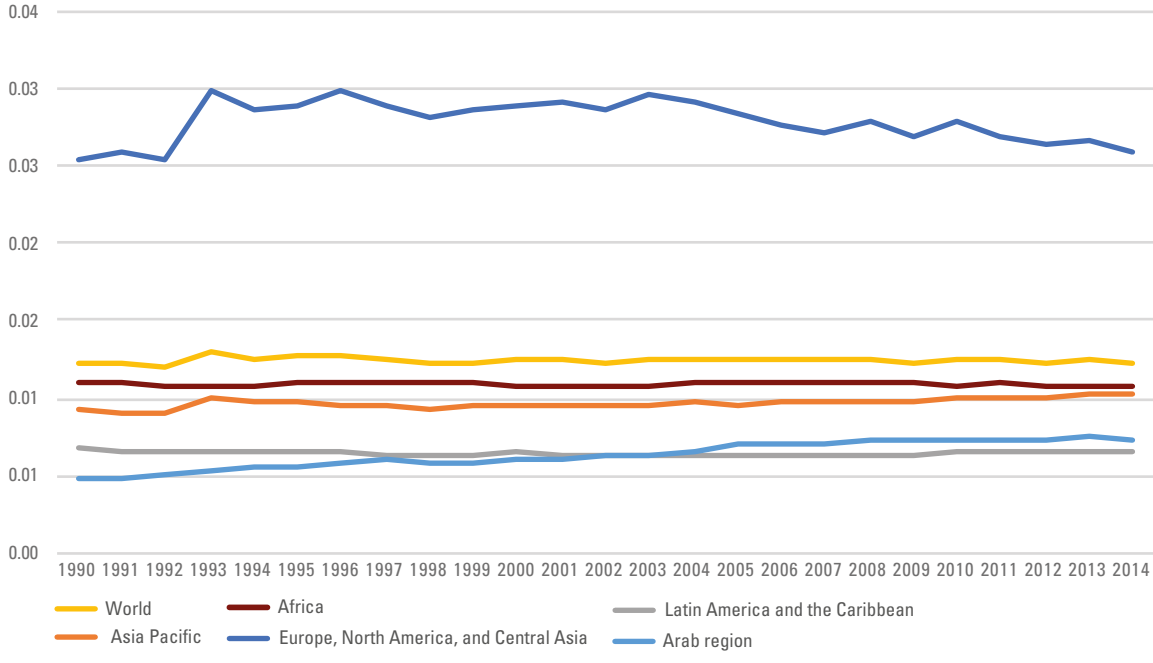
Residential consumption and services are becoming more energy-intensive

Residential consumers and service sectors account for a growing share of the Arab region's energy consumption. They are both chief final user groups of electricity, which makes them important driving forces behind electricity demand, in addition to the demand from related sectors that consume primary energy and electricity, water and food. In 2013, the two sectors combined accounted for some 60% of total annual electricity consumption in the region, of which 73% was consumed by residential customers alone.[161] Very low, subsidized prices for electricity, combined with a lack of energy-efficiency regulations in different economic sectors from building to technical appliances have resulted in a large increase in per capita water and electricity consumption over time throughout the Arab region.

In the absence of market mechanisms to manage domestic energy demand, rising living standards and economic diversification towards service-based industries have translated into rising levels of energy intensity in both sectors over time. While starting from a regionally low level of energy intensity in 1990 compared with other parts of the world, energy intensity in the residential sector has increased by around 50% since 1990 and close to 20% in the service sector. Growth in the energy intensity of residential consumption has been driven in particular by steeply rising consumption patterns in the GCC, whose rapid urban growth and high-income rates have transformed the subregion's energy market radically over the past 25 years. Consumerism and high-income ranges here meet some of the world's lowest costs for energy, making energy conservation a niche topic –until recently – including within policymaking circles.

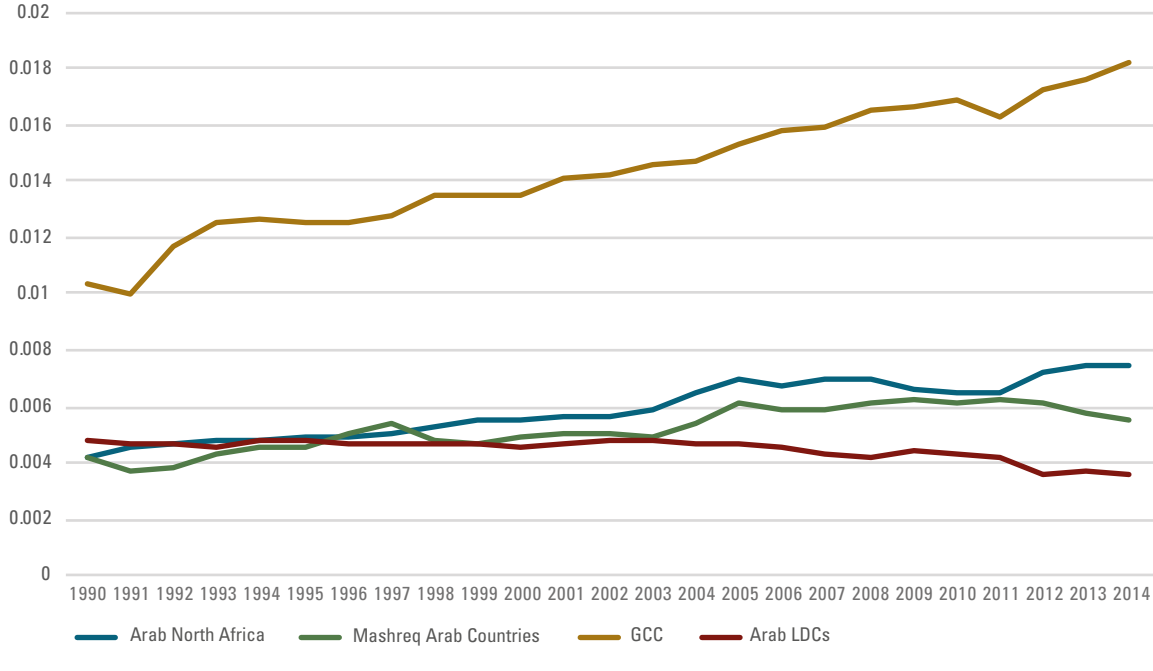
Increasing wealth – even if modest by comparison, as in North Africa and in parts of the Mashreq – has also driven per capita energy-consumption rates in other parts of the Arab region. The past 25 years have seen a tremendous rise in easy access to more affordable, often energy-inefficient home appliances and technology, including air-conditioning units, which, together with missing building insulation, results in significant energy waste. The stock of air-conditioning units in Algeria, Morocco and Tunisia, for instance, grew at a staggering rate of about 48% a year over the period 2000–2013 – a 160-fold increase in stock over a period of less than 15 years.[162] Awareness of the growing potential for savings made from energy-efficiency investments in new buildings and electric appliances is beginning to grow slowly, particularly in countries that have seen rising utility prices over the past few years, such as Morocco, Tunisia and Jordan, particularly among the urban middle class. More worryingly, the local market for counterfeit products is a trend that – if not

Figure 58. Energy intensity of the residential sector (MJ/ 2011 PPP US$)



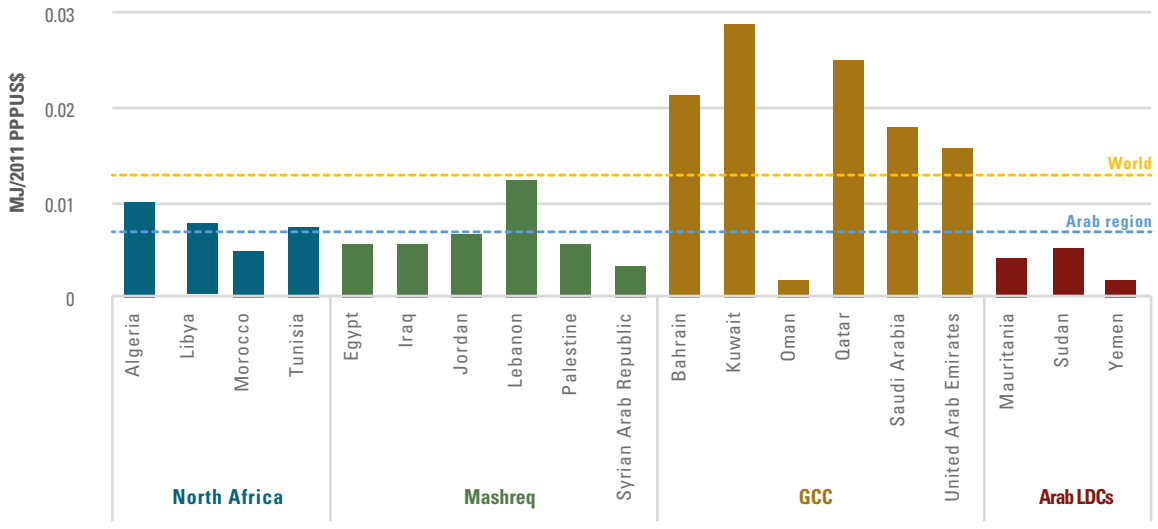
Data gaps: Palestine.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 59. Energy intensity of the residential sector by subregion (MJ/2011 PPP US$)



Data gaps: Palestine.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 60. Energy intensity of the residential sector in the Arab region, 2014 (MJ/2011 PPP US$)



Data gaps: Palestine.
Notes: Energy intensity of the residential sector measures final energy consumption of residential consumers over population.
Source: World Bank (2017a) based on IEA and UN Statistics data.

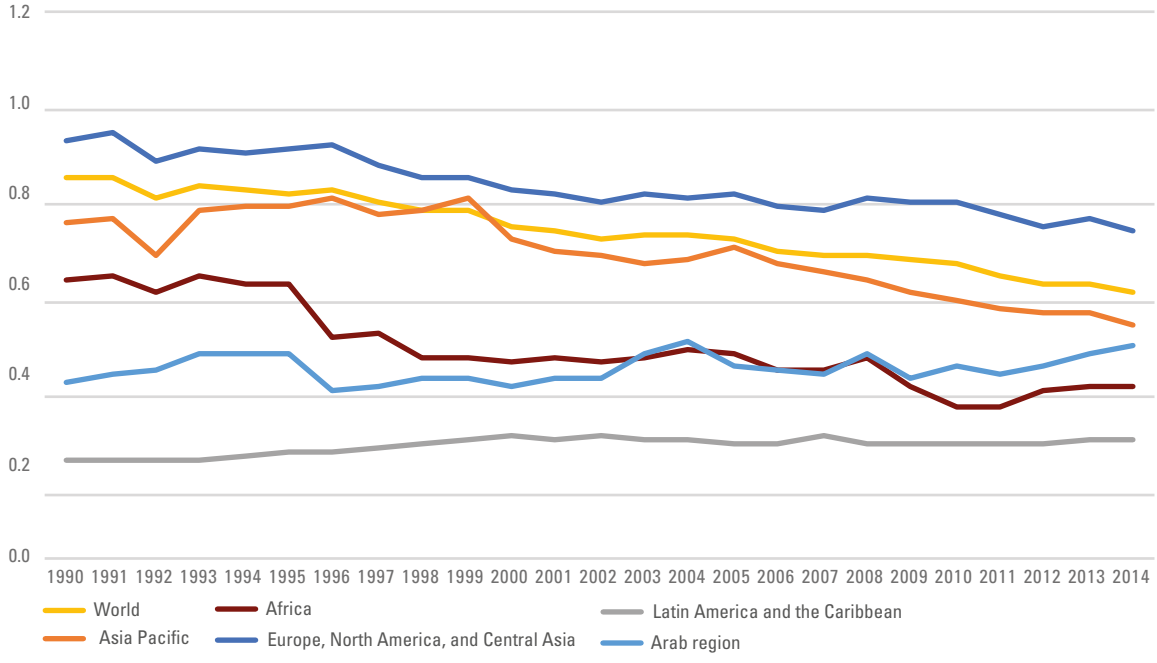
tackled effectively by the authorities – may act as a further complicating factor in popularizing more energy-efficient appliances and building materials.[163]

This pattern of consumption is likely to intensify as populations and living standards rise and more Arab economies diversify away from heavy industries into the service sector. Developmental factors play a critical role in driving energy consumption upwards in the residential and service sectors in the Arab region, particularly in middle- and lower-middle-income countries: increased access to, and use of, health services and education; sewage and refuse disposal, sanitation but also office space and information technology; recreational, cultural and sporting activities; the increasing number of people using hotels and restaurants; and increased commercial operations by the business sector. Air conditioning in homes and office spaces, and the expansion of tourism in particular have become important factors driving electricity consumption, notably in the fast-growing Gulf economies.

The region-wide absence of systematic efforts to manage final consumer demand for energy through pricing and efficiency regulation has been a critical driver of relentless energy demand growth in both the residential and the service sector. Low domestic prices for energy, electricity and water remove the most critical incentive for consumers to adjust consumption behaviour and shift towards more energy-efficient housing and technology. Few Arab countries have regulatory tools in place to constrain and rationalize growing demand in final consumer sectors, such as minimum energy-performance standards for electrical equipment and building codes. Where these were introduced in more recent years, they have often remained limited in scope and, in the case of building codes, rely on very low standards or voluntary compliance and demonstration projects.

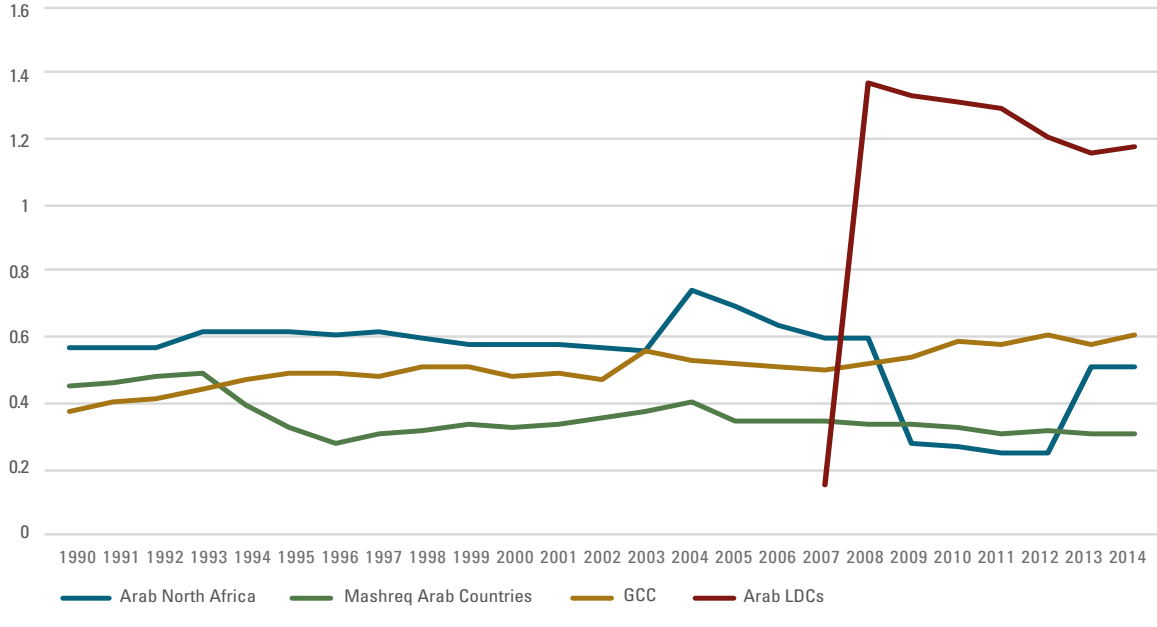
The Arab Union of Electricity Producers estimated that total power demand in the Arab region would rise by 79% between 2014 and 2024,[164] making energy efficiency in the

Figure 61. Energy intensity of the service sector (MJ/2011 PPP US$)



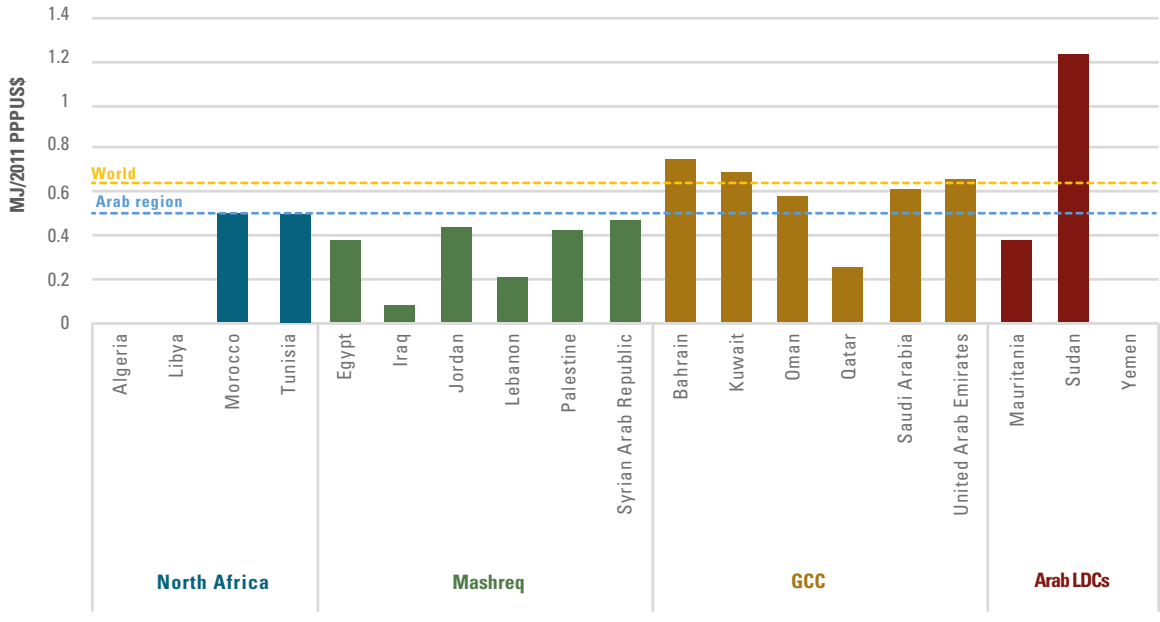
Data gaps: Algeria (1990–2008); Bahrain (1990–2009); Egypt (1990–1995); Iraq (1990–2004); Kuwait (1990–2009); Lebanon (1990–1993); Libya (1990–2014); Mauritania (1990–2006); Oman (1990–2010); Qatar (1990–1999); Palestine (1990–2014); Sudan (1990–2007); UAE (1990–2000); Yemen (1990–2014).
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 62. Energy intensity of the service sector by subregion (MJ/2011 PPP US$)



Data gaps: Algeria (1990–2008); Bahrain (1990–2009); Egypt (1990–1995); Iraq (1990–2004); Kuwait (1990–2009); Lebanon (1990–1993); Libya (1990–2014); Mauritania (1990–2006); Oman (1990–2010); Qatar (1990–1999); Palestine (1990–2014); Sudan (1990–2007); UAE (1990–2000); Yemen (1990–2014).
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 63. Energy intensity of the service sector in the Arab region, 2014 (MJ/2011 PPP US$)



Data gaps: Algeria, Libya, Yemen.
Notes: Energy intensity of the service sector measures final energy consumption of the service sector over service sector value added.
Source: World Bank (2017a) based on IEA and UN Statistics data.

residential and service sectors ever more critical for the sustainable management of energy resources.

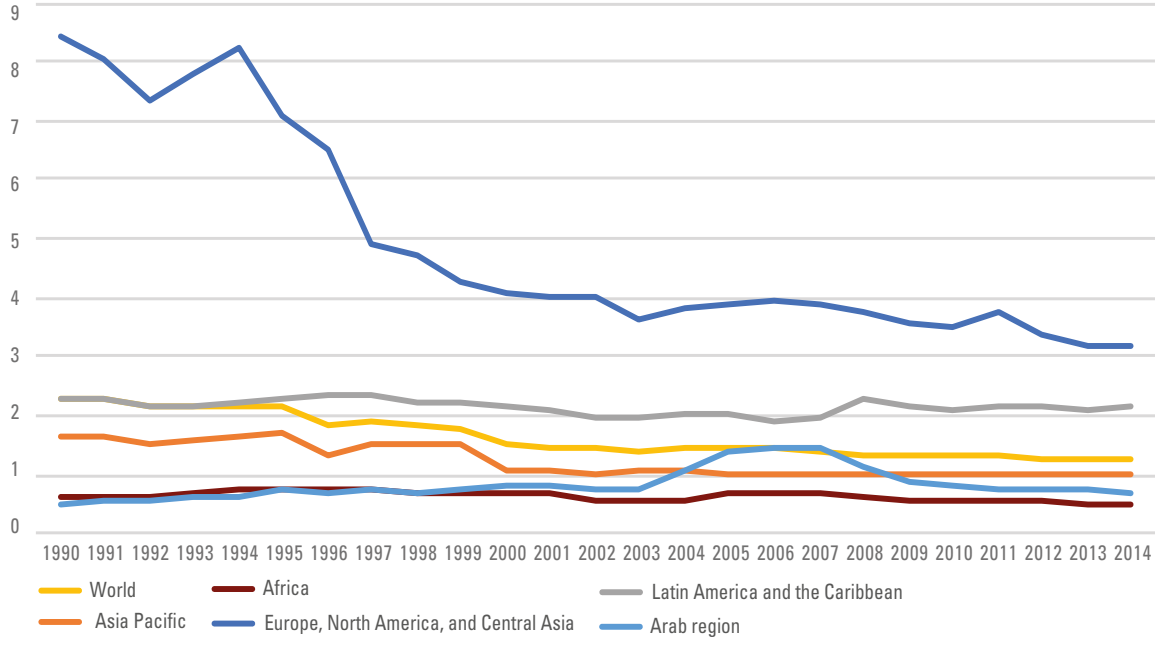
The service sector is currently the most energy intensive in the Arab LDCs. Sudan is the region's outlier in energy use in the service sector, using over three times as much energy per unit output of GDP in the service sector than Qatar (Figure 63). While slight improvements have been made in recent years, these numbers suggest that Arab LDCs waste more energy per unit of output in the service sector than any other subregion in the Arab region.

Agriculture – a special case

Agriculture is a special sector, because of its critical meaning for agricultural economies as a primary source of income and food security, but also because its energy needs change as the sector evolves. A systemic shift from more rudimentary forms of agriculture towards the use of more technology, including water pumps, machinery and fertilizers, implies a gain in crop yields, but also more energy usage per agricultural value added, typically before this intensity rate starts to decline again as more efficient technology is used. Many Arab economies with agricultural sectors are now at the stage where better technology uses more energy but improves yields in harvest. Within each country's individual geographic and climatic context, this re-emphasises the need for a trade-off as to whether the incremental cost of the increased technology and energy and water use generates enough additional food to be worth the investment.

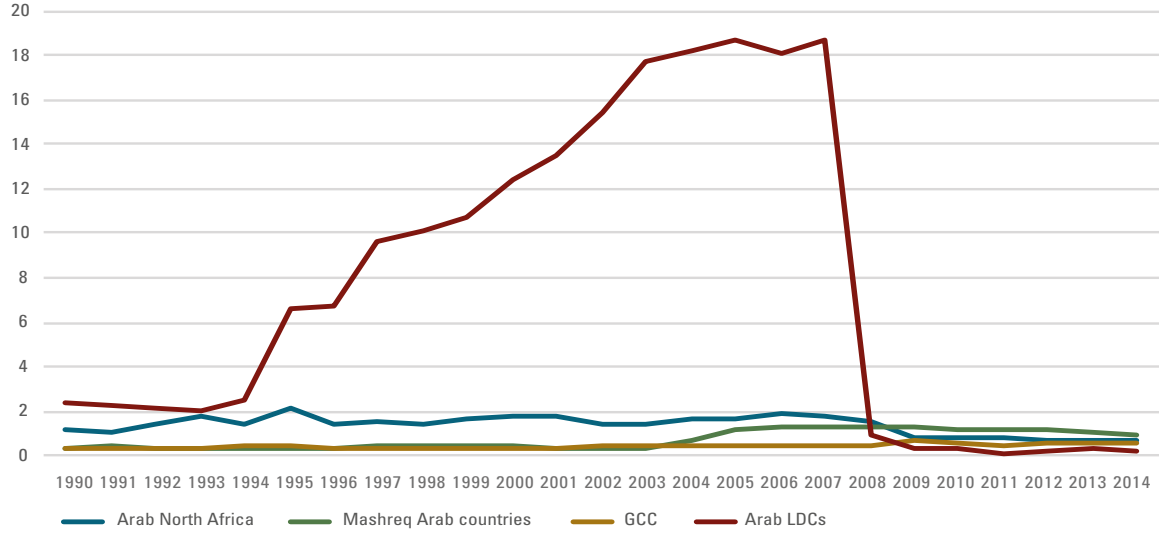
Using energy intensity as a proxy for efficiency improvements in the agricultural sector raises challenges, because of the way a number of exogenous factors influence agricultural output and hence the level of energy intensity (see Box 6 above). Exogenous factors that distort the validity of energy intensity as a proxy for energy efficiency include variations in weather

Figure 64. Energy intensity of the agriculture sector (MJ/2011 PPP US$)



Data gaps: Algeria (1990–2008); Bahrain (1990–2007); Iraq (1990–2014); Kuwait (1990–2014); Lebanon (1990–2014); Libya (1990–2014); Oman (1990–2008); Palestine (1990–2014); Qatar (1990–2014); Sudan (1990–2007); UAE (1990–2014); Yemen (1990–2014).
Notes: Energy intensity fell apruptly in the Arab LDCs in 2008 due to a statistical issue. Missing GDP and agricultural added values for Sudan and Yemen means these data are excluded from TFEC, leaving data points from here to reflect Mauritania alone.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 65. Energy intensity of the agriculture sector by subregion (MJ/2011 PPP US$)

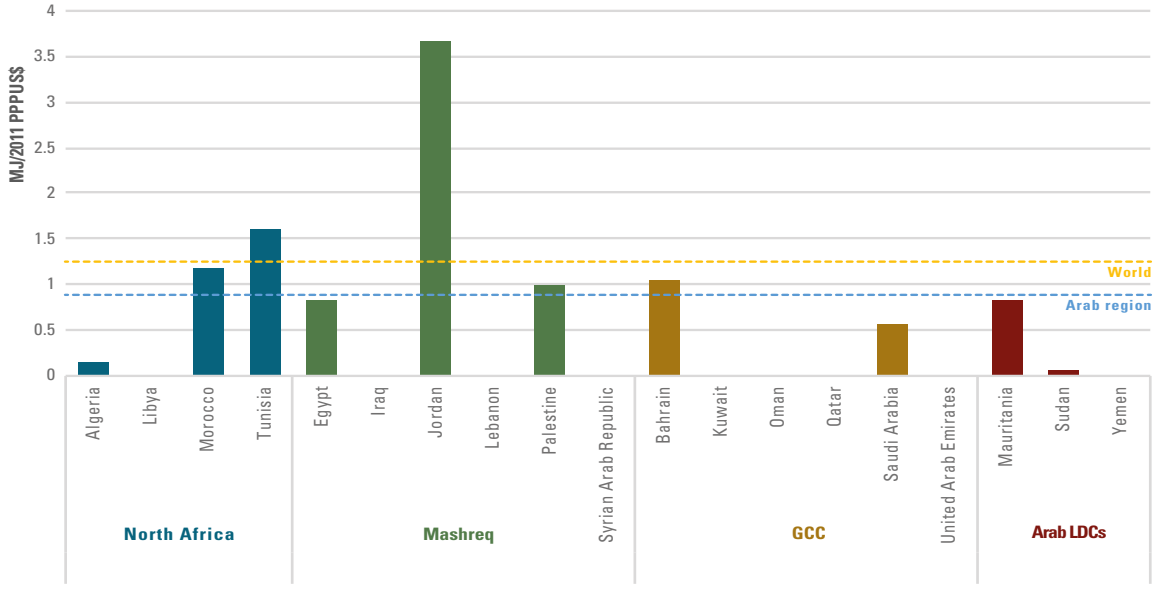


Data gaps: Algeria (1990–2008); Bahrain (1990–2007); Iraq (1990–2014); Kuwait (1990–2014); Lebanon (1990–2014); Libya (1990–2014); Oman (1990–2008); Palestine (1990–2014); Qatar (1990–2014); Sudan (1990–2007); UAE (1990–2014); Yemen (1990–2014).
Notes: Energy intensity fell apruptly in the Arab LDCs in 2008 due to a statistical issue. Missing GDP and agricultural added values for Sudan and Yemen means these data are excluded from TFEC, leaving data points from here to reflect Mauritania alone.
Source: World Bank (2017a) based on IEA and UN Statistics data.

and climate and related fluctuations in output levels; the value of agricultural products on international commodity prices, hence their value added to the economy; and currency fluctuations which affect the way domestic value added is measured in international dollar values. Taking into consideration all these caveats, we can draw some basic conclusions about energy intensity – and hence efficiency – of agriculture in the Arab region.

Regionally, the Arab region has among the world's least energy-intensive agricultural sector. This being said, climatic factors mean agricultural production, as well as livestock rearing and fishery, are highly concentrated in several key agricultural producers in the Arab region – most of them in lower- and upper-middle-income countries such as Egypt, Jordan and Morocco – and where agriculture contributes significantly to gross national output. As a labour-intensive sector, agriculture is a significant employer for rural populations, but also one that is not yet as reliant on high technology and industrial farming techniques as is, for instance, agricultural production in Europe and North America. In the Arab LDCs, many rural areas have no or limited access to modern energy services, reducing the use of simple technologies beyond mechanical water-pumping and animal-powered harvesting methods. In many lower-middle-income countries and the Arab LDCs, we hence have to assume lower levels of energy intensity are not necessarily a reflection of modern energy-efficiency solutions, but rather a lack of energy resources to exploit in the agricultural sector to start with. The added value of better technology here would probably be very high, if available. Socioeconomic development progress should change this pattern over time, making energy efficiency ever more important in managing scarce resources in these countries, including the use of available off-grid solutions that involve making the most of renewable energy sources for agriculture (see Chapter 4).

Figure 66. Energy intensity of the agriculture sector in the Arab region, 2014 (MJ/2011 PPP US$)



Data gaps: Libya, Iraq, Kuwait, Lebanon, Oman, Qatar, Syrian Arab Republic, UAE, Yemen.
Notes: Energy intensity of the agriculture sector measures final energy consumption of the agriculture sector over agriculture sector value added.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Energy-intensity rates rose regionally during the 2000s, albeit moderately, with a moderate decline since. While some of this increase is accounted for by the adoption of more energy-intensive production techniques in the Mashreq, particularly in Egypt and Syrian Arab Republic, the 2000s have also been a period of continuously declining added value in the agricultural sector, for instance in Jordan and Lebanon.[165] With similar patterns observed in Egypt and Morocco, a likely explanation is that falling value added by the agriculture sector at constant energy use implies an increase in energy intensity over times when the value of agricultural exports declines on international markets (owing to a set of complex factors including climatic factors across regions and hence the overall changes in commodity market prices and currency fluctuations), with the reverse to be the case when agriculture's added value increases.

Technology uptake in agricultural production may also exercise upward pressure on the energy intensity of agriculture where more modern machinery replaces traditional farm techniques. North Africa's agricultural sector's energy intensity by contrast rose earlier during the 2000s and then declined steeply before increasing again by the mid-2000s, a development partly explainable by systematic improvements in production methods in the sector that consume, more energy to start with.[166] Considerable variations in the energy intensity of agriculture are nevertheless difficult to interpret purely on the basis of energy-efficiency trends, as agriculture's value added to GDP undergoes significant fluctuations due to weather conditions, affecting its energy-intensity ratings and its initial energy requirements, including reduced irrigation needs if rainfall is favourable, and lessened need for mechanical ventilation of facilities for livestock-raising if temperatures are favourable during the hot season. The same considerations apply to other nations, so this highlights the limitations of using existing data proxies for this type of analysis.

Rising pressure for food production has also driven significant efforts at increasing the energy efficiency of the agricultural sector indirectly. Land productivity, for instance, has improved dramatically in Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia.[167] So has value generated by agricultural work in these economies,[168] thus potentially contributing towards higher added value relative to other input factors such as energy. On the other hand, rising yields, for instance in cereal production, in Egypt, Morocco and Tunisia, are believed to have been at least partly driven by more irrigated areas – implying potentially more rather than less use of energy and water to produce more output.[169] The disperse nature of agriculture, with many small farms spread across geographic conditions and outside the reach of centralized urban policymaking and legislation, further complicates the implementation of energy-efficiency measures in agriculture, while most financial markets in the Arab region lack financial products suited to the needs of farmers particularly.

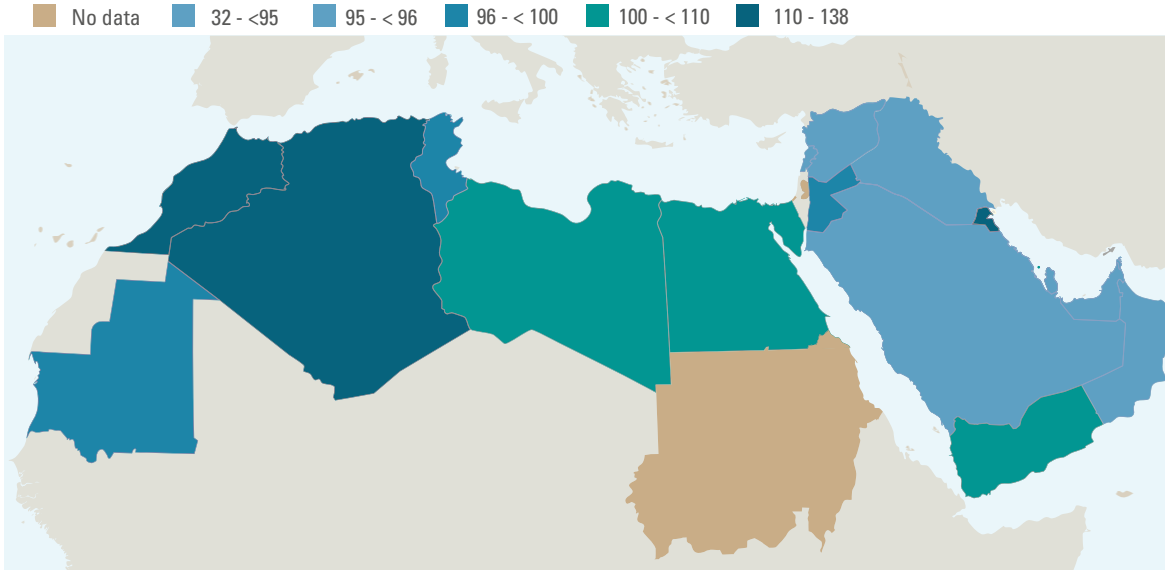
Agriculture in the GCC countries illustrates the difficulty for the Arab region's arid countries to reconcile food-security concerns with the need to use energy and water resources sustainably. In contrast to other parts of the Arab region, the GCC economies have experienced rising energy-intensity rates for their agricultural produce.[170] The subgroup of countries has been promoting domestic production increasingly since the 2000s as a way of increasing food security through reduced food imports, which account for 90% of the GCC economies' food supply.[171,172] In the GCC and Yemen, the percentage of agricultural land that is arable is only 2.2%, implying the need for significant resources such as dedicated land development and irrigation systems – particularly in the wealthier GCC economies – in order to increase production.[173] Structural barriers hence exist a priori as to how much energy intensity of agriculture in these countries can be reduced. The per capita value of agricultural production has declined in all GCC economies since 1990 except Kuwait and Oman,[174] reflecting the rapid

population growth most GCC countries have experienced since then, relative to limited agricultural resources.

Reflecting substantial differences in geographic and climatic conditions and the uptake level of modern machinery and technology across different Arab countries, energy-intensity rates for agriculture vary considerably between these countries. Food types such as cereals, fruit, vegetable and oil crops differ intrinsically in the amount of water and therefore energy they consume, as do crops compared with livestock farming and fishery. For instance, Jordan, Lebanon and Tunisia use most of their land resources for growing fruit, vegetables and oil crops (especially olives), which are competitive export commodities. On the other hand, Algeria, Egypt and Morocco use most of their land resources (between 60% and 70%) for growing cereals – overwhelmingly wheat, which is mainly intended to meet domestic demand.[175] Because much of the rationale for growing particular types of food commodities for reasons exogenous to the suitability of local land for particular products – the rationale being primarily focused on export markets or domestic food security – actual production often requires much higher inputs of water and energy than crops that are best fitted to local climatic conditions.

Agricultural resources are under increasing pressure to produce by both traditional and new demands.[176] Growing populations and rising food needs all increase the need for the effective management of agricultural resources – a message even more important in a region that is arid and vulnerable to droughts and extreme weather and that will likely become more so coming in the coming decades, due to climate change.[177] Increased water scarcity, land degradation, crop failures, loss of rangeland and other vegetation covers, livestock deaths and reduced fishery production will all be challenges to be faced by the agricultural sector in the Arab region as global temperatures rise.[178] As economies grow, agriculture also has to compete increasingly for land and water resources with other sectors, including growing urban centres and industrial sectors. Even more important, therefore, will be the sustainable management of agriculture in the region through the maximum use of resources such as energy and water – including pricing mechanisms.

Map 3. Food, net per capita production index number (2004–2006=100)(index, 2014)



Source: United Nations ESCWA based on data from FAO Statistics Division (FAOSTAT).

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4. Renewable Energy

Overview

Renewable energy holds great potential to play a fundamental role in the Arab region's struggle for more sustainable growth and development. Where it helps the economy to access clean, sustainably sourced and affordable energy, renewable energy can play a pivotal role in helping economies reconcile the need for the protection and maintenance of environmental resources with the requirements of modern-day advances that address people's needs in both the developed and the developing world. Renewable-energy sources, in particular solar power, are abundant. Country-level applications of larger-scale projects, such as wind power in Morocco and solar PV power in the UAE, have demonstrated the cost-competitiveness of such technologies if assessed under the right conditions. In Arab LDCs, off-grid applications of renewable energy not only hold the potential to enable households access to electricity, they also do so cost-effectively in comparison with conventional off-grid diesel generators.

This chapter examines progress in renewable-energy deployment in the Arab region, with three key observations:

1. Renewable energy is still a largely untapped resource in the Arab region. No other world region has such low reliance on renewable-energy sources – whether traditional or modern. A variety of reasons account for this: very low starting levels of reliance on traditional biomass in countries other than the three Arab LDCs; missing market incentives; and political priority to tap into the vast potential for renewable-energy-based technologies. Among these factors, entrenched pricing policies for existing fossil fuels and the utility sector appear to be a fundamental impediment to more systematic deployment.
2. Biomass continues to dominate the region's renewable energy mix, but its share is declining. Over two-thirds of the region's consumption of renewable energy is based on biomass, accounted for by a small number of countries whose primarily rural populations continue to use biomass, particularly in Egypt, Morocco and Sudan. As these countries' populations climb the energy ladder towards more modern sources of energy, this share is expected to decline further in the near future.
3. Wind and solar power are quickly emerging as new sunrise technologies in the Arab region. Where renewable energy consumption has grown over the tracking period 2012–2014, it has done so primarily on the basis of technologies such as solar and wind power, reflecting the very large decline in costs of both technologies, coupled with their potential to provide comparably large increments of new, cost-effective power in different settings.

While the Arab region's recent trend in solar-and wind-power energy deployment is currently driven by a few countries, more dedicated policies to establish these technologies could substantially increase the level of deployment over the coming decades. This includes

allowing markets to establish a business case for alternative technologies. In a market that remains dominated by fossil fuels – more than any other region – this will require not only more systematic reform to open up utility sectors, but also work on enabling factors for small-scale applications such as off-grid use, through mechanisms such as transparent pricing and funding.

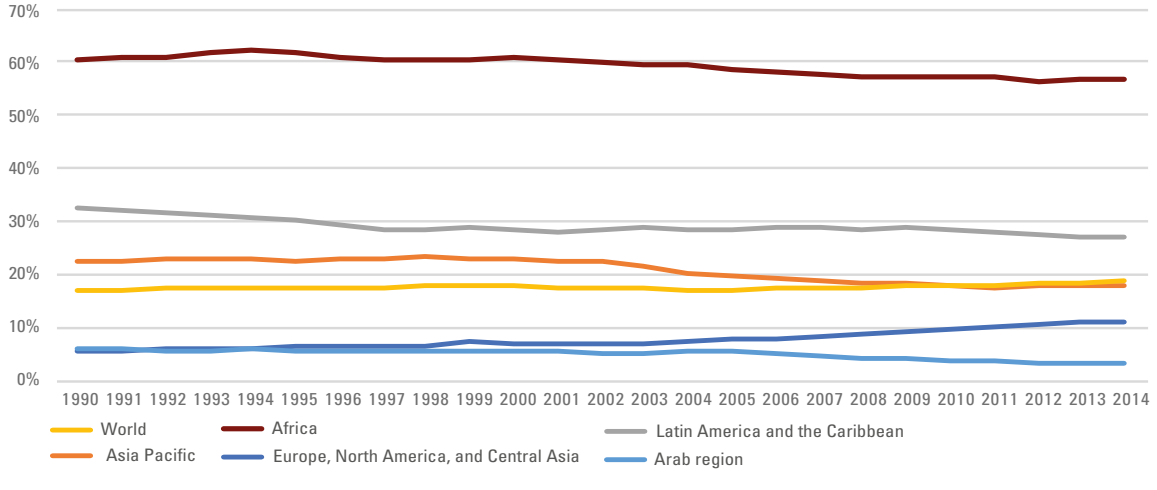
Modern renewable energy remains a largely untapped resource in the Arab region

Renewable energy plays only a marginal role in the Arab region's energy consumption. No other world region displays such a small role of renewable energy (Figure 67 and Figure 68), reflecting the Arab region's globally unparalleled reliance on non-renewable sources of energy. In 2014, renewable energy, including biomass, accounted for some 4% of the region's final energy consumption. This is despite considerable potential for renewable energy, in particular modern technologies such as wind and solar power, given the region's favourable geography and climatic conditions.[179] Enhanced policies and market frameworks would have the potential to be 30% higher in the Middle East and Africa by 2021, according to the IEA's accelerated case in its medium-term outlook for global renewable-energy markets.[180]

Barriers to modern renewable-energy deployment

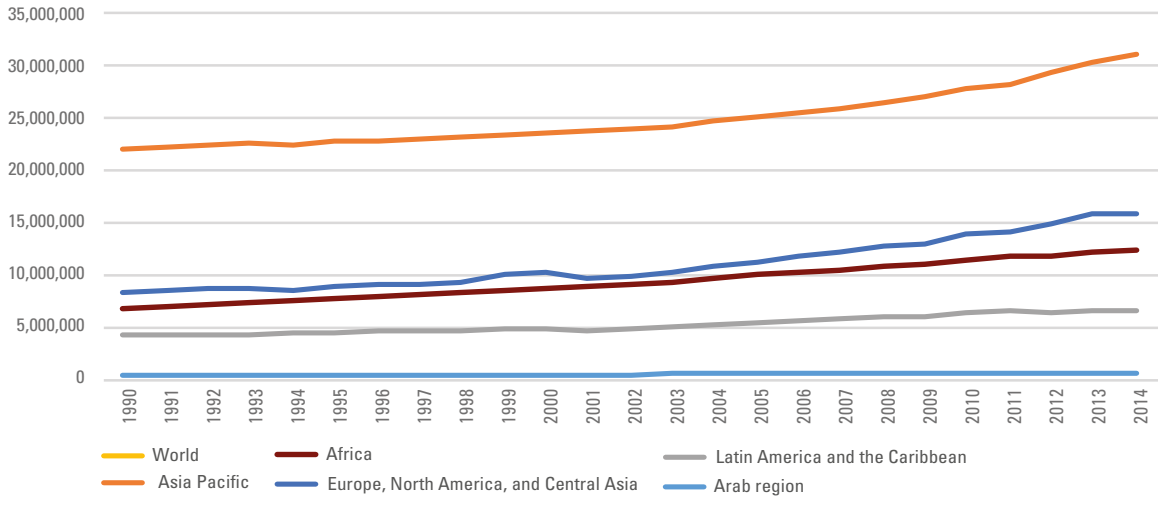
Historically, it has been difficult for modern renewable energy to compete with fossil fuels in the Arab region for a number of commercial and non-commercial reasons. In most parts of the region, conventional fossil fuels have, for many decades, underpinned the systematic expansion of access to modern energy and higher living standards, leading to near-universal access rates to electricity and clean cooking fuels, and comparably low rates of regional reliance on biomass. The Arab region has historically been an oil- and gas-producing region, with fossil fuels supplying

Figure 67. Renewable energy share of total final energy consumption (%) by global region



Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 68. Renewable energy consumption by region (EJ)



Source: World Bank (2017a) based on IEA and UN Statistics data.

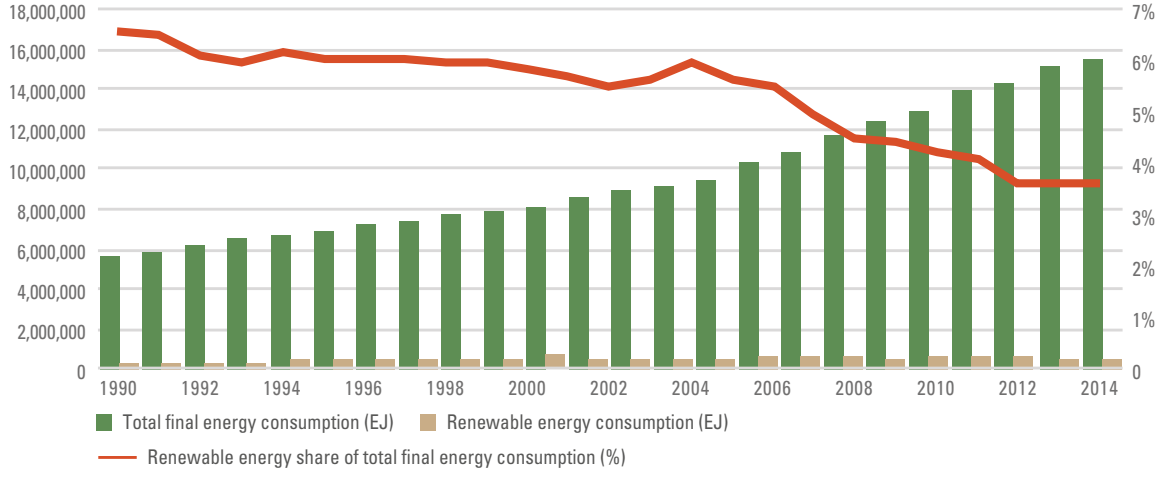
over 95%[181] of its energy needs reliably for many decades. This experience closely ties the relatively high degree of socioeconomic development to the availability of abundant, low-cost fossil-fuel-based energy resources, typically supplied by the State at a fraction of the cost of these resources in other import-dependent markets. More structurally, renewable energy deployment has been slowed by a combination of factors, some of which are more generic, and some more specific to the Arab region:

- **Cost barriers.** Like many developing regions, Arab countries have found the cost of modern renewable energy technologies such as solar and wind power expensive relative to existing energy sources until the sharp fall in technology costs in the 2000s. Kuwait studied the economics of solar power for use in its power sector as early as the 1970s, but found them to be uncompetitive on the basis of cost.[182] Rapidly falling costs for technologies such as wind and solar power since the late 2000s have slowly begun to reverse this cost disadvantage (see Box 8). Missing financial market instruments and experience in funding renewable energy projects at utility scale and at microlevel further complicate deployment (see Chapter 5 for a thorough discussion).
- **Market barriers.** Domestic energy and utility markets in the Arab region are highly regulated environments, whose particular design has, by and large, obstructed the entry of new energy technologies – whether potentially cost-effective or not. Key market features, with some intra-regional variation, include the supply of low-cost fossil fuels, either subsidized or at around marginal production cost, to industries and utilities, often at a fraction of their international market value; the parallel regulation of utility tariffs, typically highly subsidized, that deprive utilities, in turn, of profit-making, and hence the means to invest in new energy projects. Renewable-energy technologies struggle under such market conditions, unless top-down government policy makes room for politically backed projects in the absence of clear market incentives. In energy-importing countries such as Jordan, Morocco and Tunisia,

international loans and development funds supporting clean-energy development in developing countries have been a critical factor driving the deployment of renewables.

- **Technological barriers.** As in other developing-country contexts, the prospect of integrating large quantities of renewable energy provides challenges for the Arab region. Wind power is particularly affected: its production profiles are considerably more difficult to predict than, for instance, those of solar power in a region enjoying reliable daytime sunshine for most parts of the year; it also affects the viability of decentralized options, such as the mass roll-out of rooftop solar panels in both urban and rural areas to feed surplus production back into the grid. Finally, key renewable energy technologies such as wind and solar power – with the exception of higher-cost concentrated solar power (CSP) technology – are intermittent sources of energy, and have long been seen as an insufficient alternative to available fossil fuels for the large additional power needs of many of the faster-moving economies.
- **Political will and policy priority.** Political will and policy priority remain critical to driving progress in renewable-energy deployment in the Arab region, given highly distorted market signals discussed above. Renewable energy has historically had less lobby as energy security has been largely upheld by domestically and regionally produced, low-cost fossil fuels, than in typical energy-import markets for which renewables presented the additional benefit of reducing foreign imports. For Arab net importers of energy, such as Jordan, Morocco and Tunisia, the situation has changed recently, with renewable energy technologies becoming more cost-competitive and fossil fuels imported from international markets more expensive. Until now, many large and medium-sized fossil-fuel producers see renewable energy as a potential future option, more than a priority. At the off-grid level, where renewable technologies, such as rooftop solar power, are already cost-competitive with the conventional alternative of diesel generators in the long run, the political will to translate these savings into action is missing, particularly in the LDCs.

Figure 69. Share of renewable energy in total final energy consumption in the Arab region, 1990–2014

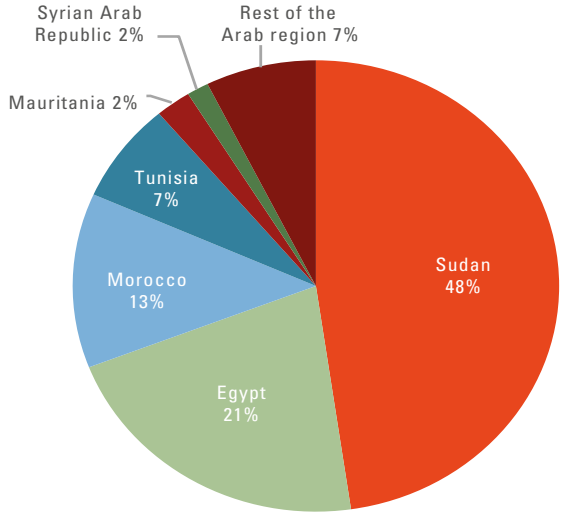


Source: World Bank (2017a) based on IEA and UN Statistics data

Measured on the basis of effective consumption, the current long-term trend in the Arab region is one of a falling share of renewable energy in its final energy consumption, the speed of which has been accelerating in recent years (see Figure 69). The reasons for this decline in the share of renewables reflect two parallel energy-sector developments: the progressive shift away from biomass – mainly traditional but also some forms of "modern" biomass – in some middle-income countries and the LDCs and the region's rapidly increasing energy demand that almost tripled between 1990 and 2014, with the vast majority of additional energy supply coming from fossil fuels.[183] Biomass accounts for more than two-thirds of total regional renewable-energy consumption[184] and changes in its consumption patterns therefore affect final renewable-energy consumption considerably. Currently, this not only makes Arab countries the least inclined to use renewable energy of all the world's regions, it also increases the gap between the rate of renewable energy use in the Arab region and, effectively, everyone else.

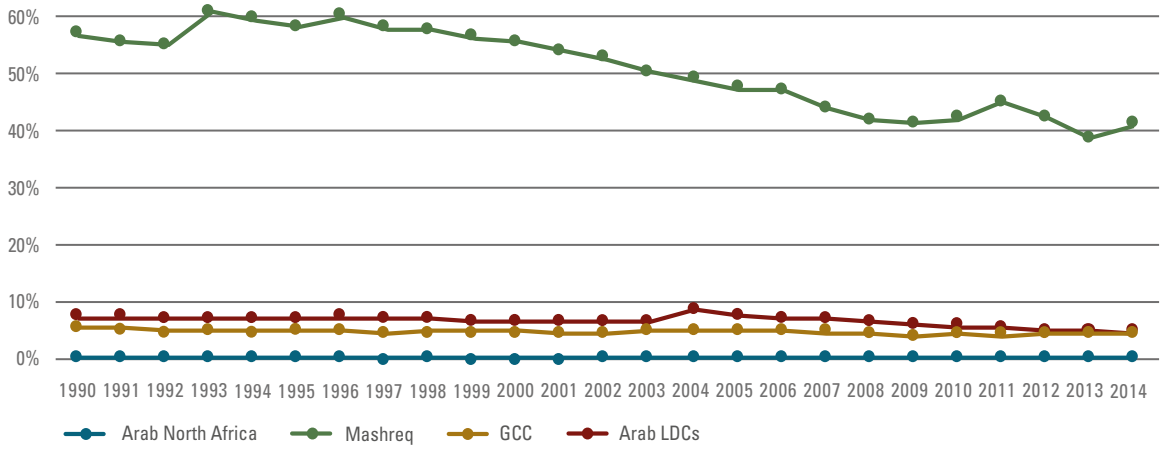
Where renewable energy contributes to the domestic energy mix, it remains highly concentrated in a few Arab countries, primarily those that have continued to use large quantities of biomass since the 1960s. Egypt, Morocco and Sudan together account for over two-thirds of the Arab region's renewable energy consumption (Figure 70).

Figure 70. Renewable energy consumption in the Arab region by country in 2014 (total = 557,047 TJ)



Source: World Bank (2017a) based on IEA and UN Statistics data.

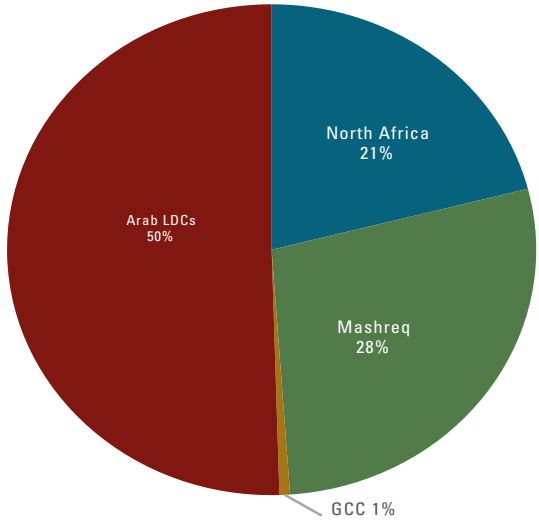
Figure 71. Share of renewable energy in total final energy consumption in the Arab region by subregion



Source: World Bank (2017a) based on IEA and UN Statistics data.

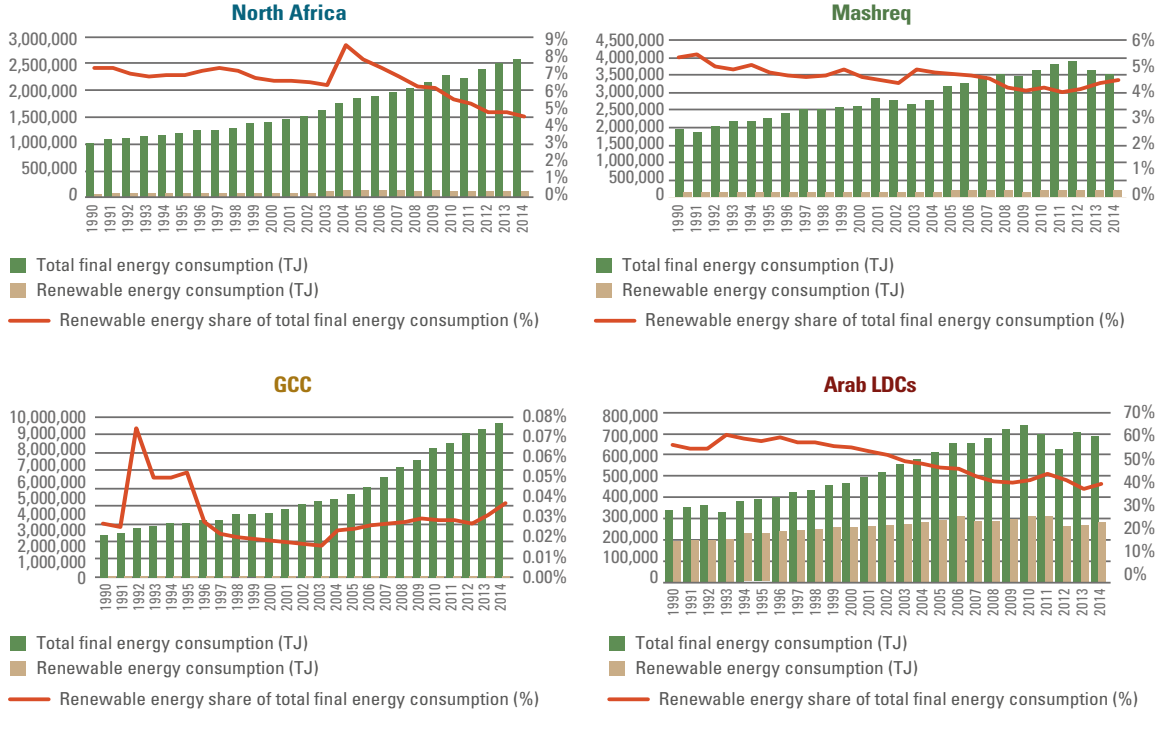
Sudan alone consumes almost half the region's renewable energy, owing to the continued use of biomass for large shares of the country's energy supply in the absence of more modern energy sources and electricity available to large parts of the population. Compared to the region's total energy needs, modern non-hydropower technologies, such as wind and solar power remain, with very few exceptions such as Morocco and the UAE, a marginal and, in all cases, very recent source of energy to the region as a whole. In subregional terms, renewable energy consumption is highest in the Arab LDCs, followed by North Africa, with smaller volumes consumed in the Mashreq and almost none in the GCC economies where, despite the recent inroads of solar power, renewable energies continue to account for relatively small amounts of the region's power mix (Figure 71 and Figure 72).

Figure 72. The share of subregions in the Arab region's total renewable energy consumption



Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 73. Share of renewable energy in final energy consumption in the Arab region by subregion



Source: World Bank (2017a) based on IEA and UN Statistics data.

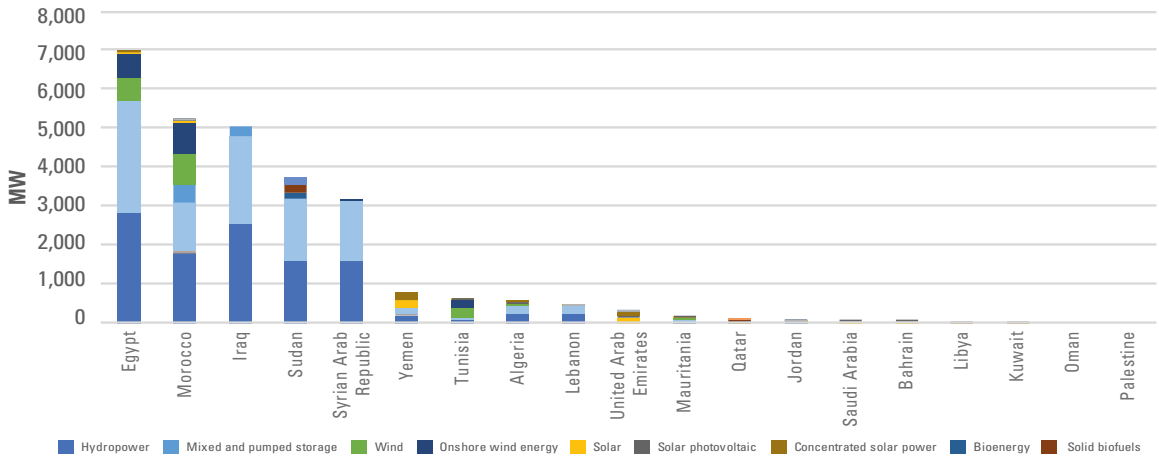
The second largest renewable energy source by deployment and consumption in the Arab region is hydropower. With a longstanding history in individual Arab countries, both small- and large-scale hydropower has formed part of local and national energy-supply strategies. The limitations to the increased use of hydropower – particularly large-scale – consist in the limited resources that are concentrated in only a few Arab countries, primarily Egypt, Iraq, Morocco, Sudan and Syrian Arab Republic (see Table 3). On the one hand, Egypt, Morocco, Sudan and the Mashreq countries along the rivers Euphrates and Jordan have long histories of utilizing their hydro resources, both for power generation and agriculture. On the other hand, the already high exploitation rates of suitable sites in the past limit the potential for a significant expansion of hydropower capacity in the future beyond small-scale applications. Large-scale hydropower potential, which has largely already been exploited, entails ecological long-term costs, such as additional environmental degradation, including dam-building, water pollution and artificial river design,[185] reflecting the virtual collapse of many natural non-energy resources in the Arab region in the absence of systematic environmental protection policies.

Table 3. Renewable energy consumption by country, 2014 (TJ)

		Biomass	Hydro	Wind	Solar	Total renewable energy consumption, 2014	
						TJ	% of TFEC
North Africa	Algeria	251	651	0	0	902	0%
	Libya	6,332	0	0	0	6,332	2%
	Morocco	56,835	5,906	6,942	0	69,683	12%
	Tunisia	36,585	161	1,458	1,889	40,093	13%
Mashreq	Egypt	71,702	42,950	4,040	758	119,450	6%
	Iraq	1,043	6,851	0	0	7,894	1%
	Jordan	199	174	6	6,368	6,747	3%
	Lebanon	4,692	627	0	1,015	6,334	3%
	Syrian Arab Republic	259	7,832	0	0	8,091	3%
	Palestine	4,120	0	0	2,650	6,770	11%
GCC	Bahrain	0	0	0	0	0	0%
	Kuwait	0	0	0	0	0	0%
	Oman	0	0	0	0	0	0%
	Qatar	0	0	0	0	0	0%
	Saudi Arabia	280	0	0	5	285	0%
	United Arab Emirates	2,372	0	0	937	3,309	0%
Arab LDCs	Mauritania	13,103	0	0	0	13,103	33%
	Sudan	238,271	27,393	0	0	265,664	62%
	Yemen	2,372	0	0	0	2,372	1%

Notes: Biomass includes both traditional and modern biomass. Considerable data gaps and inaccuracies in estimating biomass use in households, especially in the LDCs, means data for biomass must be taken as indicative.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 74. Installed electricity generation capacity from renewable energy in the Arab region, including hydropower, 2014



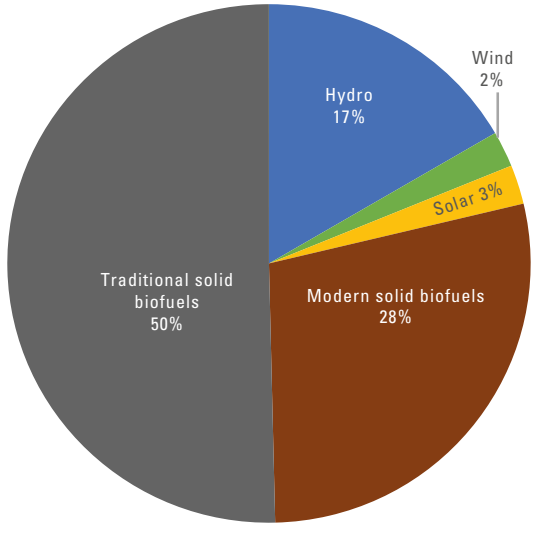
Source: IRENA (2017).

Hydropower dominates renewable-energy-based generation capacity in the power sector in the Arab region, whereas biomass is used predominantly by private households. Owing to its historical role in power generation through large-scale installations and the building of dams, hydropower is currently the most important source of utility-scale renewable-electricity generation in the Arab region. It also provides future opportunities for these countries, as available hydropower carries potential to firm, intermittent renewable energy supplies, for instance by wind and solar power. Largely as a result of this resource, Egypt, Morocco and Iraq, followed by Sudan and Syrian Arab Republic, have the largest renewable market share (Figure 74). Other countries, lacking large-scale hydroresources, currently have little renewable electricity; biomass is not widely used for power generation, nor are the region's potential geothermal resources currently being tapped.

Biomass dominates the renewables mix, but its share is declining

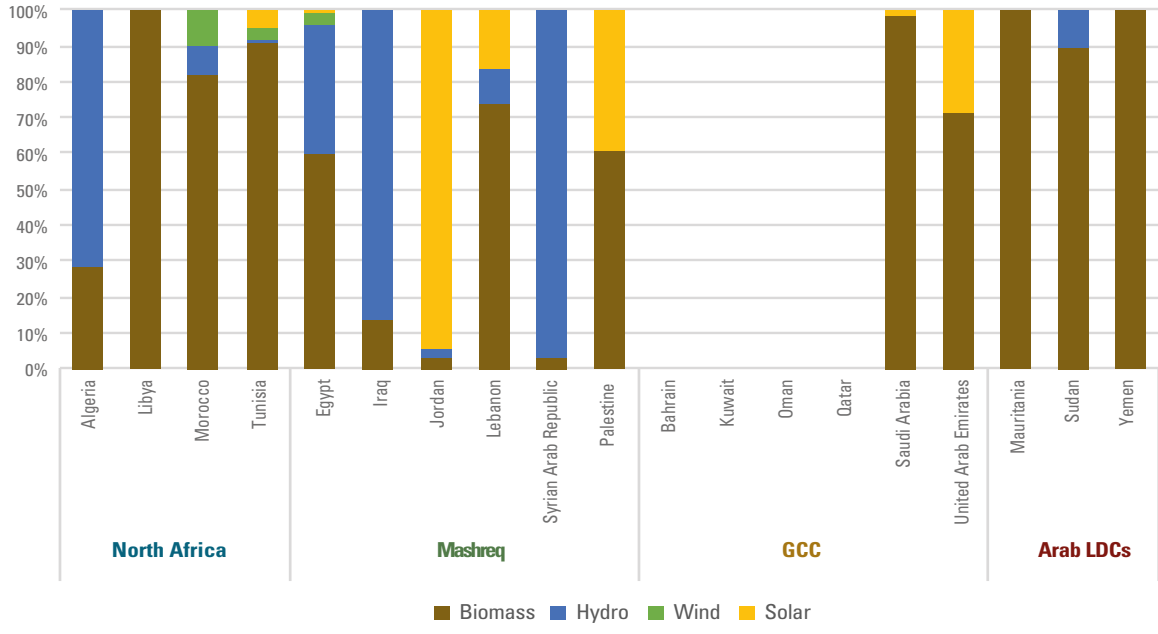
Biomass remains the most important renewable energy source in the Arab region.[186] Over two-

Figure 75. Final renewable energy consumption by source of fuel in the Arab region, 2014



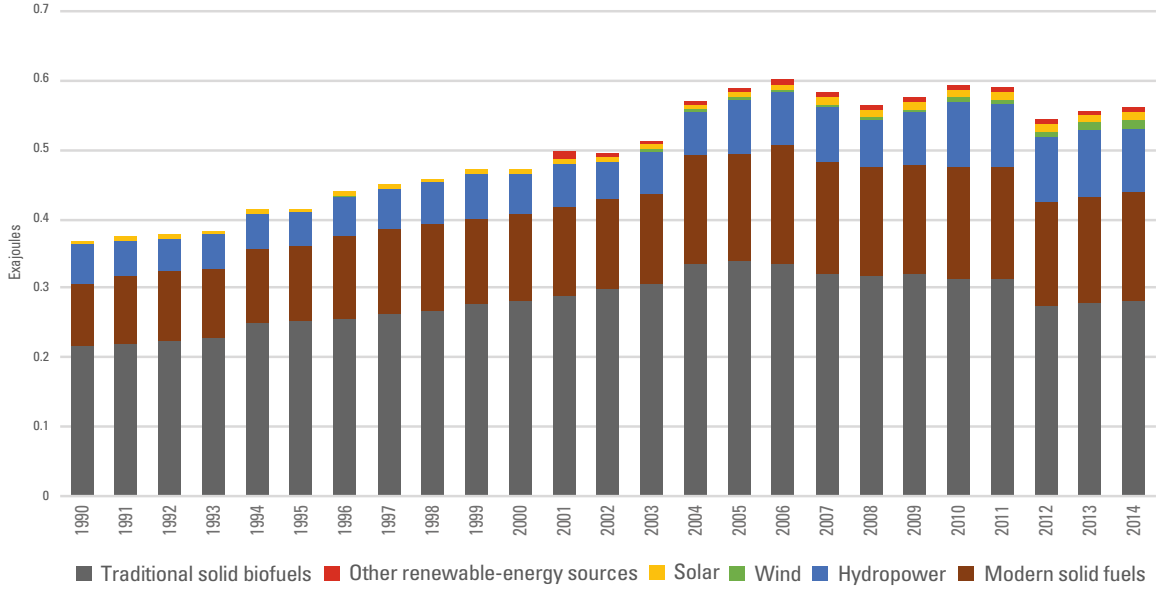
Zero consumption reported: traditional biomass – Bahrain, Kuwait, Oman, Qatar; modern biomass – Algeria, Bahrain, Kuwait, Libya, Mauritania, Oman, Qatar, Saudi Arabia; hydro – Bahrain, Kuwait, Libya, Mauritania, Oman, Palestine, Qatar, Saudi Arabia, UAE, Yemen; wind – Algeria, Bahrain, Iraq, Kuwait, Lebanon, Libya, Mauritania, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, UAE, Yemen; solar – Algeria, Bahrain, Iraq, Kuwait, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Sudan, Syrian Arab Republic, Yemen.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 76. Share of different renewable sources in total renewable energy consumption in the Arab region, 2014



Note: Zero consumption reported: traditional biomass – Bahrain, Kuwait, Oman, Qatar; modern biomass – Algeria, Bahrain, Kuwait, Libya, Mauritania, Oman, Qatar, Saudi Arabia; hydro – Bahrain, Kuwait, Libya, Mauritania, Oman, Palestine, Qatar, Saudi Arabia, UAE, Yemen; wind – Algeria, Bahrain, Iraq, Kuwait, Lebanon, Libya, Mauritania, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, UAE, Yemen; solar – Algeria, Bahrain, Iraq, Kuwait, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Sudan, Syrian Arab Republic, Yemen.
Source: World Bank (2017a) based on IEA and UN Statistics data.

Figure 77. Renewable energy consumption by source in the Arab region, 1990–2014 (EJ)



Source: World Bank (2017a) based on IEA and UN Statistics data.

thirds of the region's consumption of renewable energy is based on biomass, although its share in final energy consumption is undoubtedly declining. Biomass is a naturally found renewable energy source in the Arab region that many remote communities – particularly in the Arab LDCs – continue to use extensively as their primary source of energy. Local availability determines the nature of biomass and its form of access, while urban dwellers mostly purchase solid biofuels such as fuelwood and charcoal on the market but many rural households collect biomass directly from surrounding fields, forests and animal husbandry. Overall, the majority of biomass is used directly by households, with very limited uses of modern bioenergy stations.

Biomass use and progress in sustainable development

Biomass is not by definition a modern fuel. The efficiency of biomass – whether modern or traditional – does not compare to renewable-energy technologies such as solar, wind or hydropower. While modern biomass such as charcoal presents a considerable improvement relative to traditional biomass sources, its efficiency remains low and its sourcing is, in many cases, not sustainably managed. Biomass in most forms offers households no access to electricity. Uses for biomass of traditional materials such as crop residue and animal dung, but also low-quality fuelwood and general waste are of particularly inferior quality, with LPG offering a far superior and far more efficient, source of energy for household cooking.[187] A number of Arab countries, for instance Morocco, with remaining large portions of households using biomass for cooking, have since increased their efforts since the 1990s to raise access to LPG, including through subsidies. While the use of modern biomass appears to be growing in the Arab region, rural households remain limited in their rates of access, in particular the Arab LDCs.

Neither is biomass necessarily a clean or sustainable fuel. Traditional biomass use, in particular, results in considerable negative health impacts from the high concentrations of particulate matter and carbon monoxide, among other pollutants.[188] These effects are worsened by the way traditional biomass is often used: for instance, when mixed together with household waste and kerosene as a starter fuel (known as "fuel stacking"[189]). The negative health effects of poor-quality fuel, even where it counts as renewable – as in the case of modern and traditional biomass – through inhalation in poorly ventilated homes are well known, including pneumonia and other respiratory diseases: women and children who spend more time at home than men are overwhelmingly concerned.[190] Modern biomass, such as charcoal, burns more efficiently, but its typically decentralized production raises other environmental concerns, in particular overgrazing, deforestation and wider environmental degradation, whose consequences for local environments and biospheres can be enormous.

More efficient modern bioenergy in the form of solids, liquids and gases are not yet widely spread in the Arab region, where biomass consumption typically remains a feature of the poor in the absence of better alternatives. In Mauritania, one of the largest biomass consumers in the Arab region, natural forest areas decreased by 30% between 1990 and 2000 alone.[191] Deforestation often results in the gradual decline in fuelwood available to local communities, raising serious concerns over the sustainability of biomass supply and, in many cases, its highly destructive impact on nature, the environment and rural communities. Declining quality of biomass availability also leads to longer time periods spent by rural inhabitants collecting lower-quality biomass alternatives and to a higher propensity for conflict over land ownership.[192] In general policy, these issues related to biomass are widely known and documented, but often remain disregarded by local communities, who lack fuel alternatives.[193] The situation is spurred in countries with high rates of biomass consumption by limited government support

and improvised strategies based primarily on donor aid. In many cases, established practices lead to consumption patterns that are contrary to countries' development objectives. The World Bank, for instance, points out in the context of Africa that:

> "The transition to clean cooking also requires a transformation of mindsets and cultural practices. Longstanding dependence on traditional biomass (such as charcoal, wood fuel, and cow dung) has restricted households to existing infrastructure and practices. The abundance of easily accessible traditional biomass inhibits faster penetration of other cooking fuels."[194]

Not everywhere in the Arab region is biomass used as an inferior source of fuel. In Morocco, Syrian Arab Republic and Tunisia, biomass continues to be used in rural communities for heating and cooking, primarily fuelwood, but also charcoal and wood pellets, which burn more efficiently than traditional biomass. Minimal use in other Arab countries includes the use of fuelwood for traditional wood-fired cooking in remote areas, such as deserts. With electricity and LPG coverage in many such countries being close to universal, we can assume that the use of fuelwood for cooking and space heating is in such cases a conscious choice, rather than a necessity.[195] Such usage patterns account for a relatively small share of the Arab region's total biomass use, which remains largely an indicator of poverty and lack of access to higher-quality sources of energy than primarily a conscious choice.

Biomass use and economic –environmental concerns

Biomass collection by communities is also an economic and environmental concern. In many societies, including the Arab LDCs, fuelwood collection is primarily a women's task, involving many hours of walking each day, with security risks for many women and children in addition to the loss of time for education or more productive forms of labour. Overgrazing and extensive fuelwood-cutting by rural communities can also have detrimental effects on the local environment, including severe degradation of vegetation, deforestation, increasing soil erosion and, ultimately, loss in biological capacity.[196] Others observe the relationship between traditional biomass use and poverty reduction in the context of the Arab region:

> "In view of the considerable time commitment that biomass and fuelwood collection represent for rural households, the use of commercial fuels would provide female household members with increased spare time and would foster school attendance by children. Lack of access to commercial fuels is thus poverty- reinforcing."[197]

FAO provides an account of the highly destructive effects from overexploitation of natural biomass resources in the case of Syrian Arab Republic/Lebanon as a result of conflict and displacement on the environment and propensity for resource conflict. It also highlights the intrinsic links between energy, water and food security, and overall human security:

> "Due to the accelerating demand for fuel, woodlands and forests (by illegal cutting) by increasingly resource-poor Syrian refugees and the Lebanese host communities, natural resources are being overexploited – non-wood forest products are also exploited for daily subsidence by both Lebanese communities and refugees. In addition, the arrival of additional livestock from Syria is gradually causing overgrazing and degradation of vegetation cover on vulnerable rangelands. To meet the increasing demand of Lebanese host communities and Syrian refugees, water pumping and depletion of aquifers is approaching critical levels for both domestic and agricultural use. The influx of the refugees and their search for water points is resulting in a dramatic increase of solid waste along the rivers and coastline, causing higher pollution levels in these ecosystems. The deterioration of water quality is affecting not only potable water, but also water used for irrigation. Furthermore,

> conflicts over the use of natural resources, between host communities and refugees, has become more and more severe, putting peace and security at risk."[198]

For societies where large-scale biomass consumption entails these problems, such as Mauritania, Sudan and Yemen, falling biomass consumption has largely come as a positive development – though with the side effect of further reducing the share of renewable energy in the region's final energy mix. Reduced rates of biomass consumption have come with greater access to modern fuels such as LPG and electricity, supporting other development goals, including universal access to better-quality fuels and electricity. Within the biomass category, the difficulty of reconciling parallel development goals in the Arab region – universal energy access and the doubling of renewable-energy consumption, irrespective of its source – becomes evident. These cases illustrate the difficulty of applying renewable-energy goals blindly to developing economies, irrespective of their socioeconomic make-up, and the potential for the development of indicators better suited for renewable-energy consumption, particularly measures of non-biomass renewable-energy consumption.

Biomass use and regional food security

Systematic biofuel production, which is not yet taking place in the Arab region, also raises concern over the use of water resources and food security, given high land and irrigation requirements.[199] In its observations about biomass consumption in the Arab region, UNDP writes:

> "Biofuel crop expansion is a matter of concern in Arab countries because of its impact on food and water security, along with its impact on ecological ecosystem equilibrium and sustainable development. This is true in many Arab countries, particularly the oil-producing ones. The official Arab stance warns against the consequences of this action, while it supports the production of biofuel from agriculture waste."[200]

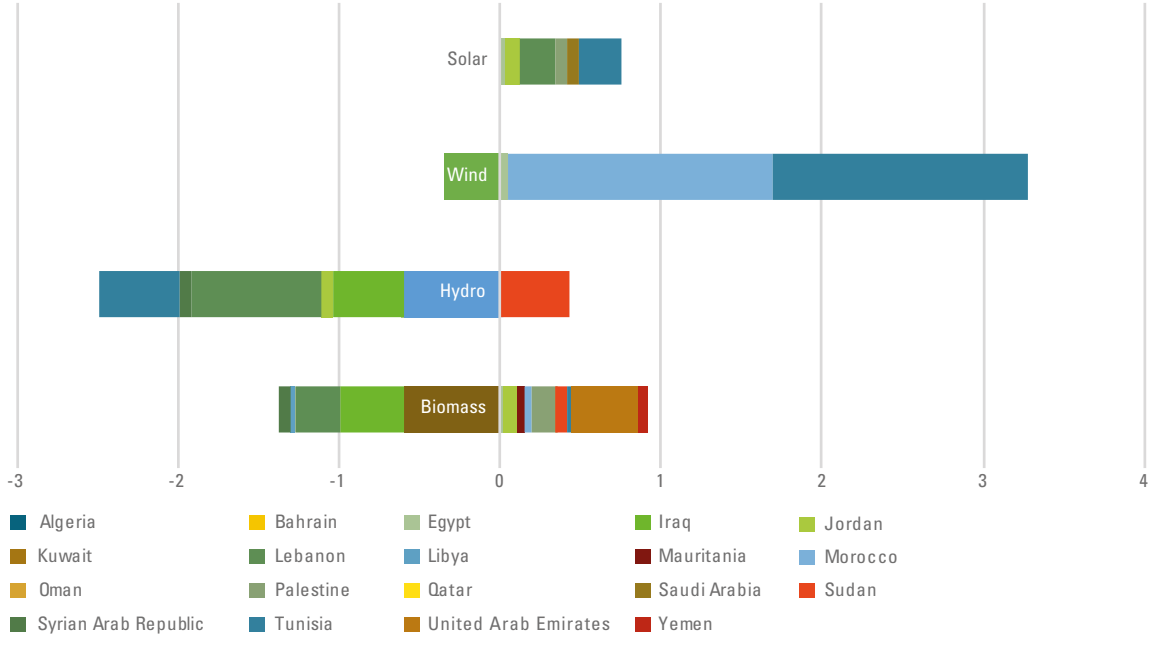
Related to this problem is the high water intensity of agricultural production across the Arab region, which is tied closely to the fact that water is, in many cases, underpriced and its use largely unrestricted. In the water-scarce Arab region, this raises further issues of sustainable natural resource use, in particular if the use of agricultural crops for power generation are to be expanded systematically in the future.

In other countries, second-generation fuels that are waste-based, rather than agricultural, are being used in technologies that transform biomass resources into clean energy. Waste-to-energy technologies can generate electricity, while providing a significant reduction in the quantities of waste that require final disposal, thereby contributing positively to the more effective waste-management schemes. Egypt, Morocco and Tunisia have already started using second-generation biofuels in the energy mix of some industrial facilities, while Jordan, Saudi Arabia, Tunisia and the UAE are using methane generated from landfill to produce electricity, although these remain so far limited to demonstration projects.[201] Waste-to-energy plants raise separate issues, however, that remain unresolved in the Arab region, including the parallel lack of recycling practices and emission and pollution controls, the effective implementation of which would increase the cost of such technologies significantly.

Solar and wind power emerge as new sunrise technologies

The trend in new, renewable energy consumption in the Arab region nevertheless moves away from biomass, towards modern renewable technologies. Where renewable-energy consumption has grown over the tracking period 2012–2014, it has done so primarily on the basis of technologies such as solar and wind power and, to a lesser extent, hydropower (Table 4). The single largest increments in renewable-energy consumption

Figure 78. Growth in renewable energy consumption in the Arab region, 2012–2014 (EJ)



Source: World Bank (2017a) based on IEA and UN Statistics data.

over the past 25 years were recorded in wind power, the consumption of which rose almost 1,000% over the period 2000–2010. This is particularly notable in North Africa, with the installation of large windfarms in Morocco and Tunisia and in the Mashreq countries during the 1990s and 2000s (see Figure 78 for changes in 2012–2014). Solar-power consumption also increased markedly from very low initial rates: up 55% across the region during the 2000s and 20% over the period 2012–2014, especially in the GCC economies. In the Arab LDCs, the largest single increment in consumption of renewables came from hydropower.

A few Arab countries account for virtually all the Arab region's newly installed renewables-powered electricity-generation capacity. The largest electricity-generation capacity additions in renewable energy in the Arab region over the tracking period 2012–2014 came from Morocco (with some 547 MW new capacity installed during 2013 and 2014) and the UAE (113 MW new generation capacity primarily from CSP) (Table 4). In the coming decade, both countries aim to significantly increase their renewable energy-generation capacity further: Morocco to a total of 2,000 MW installed wind and 2,000 MW solar capacity by 2020[202] (around 42% of total generation capacity), to be doubled by 2030 (to account for 52% of total generation capacity); and Dubai to 5,000 MW, or 25% of electricity generation by 2030 in the UAE. Other countries in the region have even larger renewable energy plans, with the highest capacity targets currently in Saudi Arabia, aiming for 9,500 MW renewable-energy-based power-generation capacity by 2030; Egypt with total capacity targets of 9,500 MW (wind and solar power), or 20% of total electricity generation by 2022; and Algeria with combined capacity targets of 4,375 MG by 2020 and 21,600 MW or 37% of installed electricity generation capacity by 2030, including wind, solar, biomass and geothermal power (Table 5).

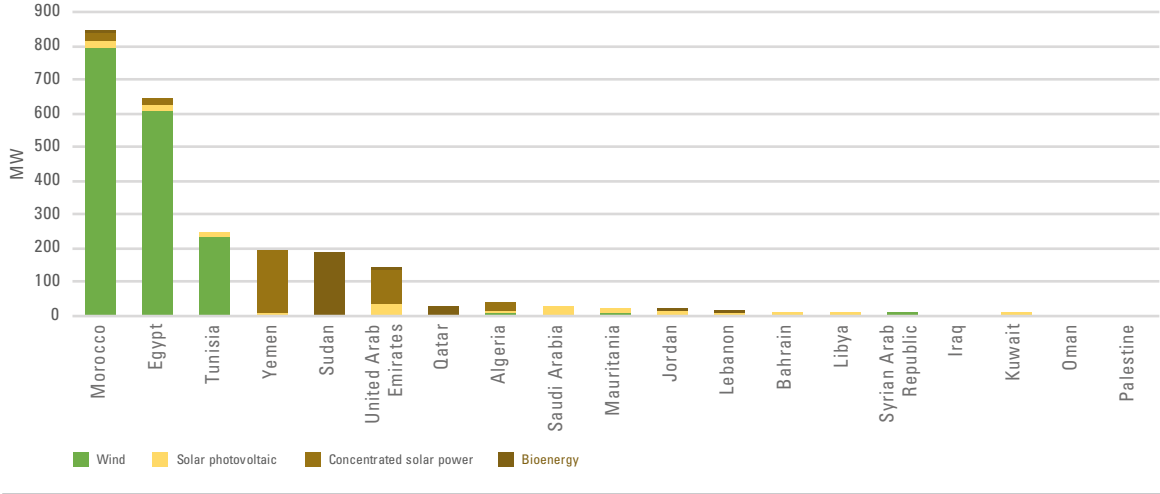
At the end of 2014, the Arab region's largest contribution of renewable energy (excluding hydropower) to electricity-generation capacity was made in just a few countries. Morocco, Egypt, Sudan, Tunisia, UAE and Yemen are

Table 4. Net renewable-energy-capacity additions and % in electricity generation in the Arab region, 2013 and 2014

		Net capacity additions (MW)						% of electricity generation				
Country	Year	Hydropower	Wind	Solar - PV	Solar - CSP	Other renewables	Total	Hydropower	Wind	Solar - PV	Solar - CSP	Other renewables
Algeria	2013	-	-	-	-	-	0	0.6%	-	-	-	-
	2014	-	10	-	-	-	10	0.4%	-	-	-	-
Egypt	2013	-	-	-	-	-	0	7.7%	0.8%	0.1%	-	0.9%
	2014	-	60	-	-	-	60	8.1%	0.8%	0.1%	-	0.9%
Mauritania	2013	21	-	15	-	-	36	-	-	-	-	-
	2014	-	-		-	-	0	-	-	-	-	-
Morocco	2013	-	240	1	-	-	241	0.3%	0.0%	-	-	0.1%
	2014	-	302	1	3	-	306	0.3%	0.0%	-	-	0.0%
Tunisia	2013	-	27	1	-	-	28	9.3%	5.3%	-	-	5.3%
	2014	-	33	10	-	-	43	5.7%	6.7%	-	-	6.7%
Jordan	2013	-	-	2	-	-	2	0.3%	1.9%	0.1%	-	2.0%
	2014	-	1	6	-	-	7	0.3%	2.7%	0.1%	-	2.8%
United Arab Emirates	2013	-	-	13	100	-	113	-	-	0.0%	0.1%	0.1%
	2014	-	-	-	-	-	0	-	-	0.1%	0.2%	0.3%

Data gaps: Mauritania (electricity generated by renewable energy source).
Source: International Renewable Energy Agency IRENA (generation capacity); OECD/IEA (generated electricity). OECD/IEA data based on IEA data from World Energy Balances © and World Energy Statistics © OECD/IEA 2016, www.iea.org/statistics. Licence: www.iea.org/t&c; as modified by UN ESCWA; authors.

Figure 79. Installed electricity-generation capacity from renewable energy in the Arab region, excluding hydropower, 2014



Source: IRENA (2017).

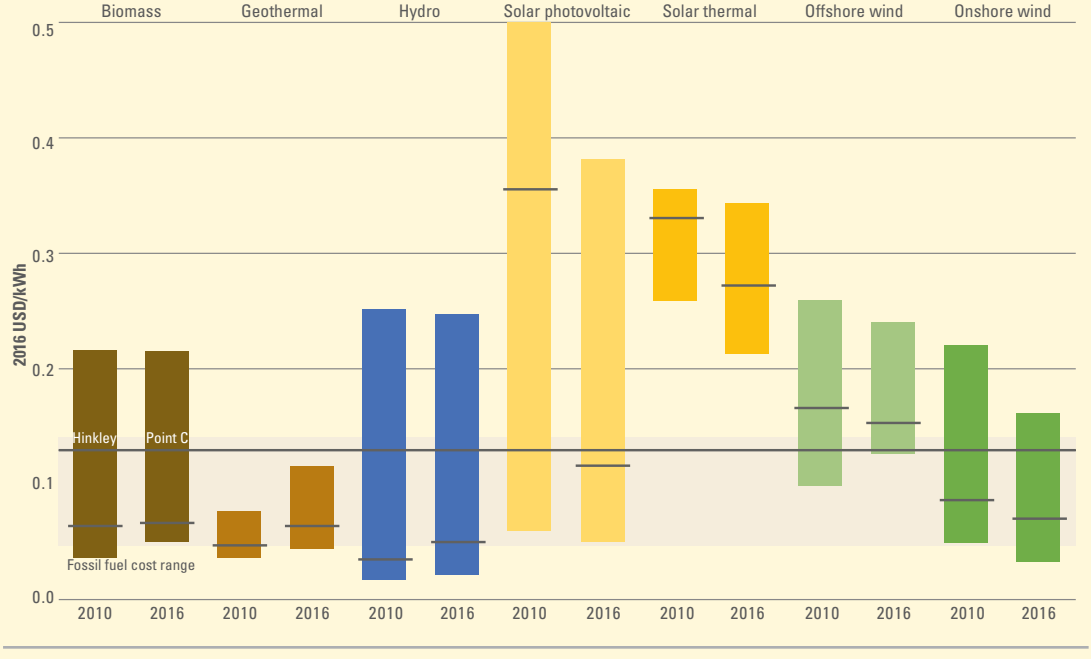
Box 8. Solar and wind power – cost is key to their regional deployment

Changes to the dynamics of cost factors play a key role in accounting for the rising potential of renewables in Arab energy markets. The considerably higher cost of modern renewable-energy technologies such as solar and wind power throughout the 1980s and 1990s vis-à-vis existing fossil-fuel technologies, relative to the cost ranges of today, made renewables in the past a commercially unattractive venture in Arab economies. Cost is key to the deployment of renewables in many Arab countries, because their history as net exporters of energy to international markets significantly reduced other incentives to adopt more expensive renewable-energy technologies, for instance for reasons of energy security. Fossil fuels have fulfilled this role in many Arab oil and gas producers for many decades, implying that cost developments for new energy technologies are critical to their success in the region.

Energy-pricing practices, including the widespread practice of energy subsidies to supply energy to domestic markets, has historically reduced the commercial playing field for renewables in the Arab region. With many Arab countries having priced fossil fuels for several decades at around the cost of domestic production – in Gulf countries, typically, a fraction of international market prices since the 1980s – incentives for fuel users such as utility companies and private households to switch to other energy technologies were virtually non-existent. Both in the case of final consumers and industrial users, including utilities, the perceived abundance of low-cost conventional oil and natural-gas technologies, has additionally weakened the business case for new energy technologies, as well as energy efficiency and conservation. As a result, deployment of renewables has become a task for the State rather than being market-driven as it would be in many cases were price signals accurate.

Incentives for States to increase their use of renewable energy, for instance through dedicated auctions, is growing continuously, however. A 2012 study by the Middle East Solar Industry Association (MESIA), for instance, points out that the commercial viability of solar power in the Middle East and North Africa power sector depends critically on the benchmark price for competing oil and gas technology. At an average price for solar PV in 2012 of US$ 2.5/W, solar power was found to be competitive with an open-cycle peaking unit at gas prices above US$ 5/million British thermal units (MMBtu), equivalent to oil at around US$ 30/bbl), but required US$ 17/MMBtu to be competitive with baseload combined-cycle power (CCP), around regional Liquified Natural Gas (LNG) prices at the time).[203] Since then, the region has seen a series of auction rounds with record-breaking low-price costs for solar PV of US$ 29.9/MWh for 800 MW in Dubai, and US$ 24.7/MWh for 1.17 GW in Abu Dhabi in 2016, with a more recent bid in October 2017 of US$ 17.5/MWh for 300 MW in Saudi Arabia.[204] These are currently the world's lowest costs for solar PV and make PV technology cost-competitive with virtually every other conventional source of energy. Perhaps of even greater consequence, CSP in 2017 was contracted by Dubai at another record low cost of 7.3 US cents per kWh, to provide night-time solar power for up to 15 hours – enabling the Gulf emirate to produce power from solar resources effectively 24 hours per day.

Figure 80. Global evolution of renewable energy technologies, 2010–2016



Notes: Weighted average cost of capital (WACC) of 7.5% for OECD and China and 10% for the rest of the world. All costs are in 2016 US$.
Source: IRENA (2017).

the six Arab countries with substantial non-hydro renewable energy (Figure 79). Wind power accounts for almost all of this capacity in Egypt, Morocco and Tunisia, with all three countries having further plans to significantly increase their wind-generation capacity in the period up to 2030 (Table 4). This is the result of the relatively high cost-attractiveness of modern renewable-energy technologies in these countries, owing to the relatively high cost of fossil-fuel imports, attractive local wind and solar resources and past access to development funding for such projects.

Both wind and solar power grew significantly over the tracking period 2012–2014. New regional wind-power-generation capacity increased by around 670 MW in 2013 and 2014, driven primarily by large-scale projects in Morocco (542 MW over a period of two years) and to a lesser extent Egypt (60 MW) and Tunisia (60 MW). Moreover, between 2012 and 2014, the Arab region combined added some 50 MW of solar PV and over 100 MW of CSP capacity, with significantly more capacity additions since 2015. The regional trend moves towards increasing project scale, as well as a more widespread adoption of new investment schemes, including private–public partnerships in promoting renewables-based projects in markets outside key driving countries such as Morocco and the UAE.[205]

Morocco has been one of the earliest investors in regional renewable-energy deployment as part of the country's policy of gradually reducing its dependence on energy imports. The most recent addition to Morocco's windparks during the tracking period was the 301 MW Tarfaya windfarm, which commenced commercial operations in December 2014. Situated on the Moroccan southern Atlantic coast, Tarfaya windfarm represents 15% of the 2,000 MW wind-energy

target set by the Moroccan Government and will contribute significantly to the country's objective of achieving 42% installed capacity from renewable energy by 2020. It is expected to help electrify some 1.5 million local households, and to offset some 900,000 tons of CO_2 emissions per year.[206]

Since 2014, Morocco has further stepped up its efforts to become one of the Arab region's fastest-growing markets for renewable energy. In February 2016, Morocco launched the first phase of its three-plant Noor-Ouarzazate CSP complex, which is expected to eventually become the world's largest CSP plant. When its 500 MW capacity is completed (planned for 2018), the plant is expected to supply power to 1.1 million people[207] – contributing to the country's target of some 2,000 MW installed solar-power capacity by 2020.[208] Noor-Ouarzazate is also expected to reduce carbon emissions by 760,000 tons per year, which could result in an estimated reduction of over 17.5 million tons of carbon emissions over 25 years.[209]

Morocco also demonstrates that renewable-energy projects can help achieve multiple development benefits at the same time. In securing significant financial assistance from international development banks, in addition to investments by the private sector, Morocco sees renewable-energy projects such as Noor-Quarzazate not only as an important source of energy supply to help reduce the country's long-term energy-import dependence, but also as an integrated project that delivers a combination of environmental benefits and new, local job opportunities, contributing to a high-performing sustainable-energy economic sector.[210] This has also been demonstrated by Morocco's tender for five new windfarms in March 2016. Totalling some 850 MW of new wind power to come online between 2017 and 2020, part of the agreement with the winning company consortium is the construction of a rotor-blade factory near Tangier to supply the windfarms with locally produced equipment.[211] Average bids as part of the tender were based on a price as low as US$ 25/MWh, amongst the lowest costs in the world.[212]

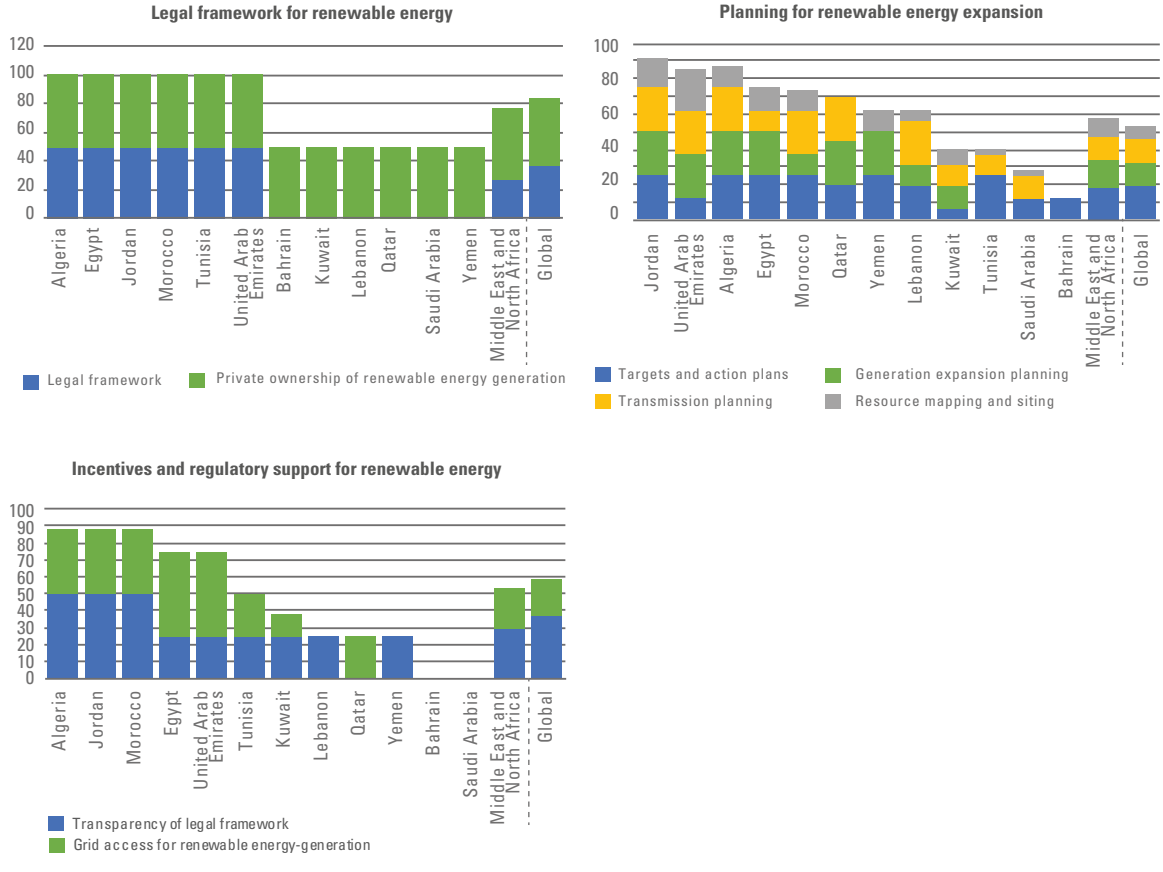
The single largest addition to regional solar-power generation over the tracking period was recorded in the UAE, which also moves the focus on renewables into the GCC. The country stepped up its renewable-energy capacity significantly over the tracking period, with the launch of the 100 MW Shams 1 CSP plant in Abu Dhabi, and another 13 MW coming online in the first phase of Dubai's Mohammed Bin Rashid Al Maktoum Solar Park in October 2013. At the end of 2014, Shams 1 made the UAE the world's fourth-largest generation capacity in CSP after Spain, the United States and India. By 2015, Morocco took its place, owing to the launch of the 160 MW Noor plant.[213] Dubai's Mohammed Bin Rashid Al Maktoum Solar Park has meanwhile been successful in attracting global record low prices for its future expansion plans – US cents 5.84/ kWh for Phase 2 and US cents 2.99/kWh for Phase 3, clearly demonstrating the commercial case for solar PV power in the GCC. The success of the project has led to plans to expand Dubai Solar Park to 5,000 MW capacity by 2030, with the ambition of making it the largest solar PV plant in the world.[214]

Other countries have been slower in harvesting the commercial potential of wind and solar power, but this may change in the near future. With its large market for energy and continuingly rising domestic consumption for energy, Saudi Arabia would, in principle, be a primary market for both technologies in view of its significant solar and wind resources – both onshore and offshore. Original plans aimed for 54 GW of renewable-energy capacity in the Kingdom by 2032, a target that was revised in 2014 and pushed back to 2040. The political succession in Saudi Arabia in January 2015 started a

series of far-reaching economic reform plans and changes to the country's institutional landscape, including in the area of energy. While much uncertainty remains over the emerging framework for the country's power sector over the coming years, new plans were launched in early 2017 for a 30% share of renewables – mainly solar and wind power – in the electricity mix by 2030, with specific plans for 10 GW of renewable-energy generation capacity by 2023.[215] The first tender announced targets 400 MW of wind and 300 MW of solar capacity overall, suggesting that Saudi Arabia might turn into a key market for investment in renewables over the coming decade.[216]

Other Arab countries have begun to seek out renewable-energy opportunities. In Jordan, cumulative solar PV capacity rose to almost 14 MW by 2014, with residential and commercial-scale projects being added under the country's net energy-metering scheme, which was introduced in 2012.[217] Several large-scale solar PV and wind projects secured financing in 2013 under Jordan's renewable policy framework, suggesting future supply additions.[218] New power purchase agreements (PPAs) were signed in 2014 for 200 MW of utility-scale solar PV projects and the 117 MW Talifa windfarm under reportedly attractive FITs (US$ 150–170/MWh for solar PV; US$ 120/MWh for wind).[219]

Figure 81. Comparison between Arab countries of selected RISE renewable energy indicators, 2015 (% RISE score)



Source: World Bank (2017d).

Table 5. Renewable energy targets in the Arab region, status 2016

	Renewable energy targets							
	Wind MW	PV MW	CSP MW	Biomass MW	Geothermal MW	Total MW	Total %	Target Date
Algeria	1,010	3,000	-	360	5	4,375	15% of electricity generation capacity	2020
	5,010	13,575	2,000	1,000	15	21,600	37% electricity generation capacity / 27% of electricity generation	2030
Bahrain	-	-	-	-	-	250	5% electricity generation capacity	2030
Egypt	7,200	2,300	-	-	-	9,500	20% of electricity generation	2022
Iraq	-	300	-	-	-	300	1% of electricity generation	2020
Jordan	800	800	100	50	-	1,750	10% of primary energy supply	2020
Kuwait	700	4,600	5,700	-	-	11,000	15% of electricity generation	2030
Lebanon	400	100-150				900-950 ***	12% of electricity generation	2020
Libya	600	344	125	-	-	1,069	7% of electricity generation	2020
	1,000	844	375	-	-	2,219	10% of electricity generation	2025
Mauritania	30	30	-	-	-	60	20% of electricity generation	2020
Morocco	2,000	2,000		-	-	6,000 *	42% electricity generation capacity	2020
	4,200	4,560		-	-	10,090	52% electricity generation capacity	2030
Palestine	44	45	20	21	-	130	10% of electricity generation	2020
Qatar	-	-	-	-	-	1,800	20% electricity generation capacity	2030
Saudi Arabia	9,000	16,000	25,000	3,000 ^	1,000	54,000	30% electricity generation capacity	2040
Sudan	680	667	50	68	54	1,582 **	11% electricity generation capacity	2020
	1,000	1,000	100	-	-	2,100	20% of electricity generation	2030
Syrian Arab Republic	1,000	2,000	1,300	250	-	4,550	30% of primary energy consumption	2030
Tunisia	1,755	1,510	460	-	-	3,725	30% electricity generation capacity	2030
UAE – Abu Dhabi	-	-	-	-	-	-	7% electricity generation capacity	2020
UAE – Dubai	-	5,000	-	-	-	5,000	25% of electricity generation	2030
Yemen	400	8.25	100	6	200	714	15% electricity generation capacity	2025

* Including 2,000 MW hydro; ** including 63 MW hydro; *** including 400 MW hydro; ^includes waste to energy.
Source: IRENA (2016c); authors.

Mauritania has described its use of renewable energy as a strategy to reduce its dependence on imported fossil fuels in the long term:

> "Mauritania's Government and national agencies are also very active in the promotion and implementation of renewable-energy applications. One of the reasons for this being the increasing price of fossil-fuel imports in the national balance of payments and variable commodity prices that affect the country's ability to develop. This has resulted in the inauguration of some of the first large-scale renewable-energy projects in the country (the 15 MW Nouakchott PV project inaugurated in 2014 and the 30 MW windfarm project in Nouakchott [….]. Several other projects are planned in the short and medium term, the most advanced being an additional 30 MW PV plant near/in Nouakchott."[220]

In Egypt, renewable energy capacity is expected to reach over 7 GW by 2020, on the back of FITs introduced over the tracking period, as well as a series of regulatory reforms in subsequent years aimed at increasing private investment in power generation.[221] In principle, both Egypt and Jordan have strong interests in diversifying their energy mix, owing to the burgeoning demand for energy coupled with high energy import prices and, in Egypt's case, significant foregone revenue from the diversion of its natural-gas production from international to domestic market for power generation. The World Bank's RISE survey captures the presence of policy factors conductive to renewable-energy deployment (see Figure 81).

The outlook for wind and solar power in the Arab region is basically positive, provided further policy reform continues to incentivize investment in new sources of energy. The IEA projects that renewable generation in the Middle East (including the Islamic Republic of Iran) is expected to double in size over 2013–2020, while it could also emerge as the world's largest deployment market for new solar thermal electricity (STE) capacity by 2020, provided conductive policies are in place, with most new developments occurring in Saudi Arabia.[222]

Renewable energy and future socioeconomic benefits in the Arab region

Renewable energy, in particular PVs and small-scale wind installations, have significant potential to play in the Arab LDCs rural electrification programmes. Nearly 60% of the world's additional electricity-generation capacity needed to achieve universal electricity access needs to come from off-grid solutions to remote, rural areas that cannot be effectively connected to their countries' main electricity grid. For the Arab LDCs, off-grid electricity access will play an increasingly important role in bringing "online" some 30 million people who continue to live without even basic access to electricity (see Chapter 2). Cost developments since the late 2000s have demonstrated the cost-effectiveness of renewable- energy technologies in the off-grid sector vis-à-vis non-renewable fuel alternatives, in particular when compared to diesel generation and kerosene-based lighting: the dominant sources of non-renewable sources of electricity in many non-electrified rural areas.[223]

Renewable energy has also formed part of initiatives designed to bring electricity access to remote rural areas. While Jordan, Morocco and Yemen have had positive experiences in the area of rural electrification with off-grid solutions based on solar PVs or hybrid systems,[224] such schemes have remained limited to specific projects and geographies. Solar and wind power hence account for only 4% of region-wide renewable energy consumption and less than 2% of final energy consumption. Additions over the tracking period reflect this pattern.

Arab LDCs have in the past acknowledged the potential for renewable energy to play a greater role in electrifying rural off-grid areas. In Mauritania, for instance, the scattered nature of many rural settlements far from existing infrastructure and transport systems makes grid expansion inherently difficult. Some 60% of the rural population live in villages of less than 1,500 inhabitants.[225] The country's Master Plan for the Production and Transport of Electricity considers connecting villages outside a radius of 120 km from the last grid-point to local off- and mini-grids powered by hybrid solar/diesel power.[226] Evidence from pilot projects in Sudan is presented in Box 9. In Sudan, a 2011 assessment of national GHG mitigation options by the Higher Council for Environment and Natural Resources specifically identified PV for rural electrification as one of six priority PV applications.[227]

Box 9. Solar PV systems for rural electrification: experiences from Sudan (Darfur) and Mauritania

The province of Darfur is one of the most impoverished parts of Sudan. The majority of the population has no access to electricity, CFTs, clean drinking water or other government services. Where access to electricity is available, it is usually interrupted, as lacking capacity and fuel make regular load-shedding inevitable. The maximum generating capacity is typically insufficient to exceed six hours per day in Darfur. The widespread use of diesel generators by those who can afford it are highly polluting, with severe consequences for human health and the environment.[228]

With about 6.1 kWh/m^2 annual average value for total daily global horizontal solar radiation, Sudan has significant solar resources with considerable potential to deliver local electricity access to rural settlements that are not sufficiently reached by modern national energy infrastructure.[229] The 2005 Comprehensive Renewable Energy Master Plan of the central Government already recognizes this potential, although limited progress has been made in its implementation. The Darfur Development Strategy, which forms part of the 2011 Doha Document for Peace in Darfur, signed between the Government of Sudan and Darfur Regional Authority, picks up on the use of renewable energy for rural electrification in Darfur.[230] The primary focus of the plan is to establish demonstration projects, particularly in the area of street lighting, hospitals, municipal offices, women's centres, community centres, police stations and schools to access affordable energy through PV lighting.

Past experience shows solar power can work in Darfur. In 2011, some 30 villages on the border between Sudan and Chad were electrified, using solar PV power.[231] A number of international initiatives by UNICEF, UNHABITAT, WHO and many NGOs such as the Norwegian Church Aid, among others, engaged in similar projects, with PV panels used for household-electricity production and solar pumps in villages.[232] Experience from such projects shows that solar-energy technologies improve the life of the rural communities in many ways. The problems for scaling up such demonstration projects remain valid both in Darfur and in other parts of Sudan: the lack of markets for solar equipment and servicing; weak local capacity for installation and maintenance; system safety, including against theft; and the difficulty of transport reaching remote areas in the first place.[233]

Mauritania faces parallel challenges. Only about 2%[234] of the country's rural population has access to electricity, the result of the scattered nature of rural settlements, difficult geography and very high levels of poverty. A joint GRET and APAUS project, PERUB, funded by the EU energy facility, installed 24 solar-based projects between 2008 and 2011; 24 other solar platforms were installed through a joint UNDP/USAID/APAUS project and six others by APAUS. Another EF project, ERUDI, installed 100 additional solar platforms between 2011 and 2015.[235] Two separate initiatives by the Abu Dhabi Fund for Development (ADFD) in collaboration with IRENA, based on hybrid technologies, aim to provide clean and affordable energy to 165 rural villages and four fishing communities along the coast.[236] Initial projects in Mauritania notably include solar, as well as wind projects.

In addition to providing off-grid electricity, renewable energy can also play a role in the provision of various other off-grid services, such as water-pumping for irrigation, local desalination, heating and wastewater treatment. Although renewable energy might not decrease the energy intensity of such operations, it can replace polluting and, in many cases, more expensive diesel-based systems and enhance the access of small, off-grid communities to water services, particularly in the Arab LDCs. Solar-based water-pumping systems already offer a cost-effective alternative to older grid-run or diesel-powered systems. The technology is mature and has already been deployed on a large scale, including in various developing countries and on islands.[237] Both Morocco and Tunisia have Government-backed plans to develop water-pumping stations in the agricultural sector until 2020.[238] While solar-based desalination is not yet economical at utility scale, it is particularly valuable in small-scale remote areas, where access to electricity or fuels is challenging.[239]

Many of the beneficiaries of renewables-based rural electrification programmes are women. Electricity access through PV units in rural health clinics is a critical pillar for providing better health services to women, including the availability of lighting and refrigerated medicines during childbirth. Because women continue to bear the majority of the work at home, spending more time inside cooking than men, they and their children are also the family members most exposed to indoor air pollution from poor-quality cooking stoves and kerosene lamps, making clean energy provision an important element in improving women's health in LDCs. Clean, rural electricity access through PVs and wind projects can also help empower women by reducing the time spent on fuel collection for use in other ways, for instance, education or productive work. Reducing the time spent by women collecting biomass for domestic energy use also improves their personal safety, as they spend less time far from the village and the risk of attack. Technology access further improves livelihoods for both men and women, including by providing homes with information about health, nutrition and personal safety. Introducing and supporting clean, renewable-energy deployment can also benefit women through new opportunities for training, employment and entrepreneurship.

The job-creation potential for renewable energy in the Arab region is considerable, particularly in the more labour-intensive market segment of manufacturing, with high relevance for North Africa and the Levant. A 2009 report of the Climate Investment Funds (CIF) estimates that the scaling-up of CSP technology alone could help create some 235,000 jobs in southern Mediterranean and European countries, including 80,000 in manufacturing (40,000 on site and 40,000 in Europe); 120,000 in construction and 35,280

in operations and maintenance (O&M).[240] Renewable energy also holds job-creation potential in other Arab economies, for instance in the GCC. IRENA estimates that achieving GCC 2016 renewable energy targets could create an average of 140,000 direct jobs every year. In 2030 alone, close to 210,000 people could be employed in renewables.[241]

Renewable energy for use in power generation and in industrial production could also translate into significant economic savings elsewhere. For example, where solar power replaces oil or natural gas in power generation at peak times at midday in the summer, its economic value can rise sharply, even for oil and gas producers. This is driven by a rapid rise in peak demand over the past decade, which can be difficult and expensive to serve. A further economic value of renewable energy within the Arab region is to help countries reduce water consumption in power generation. This is likely a quite valuable feature of renewable technologies such as wind and solar power in a region that is more water-stressed than any other part of the world.[242] IRENA calculated that renewable energy deployment along the GCC's targets could result in cumulative savings for the region of 2.5 billion barrels of oil equivalent (2015–2030). Overall savings of US$ 55 billion to US$ 87 billion, depending on oil and gas prices, were estimated. Similarly, a reduction in carbon emissions by around 1 gigaton (Gt) by 2030, equal to an approximately 8% reduction in the region's per capita carbon footprint, was also anticipated.[243]

In addition, some renewable-energy sources hold the potential to help countries save water. Wind and solar PV power are characterized by minimum life-cycle water usage that compare extremely favourably with conventional power technologies such as natural gas, coal and nuclear power. This contrasts with more water-intensive technologies, such as solar CSP and bioenergy, which, in turn, increase lifecycle water needs in the power sector.[244] This makes a careful choice of technology – suitable for each location – critical to maximizing the positive yields of renewable energy in the Arab region. Some new technology developments may help Arab countries expand the range of renewable-energy technologies that can be deployed without raising the sector's water consumption. Dry cooling, for instance, can reduce total water consumption by technologies such as CSP and is being increasingly deployed in Morocco and the UAE, which already have CSP capacity.[245] Charging industries market-based prices for water could greatly accelerate the maturation and deployment of this technology in the future. Where wind and solar PV replace oil-fired power-generation capacity, water savings can on the other hand be enormous. IRENA estimates that GCC 2016 renewable energy plans could by 2030 result in an overall reduction of 16% in water withdrawal in the power sector, equivalent to 11 trillion litres of water per year – primarily in Saudi Arabia and Kuwait – assuming renewable power generation capacity replaced old, oil-fired power generation capacity.[246]

Industries are increasingly adopting renewable energy technologies as well, including in LDCs. The period of late 2000 until mid-2014, when international oil prices were high, helped the gradual adoption of renewable energy beyond its primary markets under development policy toward a commercially rational choice. In Mauritania, several industry sectors have progressively adopted renewable-energy technologies. A good example is the country's telecommunication industry, which has embraced the use of PV modules to power cell-phone repeater towers. Wind solutions have been adopted by the country's extractive industries for their small off-grid needs: UNDP observes that success in this area and exposure to fossil-fuel price swings are also increasingly propelling the LDCs towards the hybridization of their off-grid power generation.[247]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5. Key Challenges for Progress in Sustainable Energy in the Arab Region

Overview

Efficient natural resource governance and policy play a pivotal role in driving the Arab region's energy transition. Existing market mechanisms provide insufficient incentives for a change in production and consumption patterns in the Arab region. The challenge is compounded by the absence of a culture of conserving natural resources, needed to promote necessary policy changes. On the positive side, however, sustainable energy and natural resource management are integrated within national development strategies.

This offers significant social and economic opportunities, including the creation of valuable jobs for the Arab region's young and educated youth. Over the longer term, this integration also offers a tangible improvement in the quality of life for some 343[248] million people in the Arab region. Future efficiency savings resulting from near-term policy changes can provide significant reductions in the rate of growth in energy demand and near-term financial savings as well. Over the longer term, such changes can provide significant savings to national economies and the reduction of deadweight loss to economies through resource waste.

This chapter explores key challenges in the Arab region in speeding up overdue progress in sustainable energy and natural-resource management that emerge from the analysis of the previous chapters. While national economic, social and political circumstances naturally differ across the region, we aim to focus on five key issues that apply broadly across the Arab region:

1. **Initiating proactive policymaking.** Proactive policy is a key enabling factor to the Arab region's transition towards a more sustainable use of its natural resources, including energy. Key action items for governments include: significantly strengthening the integration of energy, climate and environmental goals within the national socioeconomic development agenda; ensuring policy severity so that new policies, plans and targets are realistic and fit their purpose; and significantly improving government communication.
2. **Building institutional capacity, transparency and accountability.** Institution- and capacity-building within existing institutions is a critical component of sustainable-energy policy management, targeting long-term development in the Arab region. Key action items for governments include providing clear mandates to institutions tasked with sustainable-energy goals; building credible, professional institutions with the capacity to formulate, implement, monitor and enforce sensible policies that enable countries' sustainable growth; strengthening local governance; building on existing competence; and strengthening civil society.
3. **Restructuring domestic energy and water pricing.** Regulated energy markets are one of the most pervasive tools in policymaking: as such, they have a myriad of intended and unintended consequences of market signals, and production and consumption patterns

in the Arab region. Reductions in energy subsidies in several Arab countries in recent years demonstrate that reforming energy pricing is politically feasible and economically beneficial, helping send overdue messages to regional energy markets that energy and water consumption comes at a cost to the economy.

4. **Preparing financial markets.** Access to finance is a key factor in determining market uptake of more sustainable energy technologies, since many new technologies entail initial investments, even if net savings are made in the longer term. Preparing financial markets requires dedicated efforts by governments and the private sector to understand barriers to sustainable-energy access and to devise relevant policies and financial products suited to new technologies and overarching socioeconomic development goals.
5. **Strengthening information quality and awareness-creation.** Strengthening data and information collection and transparent dissemination is a critical enabling factor to progress not only in sustainable energy, but also across a range of sustainable-development indicators. The Arab region has a wide gap in reliable, accessible information and data, a paradox given the comparably high rates of education and access to modern mass media. Key action items for governments include the depoliticization of data, guaranteeing media and academic freedom, and strengthening civil society and consumer bodies.

Initiating proactive policymaking

Proactive policy is a key enabling factor in the Arab region's transition toward a more sustainable use of its natural resources, including energy. Energy markets present various market imperfections that reduce the ability of economies to change their way of producing and consuming energy in a sustainable way based on market signals. This includes lack of information available to both consumers and producers of energy, missing price signals, and the absence of competition. Every year, Arab economies spend tremendous amounts of financial resources to support and lose potentially vaster economic resources from entrenched, wasteful consumption and production patterns, including through untargeted consumer subsidies and missing price signals to the market, missing energy-efficiency regulation, and unresolved problems such as incomplete or unreliable access to electricity. Redirecting these resources to cleaner, more efficient and, in the long-term, more cost-effective technologies, holds potentially vast benefits for citizens, governments, and the wider economy.

Integrating energy, climate and environmental goals more closely into socioeconomic development targets

Historically, energy conservation and the protection of natural resources have not been high-priority items, neither at government level, nor in the public debate. Goals to increase the energy efficiency of national economies and therefore energy productivity, policy support for the introduction of renewable energy into new markets in the region, as well as wider issues such as the protection of water resources and air pollution, remain marginal topics that are, in many cases, regarded as being in conflict with, rather than forming part of, pressing social and economic development and industrial policies. Linking sustainable energy and environmental management to social and economic development goals much more closely than has been the case in the past is perhaps one of the most critical steps to driving change in the way governments and societies in the region think about natural resources in the Arab region.

The intrinsic link between virtually all socioeconomic development goals to the availability of modern, affordable and clean energy provides governments in principle with a powerful justification for policies aiming to reduce resource waste and improve the management of depletable natural resources. This includes a more rational use of the region's valuable fossil fuel resources, as well as the exploitation of the economic potential of energy alternatives, in particular renewable energy, and the reconsideration of legislative settings that incentivize or dis-incentivize, wasteful consumption and production patterns. The concept of energy productivity has been used to try and reframe energy efficiency as a pro-growth, industry-friendly concept.[249] Mainstreaming the notion that sustainable energy and natural resource use is in the interests of economic development also includes emphasis on long- and medium-term benefits for society, such as clean water and air, the protection of land, coastal waters and the natural biosphere and on the parallel creation of jobs and innovative industries that provide opportunities for alert citizens to contribute toward their country's future prosperity. Water in particular deserves much higher priority on public agendas; in a region as water-stressed as the Arabian Peninsula, the Mashreq and North Africa, subsidizing wasteful water use is simply not an option in the long term, a consideration which carefully directed public discourse should help to ingrain in populations as governments take meaningful policy action against waste.

Linking sustainable energy and natural resource use to wider development goals also holds much potential for closer regional cooperation and integration. Expanded energy access and the deployment of renewable energy has the potential to benefit more than one country at the same time. Using cross-regional development aid in the provision of sustainable infrastructure could, for instance, make a substantial, tangible contribution to the improvement of living standards in Arab LDCs. Large-scale renewable energy projects such as CSP in particular hold much potential to benefit from economies of scale, making cross-country investments a potential factor that could eventually lower costs for the same technology in other countries as well.[250] There is also significant potential for the creation of intraregional alliances of interest in the area of renewable energy; for instance, where investment from the capital-rich GCC economies helps create manufacturing jobs for renewable-energy technologies in Mashreq and North Africa.

Using innovative policy approaches

Where past policy frameworks have failed to attract investment into sunrise sectors such as renewable energy in the Arab region, innovative policy approaches can help governments overcome longstanding sectoral deadlock. The deployment of renewable energy in the Arab region in recent years illustrates this positive learning curve in Arab countries that have registered positive progress in the area of renewables deployment. Some countries have opened the utility sector to private co-investors for new power and desalination projects, against the background of the region's longstanding history of public utility provision at subsidized cost. Public–private partnerships are in this context becoming an increasingly attractive solution for Arab countries aiming to do both – attract private finance for sustainable-energy projects, while retaining a public hand in energy projects. What such policies do or not do is change the more structural organization of utility markets, in particular lack of opening up competitive elements of the sector to competition, and liberalizing utility tariffs in order to strengthen utility producers that invest in more efficient and cost-effective technology.

Dubai has been a primary example for the successful use of public auctions for private company consortia building and operating new utility projects in renewable energy – a form of bringing in an element of competition while retaining an upper hand for public management in the sector. Several consecutive bidding rounds for tenders to private companies have in recent years not only demonstrated the commercial viability of public auctions and public–private partnerships, but has over several rounds succeeded in reducing the costs for solar PV to global record lows.[251] The success of the

Box 10. Tackling the energy use of transport in the Arab region

One of the most important, yet perhaps most overlooked sector in the context of the future Arab energy transition is transportation. The transport sector accounts for nearly one-third of final energy consumption in the Arab region, a factor that falls frequently outside the classical focus of energy-efficiency policies. Population growth, urbanization, economic development and rising living standards will all drive up demand for personal mobility across the Arab region, implying the escalation of current energy demand by the sector over the coming decades. Additional concerns of the continuation of the business-as-usual scenario in the Arab region's transport sectors stem from the very high levels of air pollution, including fine-particle pollution, to which many Arab cities expose their population; and, from a climate perspective, the enormous impact transport will have on global emissions until 2050.

Little or no regulation of vehicle emissions, the ability of old and inefficient vehicles to continue operating in large numbers due to heavily subsidized transport fuels and the lack of available cleaner diesel fuels in some countries, have all contributed to this situation. In addition, owing to lack of public investment, limited public transport options result in very high rates of reliance on private modes of transport, a development applying equally across national income groups. National vehicle stocks, in turn, are heavily influenced by the nature of use of the majority of vehicles. In an economy with no reliable forms of public transport, a personal car is a necessity rather than a luxury, constraining a large share of private car owners in their choice of vehicle to focus on as cheap a vehicle as possible over and above considerations such as fuel efficiency and economy. In combination with low fuel prices, personal vehicle ownership rates have soared, while the quality of the vehicle stock declines.

Higher-income consumers, too, switch to larger, more luxurious and less fuel-efficient cars as a demonstration of wealth. In high-income countries, such as the GCC, vehicle purchases, including in the luxury segment, come without value-added tax and public roads, including high-speed ones, are free, with no other taxes or fees – unlike in many other countries, where motorway use, for instance, involves a toll and vehicle owners pay vehicle tax in addition to value-added tax. Only where public transport is systematically available, reliable, qualitative and promoted will it be taken up in favour of private transport, highlighting the need of many Arab economies to focus on the pivotal role public transport plays in the creation of a more energy-efficient transport sector.

A number of policies have been implemented in other regions in the past and their application is also beginning in the Arab region.[254] Further policy focus here could make a significant contribution to the energy and emissions profile of transport in the Arab region. The challenge at hand for Arab governments is the relatively long time horizon for results in the traffic sector, against the expectation of many of their constituencies of immediate results. Popularizing transport-related policies and

incentives such as greater emphasis on fuel-efficient vehicles and the switch to public transport, also entail an intrinsic need for behavioural changes, which direct legislation alone can often not evoke on its own. To make policies in transport successful, policymakers will need to link policies such as those listed below with credible messages of longer-term policy planning.

- **Improving public transport.** The availability, quality and reliability of public transport is a major factor determining consumer choices within the transport sector between private vehicle use and the use of public transport. Public transport in many Arab countries lags far behind needs, in quality as much as in quantity, reliability and security. This includes the comparably more affluent GCC economies, as much as the Mashreq countries and parts of North Africa. Taxis remain a major form of public transport in the absence of well-planned bus, train or tram connections within and between cities. Expanding public transport is a top priority in the sustainable management of emerging economies' energy consumption and a motor for sustained economic growth through mobility. Individual Arab cities have gained positive experience with expanding high-quality public transport, for instance Algiers and Dubai, through the integration of a metro and tram system; and new tram lines in the Moroccan cities Rabat and Casablanca.

- **Utilizing traffic management.** Traffic management is one of the most cost-effective policies to reduce traffic, emissions and the energy consumption of the transport sector as a whole. An essential element in traffic management is fuel-pricing: low fuel prices encourage private vehicle use. Increasing fuel prices to private vehicle users, while maintaining subsidies for public transport vehicles, can be one way of targeting government support and promoting the switch from private to public transport, where the latter is available; or, alternatively, the sale of smart cards for targeted categories of travellers. More advanced policies, some of which are increasingly popular in the Arab region, are restrictions of access to city centres of private or heavy traffic, including low-emission zones, which increase incentives for private and commercial users to gradually upgrade their vehicles to higher-quality stock; speed restrictions; and the reorganization of urban freight movements, including greater investment in infrastructure that allows road-rail integration; and better integration of stop lights. Proactive city planning plays a critical role in this context, as does the professionalization of the national workforce in urban planning and space management.

- **Implementing the use of cleaner vehicles.** Improving the efficiency and cleanliness of existing vehicles to help reduce fuel consumption and air pollution is necessary. Catalyst requirements, fuel economy and emissions standards for new cars and encouraging the use of natural gas-fuelled vehicles are key policies to increase fuel-consumption efficiency in the transport sector, with positive side effects on urban air-pollution rates and emissions. Incentives for consumers to switch vehicles to more efficient models could be an additional programme to introduce, in particular in Arab upper-middle and high-income countries. Agreeing on regionally unified fuel economy and emissions standards could further help drive down costs for car producers and consumers.

- **Land-use planning.** Particularly in countries with large rural areas, the systematic planning of land use in newly urbanizing areas can offer considerable benefits in terms of the efficiency and shorter ways for integrated, well-functioning communities. Environmentally sound and sustainable transport adds to fuel savings in the long term, as does public transport inside and between remote areas and towns and locating new settlements and developments close to agricultural or manufacturing centres.

auction has been linked to a combination of highly conductive policies, including long-term certainty provided by the PPA and price competition from the auction; attractive debt-financing terms; a sizeable equity stake by the Dubai Electricity and Water Authority, the State utility that is also the creditworthy offtaker; and free land.[252] The IEA projects that the majority of renewable capacity growth in the Middle East will be based on government auctions, especially for solar PV and onshore wind. A prerequisite to auction success is for regulatory barriers and grid-infrastructure shortages to be remedied by national governments.[253]

Egypt has in the past introduced a number of policies aiming to increase the efficiency of energy in its transport sector. Particular pressure on public infrastructure comes from Egypt's crowded cities, with significant problems in the areas of public transport access, congestion and resulting waste of fuel and inner-city air pollution. Egypt has recently introduced a vehicle-emissions testing and engine-tuning programme that combines vehicle testing in the Greater Cairo Region (GCR), together with a public awareness campaign about periodic vehicle inspections. The programme also aims for improved traffic management and restrictions to personal vehicle use and ownership in the GCR and Alexandria. Egypt has been shown to have significant potential for a reduction in fuel consumption and waste in its transport sector, including through the gradual overhaul of its very old and highly inefficient vehicle stock, the expansion of public transport infrastructure such as buses, trams and the Cairo metro, and the greater use of Compressed Natural Gas (CNG) as a vehicle fuel, including in public transport.[255]

Energy-efficiency regulation in Kuwait illustrates the recurring difficulties, but also the opportunities, of such policy. Kuwait, which has had minimum requirements for efficient-energy use in buildings since 1983, developed a revised version of the energy conservation code of practice in 2010, with more stringent requirements for energy efficiency for both new and retrofitted buildings. Particular areas of improvement in the 2010 energy-conservation code of practice included new requirements for the use of: thermal breaks for windowframes; programmable thermostats; more efficient air-conditioning systems; and proven technologies such as variable speed drives, cool recovery units, and cool storage systems. Both codes are applicable to new residential and commercial buildings.[256] A key remaining problem in promoting further upgrading of building quality and more efficient use of energy in Kuwait's building sector are the country's extremely low electricity tariffs; at 2fils/kWh (US 0.6 cents/kWh), Kuwait's electricity tariffs have remained unchanged between the 1970s and 2017, a decrease in real terms over the decades, meaning its citizens pay close to nothing for the use of electricity, as well as water. Future reform will be key to making other policy incentives for investments in greater energy efficiency, as well as renewable-energy options such as roof-top solar panels, viable as the country now has one of the highest per capita rates of electricity consumption in the world.[257]

Industries present special challenges to policymakers when regulating energy efficiency because of the effect of new regulations on industrial production costs and potentially cost-competitive advantages and hence national employment. In the Arab oil- and gas- producing countries, particularly in the GCC and parts of North Africa, energy-intensive industries have been part of their historical industrialization strategies, making a large share of their industries critical generators of export revenue and foreign currency. Fuel and feedstock for these industries are supplied at their marginal cost of production,

rather than their international export market shadow price, a key factor in these industries' international competitiveness. Raised efficiency requirements and input fuel and feedstock cost change the cost structure of these industries – a consideration that has been rallying considerable industry opposition to changes to pricing and the regulatory environment for these industries, not only in the Arab region. Arab Gulf economies rely to a large extent on intermediate industries such as petrochemicals, steel and aluminium for export revenues beyond crude oil and natural gas, which has left new industry regulation around energy-efficiency requirements and fuel prices in many countries untouched not only for years but decades. At the same time, industry consumes around 60% of primary energy in the Arab region,[258] indicating the vast potential for energy-efficiency savings in this market segment.

Evidence from the use of water in industries in Saudi Arabia nevertheless highlights the potential for significant water and economic savings in the sector. A 2011 case study of the use of water in different industry segments by Saudi Aramco indicated that conservation, re-use and recovery mechanisms for water could reduce the annual water consumption of an existing natural gas plant by almost 45%, a result that, if applied throughout the natural gas sector, could result in the conservation of over 23 million m^3 of water while also saving up to 1.6 x 10^6 kWh of energy and avoiding 1.5 x 10^6 of CO_2. Similar initiatives at Saudi Aramco's Riyadh oil refinery could reduce daily water consumption by 8,400 m^3, and net reductions at oil refineries across the sector could save up to 199 million m^3 of water annually. The case study also demonstrated that these savings would be economic; assuming various input factors such as the use of seawater reverse osmosis, the study found that water savings of up to 544 x 103 m^3/day could result in cost savings of over US$ 91 million annually, as well as reducing energy consumption and GHG emissions by up to 1.79 billion kWh and 1.72 billion kg CO_2 respectively.[259] Financial support from the Saudi Government, through loans, loan guarantees and tax credits means industry-wide policies could help save water and electricity and reduce the GHG footprint of various industry segments across the industry value chain. Alternatively, charging industries realistic water tariffs that reflect the full range of costs, including environmental costs, could incentivize a more responsible use of water without the need for active government intervention to start with.

Ensuring policy severity

Implementing effective policies also involves ensuring new policies, plans and targets are stringent and, where voluntary compliance is concerned, mandatory. This is of particular importance in contexts where various economic interests are involved, such as in regulatory efforts to improve energy efficiency. Inherent difficulties in formulating regulatory requirements involve considerations including the availability of components such as technology, applications and a market for building materials, national know-how, the availability of financial products to fund extra costs to individuals, businesses and industries, and the overall economic feasibility of certain measures. The downside of this complex array of different factors to consider can be policies whose rigidity lags behind its own objectives, for instance all voluntary efficiency codes. The case of Estidama's Pearl Rating System in Abu Dhabi illustrates this dilemma (Box 11). Excessive use of exceptions to regulations can furthermore erode regulatory frameworks over time, particularly in large-scale sectors such as building and transport.

Box 11. Abu Dhabi's Green Building Scheme: Estidama's Pearl Rating System

Building efficiency measures such as Estidama in the UAE illustrate the difficulty of implementing an effective mechanism to raise the energy performance of building stock. The UAE was the first Arab country to move beyond voluntary commitments to a more formal regulatory framework for building-sector efficiency. The emirate of Abu Dhabi introduced Estidama in 2010. It is an emirate-wide sustainable building initiative aimed at improving the sustainability and environmental impacts of its infrastructure, including the energy- and water- consumption performance of new building stock.[260]

The initiative introduced a system similar to Leadership in Energy and Environmental Design (LEED) – the Pearl Rating System – which provides various levels of certification for new buildings. There are differentiated requirements for various building structures, such as villas, large-scale housing and buildings for use by businesses. While the initiative deserves plenty of credit for being the first of its kind, its scope and impact on the quality of new buildings remain limited. For example, the mandatory minimum requirement for new private buildings such as villas is only one pearl, attainable using a relatively basic set of provisions. These include minimum interior water-use reduction, water monitoring (such as the installation of a water meter), and minimum energy performance. Two pearls are required for mosques, hotels and other projects, where a number of exceptions apply.[261] Ratings range from one to five pearls, where one pearl is the minimum requirement for any new building since the law became effective in November 2010.

A large new urban development in Abu Dhabi, Shams Marina, including two blocks of branded residences and two blocks of hotel apartments, with beachside retail, food and beverage amenities and a beach club, was signed off in late 2016. The Urban Planning Council awarded the development an Estidama a one-pearl rating – the lowest of its five levels measuring energy efficiency.[262] This rating is seemingly irrespective also of the presence of hotel space and "other" building structures such as retail units. The project forms part of a larger range of developments on Abu Dhabi's Reem Island, with homes for up to 210,000 residents, 10,000 hotel rooms, 1.4 million m^2 of office space and 850,000 m^2 of retail.[263]

While initiatives such as Estidama are in principle highly valuable contributions toward the creation of more sustainable building stock, they also illustrate a key problem in policymaking that is created by the introduction of built-in "loopholes" – often the result of the introduction of obligatory minimum performance requirements that are not adequately "sized" or targeting the relevant operators. New building-efficiency codes are unpopular among local residents building their own homes, private businesses that often already face a catalogue of regulatory requirements that add costs and large-scale private property developers, who hold considerable leverage on policymakers by threatening not to develop at all if building codes become a significant cost factor. This becomes more problematic in the construction of large units of new building stock which, once built, are meant to be a permanent part of the city's urban landscape, and retrofitting is more complicated and expensive than the application of minimum efficiency measures at the time of the initial construction.

In the future, developers could benefit from the ability to charge higher rents for more efficient buildings, given that operating costs for residents are lower. This, of course, raises the need for further work on establishing a real-estate market that can channel such options to tenants with internationally working schemes such as the US-developed LEED certification scheme. It also relies critically on cost-reflective tariffs, which make rents higher for tenants – and hence upfront investment in more efficient buildings – economically worthwhile.

Improving government communication

Many policies aimed at increasing the efficiency of energy use and helping promote the entry of new energy technologies in existing markets entail upfront costs to a variety of market segments, including industries, businesses and final consumers. Some of the reasons behind long-term policy deadlock over critical aspects of energy-sector management, such as increasing incentives to reduce resource waste, are adverse reactions by key constituencies, industrial lobbies or the wider populace to any rise in costs, even in the short term. Promoting a more efficient use of energy resources and increasing the use of alternative energy often involves complex changes to decades-old market structures and regulations. This includes the role of private-sector players in utility provision and the elimination of age-old energy subsidies that are taken for granted by many parts of the population (see Box 12 and Box 13). Overcoming this inherent dilemma requires skilled governance, credible institutions, and clear, transparent government communication to all those affected by changes in policy, actual costs of the current status quo, who pays for them and who benefits from changes.

Effective government communication and strategy-making include intragovernmental communication and coordination from the early stage of designing new policies. Ultimately, the most effective way of promoting a positive energy transition is the creation of complementary policies between different government bodies that integrate individual policy changes such as in areas of regulation with a wider policy strategy that targets the most efficient use and management of natural resources such as energy, water and food. A national strategic plan for economic growth and development, in which the use of energy and other natural resources and the environment play a major role, can help contextualize and popularize individual policies that, individually, might generate discontent in some parties. This includes policies to promote energy efficiency and renewable energy as policies in the national interest, drawing in new legislation and regulation from different ministries in coordination with each other.

Consulting rather than just informing. Government consultations with relevant stakeholders in key sectors such as energy, industry, building and economic development are important steps for the government to assess what the needs are and how government objectives can be met within a sector, bearing in mind both costs and opportunities for the sector to evolve. This includes private companies, utilities, environmental agencies, etc. Consultation can be assisted through the establishment of regular channels of communication, which can help guide government policy on an ongoing basis through internal working groups, and more systematic engagement to coordinate different stakeholders' views on wider sectoral reform, for example the question of how efficiency savings can be realized in different parts of the economy, without harming business competitiveness. Consultations are also an integral part of a government's ability to demonstrate credibility in its policy decisions, driven by timely preparation and the ability to fully assess whether particular policies are in the interest of society and the economy as a whole; and that government goals such as new renewable energy targets are realistic and can actually be met.

There are limits to consultative approaches, however. These are reached when consultation processes are used to delay policy action indefinitely and where industries and businesses will lose from planned policy changes. These more structural effects of redistributing business must be taken into account by governments when engaging in consultative approaches. This means credible

and skilful policymaking, which must weigh up the costs and benefits of policy in a context where not all interests will be satisfied at the same time.

Identifying the full cost of business-as-usual. Changing consumption behaviour and making policy initiatives successful involves, in particular in multifaceted areas such as energy efficiency, a thorough re-thinking of consumer behaviour and preferences. This includes the way policymakers address known issues such as inefficient energy consumption and production; gaps and shortcomings in existing energy infrastructure development and service quality due to existing market mechanisms (or the lack thereof); the role played by a more diversified energy mix, including renewable energy in addition to fossil fuels; and public discourse about environmental issues and climate change. A number of studies, including in the Arab region, have shown that policy reform becomes more likely when governments engage substantially with citizens on reform priorities.[264]

Box 12. Communicating energy-pricing reform in Jordan

Experience in the reform of energy subsidies in Jordan provides insights into how important the role of effective government communication is – both in reforming existing laws and regulations, and introducing new ones. In preparing Jordan's energy price-reform series starting in 2012, the Jordanian Government conducted a survey to help it better understand the population's aversion to reform, which had previously triggered mass protests. The survey found that a large proportion of Jordanians were not actually aware of the extent of fuel and electricity subsidies in their country – which had reached around JOD 740 million (around US$1 billion) by 2012, more than 10% of the Government's total expenditure for the fiscal year.[265] Jordan's subsequent series of fuel and electricity price revisions were accompanied by a comprehensive communication effort by central Government, as Inchauste et al. (2017) explore:

"The government undertook a series of efforts to ensure the political viability of the reform efforts. This included a communication strategy that centred on the fiscal costs of these subsidies and the fact that they were not reaching the poorest. The existing analytical work helped Prime Minister Ensour to counter criticism and inform the policy debate with evidence based on both the cost of subsidy policy and who was benefiting. These communications were coupled with a concerted effort to consult and dialogue with stakeholders. Before and after the November 2012 increase in energy prices, as noted earlier, [Jordanian] Prime Minister Ensour met with various stakeholders at all levels, including parliament, local non-governmental organizations, the business community, and labour representatives.[266]

(…) In addition to the importance of packaging the reforms – that is, coupling the new price rises with a new scheme to compensate many Jordanians—the communication of this package to the public played a vital role. Prime Minister Abdullah Ensour communicated eloquently, reaching out to the media, civil society, universities, industrial groups and local community leaders to ensure that the reforms were well understood. He met with every governorate and with stakeholders of every kind. In all of these meetings he was unequivocal about the risks to the economy should these subsidies continue, explaining that the main beneficiaries of subsidies are not necessarily the poorest members of society, and presenting the cash transfer mechanism as a mitigation measure to protect the most vulnerable."[267]

Key messages for governments to consider include the long-term cost of resource waste and deadweight losses to society from needless overconsumption of water, energy and other environmental resources; the detrimental effects of air pollution on people's health, in particular in urban areas; the disastrous effects of global climate change on local agricultural production and food security; and the highly inequitable benefits of current policy measures such as energy subsidies that additionally distort pricing signals in domestic energy markets (see Box 12). It should be noted that many other programmes, such as tighter energy-efficiency regulations or the opening of utility sectors to private finance for renewable-energy investments are actually much less problematic than the reform of energy subsidies, meaning public communication can in many cases focus on chances and opportunities, rather than damage-control.

Using quantifiable goals and targets that help the public understand progress. Communicating abstract and, in many cases dry, development objectives that form part of a more sustainable management of natural resources can be difficult in any social context. Demonstrating the link between a particular policy – for instance, the introduction of higher fuel economy standards in transport – with the greater public good can be equally challenging. Ensuring broad-based policy support for developmental objectives are followed up with practical policies and regulatory frameworks can hence play an important role in ensuring that their materialization is part and parcel of ensuring developmental objectives at government level are credible and realistic. One initial step is the progressive move of government rhetoric and planning from general statements of objectives to ensure a more sustainable-energy future, towards tangible goals and objectives under the establishment of clear agency mandates for their fulfilment and progress which can be tracked.

Building institutional capacity, transparency and accountability

Institution-and capacity-building within existing institutions is a critical component of sustainable-energy policy management targeting long-term development. Where institutional capacity is weak, policymaking is obstructed by the conflicting interests of different interest groups, unclear mandates and the lack of implementation capacity, even where ostentatious government plans and programmes are already being announced. The highly centralized nature of policymaking and implementation in many parts of the Arab region further distracts attention from the need for institutions to implement policy plans that the public expects will provide them with tangible benefits here and now. This is in a context where many market functions are taken over by government policy to start with, politicizing decision-making where markets are unable to function as a sensible source of allocating resources – for instance through effective price signals – to final consumers. While market mechanisms and incentives are hence disabled, institutions in many cases are poorly suited to guide markets in other ways. A recent report focusing on the region notes that:

> "At the broadest level, most [Middle East and North African] countries already have in place national targets and/or plans for [energy efficiency], and most also have specialized agencies authorized to carry them out… These are fundamental 'infrastructure', but are by no means sufficient for carrying forward successful [energy efficiency] initiatives."[268]

Institutional weakness, through lack of competence, mandate and financial and human resources, presents a major challenge to effective socioeconomic development across the Arab region. The complexity of energy-related policies and regulations

targeting energy efficiency throughout different sectors without undermining growth, of changing market dynamics and implementing policies that require large changes to existing market structures, such as increased private sector access and the reform of energy pricing, require effective institutions with sufficient access to information and data, skilled human resources with knowledge of their own area of work and the political mandate to design, implement and monitor policies. A recent study about international experience in energy-subsidy reform summarizes the inherent problems which characterize political indecision:

> "When government is not confident of its power, there are strong disincentives to adopt policies that could embolden opponents and be seen as evidence of political failure. Leaders who are politically weak or governments that are poorly administered or ineffective in delivering services have few resources to credibly offer (nor penalties to credibly threaten) to special interest groups that might block reforms."[269]

Strong institutions that are able to successfully implement government programmes are often found to share the following common characteristics:

Clear mandates

Clear policy-mandating is critical to ensuring institutions can actually do their work, including evaluating current policy, providing policy recommendations, implementing and monitoring policies and, where necessary, sanctioning non-compliance. Many existing policies and regulations in Arab countries, in areas such as rural development, and building and appliance regulations for minimum efficiency standards, suffer from lacking implementation and compliance. Missing communication between public institutions, such as ministries of energy, electricity, environment, electricity companies and regulatory agencies imply the scope for non-compliance with existing legislation can in some cases be large, while lack of clarity between institutions over mandates can add to confusion and deadlock in precisely those institutions that should be guiding production and consumption patterns in the energy sector. In practice, this implies a need for more streamlining, institutional restructuring, clear messaging and communication within government and between government bodies, as well as clear measures against personalizing ministries and public bodies, and the creation of parallel "fiefdoms".

Credible institutions

The success of policies depends closely on the credibility of the institutions that implement them. Sustainable-energy development policies rest on the availability of credible institutions more than many others, due to the inherent lag between initial costs to individuals and businesses and the eventual accrual of benefits to society and the economy in the long term. Institutions that lack capacity, credibility and competence are a liability to governments, where a record of poor policy implementation can actually make matters worse and erode public trust in government policy altogether. Susceptibility to corruption, lack of professionalism and accountability is a closely related, severe problem that appears differently across the region.[270] Popular perceptions that government institutions are corrupt and do not serve the interests of their people are a major political hurdle to implementing reforms, as is corruption, which effectively hinders the implementation of any policy, no matter whether it can work in another country's context.

Experience in the area of energy-subsidy reform has revealed the central role played by credible institutions in determining the success or otherwise of relevant government reform across the Arab region.[271] In Jordan,

for instance, the success of politically unpopular but economically necessary energy prices since 2012 has rested on credible administrative competence in identifying underlying problems with the status quo – that untargeted, generalized subsidies were disproportionately benefiting the more affluent households – and of subsequently identifying poor households that were in need of compensatory payments by the government following the reform of energy prices.[272] This highlights the need for governments not to look at sustainable energy policy as a solitary task, but as one that needs to be integrated within wider political work at the level of the public institutions themselves.

Professionalization of the public sector

Key assets to building credible institutions are human resources, particularly trained and skilled staff who are recruited on the basis of merit. This is a largely underappreciated subject in the Arab region, alongside human-resource management in the public and private sectors. Many Arab labour markets and education systems still struggle with the effective management of human skills and resources as an asset, including job-specific training and human-resource management inside jobs. UN ESCWA, for instance, observes in the context of Arab economies:

> "When recruitment is based on kinship or loyalty, civil service examinations are not necessarily used. The staffing of administrative institutions is instead viewed merely as a vehicle for governments to distribute benefits."[273]

The past practice of politicizing public-sector work opportunities and of using public-sector institutions as a mean of mass employment generation for citizens must, in this context, be seen as counterproductive to the necessary and overdue professionalization of the Arab region's public-sector workforce. This is especially so in the context of complex policy reform in areas such as energy and natural resource use, where the risk of politicization is high and the level of professionalization needs to meet conflicting needs and priorities of different stakeholders and end users within the sector. Professionalizing public-sector institutions is also critical to ensuring effective monitoring and implementation – a key factor in ensuring policies actually yield results. Advancing sustainable development in areas such as energy, water and the environment will hence require much more dedicated effort in education, training and the creation of skilled bureaucracies that are able to advise policymaking, and implement policies successfully.

Strengthening local governance and the role of cities

Policy-planning remains highly centralized around national government cores in many parts of the Arab region. Many resulting policy decisions are imposed top-down on public institutions, which are tasked to implement policy decisions from central government – sometimes with limited prior consultation and tools to implement such policies. This form of policymaking can have many advantages, for instance in setting clear messages and government targets, and creating planning security for business. It is also essential in country contexts where the local level may not have the capacity or resources to implement initiatives. On the other hand, centralized planning can also imply potential deadlock where, for instance, policy impulses are simply not forthcoming from a national government. UN Habitat identified this problem for the implementation of energy-efficiency measures, for instance in the case of transport sector policies in cities, concluding that:

> "The highly centralized governance structure in this region undermines the efficiency of municipal authorities, obstructs political participation and erodes the relationships between the citizenry and public authorities."[274]

A number of sustainable-energy initiatives are suitable for development at local level, in particular those aiming at managing urban spaces, and decentralized solutions in lower-income countries, such as in the off-grid sector. Rooftop solar-panel programmes, Feed-in Tariffs (FITs), urban and rural public transport, infrastructure development and building standards are all areas where local governments could, and often do, build capacity and implement policies.[275] A key component for leveraging local capacity to implement sustainable-energy initiatives and policy is the professionalization and clear mandating of regional and local governing institutions, such as city councils, municipalities, and district governments vis-à-vis the national government. Central governments can encourage this development by providing financial incentives for champion cities, and by strengthening local decision-making in areas that fall naturally within the responsibility of local governance, in particular in the areas of urban transport and building stocks.

Using existing competence

Sometimes governments struggle to collect data and information, even though this information is already available. Institutions such as utilities, industries and the business sector are often suited to collecting and interpreting in-depth data on demand-supply patterns in their industries and consumer behaviour. Building capacity inside government institutions to use such already existing capacities within the economy could strengthen informed policymaking and help remedy information problems that lead to a lack of process in decision-making and implementation. Key to making greater use of existing competency is the strengthening of communication channels between government institutions and public and private companies. Involving the private sector in order to work towards energy-related development goals can critically help this process and reduce the burden of top-down decision-making in favour of market places that adopt cleaner, more modern and more efficient energy technologies out of market-own incentives.

Strengthening civil society institutions

Civil society can play an important catalyst role for changing government regulations aimed at improving environmental sustainability and consumer welfare significantly. Largely non-existent in the Arab region, due to a combination of prohibitive legislation and lack of favourable political culture, civil society institutions such as consumer interest groups and environmental societies could form part of those driving the agenda behind gradual policy and regulatory change. This includes a mandate for consumer groups and the media to flag up issues of concern in the areas of transport, energy efficiency and the greater use of renewable energy, in addition to protection of the environment and a reduction in waste of water and general resources in the economy.

The lack of civil society institutions and media freedom in the Arab region make the enforcement of new and existing legislation more difficult, because those directly affected do not have their own legitimate channel for expressing concerns and discontent. While many legislative decisions, such as changes to energy prices, are seemingly unpopular; upgraded efficiency legislation would likely find valuable supporters in civil society institutions that are able to communicate costs and benefits of the business-as-usual case to their constituencies far more credibly than government institutions. Using these channels more effectively requires considerable change in the way governments in the Arab region engage with their citizens, including personal freedom of speech and of the press and the depoliticization of criticism of existing policy practice, in particular in the areas of energy, the environment and natural resource use.

Box 13. Barriers to improving the energy efficiency of air conditioning in the Maghreb countries

A recent ESMAP study examined case evidence from the Maghreb countries – Algeria, Libya, Morocco Tunisia – to provide an outlook for air-conditioning demand over the coming decade and to identify barriers to, and policy recommendations for, the improved efficiency of air-conditioning units in the region. The study pointed out the following five main obstacles to increasing energy efficiency in the air-conditioning sector.

1. Inadequacy of tariffs as an instrument to incentivize the use of more energy-efficient appliances. In the four countries, electricity prices are subsidized and do not reflect the real prices that national power companies should charge their customers, subject to variation in each country. Nor do tariffs typically reflect the time of use, providing no incentives to consumers to adjust consumption during peak times. Algeria and Libya are particularly heavily subsidized, especially in the residential sector.
2. In addition to electricity tariffs, the initial purchasing cost of the air-conditioning unit itself is an important contributing factor. Since most households in North Africa use air-conditioning units infrequently (approximately 360 hours per year, which differentiates them from near-constant air-conditioning use such as in parts of the GCC), the impact of higher power tariffs on households using air conditioning may be only slight, and not enough to change consumer behaviour altogether.
3. Cheap electricity, combined with cheaply available air-conditioner units, makes the purchase of energy-efficient air-conditioning units not particularly profitable for consumers. Governments, in turn, have a lot to gain from more efficient air-conditioning units, in terms of avoided investment costs in peak-load electricity generation. This indicates that, in North Africa's case, financial incentives may need to be topped up with substantially stricter regulatory steps that keep inefficient air-conditioning units off the market in the first place.
4. Lack of a harmonized regulatory framework in North Africa is identified as the most important challenge to improving energy efficiency of air conditioners. Missing harmonization of standards includes reference standards, testing procedures or scope of application. The authors of the study also point out that existing regulations are "either of recent vintage or are not enforced, and that the authorities have neither adopted the necessary implementing measures nor the corresponding enforcement rules".[276]
5. Disparities in the various taxes and other charges on air conditioners have furthermore created significant price differentials between neighbouring countries. With virtually unrestricted movement of goods (a problem experienced particularly by Tunisia), an informal market is flourishing to an alarming degree. This development is to the detriment of certified, high-quality goods.
6. The informal market for air-conditioning units remains active in North Africa, to the detriment of quality. According to the study: "Many traders, particularly informal importers, are active on the air-conditioning market to the detriment of quality. These informal importers are encouraged by the inadequate controls on quality and quantity at the borders. Once on the market, there are few checks at points of sale to verify either performance or consumer guarantees." The study further argues:

   > "Moreover, the main actors in the sector are often too poorly organized to be able to structure the market and raise overall standards. In many countries and regions, groups consisting of professional organizations, importers, and even power companies are set up to protect the market and to confer on key aspects of the sector (computation codes, specifications, certification of installers, tax adjustments, etc.). Such groups play a vital role in advising, training, and supporting authorities when the latter are called upon to take decisions on regulatory measures and incentive mechanisms."[277]

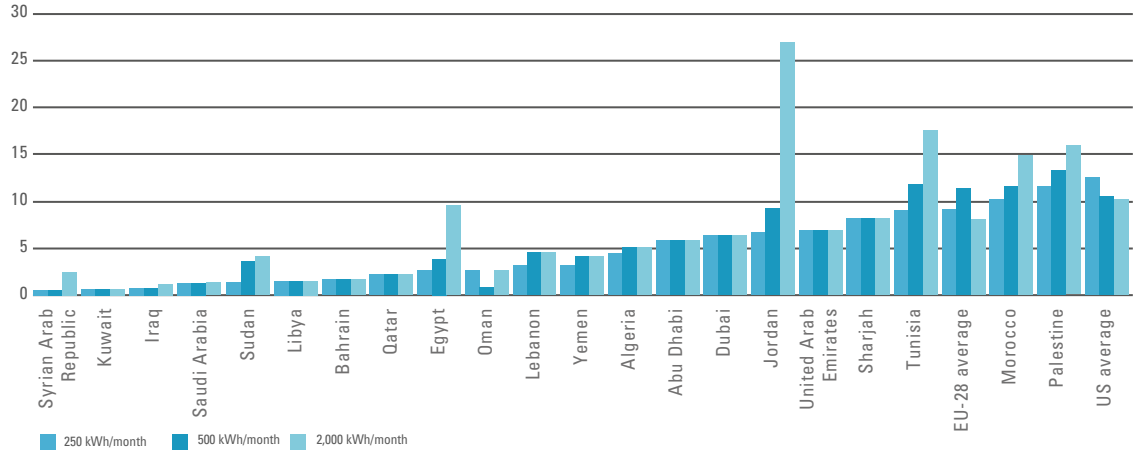
7. Training and capacity-building are necessary for all levels of the air-conditioning sector in North Africa, including customs authorities, importers and manufacturers, technical and administrative departments responsible for oversight, monitoring and management of programmes, and installers and technicians. Parallel training and education are required for users to understand technology advances and to comply with regulatory provisions.
8. Consumer choice and advice from retailers are critical determining factors of air-conditioning use: "A lack of information and awareness on the part of both sector actors and users results in inefficient decisions. The consequences (oversized units, poor energy performance, etc.) are further aggravated by the lack of actual product warrantees and by poor after-sales service (where it exists at all)."[278]

This suggests a much more proactive role is needed by governments, regulators and various stakeholders within the air-conditioning value chain – with likely similar areas of need in other technical appliance sectors.

Restructuring domestic energy and water pricing

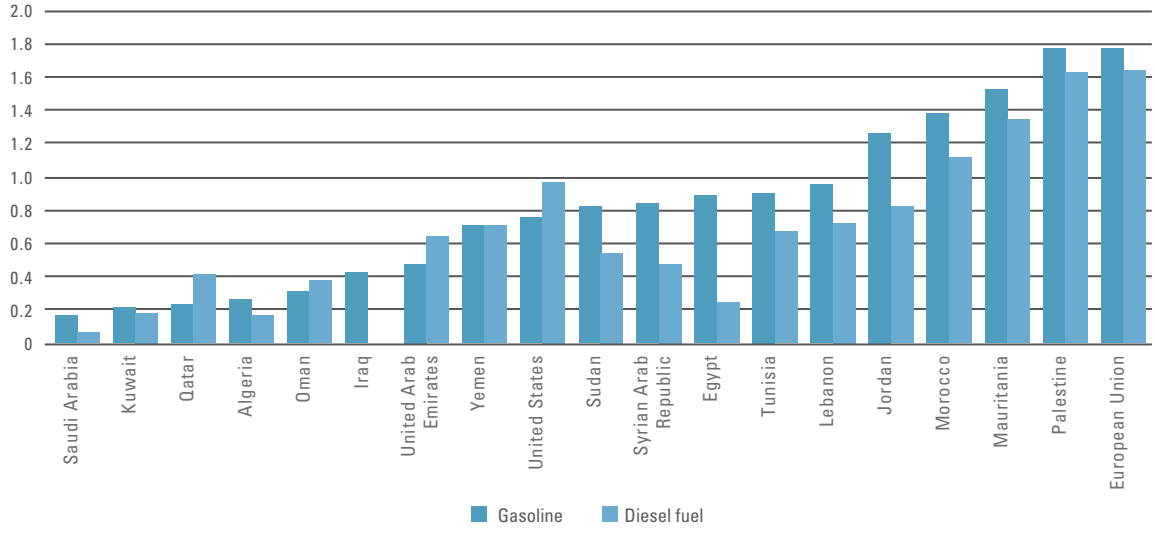
Regulated energy markets are one of the most pervasive tools in policymaking and have a myriad of intended and unintended consequences of market signals, production and consumption patterns in the Arab region. Regulated – in many cases subsidised – prices for energy and water, alongside the strong role of the State as the provider of fuel, electricity and water through State-owned utilities and energy companies, reach back to the 1950s and 1960s and the establishment of modern States. The rationale for regulated prices has typically focused on making modern energy

Figure 82. Average domestic electricity tariffs by volume of use in the Arab region, the US and Europe (US cents/kWh), 2016



Notes: Arab countries' tariffs for 2016 as per AUPTDE (2016) for average consumption at 250, 500 and 2,000 kWh/month; EU tariffs for 25–500, 500–2,000, and >2,000 kWh/month consumption; US tariffs for residential, commercial and industrial customers. Unavailability of perfectly comparable cost data meant proxy data had to be used.
Sources: Arab Union of Producers, Transporters and Distributors of Electricity (AUPTDE), Arab countries); Eurostat (EU-28); EIA (US). EU and US tariffs excluding tax and levies.

Figure 83. Pump price for gasoline and diesel fuel in the Arab region, the US and Europe (US$/litre), 2014



Source: World Bank (2017b).

and water affordable to all, while helping drive industrialization processes. In Arab oil-and gas-producing countries, a strong element of the use of domestically produced fossil fuels for the direct benefit of citizens has played a key role as well, including in the wealthiest countries such as the smaller Arab Gulf economies, whose per capita income today stands in no relation to the extremely low cost of energy and water their citizens pay. Many of the region's industrialization programmes of the 1970s and 1980s were highly energy-intensive, reflecting the perceived competitive advantage of low-cost feedstock and fuel inputs in Algeria Saudi Arabia and the UAE, which, in the eyes of many, ties their national industries' international competitiveness to the maintenance of access to low-cost fossil fuels. Many Arab oil and gas producers hence charge utility tariffs and primary energy prices at a fraction of their actual cost, leading, in development terms, to the counterintuitive outcome that some of the world's lowest energy prices are to be found in the Arab region – and some of the world's wealthiest countries – on a per capita income basis (Figure 82 and Figure 83).

Other Arab countries have been progressively increasing their domestic energy prices in recent years, although subsidies often remain. Average electricity costs in Morocco, Palestine and Tunisia for instance, are around or even above the European average (Figure 82) – a cost level that has been comparable for many years even before Morocco and Tunisia thoroughly reformed utility prices. That all three countries charge consumers such comparably high prices, while utilities still struggle to make profits, reveals some of the intrinsic problems in utility-sector market design in these countries, including decades of State utility supply, missing financial and fiscal incentives for utilities to invest in and upgrade the quality and efficiency of their infrastructure and subsidized costs for fuel that have left some of these countries' utilities running on oil-fired power generation, which today must be bought at world-market price. Owing to insufficient power-generation capacity of its own, Palestine imports much of its electricity from neighbouring Israel at market price.

Energy subsidies distort energy consumption and production patterns

The Arab region's slowly changing pricing environment for energy may yet prove to be one of the most important structural drivers of the gradual improvement of its energy efficiency. Energy subsidies, particularly if universal in nature, also distort consumer incentives, leading to the overconsumption of energy, energy waste and, eventually, deadweight loss to the economy. This problem is all the more distinct in the Arab region, because the lowest costs of energy and the highest rates of subsidization are to be found in the region's upper-middle and high-income countries, in particular the GCC and other oil- exporting countries. While providing citizens with low-cost access to essential utility supplies, the State also subsidizes round-the-clock air conditioning, inefficient power plants and transmission networks and the construction of poorly insulated buildings that will contribute toward the region's energy consumption through the building stock many decades to come.

In lower-middle-income countries and the Arab LDCs, the social cost of this status quo is problematic from a developmental point of view. The relative cost of energy subsidies relative to other sectors can quickly become enormous – as happened during the time of high world-market oil prices during 2010–2014 – and crowd out fiscal resources for investment in pro-poor sectors such as education and health or into the maintenance and systematic expansion of energy-related infrastructure and services. Relative to other spending, Egypt's total spending on energy subsidies in 2011, for instance, was three times its spending on education and seven times its health expenditure.[279] Price subsidies also give rise to black-market trade, including within countries between urban–rural areas (with particular acuteness in countries with weak central government reach, such as Mauritania, Sudan and Yemen) and to inter-state fuel smuggling. Unsurprisingly, perhaps, most substantive progress in energy-efficiency regulation and interest in new energy technology, such as renewable energy, has been made in countries that charge comparably high energy prices, such as Jordan, Morocco and Tunisia.[280]

Untargeted price subsidies for transport fuels make public transport more affordable, but also reduce incentives to use public transport in the first place or to invest in a more fuel-efficient personal vehicle. Indeed, the vast cost of fuel subsidies may compromise public funds, which are then not available to expand public infrastructure, including public transport options to start with. With most fuel subsidies being paid in the Arab region's highest-income countries, the affordability argument further loses value – low-cost gasoline and diesel support private-vehicle ownership and reduce resources available for the expansion of qualitative public transport. And even for high-income countries, energy subsidies are costly; Saudi Arabia – according to IEA estimates, the world's second largest subsidizer of energy – is estimated to have spent US$ 71 billion on energy subsidies in 2014 in the form of direct expenditure and in foregone revenue: a phenomenal amount that could have been spent on targeted income groups and investments in energy conservation and efficiency instead.[281]

Many industries and commercial consumers of industry, including utilities, would benefit substantially from a more efficient use of fuel and a reduction in technical losses of electricity through ageing transmission lines. Intrinsic market structures, typical for many parts of the Arab region, including State ownership and inherent underfunding due to tariffs that do not reflect costs, leave many utilities too cash-strapped to invest in research and development and unable to earn back returns on upfront investment. The relatively high upfront cost in efficiency upgrades in many cases deters such investments, even in upper-middle and

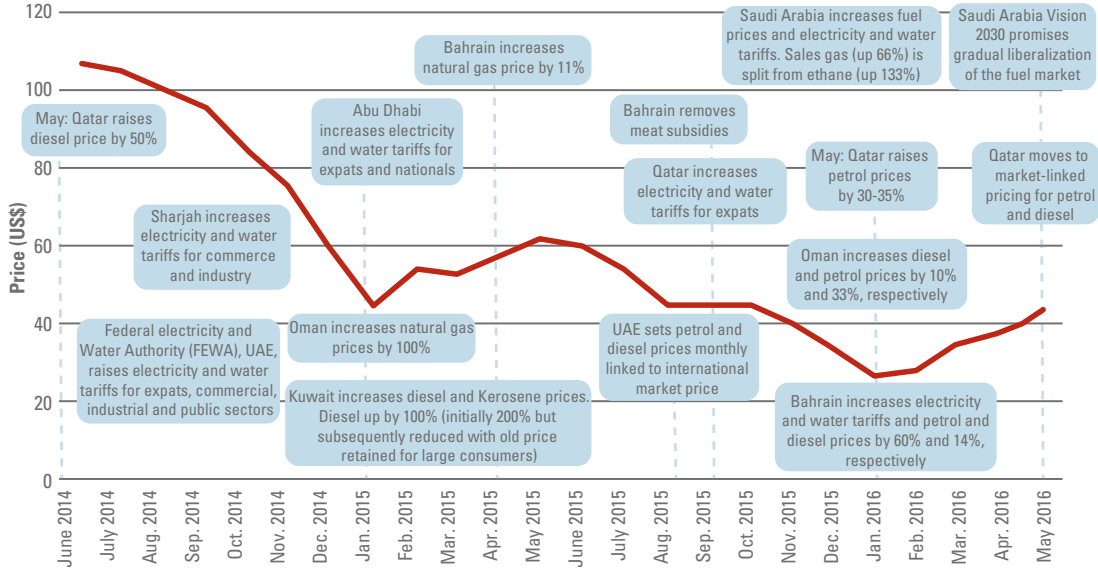
higher-income countries, while lacking policy regulation fails to provide legal requirements in place to upgrade efficiency rates in the absence of market-based incentives. Subsidies for fossil fuels supplied to domestic industries further reduce the business case for industries to upgrade their efficiency levels, while the cost of this is borne by a separate party – the State and State-owned oil and gas companies that supply the fuel inputs at a fraction of their true economic cost.

Recent reductions in energy subsidies show that reforming pricing frameworks is possible

A number of countries have engaged in the reform of fuel and electricity subsidies during 2012–2014, a trend that has further spread since mid-2014 with the fall in global oil and commodity prices. Pushed by the escalating cost of fuel subsidies since the mid-2000s, when oil prices on international markets were set to rise to previously unknown heights, net importers of energy in North Africa and the Mashreq have been among those countries that have been active in adjusting domestic pricing. Morocco eliminated all subsidies for gasoline and industrial fuel in January 2014 and now reviews its fuel prices twice a month on the basis of international market-price movements. Jordan introduced a five-year plan to reform electricity prices in June 2013 and planned to increase rates annually until 2017, shielding most vulnerable user groups from price increases. In November 2012, Jordan removed subsidies for all domestic oil products, linking domestic prices to international markets through a monthly review. Tunisia launched a reform programme in January 2014, aiming to eliminate all remaining electricity subsidies by 2021.[282]

Despite some toing and froing, Jordan eventually managed to reduce its energy subsidy bill significantly. After a reversal of

Figure 84. Recent experience in energy-pricing reform in the Arab region



* The OPEC basket spot price is taken from the OPEC Monthly Market Oil report.
National Government websites, and various national media.
Source: Data compiled by UN ESCWA and adapted from Chatham House 2016 report ("Food, fuel and utilities price reforms in the GCC", p.3).

previous subsidy reform in mid-2011 at the height of sociopolitical pressure following the events in Egypt, Libya and Tunisia a few months before, the Government eventually followed up with a series of fiscal reforms to ease pressure on public expenditure in May 2012. Fuel subsidies were slashed the same month, raising prices for gasoline, asphalt and fuel oil for power generation by around 26%, in addition to increased electricity tariffs for major industrial and service sectors. Only prices for LPG, diesel and kerosene remained protected because of their potentially large impact on the poor. Further rounds of price increases followed, initially met by public protest, that later on subsided, following a gradual change in communication strategy and the introduction of a part-compensatory cash-transfer system for households below a certain minimum income threshold.[283]

Egypt introduced a five-year plan to phase out fuel and electricity subsidies in July 2014. Fuel prices were increased overnight by between 40% and 79% for gasoline and 64% for diesel. Price-increase rates for electricity differ across user segments, but will be adjusted regularly every 1 January until 2019, by which time the Government hopes to have eliminated all remaining electricity subsidies.[284] Sudan passed a reform with sharp increases in fuel prices in September 2013. The price of gasoline sparked by 68% from 12.5 Sudanese pounds (SDG) per gallon to 21 SDG per gallon; diesel prices increased by 75% from 8 SDG per gallon to 14 SDG per gallon and cooking gas (LPG) by 67% from 15 SDG per cylinder to 25 SDG per cylinder.[285]

Since mid-2014, declining international oil prices and export revenues in oil-producing countries have shifted the momentum of energy-price reform towards Arab oil and gas exporters. The GCC economies, previously seen as immune to fiscal pressures that drove fuel and electricity price reform in other parts of the Arab region, began to implement a series of energy-price rises to an extent not seen before in their histories. Qatar, several emirates of the UAE and Kuwait raised domestic prices for diesel, kerosene and utilities in the second half of 2014; Oman raised natural-gas prices in December 2014 by 100%. In August 2015, the UAE was the first country of the GCC to link transport-fuel prices to an international market price – tax-free and with a monthly link to global prices that smoothes out price movements in a bid to maintain a role for the State in national price-setting, but a novelty nonetheless in a region defined for so many decades by government-managed fuel-pricing politics. This step was followed by several more rounds of various fuel- and utility-price adjustments in the GCC. In January 2016, a systematic reform of utility and sales gas-pricing was introduced in Saudi Arabia, with announcements for future liberalization of the Saudi fuel market.

Arab countries' energy-pricing reform efforts still end where additional market restructuring, such as the liberalization of utility markets per se, are required. This is because, in most Arab countries, utility and energy provision in general remains an essential task of State and public companies. A slow opening towards private-sector entrants into utility provision have begun tentatively in Jordan, Tunisia and the UAE. So far, private engagement remains mostly limited to build-operate-transfer (BOT) style agreements that limit competition to the early stages of project development, rather than to generation and distribution, the two most competitive elements of power generation. The aspect of wider energy-market regulation and liberalization remains one of the most important areas for further development in the Arab region. While the Arab region is today still far from the utility-market model found in other markets, where customers pick and choose an utility provider or petrol station according to cost, reform over the coming decades may eventually benefit different parties: States that still face large outlays for State energy-company subsidies; utility companies that will then have an incentive

to reduce costs and invest in the most cost-effective technology; and customers, who will face greater choice and potentially lower costs than cost-reflective prices in non-competitive energy markets.

Preparing financial markets

Access to finance is a key factor in determining market uptake of more sustainable energy technologies. For many energy markets in and outside the Arab region, economic incentives are at the core of the opportunity for, but also barriers against, the adoption of more efficient energy technologies and renewable energy; disincentives to invest in more sustainable production techniques and changing long-established consumption patterns also affect progress in other areas of sustainable development, such as the protection of water resources and food security. Supporting a transition to sustainable energy is particularly difficult if current market incentives are being considered, given the various imperfections of energy markets in and outside the Arab region, including distortions by pricing signals to producers and consumers, lacking regulatory environments, missing information for consumers and the problem of factoring the long-term sustainability of resources into today's energy prices.

Financial sector shortcomings add to the problem of popularizing clean energy technologies, in particular in the case of renewable energy and energy efficiency. Typical financial sector barriers to project funding – not only in the Arab region – include low capital market development, high capital costs, and higher perceived national risk for investors in addition for the nationally small market for renewable-energy and energy-efficient technology. The problem is amplified in low- and middle-income countries and at the level of energy access, where micro-credits often remain out of reach of small households. The example of solar power for rural electrification in Yemen illustrates this dilemma:

> "At present, an increasing number of small entrepreneurs are entering this business as suppliers. The majority of solar initiatives across the country are either donor-driven or small-scaled with limited potentiality for expansion. The demand of solar energy for use by businesses in Yemen has not been growing enough. On the other hand, the demand of solar energy in rural areas is hindered by the low purchasing power of rural inhabitants due to the high prevalence of poverty, and a lack of an appropriate policy instruments (i.e. Rural Solar Fund, and/or Solar Loan Schemes, etc.) to compensate for the high upfront cost of solar instalments."[286]

Microcredits for small-scale applications such as rural home-electrification programmes and other energy-related investments are particularly hard to access for many low-income households. Across different economies and income ranges in the Arab region, access to finance for many innovative investment schemes, such as renewable energy projects or energy efficiency improvements, remains constrained not only by missing policy support, but also by missing financial instruments and suitable credit markets that target such investments. The case of renewables-based mini-grid initiatives in Mauritania illustrate the difficulty of promoting development-linked projects without sufficient finance:

> "Mauritania has implemented the necessary legal, regulatory and financial structure to promote the development of hybrid renewable mini-grids. However, many issues still remain to be solved, including the definition of a sustainable infrastructure to promote these projects and defining a sustainable financial mechanism. Until now, most of these projects have been implemented on an ad hoc basis. Despite an existing will to promote hybrid mini-grids, the State is limited by the availability

of funds and the development of a sustainable environment for their expansion."[287]

Financing solutions – learning from good practice

A number of financing solutions have been demonstrated to drive clean-energy deployment in the Arab region, illustrating the diversity of options that can work in different circumstances. Morocco has gained considerable experience and succeeded in attracting foreign capital for a number of renewable energy projects while bringing down costs for Moroccan electricity consumers. The country's potential for solar CSP power, not only for its own market, but as a location with the potential to lower costs for users in other parts of the world through large-scale technology deployment in Morocco, has been emphasized in past studies that involved support by international financial institutions such as the World Bank.[288]

The still relatively high costs of solar CSP meant concessional and public financing were key to launching this project. The Moroccan Agency for Solar Energy, the government agency focused on the country's solar ambitions, secured over US$ 3 billion needed for the Noor-Ouarzazate complex from the African Development Bank, CIF, European financing institutions and the World Bank.[289] CIF commented on the project, which is also meant to bring significant environmental benefits and local jobs to local Moroccan communities, by saying at the launch of the first phase of Morocco's Noor CSP plant in Quarzazate:

> "This launch shows that the low-cost, long-term financing provided by the CIF can serve as the spark that attracts the public and private investments needed to build massive CSP production facilities at an attractive cost for countries interested in developing solar energy." [290]

Morocco has systematically used various financing and business that suited different renewable energy projects. Tarfaya Wind Park was built by a joint venture of two foreign companies at an overall investment of € 450 million, where debt financing was provided by a consortium of three Moroccan banks. GDF Suez and Nareva have signed a 20-year long-term PPA on a BOOT basis to sell the windfarm-generated power from the Moroccan State utility Office National de l'Électricité et de l'Eau Potable. At the time of writing, another five new windparks had been tendered out, representing more than €1 billion of investment, and will be completed under a BOOT contract for a 20-year term. As part of the contract, one of the consortium members agreed to build a rotor-blade factory near Tangier, to start operating in 2017, thus moving part of the manufacturing chain for the project to Morocco and helping generate local jobs.[291]

Part and parcel of the country's sources of funding has been finance from international institutions aimed at promoting clean-energy deployment in developing countries. As of September 2014, the World Bank for instance had a portfolio of 22 projects in Morocco alone, amounting to a committed financing of US$ 2.44 billion, providing a diverse range of support in areas such as the private sector, financial sector and governance reform, green growth and promotion of renewable energy, access to basic services such as rural roads, water, sanitation, the reduction of vulnerability and social exclusion and improvements in agriculture and solid waste management. Since 2011, the World Bank's private sector arm, the International Finance Corporation (IFC), has stepped up its engagement in Morocco and has invested US$ 590 million to support private-sector development in the country[292] – a small fraction of Morocco's approximately US$ 4.1 billion spending on untargeted subsidies for energy and food staples in 2013 alone.[293]

International sources of funding, although often limited in scope, are available for some

projects, with an increase in initiatives linked to promoting clean-energy in developing countries. This includes grants, loans and practical support for projects helping developing countries mitigate, and adapt to, climate change in addition to wider development goals. While development funding does not provide a durable alternative to market incentives to private investors to invest locally for realistic financial returns, funding of this kind can help lower-middle-income countries and LDCs to access necessary funding for one-off, large-scale and demonstration projects that can be used to drive future investment from the private sector. A World Bank document outlining plans for co-funding CSP technology in five countries – Algeria, Egypt, Jordan, Morocco and Tunisia – illustrates the kind of motivations and incentives for international development finance to assist countries with the development of technologies – in this case CSP technology. As a rationale for its assistance, it lists the following factors, including the potential for regional GHG emission reductions, demonstration potential for CSP technology, the development impact on co-financing countries, and implementation potential and relatively low additional costs other than projected project costs and low-risk premiums.[294] The plan specifically notes that:

> "The proposed programme is regional in structure, but global in objective. Together with the planned capacity additions in the US, Europe and elsewhere, cost reductions and institutional learning that will be achieved through this programme will facilitate faster and greater diffusion of this technology in other countries in Asia, Latin America and Africa that have significant potential for CSP."[295]

Making greater use of international finance available for clean-energy projects – including renewable energy, energy efficiency and energy access – is one of the key building blocks to securing funds for sustainable-energy transitions in the Arab region.

A number of international development funds, some energy-linked and some more general, are available to promote clean-energy access in its various forms. Lack of institutional capacity means many of these funding opportunities are not being claimed, while many successful pilot projects financed by international funds are never scaled up due to constraints in local capacity to secure and design suitable programmes that are fundable by international bodies.

The Clean Development Mechanism (CDM) is one example of international funds that have in the past seen limited application in the Arab region, despite the obvious need for financing options. Only 93 projects in total, or around 1% of the fund's projects until 2016, were registered in Arab countries, compared with 50 registered projects in the Islamic Republic of Iran and Israel alone; 1,000 projects in Latin America; and over 6,350 projects in Asia/Pacific.[296] Of the total of 93 CDM projects in Arab countries, 20 were registered in Egypt, 16 in Morocco and 15 in the UAE – suggesting considerable differences in government interest or capacity to secure such sources of funding. Nowadays, the United Nations Framework Convention on Climate Change (UNFCCC) supports low-emission and climate-resilient projects and programmes in developing countries through the Green Climate Fund, which pays particular attention to the needs of societies that are highly vulnerable to the effects of climate change, in particular LDCs, Small Island Developing States (SIDS) and African States, which include many Arab countries.[297]

Egypt illustrates policies in the region driven to capture the potential of private-sector finance in sustainable and clean energy. Driven by the country's rapidly rising energy needs, the Egyptian authorities have stepped up their efforts to increase the role of private participants through their ownership and financing of power plants. They have done so through different ways, including by tendering

BOOT-type wind and solar projects through the EETC, which now acts as wholesale purchaser of electricity pursuant to a long-term PPA, where the private developer builds, owns and operates the plant and sells the electricity output to EETC.[298] In addition to utility generation, the Egyptian Government during the 2010s introduced a FIT programme, which guarantees private developers a fixed price for renewables-generated electricity that is re-fed into the grid for a period of 25 (solar) and 20 (wind) years, pursuant to EETC's obligation to purchase the electricity. This is guaranteed by Egypt, acting through the Ministry of Finance.[299] Private developers are also allowed to sell electricity generated to commercial and industrial consumers through bilateral agreements.

Saudi Arabia has gained parallel positive experience in different sustainable-energy projects under public–private partnership schemes. In 2011, Saudi Arabia's General Authority of Civil Aviation (GACA) awarded a 25-year concession to an international company consortium to expand, modernize and operate Prince Mohammed Bin Abdulaziz International Airport in Medinah. The project includes best practices in energy-efficient and environmentally friendly design, recycling, GHG emissions reductions and water consumption. The contract included an investment of over US$ 1.4 billion to achieve GACA's aim to double the airport's capacity by 2020, while ensuring a minimal energy and environmental footprint of the airport.[300] The country's National Transformation Programme 2020, launched in 2016 as part of the country's new economic strategy Vision 2030, further considers the greater use of PPPs, including in infrastructure development – an objective that was followed up in 2016 by the Saudi Electricity Company by inviting international companies to express interest in building two solar plants.[301]

Enabling access to clean and more efficient energy also relates back to a country's overall business environment. Difficulty of doing business and high capital costs involved in starting up new businesses also affect private-sector innovative work in the field of energy efficiency, particularly in the Levant and African Arab economies.[302] For utilities, the dominance of State-owned business, the absence of competitive utility markets and consumer choice affect the number of innovative stakeholders in the sector, as well as incentives for large companies, industries and utility producers to make investments in alternative energy and energy efficiency in pursuit of a competitive advantage. Whereas, in Europe, many customers nowadays can choose whether they want to purchase electricity generated from fossil fuels or clean energy, the same choice is not available to consumers in the Arab region. Overwhelmingly, State-owned energy and utility sectors have incentives to act cautiously and conservatively, unless government regulations require technology upgrades – which then have to be purchased at whatever cost they are produced, rather than because of a clear, long-term technology advantage. Such regulative frameworks also affect the ensuing public and political debate, which, in many Arab countries, focuses on negative cost, rather than economic opportunity.

Strengthening information quality and awareness-creation

Improving the dissemination of information and active efforts to create awareness of the economic, social and environmental costs of business-as-usual is critical to the sustainability of the Arab region's natural resource use. Access to information plays a pivotal role in government and business decisions to invest and favour one technology over another and in guiding final consumer behaviour. The Arab region's current market structures for natural resources – energy, water and the environment – are highly distorted through one-sided government intervention,

pricing structures that do not reflect the true cost of natural resources to society and the economy as a whole and, on the other hand, a decade-long public discourse that has focused heavily on the role fossil fuels play in countries' socioeconomic development, with little emphasis on issues such as natural resource waste, environmental pollution and the degradation of the environment that hosts and feeds over 343[303] million people in the Arab region.

Data and information

Data collection and dissemination. Where policies are aimed to change behaviour and long-held consumption and production patterns, information becomes much more important. At the most basic level, this is a call for proactive efforts to improve governments' ability to collect, monitor and disseminate qualitative and quantitative data. This includes social indicators, population and household-income statistics and survey material as much as consumption and production patterns of different types of energy including gender disaggregated data on energy use, secure energy access and environmental indicators, including the protection of precious land and water resources, species protection and loss, urban and ambient air pollution, waste disposal, water usage and withdrawal, etc. Setting such indicators in the context of social and economic development, for instance through emphasis on the negative health effects of air pollution, the positive impact of the deployment of new sources of energy on employment and the creation of more sustainable, innovative urban spaces, makes data and information availability an important tool in raising awareness, and hence support for policy measures targeting sustainable-energy investment and regulatory changes.

Information-sharing between institutions. Government bodies such as ministries and municipalities also need data and relevant information on a wide range of interrelated factors, both at national and subnational level. Policies aiming to increase energy access, and raise the rate of energy efficiency in the economy and the deployment of renewable energy often entail a complex mix of changing market regulations, investment models and other incentive structures to secure project finance and change consumer behaviour. Assessing the potential impact of changes to regulations and policy design on different market segments requires information that is rarely publicly available, nor does any single institution typically collect and monitor data about all factors involved. This renders effective channels of communication and transparent information-sharing between institutions a key enabling factor for good governance and policymaking.

Improving communication

Communicating with final consumers. A critical pillar of changing energy consumption and production patterns is access to information about energy to final energy consumers. While the tenets of this assertion appear fairly self-evident, detailed data, including survey data on household energy-consumption patterns, user profiles and detailed measures taken by government entities and utilities to manage supply and demand is not systematically available in many Arab countries. Nor is information about energy consumption and measures to improve consumption habits such as household energy-efficiency improvements, available and comprehensible to most households. For instance, only about half the Arab countries covered by a recent World Bank report on energy efficiency in the MENA region, have utilities that also provide information on energy-saving opportunities to customers.[304] Some countries have recently changed this, by providing greater transparency, for instance, of the true cost of water and electricity, even where households continue to be subsidized users of these goods. The UAE has introduced smart bills that provide clear information

about household electricity and gas use and note the pre-subsidy cost of each household's consumption on the bill before presenting the final (subsidized) cost to consumers.

Improving communication and information dissemination with final consumers is also critical to effective progress in two key areas: energy efficiency and the deployment of renewable energy. While the majority of current energy-efficiency and renewable-energy policy schemes target large-scale structural reform and regulatory "must-dos", small-scale users can actually drive a substantial share of the potential investment in more modern energy technology in the residential and small-scale commercial sector. Both energy efficiency and renewable energy in the form of small-scale rooftop solar installations, for example, can present significant economic savings potential to small households in rural electrification contexts as much as in more affluent urban areas with middle- and higher-income groups that can afford to invest in better housing insulation or the installation of PV panels for the purpose of electricity generation and water-heating. Popularizing this potential for household savings requires, in addition to regulatory measures and the potential introduction of government-supported loan and payment structures for such projects, the more active communication and explanation of such opportunities to households, given the lack of such information available to large parts of the public in most Arab countries.

Knowledge creation and public discourse

Re-prioritizing sustainable energy use and environmental consciousness in the public discourse. On a broader policy level, environmental reporting and public information take low priority in reporting through public institutions, research in universities and think-tanks, and in public media. This includes core messages: issues in wasteful consumption of energy and water; the degradation of environmental resources such as groundwater levels and coastal waters; and food security. All these themes feature little in the public discourse of most parts of the Arab region, which represents a lost opportunity to sensitivize people to their own consumption behaviour. Young people in the Arab region are overwhelmingly connected to online information and social media, making them important forums for the spread of greater environmental awareness and social support for policies aimed at increasing the sustainable use of natural resources in the region in the long term.

Media and academic freedom. Lack of freedom of science, research and media in many countries also means weak civil society, in addition to weak institutions. A paradoxical situation: some governments lack institutional and human capacity to promote sustainable planning, but also keep civil society from taking over this role. Critical media, backed by qualitative research at local universities and think-tanks could play an important role in driving local solutions to local problems, such as more targeted investment in public infrastructure or the implementation of low-emission zones in cities. Critical and empowered media are also important to check on the effectiveness of local implementation of existing and new laws and regulations, helping to build trust in the capacity of institutions over time to implement new laws for the benefit of the population.

Depoliticizing data. A key problem in many parts of the Arab region is the politicization of data and knowledge – even in benign areas such as basic population and energy consumption indicators – which provides an exceptionally difficult context for any effective policy progress. Lack of publicly – and often inner-institutional – available data and information makes informed policymaking and a rational public and market response to growing problems, such

as economic deadweight loss, extremely difficult. It also harms governments' ability to justify policies that produce no immediate ad hoc results, regulatory changes aiming for longer-term energy efficiency for instance, or initially costly reduction in energy price subsidies for consumers. In the longer term, achieving sustainable development goals, including in the area of energy, will require a degree of greater freedom of science, research, data dissemination and media reporting if the Arab region does not want to lag behind.

Arab LDCs present special challenges due to their very limited institutional capacity and reach. Lack of clear mandates and competencies, including in decision-making, poor data-collection, monitoring and evaluation capabilities, added to the competing needs of different priority areas such as education, health, energy, infrastructure and overall security combined in these countries to a particularly difficult setting for effective policymaking. Different development challenges here reinforce each other: limited education means that long-term planning in areas such as energy supply, access and efficiency becomes difficult to manage, implement and monitor, not only because of lack of human skills but also because short-term priorities, such as people's access to cheap energy resources, take priority over long-term development goals.

Empowering civil society to present their interests. Where institutional data- and information-collection and dissemination capacity is limited, civil society groups can play an important role in helping governments assess society's preferences. Many governments' intrinsic fears of bottom-up interest groups as being politically harmful, rather than beneficial elements as part of countries' socioeconomic development path, obstruct this valuable resource of carrying out gradual consumer market-driven change, sometimes against their own best interests. Environmental awareness, green lobby groups, and general consumer-interest groups pushing for more adequate, market-driven regulation of public services, building-stock quality and minimum energy-efficiency standards for consumer goods, such as electrical appliances, have had almost no political backing in the Arab region.

Civil society interest groups can play a very important role not only in monitoring progress, but also in becoming third-party "watchdogs" that can make important contributions towards raising awareness in society – and hence acceptance of, and support for, policies otherwise deemed costly and unpopular. This includes stricter regulation in the area of energy, water and the environment and the re-regulation of sensitive sectors such as utilities. Underlying policy support from society can also help break deadlock inside government, for instance, where the population has a clear preference for the greater protection of local water resources or government support for new technologies such as rooftop solar installations, including for the purpose of energy access. Local interest groups and environmental associations can also play a fundamental role in supporting government efforts to collect data and hence help governments make more informed decisions.

There is no lack of human capital to drive this process in the Arab region, which is rich in young, increasingly educated and, in many cases, well-travelled populations that are able to drive positive change for their nations.

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Concluding Remarks

The Arab region is in the midst of a transition from being a major supplier of energy to international world markets, towards an increasingly important demand market in its own right. This transition raises considerable challenges, but also opportunities for the coming decades. The key message for policymakers and civil societies alike is that current business-as-usual scenarios in the areas of energy and wider natural-resource management in the Arab region is overwhelmingly unsustainable; proactive policy is critical to ensuring the region's long-term resilience and stability in view of growing populations and economies, rising living standards and expectations, and the finite nature of the region's unequally distributed natural resource wealth. Most parts of the region – excluding the Arab LDCs – have been making significant inroads to near-universal access to energy, a key development attainment. The Arab region lacks sustainable resource management, however, particularly in the areas of energy efficiency and its overwhelming reliance on fossil fuels for virtually all its energy needs.

More than environmental consideration, perhaps, direct fiscal consequences of unmanaged energy demand have, since the late 2000s, made some of the unintended consequences of the lack of policy focus on energy-sector management more visible. Arab net importers of energy have already lived with the necessity to factor in domestic energy use and supply patterns as economic and fiscal cost items, which increased in urgency during the 2000s as a result of rising energy prices in international markets. The same dynamics have also affected Arab net exporters of energy, whose opportunity cost for energy consumed at home and therefore not exported rose, along with rising oil prices, until mid-2014. Both net importers and exporters face a common key challenge: how to rationalize demand-and-supply patterns for energy at a time when national energy demand is no longer marginal and where future national energy needs will only increase.

One of the most critical aspects for policymakers in energy planning in particular is the reconciliation of increased popular pressure for quick, tangible benefits on the one hand and the design of energy markets that are sustainable in the long-term, on the other. The challenge for policymakers is significant, as is the dilemma many Arab economies face in the need to bridge the seemingly competing demands of securing high and rising living standards today and of building lasting wealth that helps sustain these living standards and their underlying resource base in the future. While non-tangible problems, such as air pollution and the long-term threat of climate change are new concepts to the region, the associated policy challenge is no smaller here than in other parts of the world. The close interrelationship between energy and other elements critical for long-term sustainable development, such as water, food, and climate change, raises the stakes for the delivery of solutions that manage to do both: they benefit the region's people in the short term, while ensuring that the consumption and production of its precious natural resources are secured for future generations.

Sustainable energy development is not a priority that is more relevant to one Arab country than another, nor is it a choice between fast growth and slow growth. As populations grow and living standards increase across the Arab region, as does the demand for energy, managing natural resources – energy but also water – is the only way to ensure inclusive growth that provides all people with economic opportunities in the future. The senseless destruction of today's natural wealth in the Arab region under the umbrella of "business-as-usual", while populations grow and economies expand is not a realistic choice, no matter what income group or status of fossil-fuel resource endowments a country holds. Arab LDCs, perhaps more than all others, epitomize the way the management of limited natural resources is a precondition, and not an impediment to lasting economic progress.

Appendix: Methodology and Background to the Global Tracking Framework Approach

Background to United Nations progress in sustainable energy and the Global Tracking Framework

In 2011, United Nations Secretary-General Ban Ki-Moon launched the SE4ALL initiative, articulating three global objectives: universal access to modern energy; the doubling of progress in energy efficiency; and the doubling of renewable-energy deployment. The same year, he was joined by World Bank President Jim Kim as co-chair of SE4ALL and initiated a global movement that has engaged numerous countries and hundreds of partners in the public and private sectors, as well as civil society.

In September 2015, the global community adopted the Sustainable Development Goals for 2030. For the first time, energy occupied a central place in the global development agenda with Sustainable Development Goal 7 (SDG7), which aims to "ensure access to affordable, reliable, sustainable and modern energy for all". SDG7, like the other SDGs, was adopted as the result of a multilateral negotiation between United Nations Member States, based on the recommendations of a working group made up of their representatives.

SDG7 builds on the foundation of SE4ALL, similarly adopting targets for energy access, renewable energy and energy efficiency. A careful comparison of SE4ALL and SDG7, indicates that the latter further extends the framework in a number of significant ways, in particular by specifying that universal access to energy is both affordable and reliable, in addition to being modern and sustainable. SDG7 also fine-tunes the indicator for access to clean cooking for a better alignment with the latest scientific evidence on the health effects of different cooking practices.

Three months after the adoption of the Sustainable Development Goals, at the 2015 Paris Climate Conference (COP21), 195 nations negotiated a historic climate agreement – one that declared that not only do we need to retain the increase in global average temperature as "well below 2 °C above pre-industrial levels" but that we also need to pursue efforts to limit the increase to 1.5 °C.

As a result of these landmark political agreements, it becomes more important than ever to track both national and global progress in energy access, energy efficiency and renewable energy. The Sustainable Energy for All Global Tracking Framework is in the third edition of its 2017 global report, co-led by the World Bank/ESMAP and IEA, with inputs from more than 20 organizations around the world. The year 2017 also marks the first year of individual reports by the UN regional commissions, including the present progress report of UN ESCWA on sustainable energy in the Arab region. Within this regional context, the GTF aims to provide the international community with a more detailed regional insight report into progress on the three pillars of sustainable energy: energy access, energy efficiency, and renewable energy in the Arab region.

Sustainable energy, socioeconomic development and regional prosperity are closely interlinked: a relationship that is reflected throughout this report. Apart from the various development aspects associated with modern energy access – increased food security, access to education, gender equality and economic opportunity – progress in sustainable energy use also holds large potential to create employment opportunities for young Arabs, provide investment opportunities for those wishing to diversify their national economies, and to make a significant contribution to the enhanced management of other natural resources in the region, including water, air and agricultural land.

The region's high vulnerability to climate change further underlines the way in which more sustainable natural resource use could help the region contribute towards the global mitigation of climate change, as well as adaptation thereto. Engaging in meaningful progress in sustainable energy presents considerable socioeconomic opportunities, while it is also in the intrinsic self-interest of Arab countries in preserving national peace and stability in the long term.

Without rapid progress in the area of secure, affordable and clean energy (SDG 7), it will be impossible to deliver on other Sustainable Development Goals by 2030 within the Arab region. The interconnections between issues such as water, food, energy, access to modern health care and education, gender equality and climate change mean the way we use, produce and ensure access to energy plays a pivotal role in achieving all other development goals. Many countries have in the past identified the lack of access to basic services, including energy, as a stumbling block to national development efforts.[305] Because financial and natural resources are limited throughout our world, ensuring the resources that are available are being used to their best effect, rather than wasted is paramount. A highly unequal distribution of access to resources such as energy, food, water and subsequently economic opportunities is also one of the most fundamental causes of political discontent, making energy and natural resource management all the more critical to the protection of the fragile economic order of the world in general and the Arab region in particular.

The choice of GTF indicators

The final choice of indicators used in this report builds heavily on historical efforts around data harmonization and consolidation by a variety of international agencies in the context of the SE4ALL Global Tracking Framework. Access indicators are derived from a compilation of household surveys – such as demographic and health surveys and living standard measurement surveys, among others – which have benefited from proactive technical assistance and capacity-building for many years as part of efforts to report on the Millennium Development Goals. Energy-efficiency and renewable-energy indicators are derived from national energy balances that have benefited from decades of effort by United Nations statistics and IEA to promote the reporting of data according to a standardized methodology and to conduct systematic checks for the consistency of data reported across countries.

Data harmonization

The fact that the GTF builds on earlier data-harmonization efforts has a number of important implications:

- Firstly, because the data-harmonization process is time-consuming, it creates a lag in the publication of standardized international data for the purposes of global tracking. It typically takes at least one year for national data to be published, a further year for these data to be collected and harmonized by international agencies, and a further year for the data to be analysed for tracking purposes. That is why the GTF for any particular year will be able to report data only for the previous three years.
- Secondly, differences between the statistical methodology used at the national level and that which has been harmonized at the international level mean that indicators reported for individual countries and those that are reported domestically may not be identical. Without this standardization, country comparisons and regional or global aggregation of indicators would not be valid or meaningful. This does not mean that either the national or global data are incorrect; they are simply measuring slightly different things.
- Thirdly, the underlying data series are updated over time by the originating agencies as new sources of information become available or previous errors are corrected. As a result, the indicators reported in each GTF report may differ from previous editions, not only for the recently incorporated data, but also because of minor adjustments in the entire historic series.

The launch of GTF2017, the global report, in April 2017 also saw the launch of a specialized website that allows easier user interaction with the data, including numerous visualizations and the ability to easily download customized reports (http://gtf.esmap.org/downloads).

The quality, consistency and completeness of global information and data reported by a significant number of smaller and/or lower-income developing

countries – including in parts of the Arab region – are still far from ideal. Additional support for capacity-building activities, targeted at both energy ministries and statistical agencies within countries, is required so that these important gaps can be addressed.

Measuring biomass and energy efficiency

Other issues of measuring energy efficiency and the sustainability of biomass under renewable energy are equally pressing. Energy efficiency – the relationship between energy inputs and physical outputs – cannot be directly measured at global level. Instead, energy intensity – the amount of GDP produced for every unit of energy consumed – is widely used as an imperfect proxy. Going beyond this would require more detailed disaggregation of data to sectors, subsectors and individual end-use activities. It would entail both improving the resolution of the national energy balances that characterize where energy is consumed in each country and obtaining complementary information on the physical outputs associated with energy consumption in each sector: for example, freight-kilometres of transportation or square metres of office space. A recent IEA energy-efficiency statistics manual provides a solid methodological basis[306] but building capacity for countries to apply this methodology and collect all the supporting data poses a major challenge.

Measuring and tracking the sustainable use of solid biofuels – and bioenergy in general – at country level is extremely complex for at least four reasons. First, the assessment of sustainability relates to multiple dimensions (economic, environmental and social) with their own set of indicators. Second, the assessment of sustainability is applied at a "situation" level (zone, project, subregion), such that several assessments are needed for national estimates. Third, because measurement is data-intensive and few data are in the form required for a comprehensive or even pragmatic assessment, harvesting data is intensive and expensive. Fourth, periodic tracking would require an organizational structure and data-collection platform that few countries have. Globally, about half of what we know as renewable energy takes the form of traditional use, often by households in developing countries for cooking and heating. The volumes used this way are imperfectly estimated at present and little is known about whether the wood and charcoal are harvested and produced sustainably.

A pragmatic approach to approximately assessing progress in the sustainable development and use of bioenergy regularly could rely on a mix of proxy, semi-quantitative, and qualitative measurements. The mix could include estimating the wood harvested in excess of the incremental growth rate at national level (or estimating the fraction of non-renewable biomass) with the methodology recently proposed and applied by Bailis et al. [307] Assessing and monitoring bioenergy sustainability at national level using Global Bioenergy Partnership indicators; and estimating the amount or share of land used under certification schemes. [308] The adoption of any of these approaches would require the consensus of, among others, international agencies, international statistics groups, and national governments. Table 6 summarizes the challenges in measuring and tracking the SE4All objectives and the wider agenda for improving data availability and quality.

National and international entities already have roles in building capacity to better track energy efficiency. National governments are the only entities with the responsibility and authority to collect and publicly report the statistics to construct national energy-efficiency indicators, while international and regional energy organizations are important in developing and promulgating standardized approaches to energy-efficiency indicators. This is all the more important in the Arab region, which provides special challenges in tracking comprehensive, qualitative and quantitative data, sometimes even for the most benign indicators.

Tracking requires a consensus-building process that would make decisions: first, on which indicators to pursue to secure meaningful, global tracking indicators and second, on which key sectors, segments and activities, as well as countries. This would include identifying the keeper and reporter of global energy-efficiency indicators, specifying the range of information needed from countries, identifying bodies that prepare and carry out associated capacity-building and generating the technical assistance to establish and maintain

Table 6. Challenges in measuring and tracking SE4All objectives and proposed actions for improving data

Objective	Central indicator	Observation	Data source
Ensure universal access to modern energy, including electricity and for cooking	Percentage of population with an electricity connection	• The presence of an electricity connection is a prerequisite for receiving electricity supply, but does not guarantee it.	National household surveys following internationally standardized questionnaires (such as demographic and health surveys, income and expenditure surveys, living standard measurement surveys, multi-indicator cluster surveys and some censuses)
	Percentage of population with primary reliance on non-solid fuels	• Solid fuel use for cooking (wood, charcoal, dung, crop residues, etc.) in the developing world is often associated with inefficiency and undesirable health impacts, although the extent of these depend on the characteristics of the cooking stove used and the behavioural practices of the user. • Non-solid fuels tend to be associated with efficient and healthy cooking practices, with some exceptions such as kerosene. • Many households rely on multiple fuels for cooking, hence the focus on the primary fuel the household relies on.	
Double the rate of improvement of energy efficiency	Compound annual growth rate of total primary energy supply to GDP at purchasing power parity	• Energy intensity is a proxy for energy efficiency. • Primary energy demand also captures energy lost in various energy-transformation processes. • PPP measures of GDP avoid undervaluing the output of developing economies.	National energy balances collected in standardized form by IEA for larger countries and by the United Nations for smaller countries
Double the share of renewable energy in the global energy mix	Percentage of total final consumption of energy from renewable sources	• Renewable sources are all those replenished as they are consumed (including wind, solar, hydro, geothermal, biomass, biofuels and ocean). • Final energy consumption does not include thermal energy lost in transformation processes and thus provides a fairer comparison with renewable energy sources where no transformation losses take place.	

Source: World Bank (2017a).

surveying and reporting capacities. This process would also identify the necessary funding, including investment capital, and possible sources.

Other indicators

The four main indicators for SDG7, despite being well rated by the UN Statistical Commission, also leave room for improvement. They do not capture entirely the underlying variables of interest. Energy intensity, for instance, is only an imperfect proxy for energy efficiency, and there is a need to collect higher-resolution subsectoral data on energy end uses as is already available for many of the Organisation for Economic Cooperation and Development countries. While the largest component of renewable energy is the traditional use of biomass by households in the developing world, there is substantial uncertainty surrounding its physical measurement and even more uncertainty regarding the extent to which its use can really be considered sustainable.

For energy access, SDG7 emphasizes the need for it to be affordable and reliable, yet current metrics capture only the presence or absence of an electricity connection in the household. The Multi-Tier Framework is a new system for measuring energy access according to a number of progressive tiers that capture these and other dimensions of service quality and make it possible to gauge whether access is really meaningful. First results from a large-scale application of this methodology are expected in 2018. The Global Tracking Framework hence provides data based on a combination of methods and assumptions: issues which highlight the large need for improved, higher-quality data in and around energy and development – an issue that is almost nowhere as acute as in the Arab region.

Endnotes

Executive Summary

1. IEA (2016a).
2. FAO (2014b), p.122.
3. Stern (2006).
4. IPCC (2007a, b).
5. World Bank (2010).
6. Odhiambo (2016); UNDP (2013a).
7. UN ESCWA (2015d), p. 3.
8. UN ESCWA (2015d), p. 5.
9. World Bank (2017a).
10. World Bank (2017a).
11. World Bank (2017a); see also UNESA (2014).
12. World Bank (2017a).
13. World Bank (2017a).
14. UN ESCWA (2016a), p. 15.
15. E.g. World Bank (2016a).
16. E.g. World Bank (2016a).
17. See Chapter 5 for a thorough discussion.
18. The International Renewable Energy Agency (IRENA) provides a global mapping tool of these resources online at: http://irena.masdar.ac.ae (accessed February 2017).
19. IEA (2016c), p. 25.
20. El-Katiri (2014a).
21. World Bank (2017a), p. 52, 117; IPCC (2011), p. 44.
22. Gualberti et al.(2006), p. 145.
23. UN ESCWA (2016b).
24. World Bank (2017b).
25. See Chapters 3 and 4.

Chapter 1

26. The Arab region considered here includes Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, Palestine, and Yemen.
27. World Bank (2017b).
28. GDP, PPP (constant 2011 international $).
29. Opec (2016).
30. IEA (2016a).
31. GCCGS (2014), p. 20.
32. UNESCO (2015), p. 78.
33. See Chapter 5 for a more thorough discussion of consumer pricing practice in the Arab region.
34. The World Bank's aggregate uses include Djibouti and the Islamic Republic of Iran, but excludes Mauritania and Sudan. World Bank (2007), p. 147.
35. UNDP (2013a), pp. 11–12.
36. FAO (2014d), p. 122.
37. Stern (2006).
38. IPCC (2007a, b).
39. World Bank (2010).
40. Odhiambo (2016); UNDP (2013a).
41. FAO (2014a), p. 122.
42. FAO (2014a), p. 122.
43. UN ESCWA (2015b).
44. FAO (2014a), p. 122.
45. UN ESCWA (2015c), p. 57.
46. UN ESCWA (2015c), p. 57.
47. UN ESCWA (2015c), p. 60.
48. World Bank (2016b), p. 2 and p. 6; UN ESCWA (2015c), p. 60.
49. The Islamic Republic of Iran is included in the World Bank's aggregate for the Middle East and North Africa.
50. World Bank (2016), p. 2, p. 6.
51. UN ESCWA (2015c); EAD (2013).
52. World Bank (2017b). Numbers for 2013 (latest available).
53. UN ESCWA (2015c), p. 66.
54. UN ESCWA (2015c), p. 66.
55. UN ESCWA (2015c), p. 66.
56. The full database is available online and free to download from WHO (2016).
57. WHO (2006), p. 9.
58. FAO (2014b); UN ESCWA (2015a).
59. UN ESCWA (2015d), p. 3.
60. Santos and Ceccacci (2015) discusses the background to this in more detail (p. 18).
61. UN ESCWA (2015d), p. 5.
62. UN ESCWA (2015d), p. 5.
63. UN ESCWA (2015d), p. 5.
64. UN ESCWA (2015d), p. 5.
65. World Bank (2000), p. 2.

Chapter 2

66. World Bank (2017b).
67. World Bank (2017b). See also UNESA (2014).
68. AFD (2013).
69. Al-Soud (2004), p. 593.
70. Saheb-Koussa et al. (2011).
71. Stambouli (2011).
72. UNDP (2014).
73. World Bank (2017a).
74. See further discussion below.
75. World Bank (2017a).
76. World Bank (2017c).
77. Ali et al. (2014), p. 5.
78. World Bank (2017a).
79. World Bank (2017a).
80. IRENA/UNEP (2015), p. 27.
81. IRENA/UNEP (2015), p. 27.
82. IRENA/UNEP (2015), p. 27.
83. World Bank (2000).
84. Schleussner et al. (2016).
85. Alley (2010); Boucek (2009); Colton (2010); Phillips (2007); ReliefWeb (2015); UNSC (2016).
86. UNSC (2016).
87. ReliefWeb (2016a), p. 9.
88. World Bank (2017a).
89. World Bank (2017a); World Bank (2015).
90. Hamdan et al. (2012); Fardoun et al. (2012); Bouri and El-Assad (2016).
91. World Bank (2008).
92. Khadduri (2013).
93. Khadduri (2013).
94. UN ESCWA (2015f), p. 33.
95. World Bank/EBRD/EIB (2013).
96. Ali et al. (2014), p. 5.
97. UN ESCWA (2016a), p. 15.
98. ReliefWeb (2016b), p. 35.
99. ReliefWeb (2016b), p. 35.
100. UN ESCWA (2016b), p. 49.
101. ReliefWeb (2016b), p. 35.
102. UNICEF (2016), p. 3.
103. UNICEF (2016), p. 4.
104. UNICEF (2016), pp. 7–8.
105. Gualberti (2006), p. 140.
106. IMF (2014c), p. 5.
107. UNDP et al. (2016), p. 4.
108. UNDP et al. (2016), p. 2.
109. UNHCR (2017a).
110. UNHCR (2017b).
111. UNHCR (2017c) see also UN ESCWA (2014); UN ESCWA (2015e).
112. UNRWA (2017).
113. UNRWA (2016).
114. UN ESCWA (2015f), p. 36, p. 39.
115. UN ESCWA (2015f), p. 36, p. 39.
116. UN ESCWA (2015f), p. 39.
117. Lahn and Grafham (2015), pp. ix–xii; see also Lehne et al. (2016); for a case study of refugee camps in Jordan, see Lahn et al. (2016).
118. FAO (2014c), p. 99.
119. Lahn and Grafham (2015), ix-xii. See also Lehne et al. (2016); for a case study of refugee camps in Jordan, see Lahn et al. (2016).

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120. World Bank (2016a), p. 9. The World Bank's regional group of Middle East and North Africa economies includes the Islamic Republic of Iran.

121. World Bank (2016a), p. 9.
122. UNIDO (2017).
123. Deloitte.
124. E.g. KAPSARC-UN ESCWA (2017).
125. E.g. World Bank (2016a).
126. E.g. World Bank (2016a).
127. The authors thank Doug Koplow for his helpful input to this paragraph.
128. See Chapter 5 for a thorough discussion.
129. See Chapter 2 for a discussion of reliability of electricity services in the Arab region.
130. Sudan has witnessed declining energy-intensity rates since 2010; the data need to be, considered as distorted however, by the secession of the South in 2011, and hence a cut in Sudan's energy consumption and GDP as a result.
131. World Bank (2017a).
132. World Bank (2016a), p. 33.
133. World Bank (2016a); World Bank (2017d).
134. World Bank (2017d).
135. World Bank (2017d), p. 8.
136. World Bank (2016b).
137. As per Décret n° 2009-2269 of 31 July 2009.
138. UNEP/Copenhagen Centre on Energy Efficiency (2015), p. 38.
139. World Bank (2008,2009a); CEDRO (2015); Bouri and El Assad (2016); Fardoun et al. (2012).
140. Razavi (2012).
141. Sharkawy and Sarhan (2015).
142. IEA (2015a), p. 199.
143. General Secretariat for Development Planning (2011), p. 21.
144. General Secretariat for Development Planning (2011).
145. IEA (2015a), p. 202.
146. IEA (2015a), p. 203; Al-ghamdi et al. (2015).
147. IEA (2015a), p. 203.
148. See Banerjee et al. (2017) for an overview of energy-efficiency regulatory approaches pursued in different regions, including the Middle East and North Africa.
149. World Bank (2016a).
150. IEA (2015a), p. 207; Kajenthira et al. (2011a).
151. IEA (2015a), p. 207.
152. IEA (2015a), p. 207; Kajenthira et al. (2011a).
153. UN HABITAT (2013), p. 64.
154. UN HABITAT (2013), p. 65.
155. UN HABITAT (2013), p. 65.
156. UN HABITAT (2013), p. 65.
157. IEA (2015a), p. 205.
158. ICCT (2014), 1–2.
159. IEA (2015a), p. 204.
160. IEA (2015a), p. 204.
161. UN ESCWA (2015g), p. 10, using data in the Arab Union of Electricity Producers' Bulletin.
162. Khalfallah et al. (2016).
163. See Box 13 in Chapter 5 for more details.
164. Arab Union of Electricity (2013). Statistical Bulletin 2013 (issue 22).
165. Santos and Ceccacci (2015), p. 19.
166. Santos and Ceccacci (2015).
167. Santos and Ceccacci (2015), p. 15.
168. Santos and Ceccacci (2015), p. 27.
169. Santos and Ceccacci (2015), p. 27.
170. Santos and Ceccacci (2015), p. 19.
171. FAO (2014a), p. 84.
172. World Bank (2009b); FAO (2015).
173. FAO (2014a), p. 10.
174. FAO (2014a), p. 38.
175. Santos and Ceccacci (2015), p. 45.
176. For detailed background, see UN ESCWA (2016c); FAO (2014b).
177. See Introductory chapter for more discussion.
178. FAO (2014a), p. 106.

Chapter 4

179. IRENA provides a global mapping tool of these resources online at http://irena.masdar.ac.ae (accessed February 2017).
180. IEA (2016c), p. 25.
181. BP Statistical Review of World Energy, 2017.
182. El-Katiri (2014a).
183. Authors' calculation based on Gaz de France (GDF) data.
184. For more background on the issue of biomass, please refer to Chapter 1 of this report.
185. World Bank (2009c).
186. Bioenergy is discussed in more detail in the Appendix. Our definition of biomass follows the IEA in comprising §a multitude of woody materials generated by industrial process or provided directly by forestry and agriculture, including firewood, wood chips, bark, sawdust, shavings, chips, sulphite lyes (also known as black liquor), animal materials/wastes and other solid biomass.
187. Various countries' experiences are available, e.g. UNDP/World Bank (2005a, b); UNDP et al. (2016); GRET (2016).
188. World Bank (2017a), pp. 52, 117; IPCC (2011), p. 44.
189. World Bank (2017a), p. 52.
190. E.g. Ramani and Heijndermans (2003); UNDP (2010), pp. 150, 213; UNDP (2013b).
191. Gualberti et al. (2006), p. 145.
192. El-Katiri (2014b); El-Moudden Saloua (2004); Fritzsche et al. (2011); Le Polain de Waroux and Lambin (2012); Schilling et al. (2012).
193. El-Katiri (2014b), p. 285.
194. World Bank (2017a), p. 52.
195. E.g. case studies from Morocco and Yemen, see El-Katiri (2014b).
196. See Chapter 1 of this report.
197. El-Katiri (2014b), p. 285.
198. FAO (2014c), p. 99.
199. UN ESCWA (2016b).
200. UNEP (2010), p. 314.
201. UN ESCWA (2015a), p. 58.
202. IRENA/RCREEE (2013).
203. Mills (2012).
204. El-Katiri (2017).
205. MESIA (2015), pp. 7–9.
206. Chadha (2014).
207. CIF (undated-a).
208. Mittal (2014).
209. CIF (undated-a).
210. World Bank (2016d).
211. Dodd (2016).
212. Parkinson (2016).
213. REN21 (2015, 2016).
214. Graves (2016).
215. Diapola (2017).
216. Diapola (2017).
217. IEA (2015b), p. 110.
218. IEA (2014), p. 118.
219. IEA (2015b), p. 110.
220. UNDP (2014), p. 15.
221. IEA (2015b), p. 72; IEA (2016c), p. 90.
222. IEA (2014), p.118.
223. IRENA (2015a, b).
224. El-Katiri (2014b); Al-Soud and Hrayshat (2004); Ali et al. (2014).
225. GRET (2016).
226. IRENA/UNEP (2015), p. 9; UNDP et al. (2016).
227. UNDP et al. (2016), p. 3.
228. UNDP et al. (2016).
229. UNDP et al. (2016), p. 2.
230. The documents are available online from the UNAMID and UNDP websites UNAMID (2011); UNDP (2013c).
231. UNDP et al. (2016), p. 5.
232. UNDP et al. (2016), p. 6.
233. UNDP et al. (2016).
234. World Bank (2017a).
235. UNDP (2014), p. 14.
236. ADFD/IRENA (2017).
237. IRENA (2015c).
238. IRENA (2015c).
239. UN ESCWA (2015d).
240. CIF (2009), p. 6.
241. IRENA (2016b), pp. 16-17.
242. See Chapter 1 for a more thorough discussion.
243. IRENA (2016b), p. 17. These calculations are based on GCC renewable-energy targets in 2016.
244. UN ESCWA (2015d) ; IRENA (2015c).
245. IRENA (2015c).
246. IRENA (2016b), p. 17. These calculations are based on GCC renewable energy targets in 2015.
247. UNDP (2014), p.14.

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248. World Bank (2017b).
249. E.g. McKinsey Global Institute (2008); Bean (2014); Dubey at al. (2016).
250. CIF (2009).
251. See Chapter 4 for more detail.
252. IEA (2015b), pp. 110–111.
253. IEA (2016c), p. 28.
254. UN ESCWA (undated), pp. 18–20.
255. Korkor (2014).

256. Krarti (2014).
257. World Bank (2017b).
258. World Bank (2017a).
259. Kajenthira et al. (2011b).
260. A full set of regulations is available on Abu Dhabi's Urban Planning Council's website at http://estidama.upc.gov.ae/?lang=en-US (accessed March 2017).
261. See footnote 242.
262. Barnard (2017).
263. Barnard (2017).
264. E.g. Inchauste et al. (2017).
265. IMF (2014b), p. 43.
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267. Inchauste et al. (2017), p. 223.
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This publication provides an overview of the progress made by the Arab region in recent years and decades in the area of sustainable energy management and universal energy access. As the Arab region depletes its energy savings and water resources and pollutes its air faster than any other region in the world, this publication urges policymakers to draw lessons early enough to manage the resources the region has carefully and sustainably nurtured.

The publication focuses on three key pillars that underlie both the Sustainable Energy for All initiative and the United Nations Sustainable Development Goals that came into effect in January 2015: scaling access to modern energy through electrification and access to modern clean cooking fuels and technologies ; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix.

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