Economic and Social Commission for Western Asia

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ESCWA

Energy Vulnerability in the Arab Region

E/ESCWA/SDPD/2019/1

Economic and Social Commission for Western Asia

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United Nations
Beirut

United Nations publication issued by ESCWA, United Nations House, Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: www.unescwa.org.

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Acknowledgments

This publication was developed by the Energy Section in the Sustainable Development and Policies Division (SDPD) at the United Nations Economic and Social Commission for Western Asia (ESCWA). The main contributing authors are Ms. Radia Sedaoui, Chief of the Energy Section in Sustainable Development and Policies Division (SDPD), Ms. Laura El-Katiri, ESCWA Consultant and Mr. Mongi Bida, First Economic Affairs Officer in the Energy Section, SDPD.

Support on data and statistics were provided by Ms. Wafa Aboul Hosn, Chief of Economic Statistics, ESCWA Statistics Division, Ms. Maya Antoine Mansour, Research Assistant in the Energy Section, SDPD, Mr. Ahmed Moummi, Economic Affairs Officer in the Economic Development and Integration Division (EDID) and Mr. Rabi Bashour, Economic Affairs Officer in Emerging and Conflicts Related Issues (ECRI) Division.

Valuable inputs and thorough reviews were provided by Mr. Fidele Byiringiro, Economic Affairs Officer and Gender Focal Point in SDPD, Mr. Yarob Badr, Regional Advisor on Transport And Logistics, EDID, Mr. Khalid Abu Ismail, Chief, Economic Development and Poverty Section, EDID and Mr. Nicholas Howarth, Research Fellow at King Abdullah Petroleum Studies Research Center (KAPSARC).

Summary

Energy plays a pivotal role in the socioeconomic development of nations. The United Nations acknowledged this when it identified energy as "central to nearly every major challenge and opportunity the world faces today. Be it for jobs, security, climate change, food production or increasing incomes".[1] This is why the seventh Sustainable Development Goal 7 (SDG7) of the 2030 Agenda for Sustainable Development seeks affordable, reliable, sustainable and modern energy services for all and aims to reach three targets by 2030: (a) universal access to affordable, reliable and modern energy services; (b) substantially increasing the share of renewable energy in the global energy mix; and (c) doubling the global rate of improvement in energy efficiency.

Energy vulnerability results from a State's inability to safeguard the universal access to affordable, reliable and modern energy services for current and future generations. In the context of this report, energy vulnerability is defined as *the absence of adequate safeguards to ensure a country's energy demand and supply patterns are sustainable to support socioeconomic growth and development in the long run*. Energy vulnerability is a result of multifaceted challenges to current energy demand and supply patterns, in particular (a) the lack of checks on energy demand through effective mitigation; (b) an undiversified, carbon-intensive energy mix; and (c) incomplete access to affordable, reliable, sustainable and modern energy, or the high risk thereof.

This study seeks to identify the sources of energy vulnerability in the Arab region that prevent member States from ensuring universal access to affordable, reliable and modern energy services for current and future generations. It also assesses strategies to tackle energy vulnerability effectively while providing perspectives on how different groups can contribute to solving these issues. Taking the SDGs of the 2030 Agenda for Sustainable Development as a milestone, the study aims to move beyond the 2030 horizon to mainstream the concept of sustainable long-term energy management in the Arab region and to address vulnerabilities that result from the continuation of a business-as-usual scenario.

Energy vulnerability is a highly relevant concept in the Arab region and its implications warrant far greater discussion at social, economic, environmental and governmental levels. The Arab region has a high degree of intraregional heterogeneity in socioeconomic development and associated large differences in access to affordable, reliable, sustainable and modern energy. Even so, the region has rapidly increased its energy demand over recent decades, combined with institutional, regulatory, infrastructural and sociopolitical structures that, in many cases, have lagged behind the region's needs.

The escalation of political conflict in the Arab region in recent years adds an additional dimension to the challenge of addressing

energy demand in a sustainable way, with important consequences for post-conflict reconstruction and future socioeconomic growth if sustainable energy remains unaddressed.

A. Demand for energy grows rapidly and largely unchecked

The rapidly growing Arab region has created a brisk market for energy and, given the region's projected continued economic and population growth, further industrialization and rising living standards, energy demand is expected to continue to increase over the coming decades. Adequate and affordable energy supply is a precondition to improving lives, powering the economy and safeguarding political stability in a region that is more fragile today than just a decade ago.

Absent or ineffective demand-side management has been an important multiplying factor that has contributed to the inefficient use of energy resources and has played a part in contributing to energy demand growth. Economic and environmental losses due to inefficient consumption patterns could be avoidable and the financial resources consumed could be used in far better ways. Aspects of missing demand-side management in the Arab region include:

Energy pricing. Domestic energy pricing is a key factor influencing demand dynamics and a means to manage energy demand in the medium and long term. In many Arab countries, energy prices have been regulated and kept below market cost for many decades, in an effort to fulfil national development objectives such as making energy universally affordable and driving industrial growth. But regulated energy prices have had unintended severe consequences, by distorting market signals to energy users. In many cases, this has resulted in inefficient and wasteful consumption patterns tied to the perceived low value of energy and related products such as water. In many Arab countries, regulated energy prices have also led to the accumulation of a significant fiscal burden, peaking during the late 2000s, with a detrimental effect on government spending on other pro-poor sectors.

Regulation and institutional frameworks. The absence of even minimum efficiency regulations, consumer information and the enforcement of existing regulations throughout the Arab region has increased the energy intensity of regional economic growth. A long-standing lack of progress in this area has created substantial liabilities, including large energy-inefficient stocks of public and private buildings and vehicles that will continue to consume significantly more energy than necessary, even as new regulations are being issued. The Arab region displays a wide range of experience in the arena of regulating energy efficiency, with a significant gap between the potential benefits of energy efficiency regulation and the actual progress achieved. In the case of high-income Arab countries, progress in energy efficiency also vastly lags behind income levels, and hence expected progress and level of sophistication of regulatory tools.

Public transport infrastructure. The absence of effective public transport infrastructure throughout many parts of the Arab region is a critical factor that drives up regional fuel consumption as an increasing number of people need mobility to access education and work opportunities. Lack of access to safe, effective and enough public transportation infrastructure

is also a developmental concern, for it affects societies' poorest, as well as women and children, most detrimentally. This absence is evident in the high and rapidly rising rate of reliance on motor vehicles in many Arab countries. At the same time, the low energy efficiency levels of much of the public vehicle stock, where it even exists in the Arab region, implies that more public resources are spent on fuel rather than the provision of better transport infrastructure and many opportunities in smarter public transport, such as job creation, remain underutilized.

Energy conservation and environmental awareness. The Arab region's fast socioeconomic development over the past three decades has triggered a rise in energy consumption but this has not been accompanied by a parallel shift in public awareness of the need for rational energy use and related topics such as environmental protection. Information management and consumer motivation are critical components in upgrading an economy's energy performance, in particular because both behaviour change and investment in upgraded technology require time to recoup initial investment costs. Many innovative solutions, such as rooftop solar panels, require consumer action that is frequently hampered by lack of information. The near absence of effective, independent consumer protection agencies throughout the Arab region – in many cases precluded by restricted space for civil society and independent media – is illustrated in the wide gap between the region's progress in areas such as education, health and technology access on the one hand and the effective management of energy markets on the other.

B. Arab countries' high dependence on oil and natural gas is costly in the long run

The Arab region economies are vitally dependent on fossil fuels, both as a source of domestic energy supply and as a source of revenue for oil- and gas-producing countries. More than 95 per cent of regional energy supply is derived from oil and natural gas, making the Arab region the most fossil fuel-dependent region in the world. The absence of alternative energy sources, especially renewable energy, is a feature that characterizes Arab economies across the board, whether exporter or net importer of energy. The increasing cost of hydrocarbon consumption also raises questions of the long-term affordability and sustainability of the current energy mix, as depletable energy sources need to be imported in increasing volumes from international markets, or else reduce domestic hydrocarbon supply available for export.

In addition to supplying the domestic energy markets in the Arab region, oil and gas are a substantial source of revenue for the Arab countries that produce them, and in many cases these economies are dominated by the hydrocarbon sector. Oil and gas exports account for between 65 to almost 90 per cent of government revenues in the economies of the Gulf Cooperation Council (GCC) countries overall, and for over 80 per cent of export revenue in Saudi Arabia, Kuwait and Qatar.[2] This level of dependence on fossil fuels – both as a source of energy and of revenue – is a fundamental vulnerability in the Arab region, economically, fiscally and environmentally.

The Arab region's high degree of dependence on fossil fuels comes with a heavy bill attached, which includes:

Fiscal cost and volatility. Energy imports put serious strain on fiscal resources as well as foreign currency reserves in import-dependant countries, since fossil fuels are typically purchased on international markets using foreign currencies. Fossil fuel exporters face converse challenges: their exceptional dependence on fossil fuels for the fiscal health of the State and the economy exposes Arab oil and gas producers to highly fluctuating revenue streams determined by external markets. Since they rely on external markets for a substantial share of their revenue generation, they are highly vulnerable to fluctuating oil prices, as well as external dynamics that affect consumer markets, such as major economic downturns and structural shifts away from fossil fuels.

Lacking economic diversification in large fossil fuel producers. In many fossil fuel producers in the Arab region, the oil and gas industry is the single most important sector generating gross domestic product (GDP). Revenue from the export of fossil fuels determines government income and the investment in a range of non-oil sectors, so prolonged periods of low international oil prices often translate into periods of low growth or recession in Arab oil- and gas-producing countries. This setup is economically unsustainable in the long run and also fails to create the kind of job opportunities the Arab region's young and highly educated population anticipates.

Increasing import-dependence. The region's overwhelming reliance on oil and natural gas for their domestic energy needs has also resulted in the growing need for energy imports, especially for the transport sector and natural gas. This not only applies to the region's traditional energy importers, but also to a growing number of net exporters of fossil fuels.[3] Rising energy imports increase the vulnerability of countries to external supply shocks, however, and expose them to fiscal volatility as a result of energy price movements on world markets. In the long term, they are also a source for concern over national energy security, a consideration that becomes all the more relevant for policymakers to consider if cost-effective alternatives, such as renewable energy, are increasingly available.

Erosion of fossil fuel export potential. The combination of unmanaged demand for energy, and of the continued reliance on oil and gas as the sole source of energy to supply this demand also threatens to curb fossil fuel producers' ability to retain their export capacity – with potentially vast implications for future fiscal revenues and fiscal stability.

Increasing air pollution… Ambient air pollution remains a separate and serious, though largely unrecognized, concern in the Arab region. Annual mean exposure to air pollution, measured by fine particulate matter (PM) air pollution (measured here in PM2.5) – generated by dust storms, motor vehicles and manufacturing – in the Arab region exceeds the World Health Organization (WHO) guidelines in 100 per cent of cases. Existing gaps in data further suggests that a significant portion of Arab populations' exposure to severe air pollution remains unassessed. This is a highly concerning result, and even more so given that any substantial responses have so far been missing across the Arab region.

… and a rising carbon footprint. In addition to air pollution, Arab economies' high reliance on fossil fuels has also contributed to the Arab region's growing carbon footprint, turning Arab countries into the second fastest growing regional emitter of greenhouse gasses (GHG). While the Arab region's total emissions are small compared to large industrialised economies, its domestic carbon footprint is increasing rapidly. On a per capita basis, the GCC economies are among the highest carbon dioxide (CO_2) emitters in the world, having by far overtaken highly industrialised nations. This warrants more climate-conscious decision-making in the future, even more so as the Arab region is highly vulnerable to climate change.

C. Lack of energy access is a major obstacle to sustainable development

Despite enormous progress and achievement in universalizing access to modern energy across the Arab region, more than 30 million people remain without basic access to electricity. Particularly large gaps remain in the Arab Least Developed Countries (LDCs) of Mauritania, the Sudan and Yemen. The escalation of political conflict and instability in recent years in many parts of the Arab region has further increased the number of people with insecure energy access and put millions more at risk of loss of secure access to modern energy.

An additional and more recent factor affecting people's energy security has been the ongoing reform of domestic energy prices across Arab countries. Without adequate mitigation measures, these reforms have the potential to negatively affect poor and middle-income households the most, rolling back previously safe access to modern energy and causing considerable economic hardship in addition to declining living standards across increasing portions of the population.

Inadequate access to energy affects wider socioeconomic progress across a range of sustainable development goals, including poverty mitigation and the universalisation of access to education, health care and, ultimately, sustainable economic growth across the Arab region. It is also a particular concern in the context of gender progress, as women often carry a disproportionate share of the burden associated with energy poverty and pay the consequences by means of their deteriorating health, lack of access to education and paid work opportunities.

D. Demand management is a key strategy to decouple energy consumption from economic growth in the Arab region

Managing energy demand growth and decoupling demand for energy from economic growth effectively in the Arab region is a challenging task. Countries looking to actively tackle domestic energy demand growth face not only the need to review and reform existing market structures and energy user incentives, but also to change consumption behaviour while at the same time addressing parallel, and at times seemingly opposite, development objectives such as protecting household incomes while promoting industrial competitiveness. Changing the way energy is produced, priced, traded and consumed is a considerable challenge, even more so in a region with large populations living on middle and lower incomes. Some of the priority areas for action to manage demand for energy more effectively in the Arab region include:

Domestic energy prices. Reforming decades-long practices of supplying energy at low cost to domestic consumers is a complex task, given different user segments – households, businesses and industries – will all be affected by increases in different ways. Successfully reforming energy subsidies without impacting affordability and hence energy access for low- and middle-income groups and without disrupting industry competitiveness requires careful economic planning. In recent years, an increasing number of Arab countries have begun to reform their domestic energy prices, with wide variance in the level and depth of reform, but considerably more work remains to be done. Capacity needs to be built within governments to monitor reform progress and to mitigate the reform of energy prices effectively so that future reforms do not cause hardship and a drop in living standards in an increasing number of Arab countries.

Energy efficiency, performance standards and practices. The potential to save energy, with financial savings accruing both to governments and to final consumers in the Arab region, is one of the most powerful mechanisms to help consumers manage higher energy prices. The challenges involved in issuing efficiency regulation in Arab countries are significant. Energy efficiency regulation in the transport, building, industrial and power sectors is complex and requires considerable capacity-building inside government bodies to plan, develop, implement and manage energy efficiency activities and initiatives. Part and parcel of this development is human resource development inside government bodies and the strengthening of communication channels between governments, regulators and final energy users. Effective enforcement of regulations is critical to policy success. Closely related to effective energy efficiency policies is the parallel reform of energy pricing, which is essential to provide financial incentives to final users to use energy efficiently.

Sustainable public transport infrastructure. Public transport infrastructure is key to ensuring the dual developmental objectives of ensuring people's mobility while managing domestic energy demand for transport fuels. Providing sustainable public transport solutions is also critical to ensure particularly the mobility of women and children, who are often disproportionally affected by the absence of safe transport options, leading to lack of access to education, work and health care. Sustainable public transport solutions are also critical to the reconstruction process currently underway in several Arab countries, or in those having recently experienced war and political conflict resulting in the systematic destruction of infrastructure. Important areas of government action are the expansion of safe, effective and sufficient public transport options in cities and in rural areas as well as the safeguard of more energy efficient forms of public transport, such as fuel-efficient public vehicle fleets and, where feasible, the electrification of public transport.

Information, awareness and the role of civil society. Improving the collection and dissemination of information and data 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. This is a call for more active efforts by governments and civil institutions to collect and publish data and information; to develop institutional capacity for qualitative and quantitative monitoring and dissemination; and for a more robust forum for meaningful social debate in the public, in particular in national media.

E. Arab countries will need to diversify how and what energy they use

Effective supply-side management is a parallel imperative in the region's striving for more sustainable energy systems. The good news is that many good policy routes exist to help countries do more with less, all while serving national socioeconomic development priorities and reducing the region's carbon footprint.

Diversifying the Arab region's energy mix. Diversifying the national energy mix has become an increasingly important strategic goal for several Arab countries in recent years. Rising world market prices for oil and gas during the 2000s and early 2010s and the parallel increase in the import and opportunity cost of relying on oil and gas for the bulk of national energy needs have prompted most Arab countries to look for sustainable energy alternatives as part of their incremental energy supply. The prospects are continually improving as costs for alternative energy technologies, particularly renewable energy, keep falling. Renewable energy also has a potentially large role to play in Arab countries with incomplete electricity access, and in conflict-affected countries, through greater use of decentralised solutions.

Increasing the share of alternative sources of energy is still not an automatic development, irrespective of national plans and targets, and is likely to require significantly more political support and financial resources than are currently available. Some of the most important actions to encourage a diversification of the Arab region's energy mix include overarching policy support; increasing private sector engagement; taking active steps to help markets overcome investment hurdles by making available financing solutions for different user groups; institutional capacity-building; and intraregional trade and cooperation in the area of clean energy, among others. A number of Arab countries have already begun to demonstrate the potential renewable energy holds in the region and the synergies renewable energy has with other development goals, such as the creation of jobs and new industries.

Regional energy trade. Intraregional cooperation over energy could be an important factor underpinning more sustainable, resilient and cost-effective energy systems in the Arab region, contributing towards economic growth, shared prosperity and reduced poverty. Enhancing regional trade in energy between Arab countries, such as through interconnected electricity grids, would entail substantial benefits for all parties, including greater security of supply; access to cleaner energy produced in bulk where it is cheapest; and considerable potential for job creation from the development of local manufacturing industries for components of technologies whose greater deployment could be driven by increasing regional cooperation in renewable energy.

Energy access and the quality of supply. Modern energy access is essential for the achievement of virtually all development goals, including the fight against poverty (SDG 1), in support of greater gender equality (SDG 5), decent work opportunities and economic growth (SDG 8) and the development of modern industries, innovation and infrastructure (SDG 9). Making progress in the achievement of universal modern energy access in the Arab region requires significant efforts by governments, particularly in the Arab LDCs, to elevate universal access to electricity to a priority position on the political agenda, backing up commitments with strategic planning, clear policies and dedicated institutions.

This includes energy development scenarios, from charting the expansion of the grid to the integration of decentralized solutions into rural electrification strategies. Identifying priority areas, such as extending electricity access to schools, health centres and productive sectors, could help in maximizing social impact with limited funds. Countries with complete grid access but uneven supply should prioritise utility sector development and secure electricity access in their policy agendas.

Decentralised energy supply. Decentralised energy supply has been expanding rapidly at the global level in recent years, owing primarily to rapidly decreasing costs of renewable-based solutions – in particular solar power – and to the establishment of local supply chains which have made these solutions accessible.[4] Off-grid systems can offer expanded electricity access to rural populations in Arab LDCs and help bring back electricity supplies to conflict-affected countries. A number of international donor projects have in recent years picked up off-grid solutions to electricity access, the success of which have demonstrated the vast benefits of such projects to local communities.

In order to increase the take-up of off-grid systems in Arab LDCs beyond donor-driven initiatives, it is essential that governments introduce mini-grid and off-grid renewables in national electrification plans, in addition to on-grid capacity to enable a decentralized organization of the energy sector with clear energy access development targets. Regulatory, financial and administrative frameworks will need to be developed accordingly, in order to support community-driven financing and to boost private sector activity in distributing and selling decentralized renewable energy, especially in remote areas.

Value creation from carbon. In the Arab region, carbon capture, utilization and storage (CCUS) is of particular interest for oil and gas producers trying to reconcile the so-called "energy trilemma" – the challenges associated with meeting international climate change commitments, keeping the lights on and managing electricity costs, all at the same time.[5] Several Arab countries are experienced with carbon capture and storage and utilisation (CCS/CCUS) projects applications.

Overcoming barriers to more CCS applications across the Arab region includes market incentives that could include pricing.[6] In addition, CCS will benefit in the region from more demonstration projects that help boost knowledge and experience, and the strengthening of national legal, regulatory and financial frameworks that make CCUS more attractive for its target groups inside industries and the power sector.

F. Energy productivity could offer the region a more intuitive target indicator for improvements in how energy is used

Energy productivity has been used by policymakers alongside energy efficiency and energy intensity around the world in response to global climate change concerns.[7] While most formal targets have been set in terms of energy intensity, increasing support is found among those who think energy productivity provides a better way forward.[8] At the macro level, energy productivity is the amount of economic output, for instance GDP, achieved per unit of energy consumption – thus, the inverse energy intensity. Proponents argue energy productivity provides insights into a country's economic

competitiveness, environmental performance and opportunities for improvement and aligns more directly with economic, energy and environmental policy agendas than energy intensity and other measures.[9]

Energy productivity is, like energy intensity, influenced by many factors such as the energy efficiency of underlying economic components and processes, but also the structure of an economy, its geography and climate, its natural resource endowments and resulting industrial focus, among other factors. Fossil fuel-rich economies that produce a larger share of their economic output from energy-intensive sectors – as is the case of Arab oil- and gas-producing countries with large industries for fertilizers, aluminium and steel – will consequently exhibit lower energy productivity than economies with higher value-added sectors, for instance services, that use less energy per unit output of GDP.

Using an increase in energy productivity could provide policymakers in the Arab region with a potent, more positively connotated and more intuitive target indicator for comprehensive improvements in the areas of energy efficiency, structural economic transformations and other factors that feed into countries' energy productivity rates. Achieving this substantial potential will require a full range of price and policy measures, including energy price reforms, a significant effort on the demand side and end-user productivity, such as through more competitive products and more effective transportation, and addressing energy availability constraints. Some key elements include:

Establishing sustainable demand-side management systems for domestic energy use. Demand-side management (DSM) aims at modifying the energy consumption levels and patterns at the end-user level. It involves the combination of specific policy instruments, institutional frameworks and special technologies. Policy instruments, championed by an adequate institutional framework, consists of various types of regulation and incentives including minimum energy performance standards (MEPS) for buildings and equipment, time-of-day electrical tariffs and financing facilities for energy retrofits and equipment deployments.

Implementing large-scale energy efficiency retrofit programmes across all economic sectors. Upscaling energy efficiency across all economic sectors is a major component of any successful and sustainable demand-side management programme. In fact, most benefits that can be potentially harvested in the short and medium terms are in existing stocks of equipment, buildings, industrial facilities and vehicle fleets. Upscaling energy efficiency, through properly designed energy retrofit programmes, offers the fastest and most efficient way to cut energy costs, CO_2 emissions and manage long-term energy demand. The development of super energy services companies (ESCOs) structures can overcome many of challenges facing the upscaling of energy efficiency programmes under conventional market systems. The mandate of these institutions should focus on developing energy efficiency policies, evaluating technologies, conducting pilot programmes, setting up national targets and goals and planning their achievements, etc.

Reprioritizing structural economic diversification. Part and parcel of increasing resilience and reducing vulnerabilities related to changing global energy market conditions – including those in consumer markets outside

the Arab region – is to diversify Arab oil and gas producers' economies away from fossil fuel-based activities. Reducing reliance on export and government income from oil and gas exports reduces fluctuations in income and creates room for alternative sectors. In fact, the effective development and diversification of high value added production, associated with an increase in exports of high-quality goods and services, can largely alleviate the overall volatility in the economy and its negative impacts. This involves service-based industries throughout Arab fossil fuel producing countries and the parallel opening up of the economy towards more private sector activity. Achieving economic diversification will require the continuation of regional reforms, including improving the business climate, opening the economy to more trade and investment, improving access to finance and developing capital markets and strengthening the regulatory environment. Increasing the flexibility of labour markets while better matching the skills produced by the educational system to those needed by the private sector is also required.

G. Energy is closely tied to progress in sustainable development in the Arab region

The Arab region demonstrates that progress on energy issues can no longer be separate from other socioeconomic development goals, but is, rather, a primary condition for sustainably powering progress. Addressing energy vulnerability in the Arab region is hence a development priority that is both integral to the success of the 2030 Agenda for Sustainable Development and spans beyond it. The ability to harness the pool of natural resources through adequate choices of infrastructure, technology, governance and sustainable management practices will be key in creating economic opportunities for young people and improving their living standards. It is also a key driver for socioeconomic development and for the attainment of gender equality, empowerment of women and intergenerational equity, which are also at the heart of driving long-term prosperity in the Arab region.

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Acronyms and Abbreviations

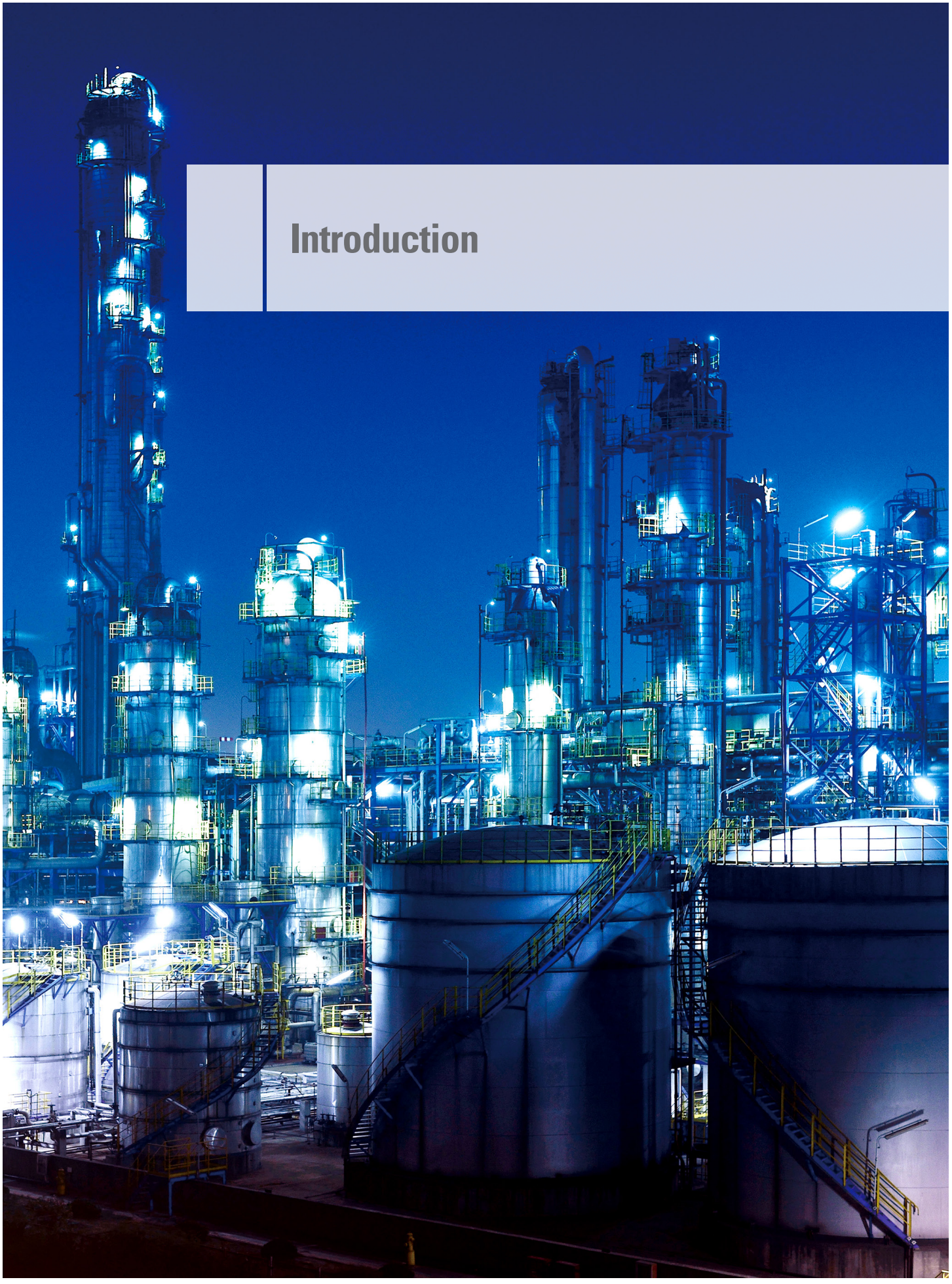
ADFD	Abu Dhabi Fund for Development
ADIA	Abu Dhabi Investment Authority
ADIC	Abu Dhabi Investment Council
ADNOC	Abu Dhabi National Oil Company
AfDB	African Development Bank
AFED	Arab Forum for Environment and Development
AMF	Arab Monetary Fund
ANME	Agence nationale pour la maîtrise de l'énergie
APICORP	Arab Petroleum Investments Corporation
AUPTDE	Arab Union of Producers, Transporters and Distributors of Electricity
bcf/d	billion cubic feet per day
bcm	billion cubic metre
BEECs	building energy efficiency codes
BP	British Petroleum
BRT	bus rapid transit
C2ES	Center for Climate and Energy Solutions
CAFE	Corporate Average Fuel Economy
CCS	carbon capture and storage
CCUS	carbon capture, utilization and storage
CDR	carbon dioxide recovery
CEO	Chief Executive Officer
CFTs	cooking fuels and technologies
CNG	compressed natural gas
CO_2	carbon dioxide
COP22	22nd Conference of the Parties
CSP	concentrated solar power
D	dinar
DEWA	Dubai Electricity and Water Authority
Dh	dirham
DSCE	Dubai Supreme Council of Energy
DSM	demand-side management
E£	Egyptian pound
EBRD	European Bank for Reconstruction and Development

EDL	Électricité du Liban
EE	energy efficiency
EIA	Energy Information Administration
EIB	European Investment Bank
EIJLLPST	eight country interconnection project
EOR	enhanced oil recovery
ESCOs	energy services companies
ESCWA	Economic and Social Commission for Western Asia
ESMAP	Energy Sector Management Assistance Program
Etihad ESCO	Etihad Energy Services Company
FAO	Food and Agriculture Organization of the United Nations
FNME	Fonds national de maîtrise de l'énergie
GCC	Gulf Cooperation Council
GCCIA	Gulf Cooperation Council Interconnection Authority
GCR	Greater Cairo Region
GDP	gross domestic product
GEF	Global Environment Facility
GEI	Global Energy Interconnection
GHG	greenhouse gas
GPC	gas processing centre
GTF	Global Tracking Framework
GW	gigawatt
GWh	gigawatt hour
ICD	Investment Corporation of Dubai
IDA	International Development Association
IDPs	internally displaced persons
IEA	International Energy Agency
IFC	International Finance Corporation
IMF	International Monetary Fund
INDCs	intended nationally determined contributions
IPCC	International Panel on Climate Change
IPIC	International Petroleum Investment Company
IRENA	International Renewable Energy Agency
ISG	In Salah Gas
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KACST	King Abdulaziz City for Science and Technology
KAPSARC	King Abdullah Petroleum Studies and Research Centre

KAUST	King Abdullah University of Science and Technology
KFUPM	King Fahd University of Petroleum & Minerals
KfW	German Reconstruction Bank (Kreditanstalt fuer Wiederaufbau)
kg	kilogram
KIA	Kuwait Investment Authority
km	kilometre
ktoe	kiloton of oil equivalent
kWh	kilowatt-hour
LDC	least developed countries
LNG	liquefied natural gas
LPG	liquefied petroleum gas
m^2	square metre
MDBs	multilateral development banks
MENA	Middle East and North Africa
MEPS	minimum energy performance standards
MOF	Ministry of Finance
MRV	monitoring, reporting and verification
MW	megawatt
MWe	megawatts electric
MWp	megawatt peak
NDCs	nationally determined contributions
NEEAP	National Energy Efficiency Action Plan
NGV	natural gas vehicles
NOx	nitrogen oxide
OAPEC	Organization of Arab Petroleum Exporting Countries
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OECD	Organisation for Economic Co-operation and Development
OIF	Oman Investment Fund
OPEC	Organization of the Petroleum Exporting Countries
OVSRP	Old Vehicles Scrapping and Recycling Programme
PACE	Pan-Arab Clean Energy Initiative
PEA	Palestinian Energy Authority
PENRA	Palestinian Energy and Natural Resources Authority
PERG	Programme d'électrification rurale global
PIF	Public Investment Fund
PM	particulate matter
PPP	purchasing power parity
PV	photovoltaic

QAFAC	Qatar Fuel Additives Company
QCCSRC	Qatar Carbonates and Carbon Storage Research Centre
QIA	Qatar Investment Authority
R&D	research and development
RAK	Ras al Khaimah
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
scf/d	standard cubic feet per day
SDG	Sustainable Development Goals
SWFs	sovereign wealth funds
T&D	transmission and distribution
TPES	total primary energy supply
TWh	terawatt hours
UHV	ultra-high voltage
UN Habitat	United Nations Human Settlements Programme
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
VAT	value-added tax
WHO	World Health Organization
YEEAP	Yemen Emergency Electricity Access Project
$\mu g/m^3$	micrograms per cubic metre

Introduction



Introduction

Energy plays a pivotal role in the socioeconomic development of nations. The United Nations acknowledged this when it identified energy as "central to nearly every major challenge and opportunity the world faces today. Be it for jobs, security, climate change, food production or increasing incomes".[10] This is why the seventh Sustainable Development Goal (SDG7) of the 2030 Agenda for Sustainable Development seeks affordable, reliable, sustainable and modern energy services for all and aims to reach three targets by 2030: (a) universal access to affordable, reliable and modern energy services; (b) substantially increasing the share of renewable energy in the global energy mix; and (c) doubling the global rate of improvement in energy efficiency.

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Building on the SDGs, this report aims to move beyond the horizon of 2030 to mainstream the concept of sustainable long-term energy management in the Arab region and to address vulnerabilities that result from the continuation of a business-as-usual scenario.

A. Why think about energy vulnerability in the Arab region?

Energy vulnerability is a highly relevant concept in the Arab region and its implications deserve far more discussion at social, economic, environmental and governmental levels. This is not only due to the Arab region's high degree of intraregional heterogeneity in socioeconomic development and associated large differences in access to affordable, reliable, sustainable and modern energy, but also due to the region's rapid increase in energy demand over recent decades, in combination with institutional, regulatory, infrastructural and sociopolitical structures that lag behind the region's energy needs in many cases. The escalation of political conflict in the Arab region has added an additional dimension to the challenge of addressing energy demand in a sustainable way, given the potentially critical consequences for future socioeconomic growth and post-conflict reconstruction if sustainable energy remains unaddressed.

1. Rapid and largely unchecked demand growth for energy

The rapidly growing Arab region has created a brisk market for energy and, given the region's projected continued economic and population growth, further industrialization and rising living standards, energy demand is expected to continue to increase over the coming decades. Adequate and affordable energy supply is a precondition to improving lives, powering the economy and safeguarding political stability in a region that is more fragile today than just a decade ago. In recent years, a number of Arab countries have witnessed increased policy focus on management of domestic energy markets with a view to longer term demand management that moves beyond safeguarding energy supply. Such policy initiatives include the introduction of more rigorous energy efficiency codes and the reform of domestic energy prices.

Countries looking to actively tackle domestic energy demand growth face not only the need to review and reform existing market structures and energy user incentives, but also to make profound changes in consumer behaviour while at the same time addressing parallel, and at times seemingly opposite, development objectives such as protecting household incomes concurrent with promoting industrial competitiveness. Changing the way energy is produced, priced, traded and consumed is a considerable challenge, even more so in a region with large populations living on middle and lower incomes. Existing infrastructure, such as stocks of energy-inefficient buildings and vehicles, make addressing the issue of demand-side management a long-term challenge.

2. An exceptional degree of dependence on fossil fuels

More than anywhere else in the world, the Arab region relies on oil and natural gas for most of its energy mix. The region's fast growth in energy demand warrants an immediate and pressing investigation into cost-effective alternative sources of energy supply, especially renewable energy. Alternative sources of energy could also play a major role in helping Arab countries increase electricity access rates through a greater use of decentralised solutions. The prospects for reducing fossil fuel dependence are continually improving as costs for alternative energy technologies, particularly renewable energy, keep falling.

3. A continued and widening gap in energy access

Despite enormous progress and achievement in universalizing access to modern energy across the Arab region, more than 30 million people live without basic access to electricity. The escalation of political conflict and instability in recent years in many parts of the Arab region has increased the number of people with insecure access, or at risk of losing secure access, to energy. Women are disproportionally affected by lack of access to secure and modern energy. Inadequate access to energy affects wider socioeconomic progress across a range of sustainable development goals, including poverty mitigation, the universalization of access to education, health care and, ultimately, sustainable economic growth across the Arab region.

In addition, without adequate mitigation measures, the ongoing reform of domestic

energy prices across Arab countries has the potential to negatively affect poor and middle-income households the most. Reform in the energy sector needs to be closely coupled with the development of more effective social safety nets that can address income poverty and unequal access to economic opportunities.

B. Who is affected by energy vulnerability?

Energy vulnerability affects many different groups which highlights the importance of making sustainable energy planning an integral part of countries' socioeconomic development agenda.

1. High-, low- and middle-income countries

Countries in the Arab region are characterized by a high degree of heterogeneity in terms of income levels, living standards and rates of socioeconomic development. As a result, different countries experience different aspects of energy vulnerability and are also differently equipped to deal with them.

Arab high-income countries, all of them net exporters of energy, face the dual challenge of managing energy demand and supply sustainably while maintaining their high living standards. Their fiscal stability endows them with the financial resources to help counter unsustainable development patterns in their own countries, as well as to potentially support others. Properly managed, energy vulnerability in these countries can translate into an opportunity to drive positive change, both domestically and elsewhere in the region.

The picture is more diverse in the group of Arab region middle-income countries, which include both energy importers and exporters as well as countries affected by recent conflict. They experience a range of vulnerabilities, including unmitigated energy demand growth, lack of diversification of energy sources and, in many cases, high risk that some population groups may lose access to affordable and modern energy. Their more limited financial resources compared to high-income countries constrain their scope of response, as does the much higher incidence of income poverty and a highly vulnerable middle class, who are bound to be directly affected by reforms that increase costs for energy and general living expenses.

Across the board the Arab least developed countries (LDCs) face their own distinct challenges with most development indicators, such as in health and education, underscoring the struggle to supply basic services to most of their population. Progress in SDG 7 – ensuring universal access to affordable, reliable, sustainable and modern energy – here forms an integral part of ensuring progress in other sustainable development goals. Responding effectively to the various facets of energy vulnerability experienced by LDCs, including at the outset the lack of access to modern energy and towards a more sustainable management of natural resources, is unmistakably a challenging task, and one which deserves far greater attention than it has received.

2. Energy importers versus exporters

Energy importers are facing challenges in meeting the fiscal cost of rising levels of energy imports, leading to heightened concerns about their energy security. In addition to fiscal challenges and losses in income, the unchecked domestic demand in energy-exporting countries reduces their export capacity. Even so, many

exporters continue to subsidize the domestic energy markets thereby reinforcing the problem. Both groups share a historically high degree of dependence on fossil fuels, though some progress has been observed in both energy importing and exporting countries that have made diversifying their domestic energy mix a policy priority.

Table 1. Selected macroeconomic indicators in the Arab region, 2014

Country	Population (million)	GDP per capita, PPP (current international $)	Total primary energy use (kg of oil equivalent per capita)	Annualized growth in total primary energy consumption, 2010-2014 (percentage)	Fossil fuel energy consumption (percentage of total)	Energy imports, net (percentage of energy use)*
Maghreb						
Algeria	39	14 203	1 321	2	100	-177
Libya	6	17 246	2 880	4	99	-103
Morocco	34	7 457	553	4	88	91
Tunisia	11	11 342	944	2	89	36
Mashreq						
Egypt	92	10 408	815	3	98	-7
Iraq	35	15 631	1 413	3	96	-229
Jordan	9	9 082	1 272	4	98	97
Lebanon	6	14 567	1 337	3	98	98
Syrian Arab Republic	19	n/a	563	-4	98	48
State of Palestine	4	4 550	n/a	n/a	n/a	n/a
GCC						
Bahrain	1	46 180	10 594	4	100	-62
Kuwait	4	74 617	8 957	2	94	-391
Oman	4	42 522	6 142	10	100	-206
Qatar	2	127 318	18 563	9	100	-399
Saudi Arabia	31	52 628	6 937	5	100	-192
United Arab Emirates	9	67 360	7 769	4	100	-184
Arab LDCs						
Mauritania	4	3 850	n/a	-4	68	n/a
Sudan	38	4 412	381	3	32	-9
Yemen	26	3 968	n/a	1	99	n/a

Sources: Authors calculations based on World Bank, 2017a; Jordan, Ministry of Energy and Mineral Resources, 2017.
Note: * Net energy imports are calculated by deducting total exports from gross imports, and then calculating the share of these in total energy use.

3. Subregional groups

While every country has its own socioeconomic context, the Arab region can be subdivided into well-defined subgroups: the Maghreb, the group of middle-income countries in North Africa; the Mashreq, also middle-income countries, with comparably diversified economies relative to the Gulf States (with exceptions such as Iraq), but also with escalating conflicts. Then, on the two extremes, the GCC countries, with their high per capita income, small population and highly fossil fuel-centred economies; in contrast to the Arab LDCs which lag behind all other parts of the region in terms of overall socioeconomic development and have very different energy consumption patterns compared to the rest of the Arab region (table 1).

4. Urban and rural populations

A total of 56 per cent of the Arab region's population already lives in cities and the United Nations projects that by 2050 this proportion will increase to over 68 per cent. Cities add further pressure to the water-food-energy nexus, as they comprise higher water, food and energy consumption patterns in a smaller space, coupled with environmental degradation and urban air pollution. This trend suggests that urban centres will become more vulnerable to energy service disruptions and affordability of access, while at the same time they will be increasingly important engines of growing energy consumption. Rural areas, on the other hand, already struggle with energy access, particularly in the Arab LDCs but also in some middle-income countries.

5. Conflict-affected and post-conflict countries

In recent years, the Arab region has witnessed an escalation of political conflict and instability that has affected an increasing number of countries. Egypt, Libya, Tunisia and Yemen have all witnessed the demise of long-standing governments. Both Libya and Yemen experienced military interventions from foreign coalition forces and ongoing instability. Political instability has severely affected the functioning of both Iraq and the Syrian Arab Republic. Mauritania and the Sudan have experienced recurrent periods of conflicts for decades, and following a referendum, the Sudan split into two states in 2011. The Arab region's various conflicts have displaced millions while many millions more live with unstable access to energy due to the damage war and conflict have inflicted on their infrastructure, a burden that will endure for many years to come. Building secure, affordable and sustainable energy systems that can support these countries' dire socioeconomic conditions will be fundamental in enabling their transition to a successful post-conflict State-building.

6. Women

While women constitute half of the Arab region's population, their interests are addressed less often than those of men. Women often carry a disproportionate burden of the consequences of unsustainable energy and resource management and are directly affected by poor or no access to modern energy to support their personal health, education and work opportunities. Women's voices are more often not heard in policymaking and their needs

subjugated to gender-blind policy priorities, including in energy and development planning. Women often have less access to power and information, are less likely to be able to tap into credit facilities and to make their own decisions within their communities. The way women – and through them their children – are negatively affected by poor energy sector management and lack of energy fundamentally affects prospects for socioeconomic development of this and future generations.

7. Households, businesses and industries

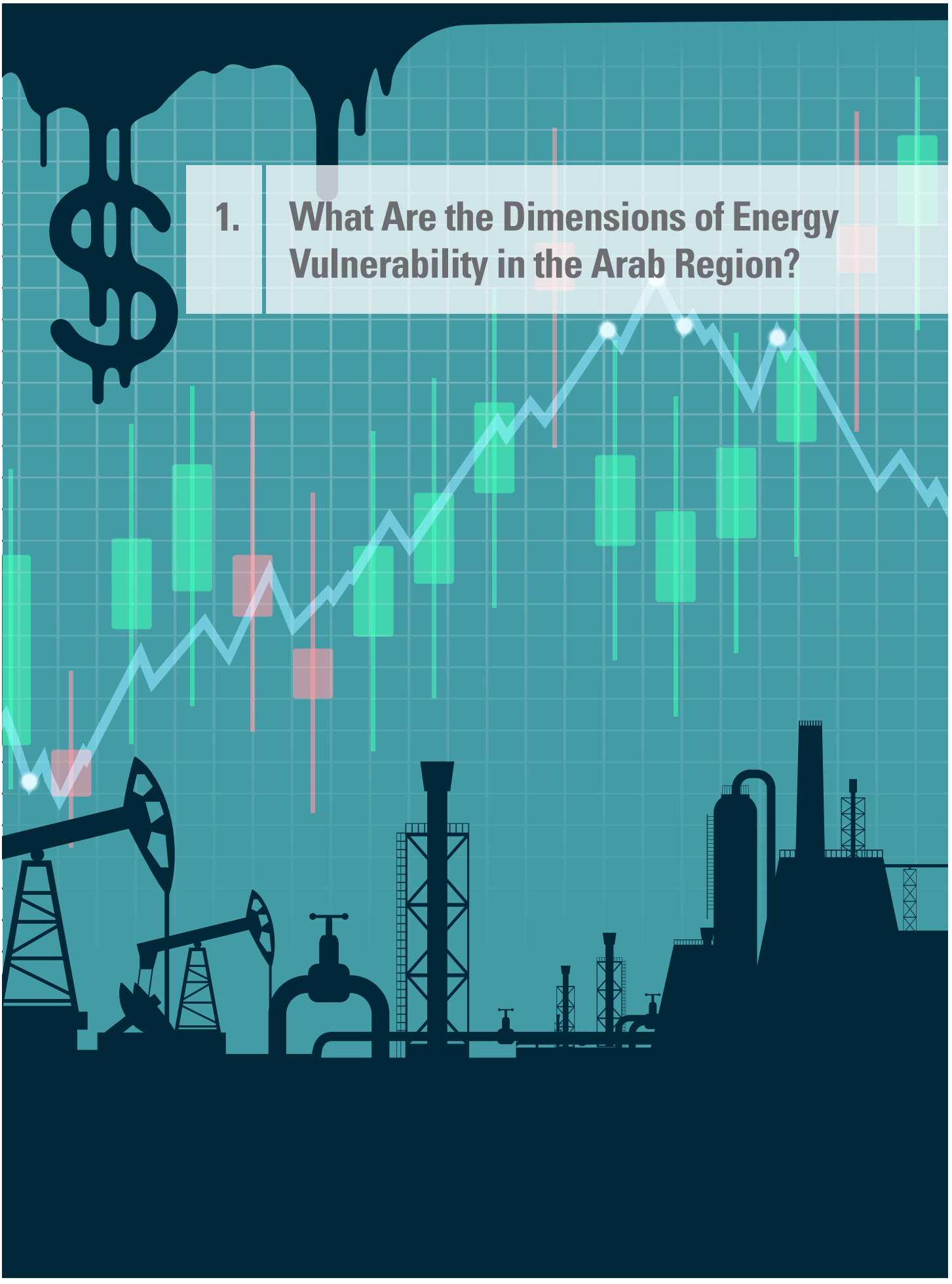
While energy vulnerability affects all actors in an economy, the way they are affected differs from one to another. Since households themselves differ in income ranges, levels of education, access to information and financial means, they respond differently to government decisions, such as shifting rules and regulations. Overall, low and lower middle-income households are among the groups most vulnerable to the negative consequences of both business-as-usual polices as well as to changes in policy. Industries, on the other hand, have much to lose from reforms, such as sudden pricing reforms, that threaten their economic viability by increasing their energy-related costs, but their vast needs for energy in parts of the Arab region also make them instrumental in achieving more sustainable energy use.

With prospects for continued economic growth, rising population and improved socioeconomic aspirations, the transition towards secure, affordable and ultimately sustainable energy systems is a priority for all Arab economies.

C. About this report

Reducing energy vulnerability is a comprehensive endeavour between different agents, including governments, industries and households. This study seeks to identify sources of the Arab region's energy vulnerability that prevent member States' ability to ensure universal access to affordable, reliable and modern energy services for current and future generations. It also assesses strategies to tackle energy vulnerability effectively while providing a perspective on how different groups can contribute. Building on the SDGs of the 2030 Agenda for Sustainable Development, it aims to move beyond the 2030 horizon to mainstream the concept of sustainable long-term energy management in the Arab region and to address vulnerabilities that result from the continuation of a business-as-usual scenario.

The remainder of the report is organized as follows: chapter 1 describes the main vulnerabilities of the Arab region in the context of sustainable energy. Chapter 2 emphasizes the need to adjust and speed up the mainstreaming of sustainable energy management in the Arab region and offers alternatives for the region's multiple actors – governments, public and private institutions, businesses and civil society – to increase their own, and their nations' resilience to self-induced vulnerabilities related to energy. Chapter 3 provides concluding remarks.



1. What Are the Dimensions of Energy Vulnerability in the Arab Region?

1. What Are the Dimensions of Energy Vulnerability in the Arab Region?

This chapter describes the main vulnerabilities of the Arab region in the context of sustainable energy. It begins by providing a background to the Arab region's fast growth in energy demand through its economic and demographic expansion. It then moves on to explore the three main facets of energy vulnerability as defined in this report as: (a) *unchecked energy demand*; (b) *an undiversified energy mix*; and (c) *missing or insecure access to modern energy*, which has in recent years increased due to political conflict and instability in a number of Arab countries, as well as surging energy costs in a range of countries.

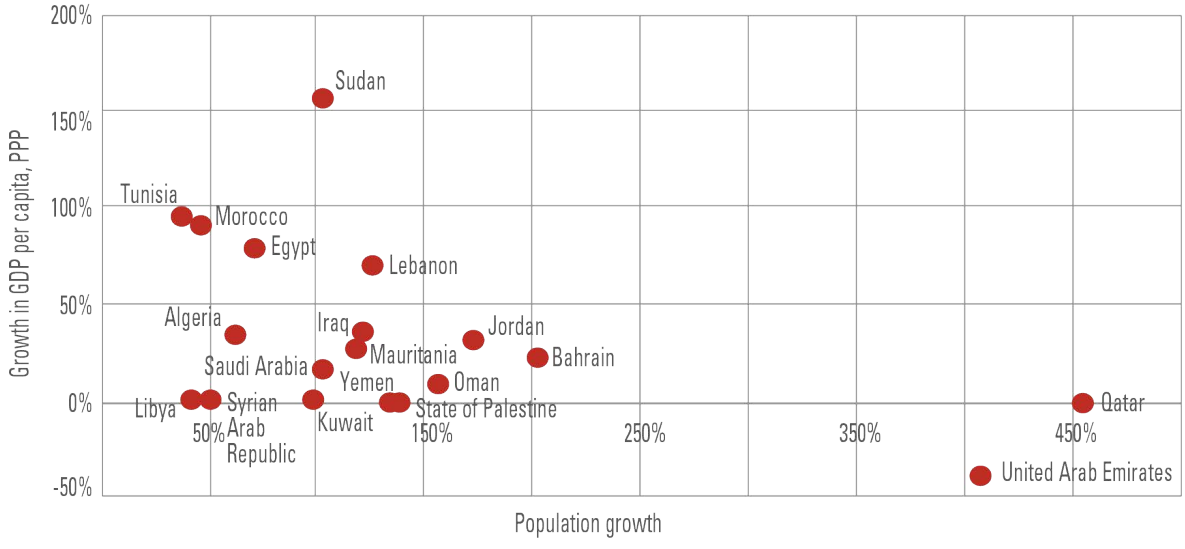
A. Economic and demographic growth

1. Population growth and rising living standards

The Arab region's population has grown considerably over the past decades, from around 216 million in 1990 to almost 400 million in 2017 with exceptionally high population increases in individual GCC countries ranging from 100 per cent in Kuwait to over 400 per cent in Qatar and the United Arab Emirates, owing to large-scale labour migration and high birth rates. At the same time, Arab living standards have risen dramatically, alongside high levels of education and health care access, particularly in upper middle- and high-income countries. Since 1990, per capita GDP purchasing power parity (PPP) in Arab countries has risen by 16 per cent in Saudi Arabia, 36 per cent in Jordan, 70 per cent in Lebanon and over 90 per cent in Morocco (figure 1).

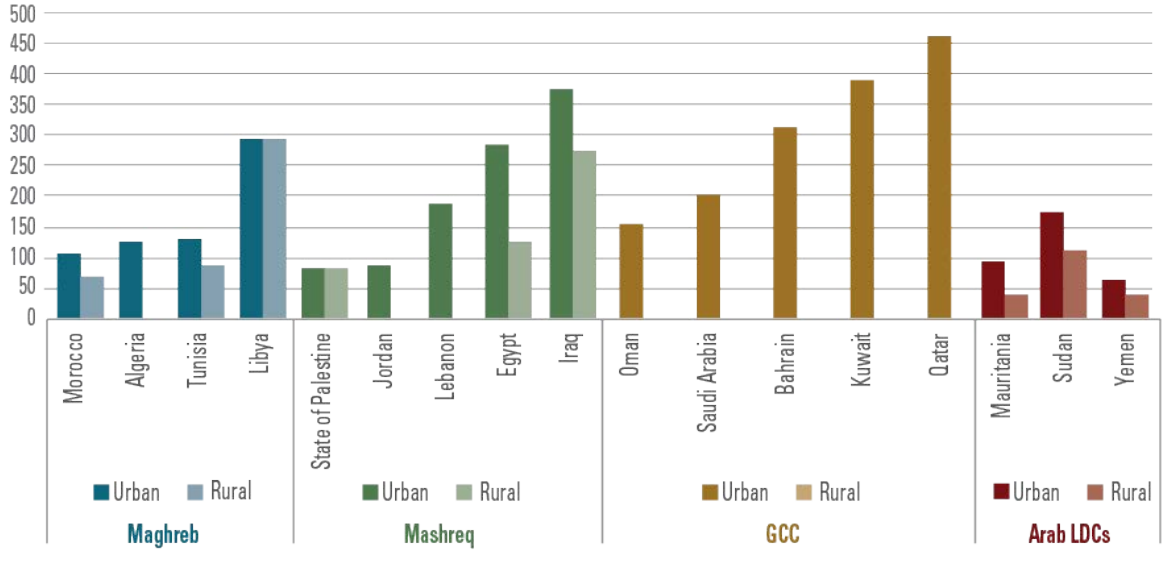
Except for Arab LDCs, the Arab region is characterised by near universal access to electricity and modern energy services, implying that more people are enjoying higher living standards and, all things being equal, consuming more energy. Water consumption has been rising in parallel,[11] with the process of water generation and distribution – in sectors ranging from residential, commercial and industrial water supply to agriculture – consuming considerable amounts of energy. The production and generation of energy, in turn, consumes water, creating a nexus of water-energy dependence in the Arab region that feeds into an overall picture of expanding demand for natural resources alongside further socioeconomic growth (figure 2).[12] A rapid increase in urbanisation rates, but also in physical mobility, including high rates of motorisation,[13] and the combination of the abovementioned factors has spurred demand for energy products on a per capita level.[14]

Figure 1. Population and GDP per capita growth in the Arab region, 1990-2017



Source: World Bank, 2018a.
Notes: Not represented due to incomplete data: Kuwait, Libya, Qatar, State of Palestine, Syrian Arab Republic and Yemen.

Figure 2. Water consumption, 2013 (litres/capita/day)



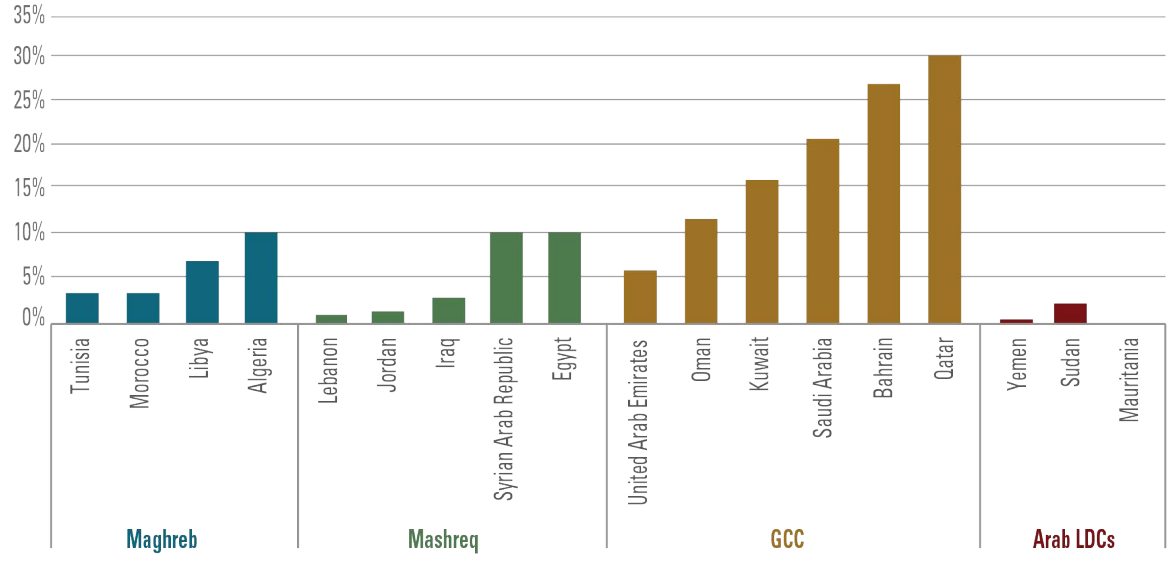
Sources: E/ESCWA/SDPD/2016/Booklet.5.

2. Economic growth and energy-intensive industrialization

Arab countries have witnessed tremendous economic growth over the past decades, through industrial growth and diversification. The region is home to industries such as agriculture, textiles and tourism as well as heavy industries and wider service-based industries. Energy has played a fundamental role in driving the growth of all of them, including seemingly less energy-intensive sectors such as agriculture, which has undergone significant technological upgrading across countries in the Maghreb and the Mashreq since the 1990s and the region's much-promoted service sectors such as the financial services, tourism and hospitality, which helped build the region's skyscrapers and develop its transport sector. All these industries play an important part in integrating Arab economies into the global economy, while ensuring revenue and economic growth and diversification, including in oil- and gas-producing countries.

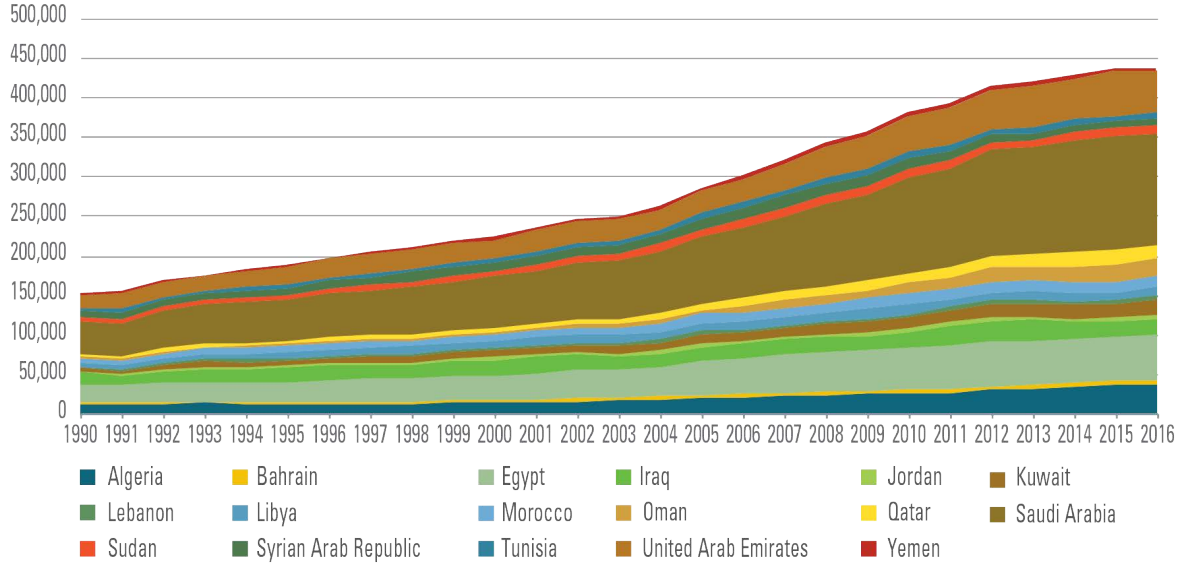
The highest demand for energy from the Arab region's growing industrial base however comes from its industries such as aluminium, steel, cement, fertilizer and petrochemicals. The share of the non-energy sector in total final energy consumption ranges from 30 per cent in oil and gas producers such as Bahrain and Qatar to a still strong 15-20 per cent in Kuwait and Saudi Arabia, reflecting the significant energy needs of the large, energy-intensive industries in these countries (figure 3). Despite the small population numbers in these countries, these energy profiles help explain the exceptionally high per capita energy consumption rates in this part of the Arab region.

Figure 3. Share in total final energy consumption by the non-energy sector in the Arab region, 2015



Source: International Energy Agency, 2018b.
Note: Data for Mauritania and State of Palestine are not available.

Figure 4. Historical total final energy consumption in the Arab region by country, 1990-2016 (ktoe)



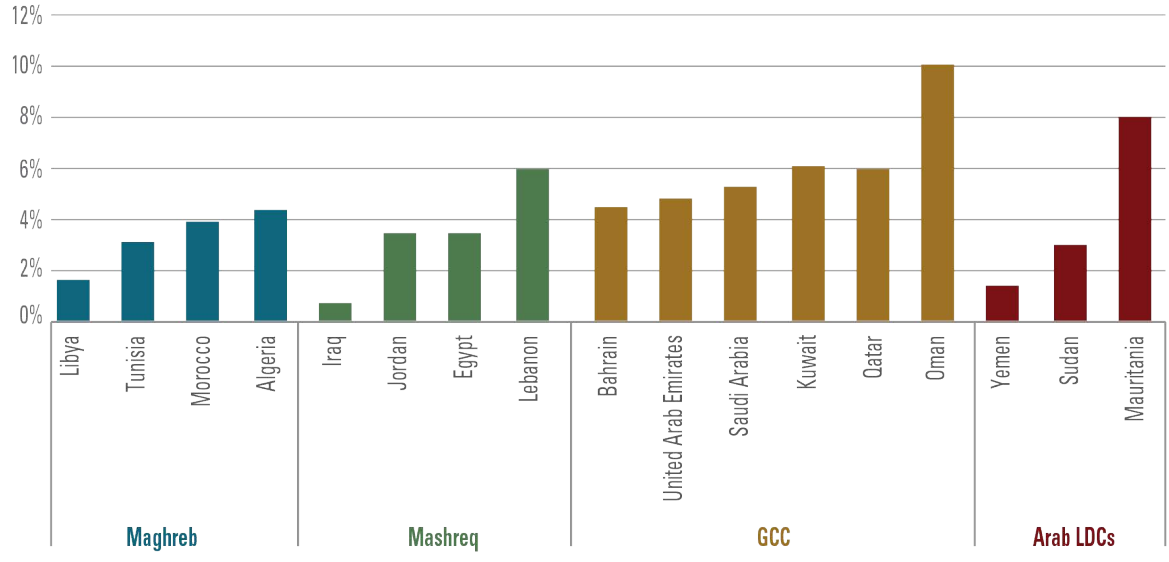
Source: IEA, 2018b.

The Arab region's fast growth in energy demand can be explained by a combination of the growth of populations and economies in tandem with rising living standards and industrial expansion across a range of energy-consuming industries. These socioeconomic development-related factors are expected to continue to characterize the region in coming decades. Decoupling growth from energy consumption will hence be one of the fundamental challenges for Arab economies, along with ensuring that future growth is inclusive through access to secure, clean and affordable energy.

B. Unchecked energy demand

Energy demand in the Arab region has risen rapidly over the past few decades – in some parts of the region faster than anywhere else in the world. Over the past 26 years, regional primary energy consumption tripled, from around 150,000 kiloton of oil equivalent (ktoe) in 1990 to around 436,000 ktoe by 2016 (figure 4). Some of the region's fastest growing energy markets can be found in the GCC countries, but surging demand for energy has also been registered in the Maghreb, the Mashreq and the Arab LDCs. In the GCC country economies, total energy consumption has quadrupled since 1990, with smaller Gulf States such as Qatar, the United Arab Emirates, Bahrain and Oman having seen particularly fast growth in consumption of between 5 and 10 per cent per annum (figure 5).

Figure 5. Annualized growth in total final energy consumption in the Arab region, 1990-2016 (percentage)



Source: IEA, 2018b.
Notes: Data for Mauritania was provided by the Ministry of Petroleum, Energy and Mines of Mauritania. No values for the Syrian Arab Republic due to data distortions during the 2010s. No data available for the State of Palestine.

In addition to macroeconomic factors of population growth and economic and industrial expansion that have contributed to the region's rising energy demand, an important element missing in the Arab region's domestic energy markets has been effective demand-side management. A number of factors account for this historical lack of domestic energy demand management practices, such as the region's historically small domestic energy markets, particularly in relation to the seemingly abundant supply of low-cost fossil fuels produced either domestically or in neighbouring Arab countries as well as pressing priorities for fast access to low-cost modern energy and building stock in pursuit of economic growth and development.

Missing or ineffective demand management in the energy sector, and other, sometimes seemingly conflicting, priorities such as the provision of affordable energy to all citizens, has been reflected in a number of structural features in Arab economies, in particular low energy prices that typically do not reflect actual energy costs for a substantial portion of energy users; an absence of energy efficiency regulation in sectors such as transport and building; lack of public transport infrastructure, which has contributed to the region's surging demand for transport fuel; and lack of environmental awareness. Below, we explore the factors behind the Arab region's unchecked energy demand in more detail.

1. Energy pricing

Pricing policies are of pivotal importance for the allocation of scarce resources, including energy. In the Arab region, prevailing practice for much of the past decades has been state pricing and provision of the supply of energy to domestic consumers. The price of energy, such as electricity, liquefied petroleum gas (LPG) and transport fuel was not necessarily determined on the basis of its marginal cost[15] to the state, but tied to a variety of factors, including socioeconomic development priorities such as safeguarding the affordability of modern energy services and promoting industrialisation through low-cost energy provision. The result has often been extremely low energy prices across different user groups and with very limited differentiation between large and small consumers leading in some instances to among the lowest-priced energy in the world.[16]

Figure 6 shows electricity tariffs across Arab countries for 2016 as an indicator for wider energy prices in these economies. Particularly low tariffs were found in Arab oil and gas producers, especially in the GCC economies, Iraq and Libya. Energy price reforms in recent years in several Arab countries mean many of these tariffs are already significantly above their historical rates (see further discussion of energy price reform in chapter 2). In contrast to this scenario are the Arab region's net importers of energy: Morocco, Tunisia, Jordan and the State of Palestine. Some higher volume consumers in these countries pay more for electricity than the average American household, reflecting more cost-reflective pricing policies in response to these countries' need to import the majority of their energy supply.

While high prices for energy constitute a socioeconomic problem for many households, artificially low energy prices encourage wasteful and inefficient consumption patterns. This is particularly the case where low energy prices or price subsidies are universal in nature and benefit large energy consumers and higher income groups. Low energy prices are often associated with the commensurate low levels of energy efficiency, owing to a lack of cost incentives and resulting resource waste.[17]

In the GCC and other oil- and gas-producing countries, electricity tariffs are largely undifferentiated between user groups, meaning high-income households and large users pay as little for energy as the lowest income household group. Often in combination with relatively high average incomes and an absence of regulatory incentives for energy efficiency, such market design can cause very inefficient consumption patterns by eliminating any financial incentives for users to upgrade technology and equipment and to adjust energy use behaviour.

The Global Tracking Framework (GTF) summarises these unintended consequences in its 2017 report, arguing:

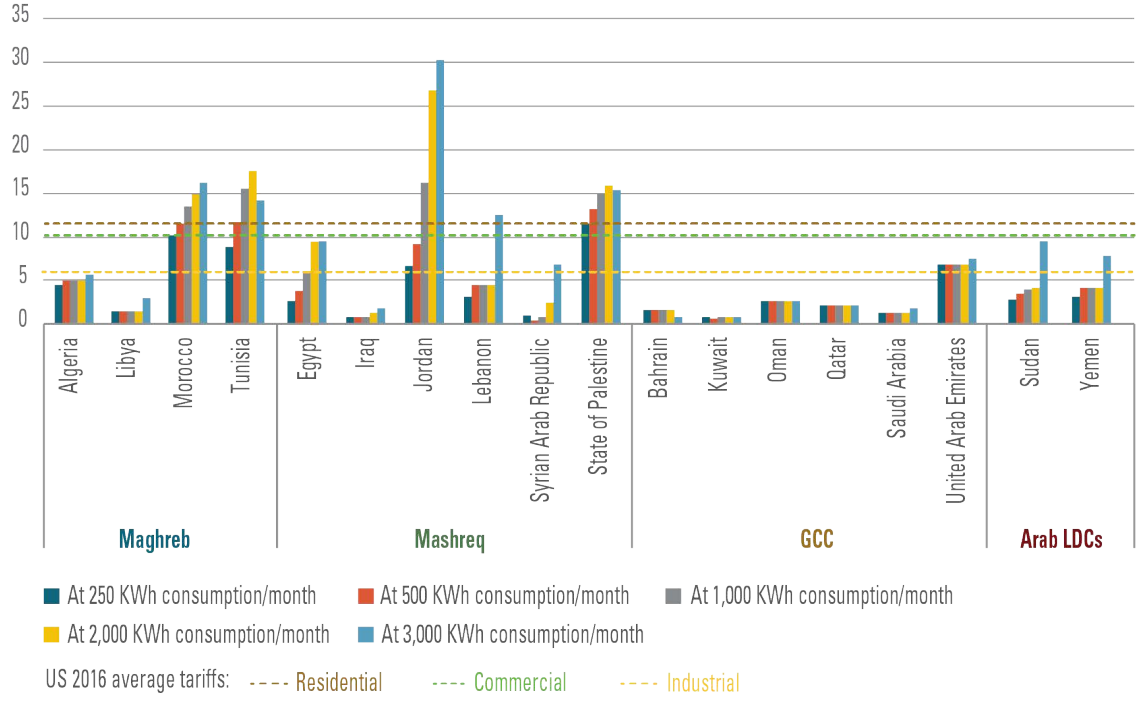
> Energy subsidies, particularly if universal in nature, also distort consumer incentives, leading to the overconsumption of energy, [and] energy waste […]. This problem is more distinct in the Arab region, because of the lowest costs of energy – and therefore highest rates of subsidization – are to 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.[18]

Universal price subsidies for fuel and electricity that do not discriminate between user groups are also a highly inefficient tool to target the poor, as the largest beneficiary groups of energy price support are those who proportionally consume the most energy higher income groups, businesses and industries.[19] At the same time, they accumulate large costs, draining fiscal resources from targeted pro-poor spending, such as investment in education and health and the maintenance and expansion of power sector infrastructure, including the expansion of grid infrastructure in Arab LDCs.[20]

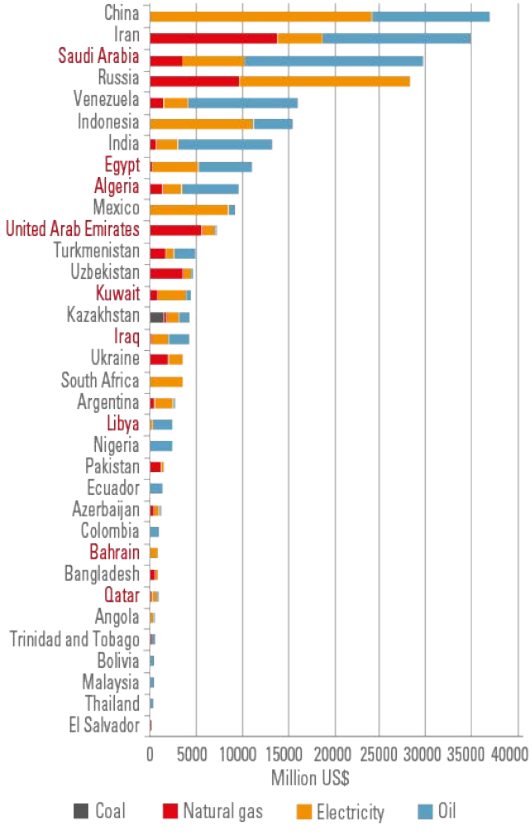
The fiscal impact of energy subsidies in the Arab region has been a source of vulnerability in its own right. The total fiscal value of energy subsidies – measured here as the difference between domestic and international prices for given fuels and electricity in Arab countries in 2016 – has been estimated at around US$70 billion (down from $133 billion in 2014 and $100 billion in 2015), or around one quarter the value of the world's energy subsidies.[21] Saudi Arabia remains the world's third largest subsidizer of energy, according to International Energy Agency (IEA) data, with total subsidies amounting to around $30 billion (down from $57 billion in 2014 and $44 billion in 2015), close to half of the region's total (figure 7).[22]

Figure 6. Average domestic utility tariffs in the Arab region, 2016 (US cents/kWh)



Sources: Arab Union of Electricity, 2016a; U.S. Energy Information Administration, 2017.
Note: No data available for Mauritania.

Figure 7. Energy subsidies by country, 2016 (million US$)



Source: IEA,2018a.

Egypt has been spending between 10 to 14 per cent of its total government expenditure between 2014 to 2016 on energy subsidies alone[23] – nearly as much as the country's total expenditure on education and health care combined.[24] Maintaining and justifying such levels of spending has become increasingly difficult in recent years, prompting a series of reform efforts as States have had to consolidate their finances in view of reduced incomes from oil and gas exports and increased costs for fuel imports (see discussion in chapter 2 section A.1). With reform efforts themselves turning into another socioeconomic liability (chapter 1 section C.3), it is clear that energy pricing will remain a fundamental issue of discontent and challenge policymakers to find sustainable medium- and long-term solutions that balance competing short-term priorities.

2. Regulation and institutional frameworks

The absence of even minimum efficiency regulation, consumer information and enforcement of minimum performance standards increases energy waste, to the detriment of both consumers and the wider economy. Long-standing lack of progress in this area also creates substantial future liabilities because once in place, core infrastructure such as building stock, public transport vehicle and private transport vehicle stock, is expensive to retrofit and will continue to result in inefficient energy consumption for long periods even if regulatory frameworks become more rigorous. Consequently, strong government institutions with the capacity and mandate to regulate, monitor and enforce minimum energy performance standards play a critical role in domestic energy demand management, and thus in the implementation of domestic energy policy objectives.

While the Arab region displays a wide range of regulatory experience in energy efficiency, there are significant gaps between the actual regulatory progress achieved and the potential benefits energy efficiency regulation could bring about. In the case of high-income Arab countries, progress in energy efficiency also vastly lags behind income levels, and hence expected progress and sophistication of regulatory tools.[25] A number of Arab countries have adopted national energy efficiency programmes and set up energy efficiency agencies with the aim of updating regulatory frameworks across different economic sectors.

However, common problems persist, including a lack in progress in actually implementing regulation, regulatory rigour and limitations in monitoring and enforcement capacity. Moreover, much potential for cross-border cooperation in harmonising efficiency standards, for instance in the case of electric appliances, remains underutilized.

(a) Energy efficiency in the building sector

The building sector exemplifies some of the problems related to energy efficiency regulations in the Arab region. Population growth and, in many countries, rural to urban migration has resulted in the rapid construction of new building stock that has lost many traditional attributes with minimal or no regulation for modern building standards. Energy efficiency regulation in the building sector should include prescriptive standards, such as requiring houses to have cavity wall insulation; or performance standards which set minimum or maximum efficiency levels for energy consumption for building structure, such as insulation, air sealing, day lighting, windows and doors, as well as heating, cooling and hot water systems.

Lack of energy efficiency regulation is a classic example of market failure and is where effective government regulation and enforcement of standards plays a critical role in ensuring a minimum level of performance. Building developers have no incentive to build more efficiently without regulation, regulatory enforcement and financial incentives to invest in more energy efficient buildings. There is a lack of stock of affordable energy efficient buildings with clear and transparent labelling for tenants. Given the large proportion of rented accommodation, tenants with average income ranges often have no choice and end up bearing the cost of rising electricity bills while having no influence on the efficiency of building materials and design.

Moreover, many of those who build for themselves in middle-income countries lack access to information about cost savings, available materials and financing options. The existence of large informal markets for counterfeit products, such as in the Maghreb and Arab LDCs, make it more difficult for individuals to safeguard the quality of materials. For many industries, financial incentives to invest in more energy efficient technology is missing, given the low prices for energy inputs, lack of financing and financial incentive schemes and, in some cases, no domestic markets for higher quality materials. Without intervention in the form of strong regulatory oversight, markets alone are unable to correct these energy usage patterns.

With limited minimum performance requirements for building stock and building materials until recently, a history of low-cost energy and climatic conditions that make heating and/or air conditioning essential across the Arab region, the result is highly inequitable. The revision of decades-old electricity subsidies while national building stocks remain poorly equipped to ensure an efficient use of energy, raises concerns of long-term affordability of electricity in the Arab region. This concern is amplified by the impact of climate change, which over the coming decades is expected to affect Arab countries with ever more extreme weather conditions, including colder winters in Maghreb and the Mashreq and hotter summers in the Gulf States and Arab LDCs.

Box 1. Unimplemented energy efficiency regulation in the Maghreb and the Mashreq

Even though regulatory and institutional frameworks have evolved considerably in the past years, they often lack rigour and include many exceptions that can significantly weaken well-intended pieces of legislation, as has been seen for instance in Algeria, Morocco and Tunisia. In addition, in many cases in the Arab region the implementation of existing legislation on the ground is still wanting.

Morocco. Morocco adopted an energy efficiency law, Law 47-09, in September 2011, but the implementation decrees have not been published, which means that the law has not been implemented nor enforced.[a] Indeed, energy efficiency measures are currently enforced only in major commercial buildings such as hotels and factories, where the local authorities require investors to incorporate energy efficiency standards in their projects in order to get licenses.

Egypt. The Egyptian government adopted an electricity law in 2015, Law No. 87, and a National Energy Efficiency Action Plan ('NEEAP') for the period of 2012-2015, which focused mainly on the electricity sector, establishing a cumulative energy efficiency target of 5 per cent and creating an energy efficiency unit within the Council of Ministers to develop strategies and related policies. Despite these efforts, a lack of clear by-laws to implement the energy efficiency goals constrained any significant progress.[b]

Jordan. Although Jordan was one of the first Arab countries in the region to specify a thermal insulation code for residential buildings back in the mid-1980s and has since seen the creation of one of the most comprehensive national building energy codes in the region, enforcement is limited. A recent study concludes that "Although compliance with all building codes is compulsory and is mandated by the national building law, enforcement mechanisms are either absent or ineffective… On-site inspection is rarely carried out to ensure that the construction follows the design requirements, and therefore the code requirements. This resulted in limited and sporadic compliance with the thermal insulation code, as well as other building codes. In a recent survey conducted in 2015 […], it was found that only 23 per cent of Jordanian dwellings are insulated either with polystyrene, polyurethane, or rock wool… Less than 9 per cent comply with the code".[c]

Sources:
[a] Dref, 2018.
[b] Regional Center for Renewable Energy and Energy Efficiency, 2015.
[c] Al-Hinti and Al-Sallami, 2017.

A recent Energy Sector Management Assistance Program (ESMAP) study examined case evidence from the Maghreb countries of Algeria, Libya, Morocco and Tunisia to provide an outlook for air conditioning demand over the coming decade, identify barriers and make policy recommendations for improved efficiency of air conditioning units in the region.[26] Among its findings, the study points out several key obstacles to increasing energy efficiency in the air conditioning sector, including inadequacy of tariffs as an instrument to incentivize the use of more energy efficient appliances; the high initial purchasing cost of air-conditioning units; lack of a harmonized regulatory framework in the Maghreb; disparities in the various taxes and other charges on air conditioners that have, in turn, created significant price differentials between neighbouring countries; and the continued omnipresence of a large, informal market for air-conditioning units in the Maghreb, to the detriment of energy performance.

The study also found that existing regulations were "either of recent vintage or are not enforced, and that the authorities have neither adopted the necessary implementing measures nor the corresponding enforcement rules".[27] In addition, the study pointed out that:

> 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.[28]

(b) Energy efficiency in the transport sector

The transport sector in the Arab region faces parallel challenges with regard to fuel use and energy efficiency. In addition to wide-ranging infrastructure constraints that reduce the efficiency of energy use in transport (see chapter 1 section B.3), many Arab countries have lagged behind in issuing efficiency regulation such as minimum fuel economy standards.

A 2009 United Nations report found that environmental standards and regulations relating to the transport sector in most Arab countries either do not exist or are not sufficiently enforced.[29] Import requirements for vehicles, different for each Arab country, are minimal, with no import restrictions in Bahrain, Morocco and the United Arab Emirates at the time the report was written in 2011, with Saudi Arabia merely specifying that imported second-hand vehicles must be manufactured after 1974.[30] While a number of Arab countries have since issued new legislation for newly purchased cars, many gaps remain. The United Nations observed in this context that "it is not unusual to find that more than 70 per cent of the light-duty vehicle fleet in a developing country does not receive regular maintenance or diagnostic testing and has an average age of about 15 years".[31]

Since the transport sector consumes a significant share of fuel, the lack of adequate regulation and fuel economy standards is a major source of vulnerability in Arab countries. While reforms and regulatory changes have become more frequent in recent years, the existing vehicle stock in the Arab region is a significant liability.

3. Public transport infrastructure

Effective public transport infrastructure is another key factor in managing energy demand in the transport sector. Arab countries share a wide range of characteristics in their transport sectors, including high rates of private vehicle use linked to the absence of available public transport services; high reliance on road transport (including for commercial transport) in the absence of railway links, inner-city trams and metro systems; a high degree of urban congestion owing to a stalled infrastructure development, including roads, parking solutions and public transport; and a high degree of reliance on liquid fuel in the transport sector, with significant but underutilised potential for electrification, in particular in public transport (railway, tram, metro and public busses).[32]

(a) Effective public transport infrastructure is another key element in managing energy demand in the transport sector

Lack of access to safe, effective and sufficiently available public transportation infrastructure is first and foremost a developmental concern. Lack of transport constrains development by

preventing the poorest, who cannot afford private personal transport, from movement. Women and children are proportionally more constrained by the absence of effective and safe public transport, who in cases of severe shortcomings of safe and affordable transport, cannot access education, health care and work.

The World Bank in a 2010 report described the quality of transport infrastructure in the Middle East and North Africa (MENA) as "deficient" that it "cannot support growing, modern economies". Moreover, it observed "serious capacity gaps in urban and rural transport infrastructure and multiple constraints to regional transport" in addition to the rapidly growing and serious problem of congestion in most large urban areas.[33] An ESCWA study in 2018 reached similar conclusions, pointing out weak and antiquated railway links (with an average of 7 km per 100,000 people in the Arab region, compared to 42 in European Union, 71 in the United States, and 15 as world average); poor road infrastructure; and low levels of Arab integration.[34]

In rural areas, especially in countries with a large rural population such as Egypt, Morocco and Yemen, all-weather access is limited by the poor condition of road networks and the inadequacy of basic transport services. A report by the Arab Forum for Environment and Development (AFED) confirms this view, concluding that:

> Although policies and measures envisioned by Arab countries aim to some extent at creating sustainable transportation systems…, deficiencies continue to exist in major areas: poor urban transport services characterized by inadequate mass public transport, congestion, and poor air quality; limited access to rural areas; significant contribution to greenhouse gas emissions […]; and weak trade flows caused by inefficient transport systems.[35]

The absence of sufficient, quality public transport is evident of many Arab countries' comparably high and rapidly rising rate of motorisation. Large numbers of people rely on low-cost vehicles as the only reliable available form of transport. This trend links the economic activity and the population growth to the availability of private modes of transport: economic growth requires that more people with jobs need more cars, consuming more fuel than commuters who would use public buses, trams and railway networks. The absence of effective railway networks also increases the use of heavy-duty vehicle transport of commercial and industrial goods, leading to significant additional draw on transport fuel. The United Nations Human Settlements Programme (UN-Habitat) estimated the number of motor vehicles in the Arab region in 2008 to be 26.7 million;[36] by 2015 the International Organization of Motor Vehicle Manufacturers estimated this number at 46.5 million,[37] an increase of almost 75 per cent in just seven years.

Much of this growth has been in personally-owned vehicles. According to the limited data available from the World Bank, the number of vehicles registered per 1,000 people increased between 25 and 33 per cent between 2003-2010 in countries like Egypt, Tunisia, Algeria, Kuwait; a whopping 65 per cent in Jordan and doubling over the same period in the Syrian Arab Republic.[38] In annualized terms, this translates into growth rates of between 4 and 8 per cent (figure 8), with significant data gaps for other Arab countries and no new World Bank data available since 2010. Dubai's vehicle density in

2015 reached 540 vehicles per 1,000 people, meaning one private vehicle for every two people living in Dubai – the highest rate in the region and one of the highest in the world.[39]

Figure 9 shows the average railway coverage per 100,000 people in the Arab region. The highest rates of railway network development can be found in Tunisia, followed by Mauritania, the Sudan, the Syrian Arab Republic and Algeria. The high proportion of lower middle-income countries among these indicates that income levels do not reflect the development of national railway infrastructure. The region's high-income countries – Bahrain, Kuwait, Qatar and the United Arab Emirates – notably have no railway infrastructure at all, indicating all transport is road-based. This suggests ample scope for improvement in railway development across the region.

4. Energy conservation and environmental awareness

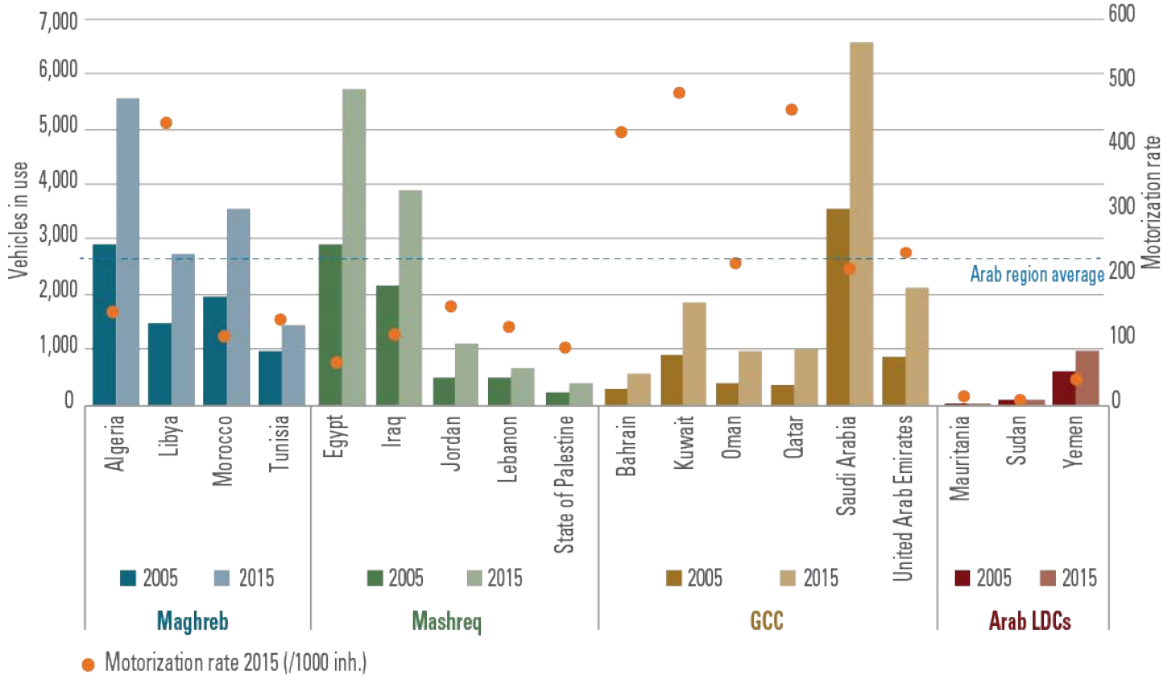
The Arab region's fast socioeconomic development over the past three decades has triggered a rise in energy consumption but it has not been accompanied by a parallel shift in public awareness of the need for rational energy use. Creating a culture of energy conservation is not automatic and builds on a combination of factors including education, information and regulatory incentives. Nor is it exclusively tied to a country's financial capacity because some aspects merely entail behaviour change. Financial resources become important once energy users wish to make investments in energy efficiency, but from a culture-centric perspective, an ethos of using energy rationally and environmental awareness centres around an intrinsic public interest in such issues such as cleaner air and energy, environmental protection and pollution management as a matter of socioeconomic priority, not as a luxury problem for countries elsewhere.

Information management and consumer motivation are critical components in upgrading the energy performance of an economy. This is because savings made from greater energy efficiency accrue only in the medium- and long-term but usually require substantial investment at the outset. Similarly, alternative energy solutions, for instance rooftop solar panels, can be economic in a variety of off- and on-grid settings but require initial investment in technology that is not yet mainstream in the Arab region. Fostering and encouraging bottom-up support for a more sustainable use of natural resources is also essential to gain momentum for policies that may include additional costs, such as for minimum-performance equipment and adjustments to energy and water prices, and therefore be unpopular in the public eye.

In some of the Arab region's large energy producers, where low household income is not an issue, the constraint has been a lack of awareness combined with missing economic incentives, because energy has been so cheap. In some cases, there is a perception that abundant low-cost energy is a citizens' birthright.

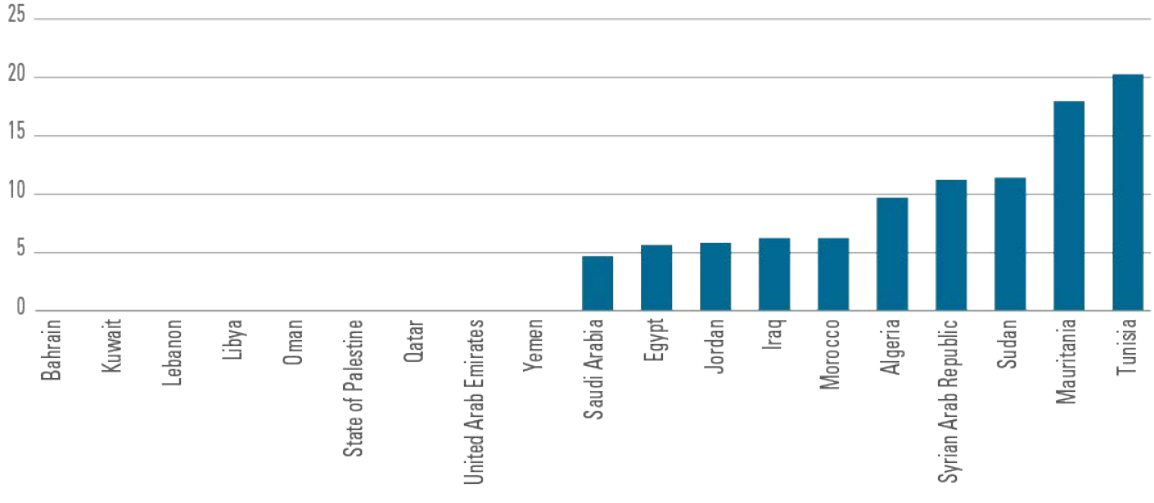
The virtual absence of effective, independent consumer protection agencies throughout the Arab region – which in many situations has been precluded by the more general restriction of spaces for civil society and independent media – illustrates the wide gap between the region's progress in areas such as education, health and technology access on one hand and the effective management of energy demand on the other.

Figure 8. Total number of vehicles in use in the Arab region, 2005 and 2015



Source: International Organization of Motor Vehicle Manufacturers 2015.
Note: No data available for the Syrian Arab Republic.

Figure 9. Railways (km) per 100,000 people in the Arab region, 2014



Source: World Bank, 2018a.

Box 2. Examples of social norms associated with a more rational use of energy through behaviour change

A culture of energy conservation and environmental awareness can entail a number of different interests among individuals, companies and society, allowing for bottom-up support for respective legislation by policymakers, including:

- Making some small efforts in return of reductions in energy waste; for example, reducing instances of open doors and windows in public buildings in the presence of running air conditioning systems; proper adjustment of room temperature in air-conditioned spaces; minimum caulking of windows and doors to reduce heat or cool air exchange with outside;
- Positive associations with alternative forms of public transport, including for higher income jobs (taking the public transportation to work as opposed to a private car);
- Consumer choice over "green" versus conventional products;
- Economic smartness through investment in rooftop solar panels and other home technology solutions that bear financial savings in the medium term;
- Positive roles for the natural environment, clean air and water, the protection of land and sea for future generations;
- Fostering of awareness of climate change, environmental destruction and overconsumption of natural resources.

Usage patterns reflect a disregard for issues such as resource waste, often unintentionally aggravated by lack of information and awareness. Lack of awareness about the potential long-term savings of higher quality building materials or changed usage patterns can impose substantial and often unnecessary costs on households. Because of poor building structure, homes end up cold in winters and hot in summers accruing high utility bills, even with only limited usage of technology such as heating or air conditioning units. This is often combined with lack of priority given to related fields, such as water conservation, environmental protection, and pollution control – both by governments and by civil society. This is the case even in high-income countries with significantly more financial resources and underscores the need for more information and education, in combination with more effective regulation and priority-setting, by governing authorities.

The fundamental lack of a well rooted energy conservation culture in many Arab countries is a critical source of vulnerability for the long-term sustainability of energy use across the region. Government laws, regulations and incentive schemes play a pivotal role in initiating changing consumption habits, but these can only go so far without public support and behaviour change among final consumers and developers of buildings and public infrastructure. Likewise, the lack of popular pressure – in part because laws and regulations that support a more sustainable use of energy are seen as going against short-term public interests – can be major stumbling blocks for policymaking. Lack of awareness can hence be classified as a largely overlooked source of vulnerability in the Arab region, along with lack of public information and a culture of safeguarding natural resources.

C. High dependence on fossil fuels

1. Fossil fuels as part of the regional energy mix

The Arab region's economies are vitally dependent on fossil fuels, both as a source of domestic energy supply and as a source of

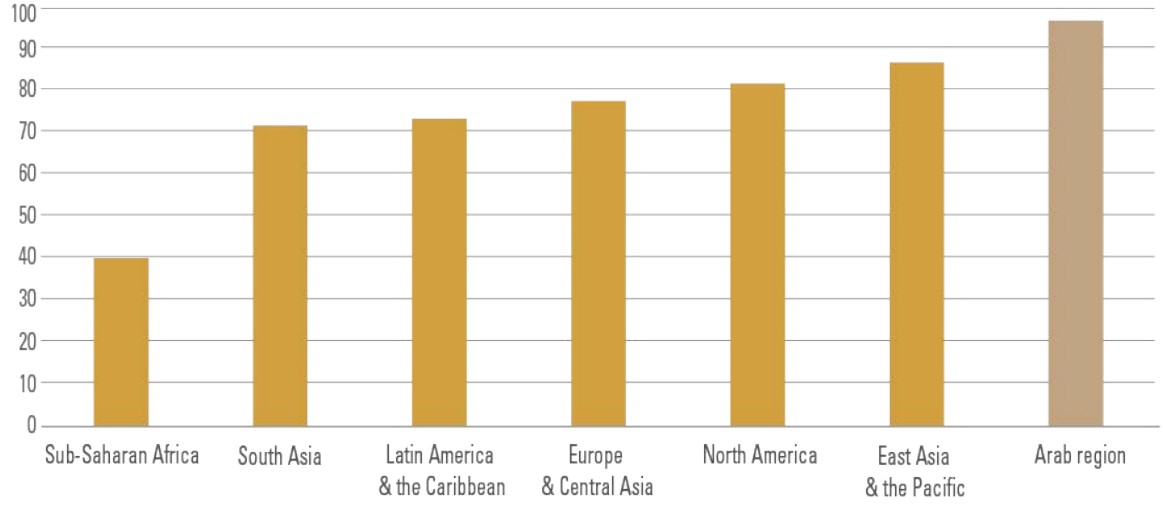
revenue in oil- and gas-producing countries. More than 95 per cent of regional energy supply is derived from just oil and natural gas, making the Arab region the most fossil fuel-dependent region in the world (figure 10). The absence of alternative energy sources, especially renewable energy, characterizes Arab economies across the board, whether exporters or net-importers of energy, with the few notable exceptions of countries with large hydropower resources, such as Egypt, Iraq, Morocco and the Sudan.

The increasing cost of hydrocarbon consumption also raises questions for the long-term affordability and sustainability of the current energy mix, as depletable energy sources need to be imported in increasing volumes from international markets or else reduce hydrocarbon supply available for export. The region's undiversified energy mix also contributes toward its rising carbon footprint, while at the same time Arab countries are missing out on capitalizing on key technological innovations and development in the area of clean energy, despite the vast potential in the region.

2. Fossil fuel exports as a source of revenue

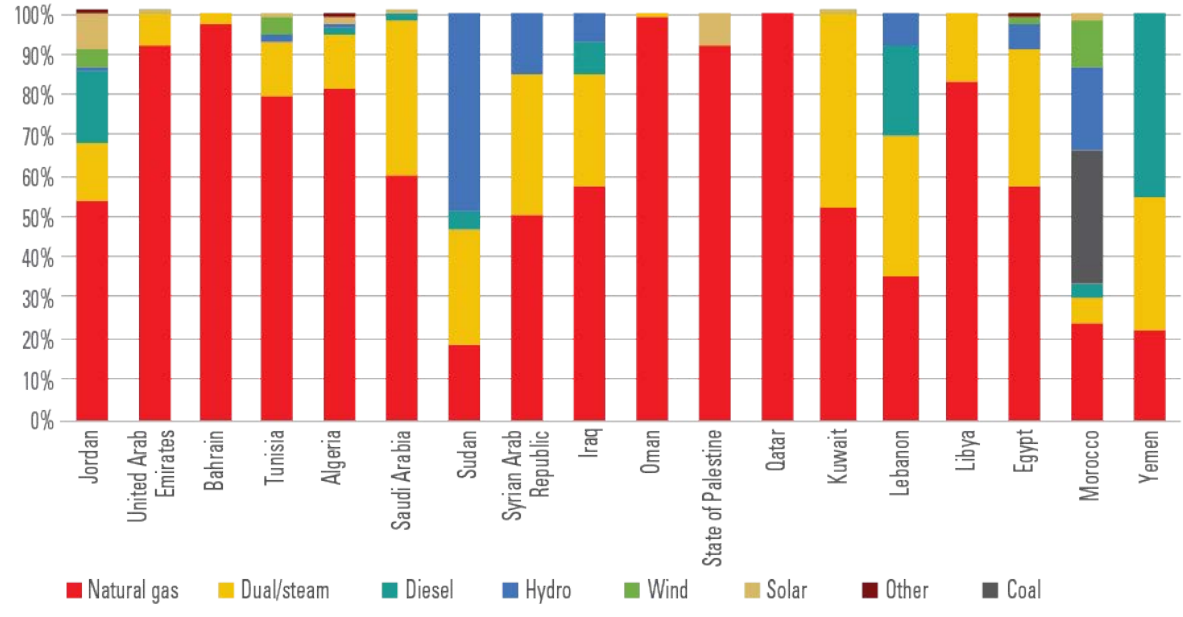
In addition to supplying domestic energy markets in the Arab region, fossil fuels also continue to generate vast portions of revenue for those countries that are oil and gas producers and whose economies are, in most cases, dominated by the hydrocarbon sector. Oil and gas exports account for between 65 to almost 90 per cent of government revenues in the GCC country economies, and for over 80 per cent of export revenue in Saudi Arabia, Kuwait and Qatar (figure 12).[40]

Figure 10. Fossil fuel energy consumption by world region, 2014 (percentage of total primary energy supply)



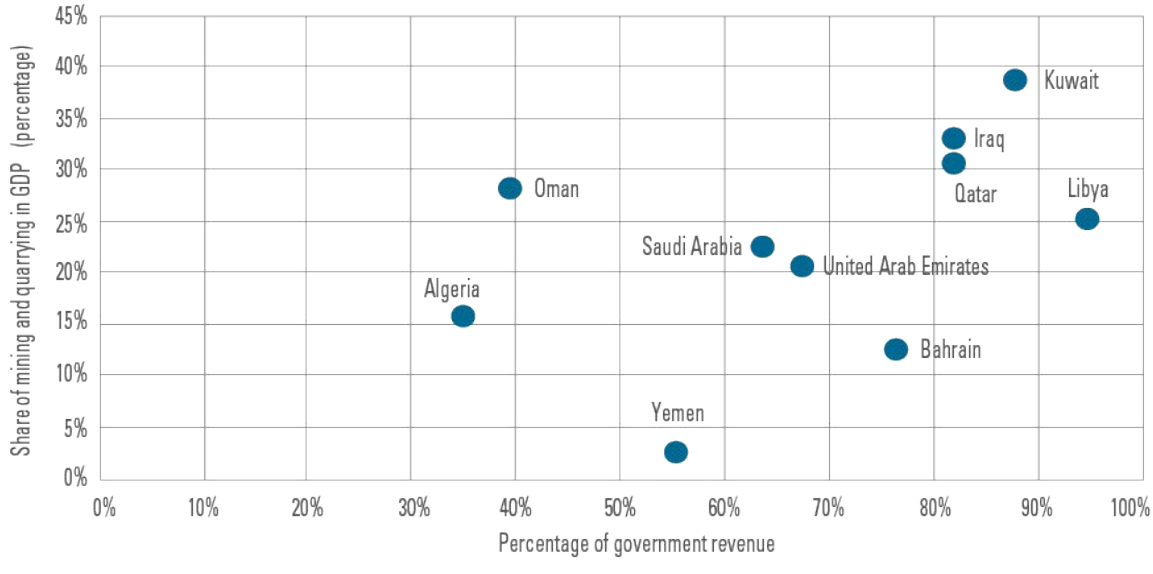
Source: World Bank, 2018a.

Figure 11. Installed electricity generation capacity by source in the Arab region, 2017



Source: Arab Union of Electricity, 2017.

Figure 12. Economic reliance on the hydrocarbon sector in the Arab region, 2016



Source: Authors' calculation.

This level of dependence – both as a source of energy and of revenue – is a fundamental vulnerability in the Arab region, economically, fiscally and environmentally. Below, we look in more detail at this very high degree of regional dependence on fossil fuels.

3. Consequences of high fossil fuel dependence

(a) Fiscal volatility and economic diversification

The Arab region's high degree of dependence on fossil fuels comes with a heavy fiscal bill. Among Arab net importers of energy – such as Jordan, Morocco and Tunisia – fossil fuels account for virtually all domestic energy supply. Jordan and Morocco depend on imports for more than 90 per cent of their energy, with energy typically accounting for between 15 to 18 per cent of annual import expenditure or the equivalent of around one third of their annual trade deficit. Energy imports thus put serious strain on fiscal resources as well as foreign currency reserves, since international energy markets typically use foreign currencies. As international markets fluctuate, so does spending on imports, as illustrated by the example of Morocco in figure 13.

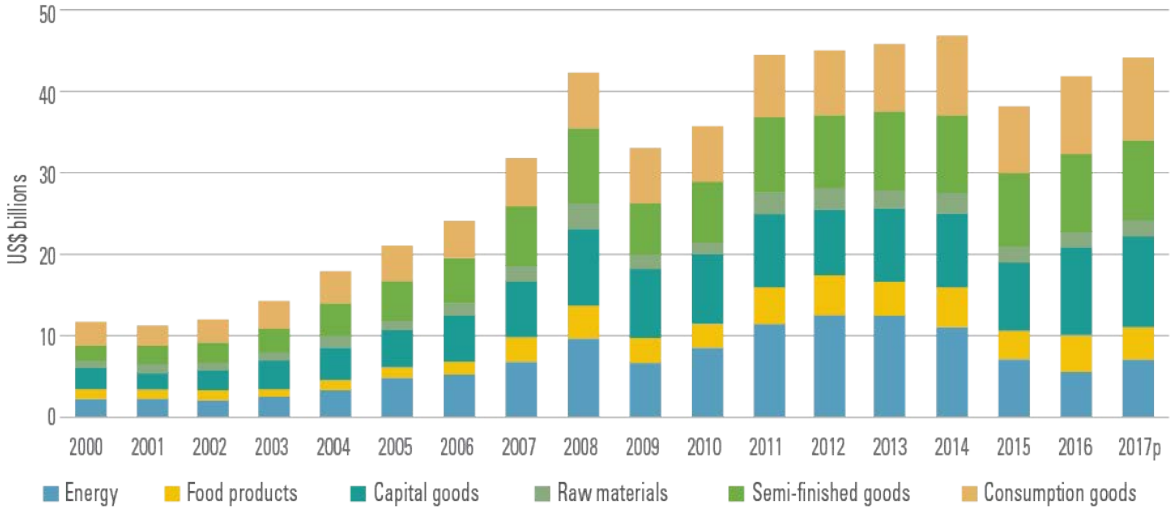
Fossil fuel exporters face converse challenges. Their exceptional dependence on fossil fuels for the fiscal health of both the State and its economy exposes Arab oil and gas producers to highly fluctuating revenue streams determined by external markets. Since they rely on external markets for a substantial share of their revenue generation, they are highly vulnerable to fluctuating oil prices, as well as external dynamics that affect consumer markets, such as major economic downturns and structural shifts away from fossil fuels. International oil price movements hence become major factors determining these governments' budgetary expenditure and in turn affecting non-hydrocarbon sectors as well.

Table 2. Current account energy trade balances in Arab net importers of energy

	Total current expenditure on energy imports (US$ billion)	Share of total current spending on imports (percentage)	Trade balance (US$ billion)	Share of imports in total energy supply (percentage)*	Year
Jordan	3	17	-10	97	2015
Morocco	5.5	15	-17.7	91	2016
Tunisia	4.1	18	-6	36	2012

Source: Based on Article IV Consultation reports.
Note: Syrian Arab Republic not included due to unreliable data; Lebanon not included due to data availability.
* Data as of 2014.

Figure 13. Moroccan imports by type of good, 2000-2017 (US$ billion)



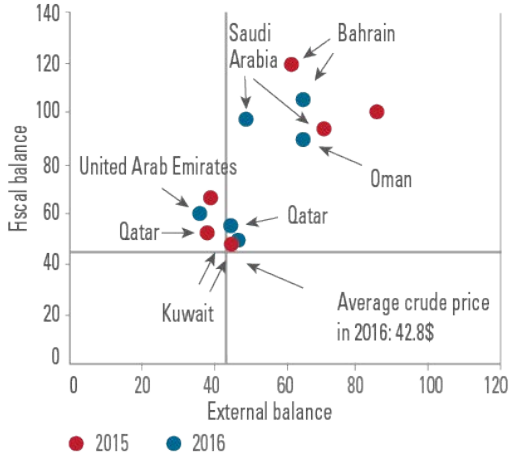
Source: IMF, 2017e.
Note: Figure includes IMF projections for 2017.

Figure 14 shows shifting fiscal and external balances in oil-producing countries between 2015 and 2016, illustrating how fiscal balances in these countries were affected by external energy market dynamics.

(b) Lack of economic diversification in large fossil fuel producers

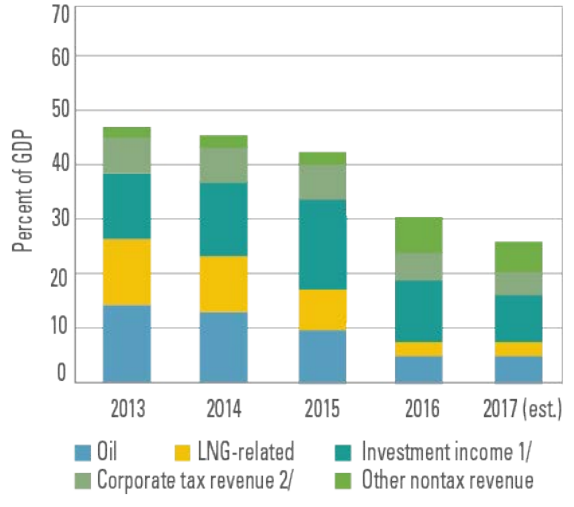
In many fossil fuel producers in the Arab region, the oil and gas industry is the most important single sector generating GDP. Mining and quarrying typically accounts for a substantial share of GDP in the Arab region's larger oil- and gas-producing countries as well (figure 12). Revenue from the export of fossil fuels also determines government income and hence investment in a range of non-oil sectors, meaning that prolonged periods of low international oil prices often translate into periods of low growth or recessions. Economic diversification over the past decades has had only limited effect on the vulnerability of these economies to international oil price fluctuations.[41] Economic growth in the GCC country economies in 2016, for instance, was the slowest in several years, a reflection of the fall of global energy prices.[42]

Figure 14. Break-even oil prices in selected Arab oil producers (US$/barrel)



Source: Based on Article IV Consultation reports.

Figure 15. Central government revenue in Qatar, 2013-2017 (percentage of GDP) (est.)

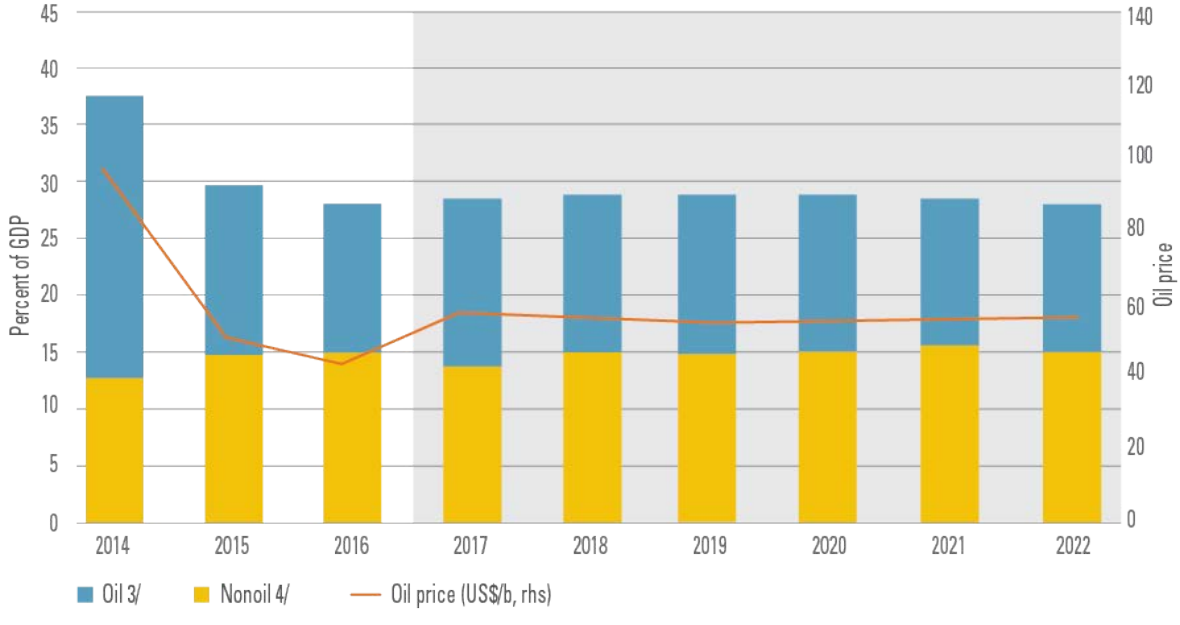


Source: IMF, 2018b.

(i) Increasing import dependence

The overwhelming reliance on oil and natural gas for domestic energy supply has also had implications in the form of increasing energy imports as demand for energy inside the Arab region has grown. This applies not only to the region's traditional energy importers, but also to a growing number of net exporters of fossil fuels.[43] Rising energy imports increases the vulnerability of countries to external supply shocks and exposes them to the fiscal volatility of energy price movements on world markets. This is because energy imports usually account for a large portion of the import value of net-importing countries. Moreover, increasing energy imports elicit fiscal dilemmas for countries with regulated domestic energy prices, as the difference in international market and domestic sales prices must be covered by the State.

Figure 16. Central government revenue in the United Arab Emirates, 2014-2022 (percentage of GDP) (projected)



Source: IMF, 2017g.

Petroleum products are an obvious example of how many Arab countries' import reliance has been growing along with demand in key sectors, including transport and industry. Many Arab countries have their own refining capacity but purchase petroleum products on world markets, including oil producers. Egypt's gross imports of oil products nearly doubled between 2010 and 2016 alone, establishing the former fuel net exporter as a major import market for oil products within the region (figure 17). In combination with rising levels of imports, static domestic fuel prices often translate into substantial losses either by fuel distribution companies or by the central government in the form of subsidies which, in turn, reduce fiscal resources for other expenditures. In Morocco, where consumers already pay market prices for fuel, the opposite has been true: in 2018, protests and social media calls for boycotts of fuel distribution companies erupted following a report that showed fuel distribution companies had not passed reductions in international crude oil prices on to final customers.[44]

The most spectacular growth in regional energy imports, however, has been seen in the natural gas industry. Substitution of oil with less expensive and more efficient natural gas in power generation and inside industries has increased demand for gas in fossil fuel-producing countries.[45] Since new production capacity has been slow to come on line, a number of gas producers in the Arab region have become importers, some of them net importers, of natural gas. The gas-poor markets of the Mashreq and parts of the Maghreb have struggled to meet the need for adequate volumes of natural gas owing to a combination of lack of infrastructure and political inertia around the import of gas.

Gas consumption is supply-driven in the Arab region, so the current demand growth for gas must be seen as below the actual potential for consumption. Insufficient gas supplies have constrained and delayed the fuel switch in power generation, with gas imports quickly increasing in new importers once a source of supply – such as pipeline or Liquefied Natural Gas (LNG) – has been secured. The fastest growth in natural gas imports has been seen in the Gulf countries, whose burgeoning demand for energy coupled with their own sluggish production of gas has prompted pipeline and LNG imports by Kuwait, Oman and the United Arab Emirates (figure 18), all of which are natural gas producers themselves.

In 2016, a total of nine Arab countries imported gas, more than double the number 10 years earlier.[46] Jordan, Kuwait, Morocco and the United Arab Emirates turned to gas imports during the 2000s. Tunisia has been an importer of gas since the 1990s. Lebanon, the State of Palestine and the Syrian Arab Republic would be significantly larger markets for natural gas, but are constrained due to lack of available import options tied to existing import infrastructure (pipeline capacity with exporting countries or LNG regasification terminals). In the case of the Syrian Arab Republic and the State of Palestine, there are political circumstances linked to continued situations of conflict. In Lebanon, the possibility of development of gas resources would be a potential for domestic energy market.

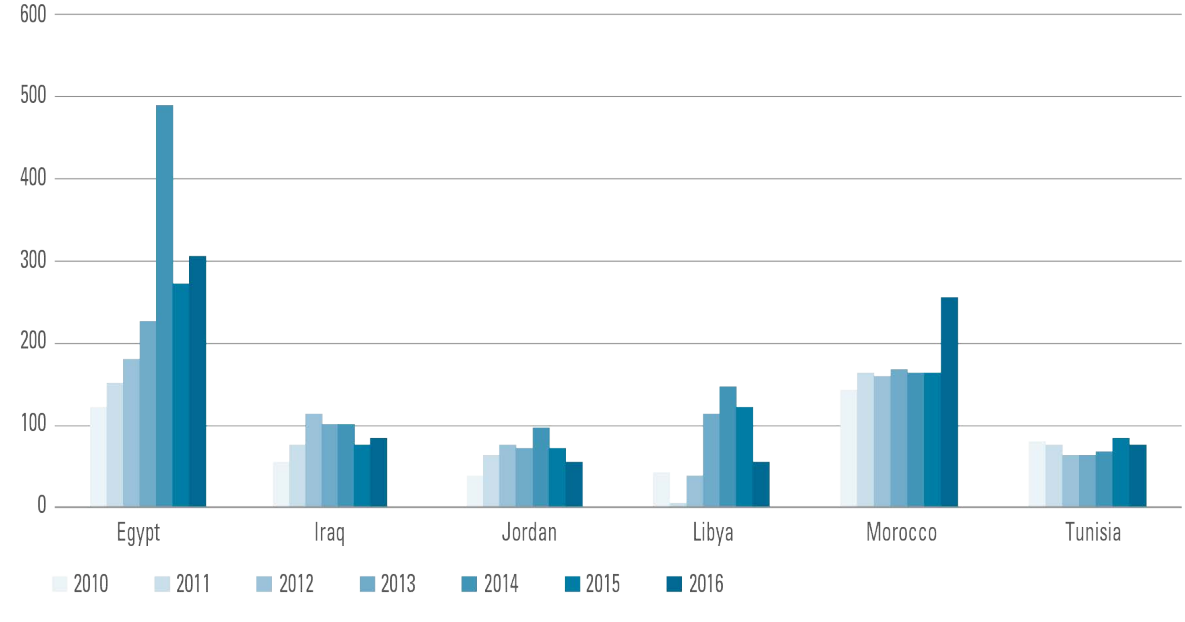
Among the GCC economies, the United Arab Emirates was the first to turn to gas imports and is the first Arab country to switch its role from a net exporter to a net importer of natural gas today. In 2008, Qatar and the United Arab Emirates launched the region's most successful

so far intraregional gas pipeline, the Dolphin pipeline, turning the United Arab Emirates into a net-importer of pipeline gas and later adding more flexible LNG supplies. The United Arab Emirates is no small gas producer: it holds the world's seventh largest natural gas reserves, and produces around 63 billion cubic metre (bcm) per year, yet its natural gas needs cannot be met by domestic production alone.[47] Gas imports are an economic solution to the country's gas deficit, ensuring remaining, existing LNG export contracts can be supplied and more valuable oil can be exported instead of being burnt in domestic power generation, as is the case in neighbouring Saudi Arabia.

The United Arab Emirates is not alone in the GCC with this situation; neighbouring oil producer Kuwait, despite sitting on gas reserves of the size of Norway's, turned to LNG imports in 2010 due to straggling production. Oman has been importing small volumes of natural gas during the summer months via an extension of the Dolphin pipeline from Qatar and has been mulling over gas imports from Iran for several years.[48] Bahrain[49] and more recently Saudi Arabia considered LNG imports to compensate for shortfalls in domestic production.[50]

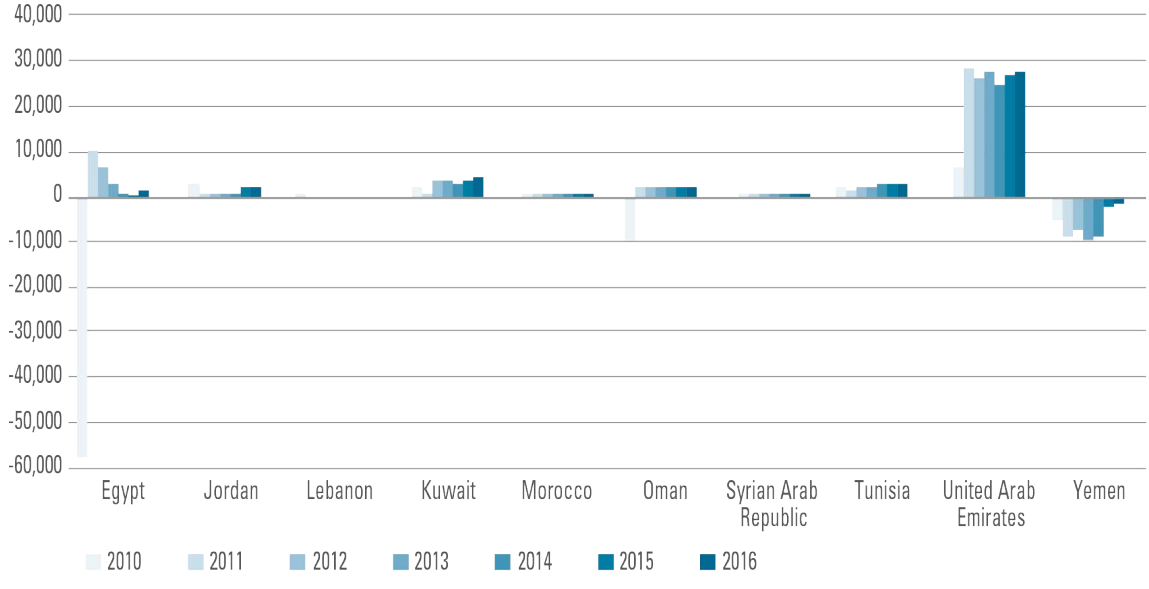
Egypt is the most recent Arab country to turn into an importer of natural gas. Being one of the Arab region's earliest gas exporters, the country's burgeoning demand coupled with limited output growth since the 2000s has within just a few years turned the country into the Arab region's second largest gas importer behind the United Arab Emirates. While Egypt's most recent gas discoveries have raised hopes they could supply its rapidly growing domestic energy market, the long-term reality for most Arab countries is that rising demand will need to be met by increasing imports.

Figure 17. Net imports of petroleum products, 2010-2016 ('000 barrel per day)



Source: Organization of Arab Petroleum Exporting Countries, 2017.

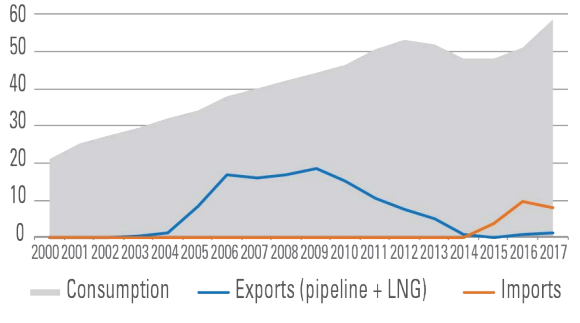
Figure 18. Net imports of natural gas, 2010-2016 (million cubic metre)



Source: Organization of Arab Petroleum Exporting Countries, 2017.

Concern about rising imports is matched by the very real possibility of rising domestic demand for energy curtailing future energy exports, as has been the case in countries like Egypt.

Figure 19. Egyptian natural gas exports and imports (bcm)



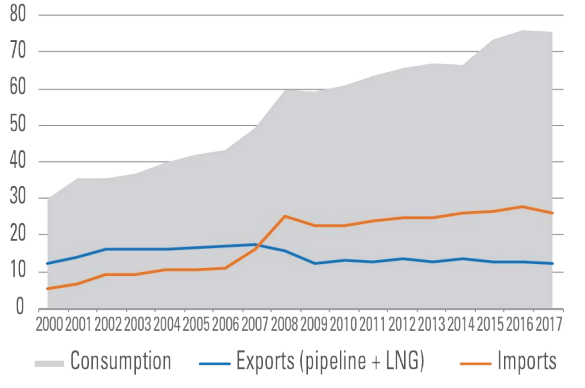
Source: CEDIGAZ, the International Association for Natural Gas, n.d.

(ii) Erosion of fossil fuel export potential

The combination of unmanaged demand for energy and the continued reliance on oil and gas as the sole source of energy to supply this demand threatens fossil fuel producers' ability to retain their export capacity – with potentially vast implications for fiscal revenues. The case of Saudi Arabia illustrates this, as senior members of the country's energy sector leadership have been vocal about the need to change the country's modus operandi in its use of energy. In 2010, then Chief Executive Officer of Saudi Aramco, Saudi Arabia's national oil company, and today's Minister of Energy, Khalid Al-Falih warned publicly that if no progress was made in curbing energy demand or diversifying sources of energy supply, Saudi Arabia's export capacity for crude oil might fall significantly by the late 2020s.[51] A 2011 Chatham House study suggests

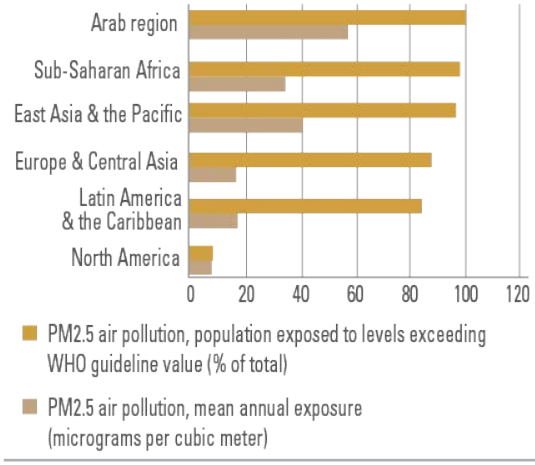
a business-as-usual approach might limit Saudi Arabia's export capacity within a decade – a concerning prospect for the country in which almost 80 per cent of government revenues depend on oil export revenues.[52] As described above, export capacity has already been eroded in the case of natural gas in a number of historical Arab gas exporters, including Egypt, Oman, the United Arab Emirates and the Syrian Arab Republic before the ongoing conflict.

Figure 20. United Arab Emirates natural gas exports and imports (bcm)



Source: CEDIGAZ, the International Association for Natural Gas, n.d.

Figure 21. PM2.5 air pollution (annual mean, µg/m^3) (WHO long-term guideline value = 10 µg/m^3)



Source: World Bank, 2018a.

(iii) Increasing air pollution and a rising carbon footprint

Ambient air pollution remains a separate serious, though largely unappreciated, concern in the Arab region and policy responses have notably been lacking. Annual mean exposure to air pollution in the Arab region measured by fine air (PM) pollution – generated by dust storms, motor vehicles and manufacturing – exceeds the WHO guidelines in 100 per cent of cases (figure 21). Urban areas are particularly polluted, owing to heavy vehicle traffic. 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.[53]

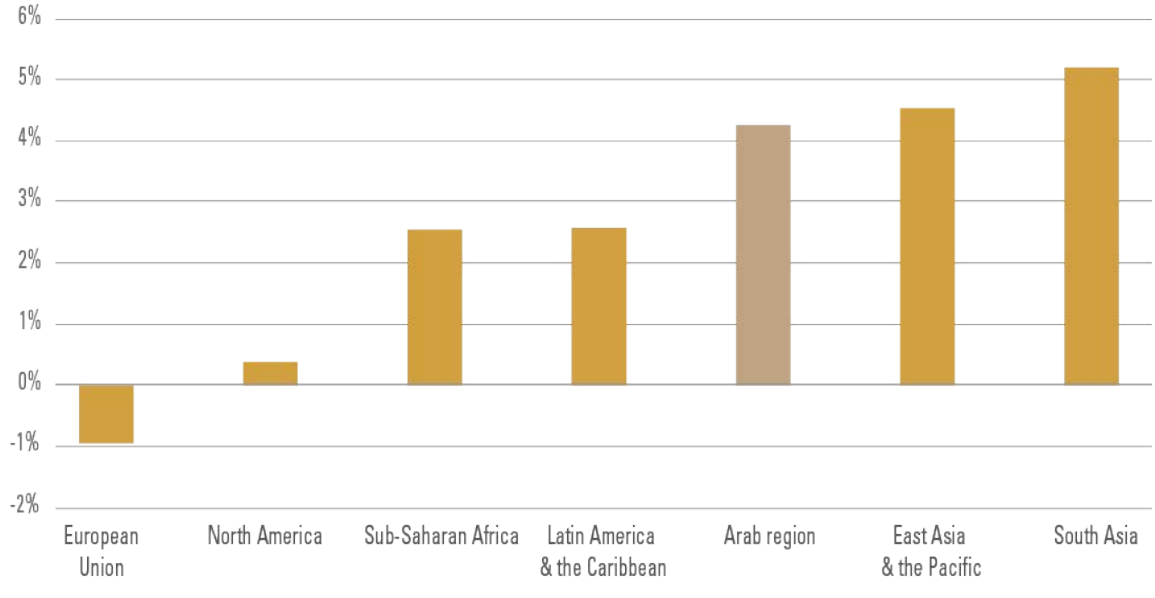
This is a highly worrying result, and even more so if seen combined with existing gaps in data that suggests that a significant portion of Arab populations' exposure to severe air pollution remains unassessed, unreported and hence, unaddressed. The long-term consequences of this situation include the potentially vast costs related to deteriorating public health, the treatment of respiratory disease and severe impacts on life quality, including in the region's wealthiest countries. To date, no Arab country has conceived focused strategies to systematically assess and combat air pollution, such as through more mandated pollution controls and filter equipment in industries and incentives to switch parts of the vehicle fleet to natural gas.[54]

In addition to air pollution, Arab economies' high reliance on fossil fuels has also contributed to the Arab region's growing carbon footprint. While the Arab region's total emissions are small compared to large

industrialised economies, the region accounts for around 5 per cent of global greenhouse gasses (GHG) emissions and its domestic carbon footprint is increasing rapidly. The three largest energy consumers – Egypt, Saudi Arabia and the United Arab Emirates – account for more than half the total emissions from the Arab region.[55] Demand growth for energy in the GCC country economies has been a major driver behind the Arab region's overall growth in CO_2 emissions over the past three decades (figure 22), turning Arab countries into the third fastest growing regional emitter of GHG after South and East Asia.

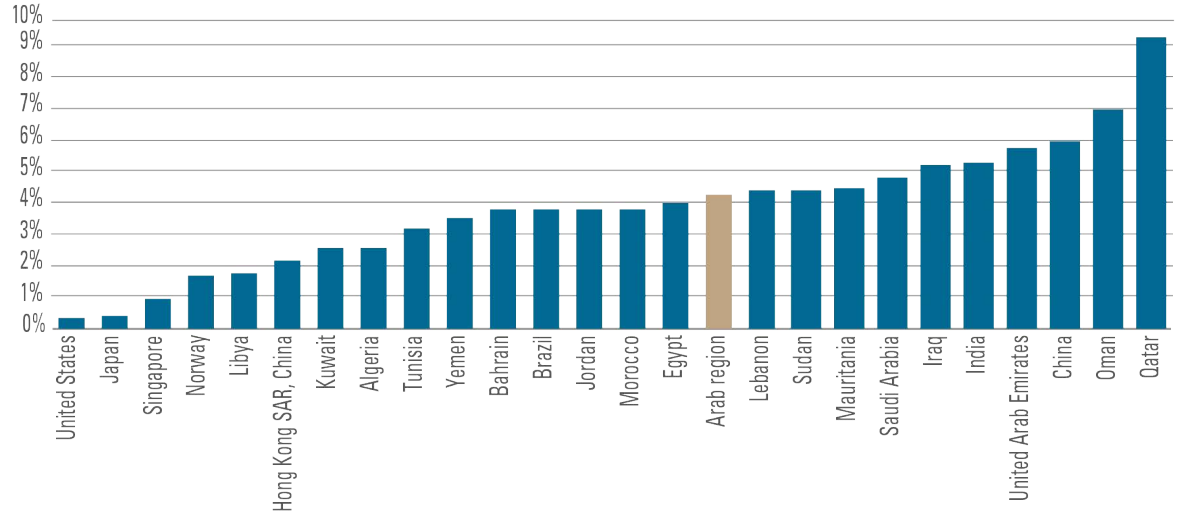
Reasons include heavy reliance on fossil fuels in power generation combined with rapidly increasing power generation, a focus on energy-intensive industrialization and a rapid rise in transport fuel consumption. On a per capita basis, the GCC country economies are among the highest CO_2 emitters in the world, having overtaken by far highly industrialised nations such as the United States and Japan (figure 23), reflecting the high energy and fossil fuel content of their national industries relative to their small populations. Saudi Arabia is also in absolute terms one of the top 10 global emitting countries of CO_2, with a share of 1.4 per cent of global emissions in 2014.

Figure 22. Annualized growth in CO_2 emissions, 1990-2014 (percentage)



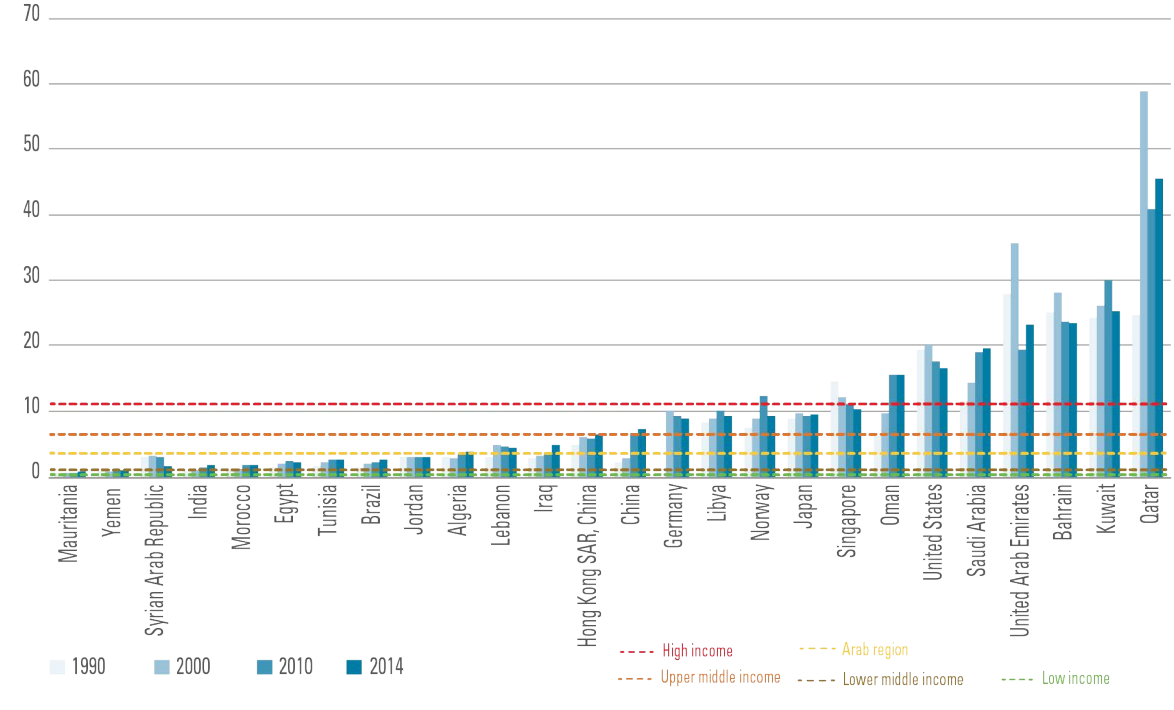
Source: World Bank, 2018a.

Figure 23. Annualized growth in CO_2 emissions for selected countries, 1990-2014 (percentage)



Source: World Bank, 2018a.

Figure 24. CO_2 emissions, 1990-2014 (metric tons per capita)



Source: World Bank, 2018a.

The Arab region is highly vulnerable to climate change. The Arab Ministerial Water Council, the Council of Arab Ministers Responsible for the Environment, the Arab Permanent Committee for Meteorology and intergovernmental mechanisms responsible for agriculture and health have identified climate change as a challenge to consider within the context of regional and national efforts to achieve sustainable development. The Arab Climate Change Assessment Report of the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) which was launched as a joint regional initiative of the League of Arab States (LAS) and the United Nations, suggested the following in its 2017 edition:

> In recent years, extreme temperatures and precipitation events in the Arab region have recurrently led to a variety of weather- and climate-related hazards such as heatwaves, droughts, floods, cyclones and sand and dust storms (SDS). These natural events have become more frequent and more severe, with substantial and widespread consequences on social and economic conditions in many areas. Drought is the most prevalent climate hazard; its impacts on livelihoods are severe and cause the highest human losses. Its effects include decreased water supplies, as well as loss of harvest and livestock, which, in turn, threaten food security and often cause widespread malnutrition.[56]

> Climate projections for the Arab region suggest that the highest increases in average mean temperature in the Arab region are projected in the non-coastal areas, including the Maghreb, the upper Nile River Valley, and the central and western parts of the Arabian Peninsula.[57]

> Precipitation trends are largely decreasing across the Arab region until the end of the century, although some limited areas are expected to exhibit an increase in the intensity and volume of precipitation.[58]

The vast implications of continuing to ignore the threat of climate change in the Arab region are a massive long-term liability that make the region highly vulnerable, not only to energy supply disruptions, but to long-term economic stability and the safety of food, water and inhabitable land supply and on ecosystems.

D. The energy access gap

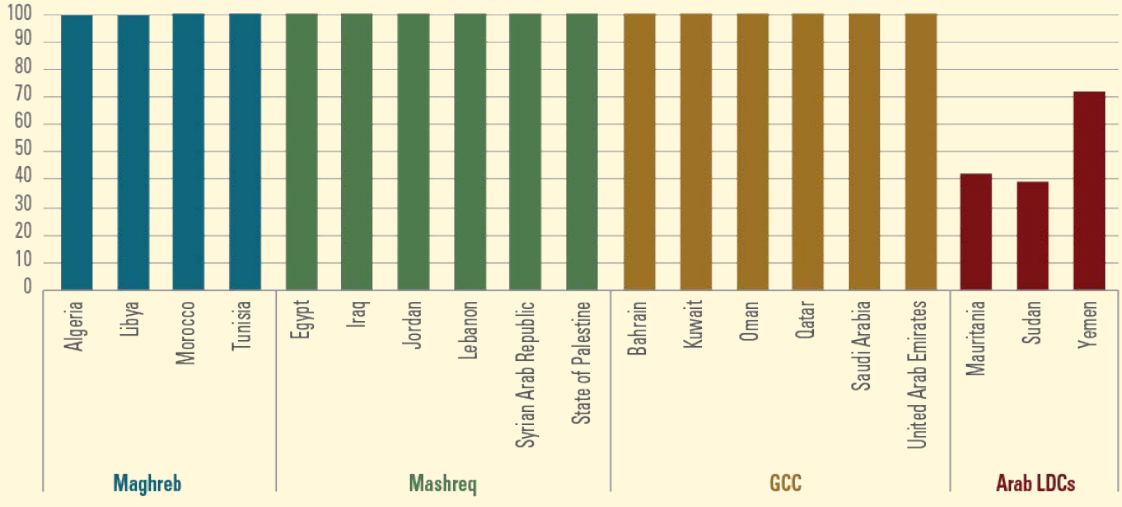
The Arab region as a whole has made tremendous efforts to facilitate universal energy access for its citizens. The GTF Report estimated electricity access in the Arab region at around 90 per cent in 2016 and access to clean cooking fuels and technology (CFTs) at around 86 per cent, with universal access in the GCC countries and close to universal access in the Mashreq and the Maghreb.[59] This sets the Arab region apart from all other developing regions in terms of access to modern energy services.

Nonetheless, large gaps in access to modern energy remain in the Arab LDCs and the quality of energy services, in particular electricity, differs across countries. Political conflict has resulted in the loss of access to secure energy for millions of people, especially in Iraq, Libya, the State of Palestine, the Syrian Arab Republic and Yemen. Moreover, the reform of energy pricing and lifting of subsidies across several Arab countries has increased costs for electricity and other basic energy services for an increasing number of people, often with no complementing improvements in social safety nets, with the consequences on access rates yet to be seen.

Box 3. Electricity access and quality of services in the Arab region

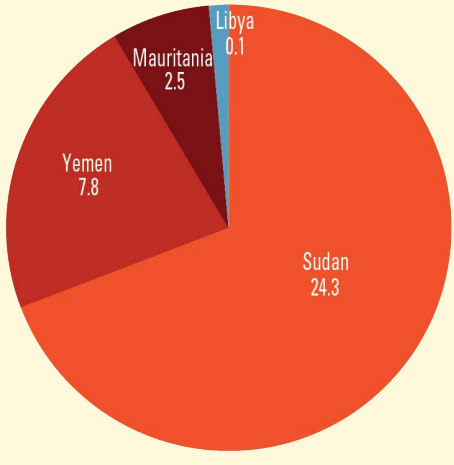
Despite impressive progress in the Arab region's electrification, electricity access remains incomplete in the Arab region. ESCWA estimates around 35.2 million people in the Arab region did not have electricity access in 2016, the majority of which live in Mauritania, the Sudan and Yemen (figure A and figure B). Given the difficulty of collecting accurate data on energy access in conflict-affected countries, it is likely that these numbers understate the extent of missing or insecure electricity access in a number of conflict-affected countries. In countries with incomplete electricity access, significant differences remain in the coverage of electricity access between urban and rural areas. For example, many rural areas that are registered as being electrified may have electricity for only a few households.

Figure A. Share of population with electricity access in the Arab region, 2016 (percentage)



Source: IEA and others, 2018.

Figure B. Population without access to electricity in the Arab region, 2016 (millions of people)



Source: IEA and others, 2018.

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An additional problem in many parts of the Arab region is interrupted access or poor-quality electricity supply. Load shedding, or planned disruptions, as well as unplanned disruptions can be caused by a number of factors, but typically relate to inadequate generation capacity to supply peak load; capacity constraints in transmission and distribution (T&D) infrastructure; maintenance work and repairs; and damage to T&D infrastructure as a result of accidents, sabotage, terrorist attacks, or armed conflict.[a] In addition, many off-grid and mini-grid access solutions, in particular in rural areas, are often designed to supply only a few hours of electricity per day.[b] The escalation of political conflict across the Arab region in more recent years has further contributed to this problem and is not yet adequately reflected in most recent data available.

Survey data collected by the World Bank reveals that over 50 per cent of businesses in the Middle East and North Africa reported some interruption to electricity services in recent years.[c] Eighty per cent of Egyptian businesses reported electricity outages in 2013, although this number fell to around 38 per cent by 2016; with 73 per cent of businesses in the State of Palestine (2013), 77 per cent in Iraq (2011) and more than 95 per cent in Lebanon and Yemen (2013) reporting outages.[d] Electricity outages and load shedding create considerable challenges even for those with formal electricity access, and typically involve considerable additional costs for backup generators and fuel in order to prevent the effects of frequent power outages on daily life and economic activity.

Conflict-affected countries have also seen the use of electricity cuts as a tool used by conflict parties; In 2007, for instance, armed groups in the southern provinces of Iraq such as Basra, Diwaniya and Nasiriya disconnected their power plants from the national grid in order to restrict access to electricity to their own supporters.[e] Sabotage and terrorist attacks on energy infrastructure have in recent years been reported in Egypt, Iraq,[f] Libya,[g] the Syrian Arab Republic[h] and Yemen.[i]

Sources:
[a] El-Katiri, 2014a.
[b] Ibid.
[c] World Bank, 2018b. The World Bank collects survey data from enterprises in the region, which may over-represent certain types of businesses and countries.
[d] Glanz and Farrell, 2007.
[e] Ibid.
[f] Slav, 2018.
[g] Reuters, 2015.
[h] BBC News, 2016.
[i] Reuters, 2013.

Non-existent, unreliable or unaffordable access to modern energy constitutes a considerable long-term challenge to national socioeconomic development in the periphery of the Arab region. Secure energy access is a critical enabler for key socioeconomic goals including food security and secure access to clean water and sanitation, health services, education and communication.

The lack of access to energy aggravates extreme poverty and women can be particularly affected, especially in rural and peri-urban areas. Women and girls are often in charge of collecting traditional energy sources such as fuelwood, reducing their time available for education or paid work. They are also often most directly exposed to the negative health effects of burning inferior sources of energy such as kerosene and household waste when cooking indoors. Women often have less access to land, credit and to the information needed to take advantage of opportunities to improve their access to energy and generate income from microenterprises. This situation further stalls progress in poverty alleviation, including in

conflict-affected countries such as Yemen, which has an increasing number of female-headed households due to the war.[60]

Some reports suggest that in developing countries, concentrating investment in energy services associated with production activity (generally considered to be carried out by men) has neglected the needs of rural households. This has led to policies that are not only gender-biased but are also less effective in reducing poverty and can aggravate energy vulnerability.

Furthermore, if not fully engaged as producers, suppliers and decision makers in the energy sector, the enormous potential of women is underutilized. Empowering women and men to make significant contributions on an equal basis is necessary to address the energy vulnerability issues in the region.

Insecure energy access also results in environmental destruction, often in the form of poor water and natural resource management and deforestation, as people fall back on traditional sources of energy such as biomass, making this situation a significant source of vulnerability. The following section reviews (a) incomplete access to modern energy in the region in the Arab LDCs; (b) lost access in conflict-affected countries; and (c) risk factors compromising future secure access to affordable energy in other Arab countries.

1. Energy access in the Arab LDCs

Despite progress in Arab LDCs' access rates to modern energy, the Sudan, Mauritania and Yemen continue to face the most pressing gaps in energy access in the Arab region.

(a) The Sudan

The Sudan has the Arab region's largest number of people with no access to electricity and clean CFTs. More than 24 million do not have electricity access (figure B). Only 39 per cent of the total population and only 22 per cent of its rural population have access to electricity, and 41 per cent of the population use clean CFTs.[61] The Sudan's rural population remains to a large extent cut off from modern energy, making investment in providing the country's large rural population with secure access to electricity an urgent development priority.

Poor electricity service quality also affects homes and businesses in the cities: some 94 per cent of Sudanese businesses report regular electricity outages, typically at least three days per month.[62] The country has been experiencing political conflict for decades, and a 2011 referendum resulted in the secession of the South that created two separate states. The Sudan's 2016 fuel and electricity price reform helped the country reduce its large fiscal deficit[63] but higher consumer prices have impacted affordability and the political stability.[64]

(b) Mauritania

Mauritania has one of the Arab region's lowest rates of electricity access. In 2016, only 42 per cent of households had access to electricity and the rural electrification rate was a mere 2.3 per cent.[65] Over 90 per cent of businesses report electricity outages, on average of five days per month.[66] Despite continuous efforts by the Mauritanian government to increase energy production and access mainly through renewable energies, the gap between its few

urban centres and many rural areas is unlikely to diminish in the coming years. The Mauritanian Government's current target is to provide electricity to 40 per cent of rural communities by 2020, through a combination of on- and off-grid solutions.[67]

(c) Yemen

Yemen faces similar challenges. The country had an electrification rate of 72 per cent in 2016, and a clean CFT access rate of 65 per cent, with significantly lower rates in rural areas, including most parts of the former South Yemen.[68] Yemen's energy access problem long predates the current conflict, reflecting decades-long gaps in the development of certain regions, a factor that has undoubtedly played into the current situation of war and political instability.

In 2005 prior to the current conflict, the United Nations carried out a comprehensive survey household energy use in Yemen and found significant divergences in coverage between regions, with considerable effects on poverty levels and access to health facilities and education. In Yemen, energy poverty translates into women and children in many rural areas needing to spend significant periods of time each day collecting fuelwood, rather than attending school or working. They also spend much time in poorly ventilated rooms using poor-quality fuels, such as traditional biomass and kerosene, for cooking.[69] Ninety-three per cent of Yemeni businesses reported an average of 38 power outages in a typical month[70] and a substantial number noted the weakness of electricity service quality even where formal grid access existed and was paid for.

2. Lost access due to conflict and political instability

Political conflict and instability are factors that reach beyond the Arab LDCs and have intensified significantly in recent years with ongoing conflict in Iraq, Libya, the Syrian Arab Republic and Yemen in addition to other long-standing conflicts such as in the State of Palestine. Situations of prolonged instability have had devastating effects on energy access and service quality in a number of Arab countries, with years of underinvestment in and damage to infrastructure and statehood increasing the vulnerability of millions more of people in the Arab region who lack access to energy services.[71] This situation further adds to the humanitarian challenges, including inadequate access to basic health services, sanitation and education. The destruction of infrastructure such as roads, power stations, transmission networks, industry and housing all mean that current conflicts will have a lasting effect on socioeconomic factors for many more years to come.

(a) Iraq

Iraq has seen many decades of conflict and political instability, but the emergence of various extremists' groups and the subsequent fighting between different internal entities and external actors has added further damage. The United Nations High Commissioner for Refugees (UNHCR) estimates that as of May 2018, over 2.1 million people were still displaced inside Iraq and over 360,00 were in temporary settlements.[72] Over the years, Iraq has been experiencing a dramatic deterioration in basic services, including water and electricity supplies. More than a decade and a half of

political instability has severely affected the country's economic performance as well as the underlying structure and capacity of its institutions. Facing multiple parallel challenges, the country's energy sector has suffered from lack of investment, an ambiguous legal environment and an absence of long-term policy. The Investment Climate Assessment (ICA) lists lack of electricity as one of the key constraints to private sector development in Iraq, alongside issues such as political instability, corruption and lack of access to finance.[73]

In addition to deteriorating energy services that have left many Iraqis with poor or even no energy services, the country wastes its energy resources at alarming rates. Iraq is the fourth largest gas flaring country in the world, even though it suffers from a shortage of natural gas. The World Bank describes Iraq's energy sector situation in the following words:

> Because Iraq is not capturing the gas produced during the flaring process in order to use it in electricity production, more than 50 per cent of the fuel used to operate gas turbines consists of gasoil, crude oil, and heavy fuel oil, which are more expensive than natural gas and degrade the performance and useful life of generation equipment. The result is that a country that is rich in energy resources relies on expensive and imported fuels to produce electricity, costing an estimated US$6 to 8 billion per year. Gas flaring is not only costly and wasteful but also the use of alternative fuels (primarily diesel and heavy fuel oil) generates more local pollutants and greenhouse gas emissions than would have been the case with gas.[74]

Managing oil and natural gas resources more effectively by reducing flaring and replacing oil products in power generation could lead to significant cost savings for Iraq's national budget and energy consumers, in particular if inter-fuel substitution was accompanied by a parallel upgrading of the grid and a containment of what are thought to be enormous leakages in infrastructure spending.[75] The World Bank concluded that:

> Improving the delivery of public services would fortify trust and legitimacy between citizens and the state. [...] Iraqis have witnessed a dramatic deterioration in most basic services: electricity, water and sanitation, health, education, and transportation – and above all security.[76]

Iraq illustrates the devastating effects of conflict on sustainable energy sector planning and service provision, which in turn affects progress across all other sectors.

(b) Syrian Arab Republic

The situation in the Syrian Arab Republic is even worse. As of March 2018, UNHCR estimated that around 13.1 million people, or around 70 per cent of the population, were in need of aid; 6.1 million persons were internally displaced and 2.98 million were in hard-to-reach and besieged areas with little or no access to the outside world.[77] The Syrian Arab Republic has been described by the UNHCR High Commissioner Filippo Grandi as "the biggest humanitarian and refugee crisis of our time".[78] Even with little data or information on energy access, it is nevertheless clear that access to energy is precarious for a significant portion of this population.

(c) Yemen

The intensifying conflict in Yemen, a country with severe pre-existing gaps in access to modern energy long before the current situation, has further worsened its energy access gap (see discussion in chapter 1 section D.1). Armed conflict and an external military intervention have led to the destruction of infrastructure and the displacement of large numbers of people into precarious, and largely improvised living conditions. UNHCR estimates that in early 2018, around 22.2 million Yemenis, or about 80 per cent of the population, needed assistance, with some 2 million internally displaced and almost 1 million people having fled to neighbouring countries.[79] The effects on society and the wider economy have been devastating (box 4).

In 2017/2018, the closure of Yemen's ports led to fuel, water and electricity shortages and skyrocketing prices for food and fuel. The situation led international aid agencies to call for an end of the blockage in order to save Yemen from an impeding water and health crisis due to fuel shortages.[80]

(d) Lebanon, Jordan and other neighbouring countries

Neighbouring countries have also been affected by conflict in the Syrian Arab Republic and Iraq. Since the beginning of the Syrian crisis in 2011, over 5.4 million people have fled, seeking safety in Lebanon, Turkey, Jordan and beyond.[81] Turkey hosts the largest number of Syrian refugees, around 3.55 million at the end of March 2018; followed by Lebanon (991,000 Syrian registered refugees), Jordan (659,000) and Iraq (248,000).[82] This is in addition to some 2.18 million Palestinian refugees in Jordan and 460,000 Palestinian refugees in Lebanon.[83] Iraq also has a large population who has been internally displaced (see above), in addition to a large long-term diaspora, in particular in Jordan, as a result of two wars in the country. The influx of large numbers of Syrian refugees has led to significant challenges in providing access to basic services such as sanitation and electricity to those communities hosting in neighbouring countries. UNHCR reports that:

> In Lebanon, life is a daily struggle for more than a million Syrian refugees, who have little or no financial resources. Around 70 per cent live below the poverty line. There are no formal refugee camps and, as a result, Syrians are scattered throughout more than 2,100 urban and rural communities and locations, often sharing small basic lodgings with other refugee families in overcrowded conditions.[84]

Jordan, according to UNHCR, faces parallel challenges:

> In Jordan, over 655,000 men, women and children are currently trapped in exile. Approximately 80 per cent of them live outside camps, while more than 139,000 have found sanctuary at the camps of Za'atari and Azraq. Many have arrived with limited means to cover even basic needs, and those who could at first rely on savings or support from host families are now increasingly in need of help. It is estimated that 93 per cent of refugees in Jordan live below the poverty line.[85]

Box 4. Conflict, lost access to modern energy and gender in Yemen

A study from 2016 that includes a household survey held during the conflict in Yemen illustrates the devastating effect the war has had on electricity access, and accordingly wider living conditions. Access to electricity declined on average from 84 per cent before the crisis to 61 per cent at the time of the survey, with 74 per cent of households reporting that electricity was available from between 5 and 12 hours a day.

Female focus group participants reported the various negative consequences of recurring power cuts and overall lack of access to electricity. These included:

- The inability to refrigerate food and medicines for long periods, with resulting negative health consequences;
- A fragile security situation exacerbated by lack of lighting, increasing the risk of gender-based violence;
- Negative impacts on children's ability to study;
- The collapse of some businesses, such as those reliant on refrigeration.

Cooking fuel shortages and spikes in fuel costs have also severely affected household income, with many households now allocating large parts of their income to the provision of gas. The replacement of gas with fuelwood had, according to participants, led to increased competition for scarce resources, resulting in further conflict between internally displaced Yemenis and their local host communities.

Female participants expressed their concerns about the consequences if trees continued to be cut down at current rates and the risk of fire. Pregnant and lactating women together with their children have been most affected by the lack of fuel, particularly those living as IDPs in makeshift shelters such as huts and tents. Extreme poverty often caused households to burn plastic materials for cooking, with severe health threats.

The responsibility for collecting fuel shifted during the conflict from one traditionally carried out by men, to one carried out primarily by women and girls. This increased their risk of exposure to verbal harassment and gender-based violence, in addition to negative health consequences such as miscarriages as a result of carrying heavy loads. Time spent on fuel collection also meant less time spent on education and income-generating work.

Source: Oxfam International, 2016.

At the same time, the large number of Syrian refugees has increased pressure on existing challenges to provide stable national energy services in countries such as Lebanon. A joint report by the Lebanese Ministry of Energy and Water, and the United Nations Development Programme (UNDP) on the situation of Lebanon's power sector from 2017 concludes:

> Prior to the onset of the Syrian crisis, Lebanon was, and still is, suffering from serious and persistent issues in its energy sector. The limited generation capacities and the increasing demand impede Électricité du Liban (EDL), the national utility, from meeting the country's electricity demand… Efforts have been made to improve the situation through the rehabilitation of some generation plants and through rented generation barges that increased the generation capacity by about 440 megawatt (MW). However, power outages remained the same across the country because additional capacities are equated by an almost similar demand by the displaced Syrians.[86]

Lebanon ended its previous four year-long "open border policy" at the end of June 2015, by which time the country had reached its limits of accommodating more refugees, recorded at 1,174,830 persons by UNHCR,[87] about one sixth of Lebanon's population at the time. Jordan, too, has been facing increasing socioeconomic pressures, including related to energy provision; the Moving Energy Initiative by Chatham House documented that:

> The latest and largest rise in Jordan's population resulting from the Syrian crisis beginning in 2011 (variously estimated at 7-14 per cent), has inevitably increased pressures on public services and already strained water and energy resources. Fuel, power and water use have risen sharply since 2011, as have subsidy bills for the government. Simultaneously, public facilities are costing more. State schools, for example, must run double shifts to cope with the demand, doubling their electricity and water bills for the Ministry of Education. Low- to middle-income Jordanians are feeling the pressure from inflation, a housing shortage and unemployment, all of which are perceived to be exacerbated by Syrian and Iraqi refugees and the influx of foreign aid agencies.[88]

Examples such as this in Jordan also underline the multifaceted impact refugees and their basic needs have on the socioeconomic fabric of the host country:

> Perceptions of additional pressures on limited energy and water resources have implications for social cohesion. In urban areas where the majority of Syrian refugees reside, the strain on energy and utilities is a factor that can affect relations between the host community and refugees, particularly regarding potential tension between landlords and tenants.[89]

This underlines the strong link not only between energy and socioeconomic development, but also between secure energy supply and social peace, underlining the challenges ahead for other countries with unsustainable energy systems.

(e) The State of Palestine

The State of Palestine has been affected for many decades by insecure energy access through a combination of the lack of its own power generation capacity, the dearth of funds to develop new capacity and invest in its own transmission and distribution infrastructure and its dependence on Israel for fuel and electricity supplies. Historically, Gaza has been hit most severely by consecutive fuel and power crises that have severely affected the functioning of its economy. In 2013, Gaza was hit by one of the most serious energy crises in recent years when informal supply tunnels to Egypt were closed. The operation led to the shutdown of Gaza's only power plant, which depended exclusively on fuel delivered through Egyptian tunnels, triggering power outages of up to 16 hours per day, up from 8-12 hours prior to that.[90] The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) reported in 2013 that "the current fuel crisis has compounded an already fragile humanitarian situation generated by the longstanding Israeli restrictions on the movement of people and goods to, from and within the Gaza Strip".[91]

Fuel shortages, according to the report, severely disrupted the delivery of essential services, which depended on the operation of backup generators during the electricity outages.[92]

The situation was repeated several more times in recent years, most recently in early 2018, when Gaza's sole power plant was shut down again, leaving Gaza residents with a mere four hours of electricity per day through power supplies imported from Israel.[93] Every shutdown in electricity services triggered the closure of essential services, including hospitals, health centres and schools, who had been running on backup fuel.[94]

Lack of fuel has had pervasive effects ranging from unavailability of infant and intensive care in hospitals; the decreased ability to teach and learn due to lack of lighting in some schools; noise, fumes and smell from generators; lack of meals in school canteens due to inadequate capacity for the refrigeration of food; lack of water for hand washing due to reduced water supplies; damaged electronic equipment due to frequent electricity cuts; and for many, lack of transport to schools and health facilities. Failure to operate generators has also resulted in severe and long-lasting environmental damage, including flooding from sewage pumping and the release of 108 million litres of untreated wastewater into the sea off Gaza every day.[95]

Gaza's situation is highly concerning from a humanitarian perspective, in that lack of secure energy has been severely affecting chances for socioeconomic development, as well as resulting in significant environmental damage that is likely to have long-lasting effects on prospects for positive development in the State of Palestine.

3. Risks of emerging energy poverty due to affordability

Beyond issues of incomplete access to electricity, the Arab region is comprised of substantial populations at risk of energy poverty, that is of losing previously held access to clean, secure and affordable energy. Energy is not a universally low-cost good in the Arab region, as illustrated by the case of electricity tariffs in figure 6 in chapter 1 section B. Consumers in countries such as Jordan, Morocco, the State of Palestine and Tunisia pay significantly more for electricity than anyone else in the Arab region, and in some cases, more than consumers in the United States and Europe.[96] At the same time, the average income in these countries is often significantly lower than others in the Arab region, with particular hardship arising from the high cost of electricity in the State of Palestine relative to its low household incomes.

Reform of energy subsidies, including on electricity and transport fuels, in recent years increased costs for energy as well as other goods and services in a number of Arab countries (see more in chapter 2 section A.1). While necessary and often unavoidable from a fiscal perspective, these reforms hold significant potential to increase energy poverty if unmitigated. The ability of low- and lower middle-income households to further adjust consumption patterns is often very low, eventually leading to a loss of access to essential energy service, and affecting other developmental aspects such as food security and access to the outside world.[97] In many situations, the result can also be a shift back to traditional energy sources and, in the case of transport, curtailed mobility. Women, as mentioned prior, bear a disproportionate share of the burden of losses of household income related to rising energy costs, including through heightened impacts on their ability to access work, education and health services.[98]

Losses in living standards are likely to be felt strongly among lower middle-income

households, which constitute a substantial share of households in many Arab countries. As mitigation measures – if available – are often limited to low-income households and lowest user segments, lower middle-income households also miss out on the many remaining welfare networks, making this group highly vulnerable to energy price increases. Among these income groups in particular, the potential for political mobilisation as a result of further reductions to living standards can be significant. The case of Yemen, discussed in more detail in chapter 2 section A.1, exemplifies this problem.

2. Towards More Sustainable Energy Systems

2. Towards More Sustainable Energy Systems

Developing more sustainable energy systems and reducing energy vulnerability in the Arab region is of vital importance for the Arab region's future growth and to safeguard its socioeconomic development. Sustainable solutions to the region's multifaceted challenges in energy production and consumption patterns can be developed based on a candid diagnosis of the situation in each country combined with a strong collective will to promote and establish sustainability as the ultimate criteria in the development of the countries' energy systems. This chapter describes some of the avenues that may help not only governments, but also industries, businesses and civil society, to build more sustainable energy systems that are able to safeguard universal access to clean, secure and affordable energy. It does so by learning from previous experience, as well as highlighting areas where much more work needs to be done.

A. Mainstreaming the requirements of high energy performance

1. Domestic energy prices

Domestic energy pricing is a key factor influencing demand dynamics, and hence in managing energy demand in the medium and long term. The use of regulated energy prices that have kept the cost of energy across consumer groups below market cost, as discussed in depth above, has served important development objectives in the past. These include universal access to modern energy, including electricity, virtually throughout the Arab region, albeit with gaps in the Arab LDCs, and industrial growth that made use of the availability of low-cost fossil fuels produced domestically. Regulated, artificially low prices for energy have also had many unintended consequences, including the distortion of market signals that should have rationalised demand and that have inhibited the switch, where available, to more efficient energy technologies. In a number of Arab countries, low prices have also led to the accumulation of a significant fiscal burden during the 2000s, with a detrimental effect on government spending on other pro-poor sectors (as discussed chapter 1).

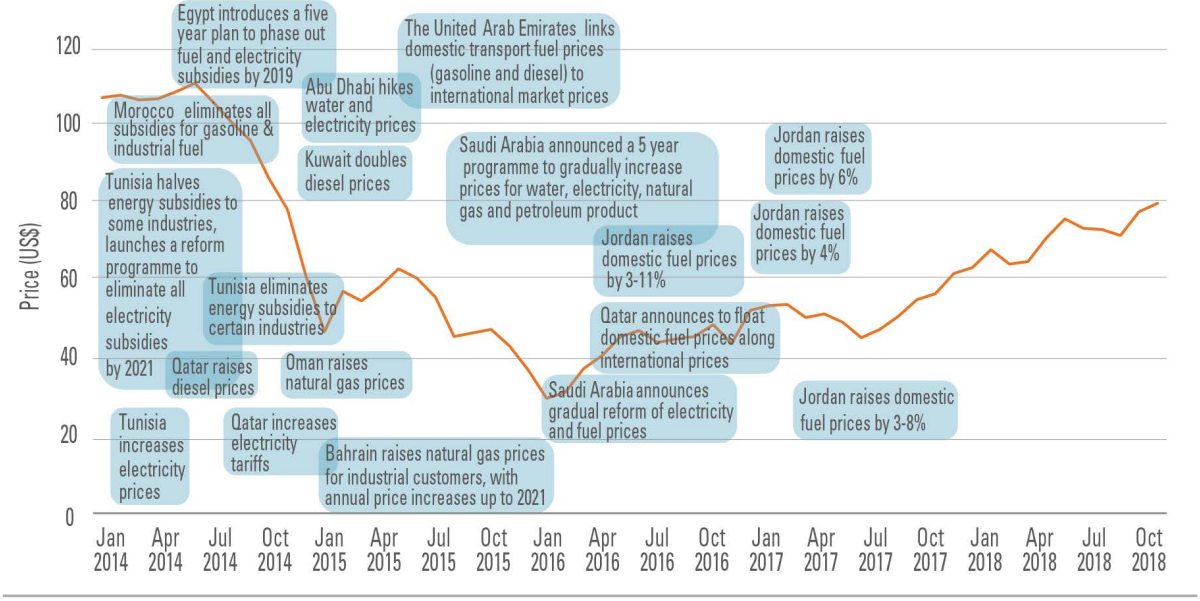
Reforming decades-long practices of supplying energy at low cost to domestic consumers is a complex task, given that all the different user segments – households, businesses and industries – will be affected by increases in different ways. Large price increases will impact affordability and therefore energy access for low- and middle-income households and could put industries out of business: an uncomfortable outlook made even more so in a region that has experienced tremendous sociopolitical turmoil in recent years. In many instances, controlled energy prices have been perceived as one of few tangible benefits provided by the State to the poor, even though high-income households benefit proportionally more from untargeted price controls and energy price subsidies.

Successfully reforming energy subsidies without causing hardship to the lowest income groups and without disrupting industry competitiveness hence requires careful economic planning. In recent years, an increasing number of Arab countries have begun to reform their domestic energy prices (figure 25).[99]

The level and depth of reform differs significantly between countries and energy sources, with many price corrections for selected fuels and consumer groups made in an ad hoc manner and few systematic reforms in domestic energy pricing. Ad hoc price corrections simply translate to higher prices for the final consumer groups, whose price remains effectively static after the price increase, irrespective of further price movements for energy products on international markets.

The resulting savings in subsidy costs for the government or distribution companies is reduced only temporarily and these steps do not insure governments against the recurrent build-up of energy subsidies once international fuel prices rise. Falling fuel prices on international markets since 2014 have helped a number of Arab countries to reduce their subsidy burden without charging consumers higher prices (table 4), but at the risk of a return to the status quo once international oil prices pick up again.

Figure 25. Energy price reform in Arab countries



Source: Based on EIA, 2018.
Note: Brent price.

Only a few countries have taken effective steps to link their domestic prices to international ones, therefore ending price subsidies altogether. Morocco and Jordan have eliminated fuel subsidies using local price adjustments that update prices periodically for consumers based on international market prices. Jordan has phased out electricity and natural gas subsidies completely, while Egypt adjusted electricity and gas in the period 2013-2015, with plans for further tariff increases over the next five years.[100] Egypt, the Sudan and Tunisia have implemented a number of ad hoc price corrections for fuel and utility services but continue to shield domestic consumers from global price movements.[101]

Table 3. Prices for energy products in the GCC countries and the United States (August 2017 or latest available)

	Gasoline	Diesel	Electricity
	US$/litre		US$/KWh
Bahrain	0.38	0.37	0.04
Kuwait	0.31	0.36	0.02
Oman	0.5	0.53	0.04
Qatar	0.45	0.42	0.05
Saudi Arabia	0.22	0.10	0.10
United Arab Emirates	0.5	0.53	0.12
GCC average	0.39	0.39	0.06
US Prices	0.55	0.52	0.10

Source: IMF, 2017b, p. 11.

Among the region's oil exporting countries, several GCC country economies have revised domestic fuel prices, with only the United Arab Emirates having effectively eliminated price gaps between domestic and international prices by linking the former to the latter. Prices for fuel and electricity remain substantially below those found elsewhere in the world (table 3).

The IEA has documented the positive experience with effective energy efficiency regulation in the cement and aluminium sectors internationally, revealing that "energy efficiency, in the form of reductions in energy use per unit of gross economic output, can contribute to the competitiveness of industry subsectors, particularly those with higher energy intensity".[102] Reforming fuel prices in the industry sector across the Arab region thus needs to go hand in hand with updated efficiency regulations and investment incentives that help equip industries with competitive advantages beyond low-cost energy inputs. Table 4 documents fiscal savings that have resulted from the reform of energy prices in Arab countries over the past few years, including Arab oil and gas producers that have long seen energy subsidies as an integral part of their energy market policy. Fiscal pressure has arguably been a major driving force behind this wave of reform which was started off by the region's energy importers against the rise in global oil prices during the late 2000s up until 2014. It was then followed by reform in a number of energy exporters after the subsequent fall in oil prices and consequently government revenues since 2014.[103]

Table 4. Petroleum price subsidies in Arab countries, 2013-2016 (percentage of GDP)

	2013	2016	Change	Contribution to change			
				International oil price change	Price adjustment	Consumption	Residual
Oil importers	**4.1**	**1.9**	**-2.2**	**-3.7**	**0.8**	**-0.4**	**1.1**
Egypt	6.9	3.2	-3.6	-3.2	-0.2	-0.5	0.3
Jordan	2.1	1.2	-0.9	-8.1	6.7	-0.5	1
Lebanon	2	2.7	0.7	-6.1	6.6	-0.4	0.7
Mauritania	0	0	0	…	…	…	…
Morocco	1	0.2	-0.9	-3.5	0.6	-0.2	2.3
Sudan	2.7	0	-2.7	-2.8	-0.6	-0.6	1.3
Tunisia	2.1	0.3	-1.8	-3	0.8	0.3	0.1
Oil exporters	**5.2**	**2.2**	**-2.9**	**-3.4**	**-0.2**	**1.5**	**-0.9**
Algeria	5.6	3.1	-2.5	-3.5	0.1	2.3	-1.4
Bahrain	2.8	0.8	-2.1	-1.6	-0.5	0.4	-0.3
Iraq	7.1	1.9	-5.2	-5.5	0	1.3	-1
Kuwait	3.4	0.8	-2.6	-2.1	-0.9	2.4	-2.1
Oman	4.5	0.8	-3.7	-3.3	-0.6	2.1	-1.8
Qatar	2.2	0.7	-1.5	-1.5	-0.3	1.3	-1
Saudi Arabia	8	4.1	-3.9	-4.2	-0.6	2.1	-1.3
United Arab Emirates	0.9	0.2	-0.7	-2.2	0.4	0	1.1

Source: IMF, 2017c.
Note: No data available for Libya and State of Palestine.

Because of the sensitivity and the complexity of energy price reform for industrial users, many Arab governments have so far shielded industries from energy price reform, even as individual consumers and businesses have had to absorb higher energy costs. This has in many situations put the brunt of higher energy costs on individual users and businesses who are often confronted with parallel increases in the costs of transport fuel, water and electricity, and the indirect increases in living costs and in costs of doing business as a result of higher energy prices.

Egypt saw prices rise both for households and for industries as it reformed energy prices in July 2014. Fuel prices rose around 46 per cent for refiners, 79 per cent in electricity generation

and 122 per cent in transport, in addition to other consumer segments. Even with these large price changes, subsidies in Egypt remained substantial: a paper by the World Bank estimates that the budgetary cost of the subsidies would fall by only about one third, from about Egyptian pound (E£) 150 billion (around $20bn) to E£100 billion (around $14 billion), and in the short term the budget deficit would remain high, declining from 8 per cent to 6 per cent of GDP.[104] Moreover, Egypt implemented no permanent change to the mechanism used to determine energy prices, with the risk that energy subsidies will increase again if international oil prices rise, making the reform only partial.

(a) Mitigating the negative effects of energy price reform

Most Arab countries have tried to mitigate the reform of energy subsidies by designing reforms stepwise, as was done in the Syrian Arab Republic (2008), the Sudan (2012 and 2013), Tunisia and Egypt (2014), Saudi Arabia (2015) with Bahrain, Oman and Qatar following soon after Saudi Arabia.[105] Jordan, on the other hand, dismantled most fuel subsidies in one stroke in 2012; as did the United Arab Emirates in 2015.[106] In most cases, these price steps included no, or very limited efforts, to expand other social protection nets, such as through better targeting of low and lower middle income households via direct cash transfers.

Accompanying mechanisms to help protect the poorest against price increases have instead focused on direct targeting for fuel or electricity consumption. When the Syrian Government drastically cut diesel subsidies in 2008, for instance, the Government issued coupons allowing each household to purchase 1,000 litres at a price almost as low as the old one.[107] Tunisia introduced a “lifeline tariff” formula to assist households who consume only a small amount of electricity.[108]

Arguably not all compensatory systems have proven effective. Egypt originally intended to launch a smart card system limiting the amount of subsidised fuel sold per year per vehicle, but later cancelled the system due to “insolvable problems”.[109] No alternative arrangements were made to target vulnerable groups directly through social safety protection. Experience with ration cards in the region also suggests such systems raise new problems related to social equity, because cards are often awarded based on social status, for instance to pensioners and civil servants, rather than to those with the lowest income.[110]

Morocco, on the other hand, has long been shielding prices for LPG bottles. This policy is to some degree designed to be self-targeting, since household consumption of LPG tends to be limited to cooking and water heating, benefiting particularly low- and middle-income households. However, it has seen substantial leakages of benefits to higher income earners.[111] Saudi Arabia, too, shields households with a monthly consumption below 4,000 kilowatt-hours (kWh) from its recent power tariff reform[112] – a consumption threshold so large it would include most higher income households, at the cost of significantly reducing the effectivity of the price reform. This illustrates the dilemma for policymakers aiming to reform energy prices in the absence of State institutions evolved enough to target vulnerable groups through other means to alleviate poverty effectively.

Yemen’s case underlines the difficulty of reforming domestic energy prices in countries with ineffective alternative social welfare

systems and high rates of poverty. During the 1990s and 2000s, repeated attempts were made to cut the country's costly and regressive fuel subsidies, but currency depreciation and inflation ensured that any desired effect was rapidly negated in real terms.[113] By 2014, the situation had become fiscally untenable, with the Government selling fuel at a loss, resulting in severe shortages and leading to prices for diesel spiralling up on the black market, making fuel unaffordable for many.[114] One half of the country has no access to grid-based electricity and depends on diesel fuel for basic electricity services. Decades of under-pricing electricity, in turn, has deprived the State utility from investing in upgrading the country's grid infrastructure. Since the country's farmers also depend on diesel for their trucks, the country's food security depends on affordable diesel.

When the Yemeni Government decided to drastically cut fuel subsidies, food price inflation surged and large parts of the population were cut off from an affordable supply of energy. No alternative social protection measures were in place. Violent protests erupted in Sana'a, where in September 2014 the Government headquarters were captured by rebels from the Houthi movement – one of whose main demands was that the fuel subsidy cuts be reversed.[115] Yemen's fragile political situation further escalated in the months following, with fuel subsidies playing a significant role as an indicator of the many ongoing disputes between the central Government and the provinces over people's access to basic services and economic opportunities. This illustrates the potential that energy prices and poor governance can have in triggering further political uproar and the need, for the sake of political stability, to carefully manage the Arab region's ongoing energy transition in a socially equitable manner.[116]

The wide variance of reform experience in Arab countries highlights that while the overall macroeconomic objective of reform may be valid, reform implementation raises many further dilemmas for socioeconomic development, particularly in countries with low government capacity in social welfare and security. One of the fundamental challenges in reforming energy prices is how to protect specific groups in middle-income countries in particular from the negative consequences of the substantial energy price increases reform entails.

Capacity-building inside governments to design and implement energy price reform is a critical component to long-term policy success. This includes the capacity to target different levels of income groups more effectively through alternative social protection programmes; and to support audit and develop programmes designed to help industries remain competitive on world markets despite higher fuel and raw material costs. The parallel pursuit of tangible improvements in energy efficiency, both in industry and in the building and transport sector, could be a powerful tool if used effectively by governments, particularly if used in addition to systematic investment in pro-poor sectors such as accessible and affordable public transport (see discussion further below).

2. Energy efficiency, performance standards and practices

The potential to save energy, with financial savings accruing both to governments and to final consumers, is one of the most powerful mechanisms to help consumers manage higher energy prices in the Arab region. By reducing energy consumption per unit of economic output, energy efficiency also allows for

more money in the economy to be spent productively, while its greater use also translates into employment opportunities in areas such as technology research and development (R&D), production of materials such as building insulation and of equipment such as more efficient appliances, and installation and maintenance.[117]

The challenges involved in issuing efficiency regulation in Arab countries are significant. Energy efficiency regulation in transport, building, industry and power sector is complex and requires capacity-building inside government bodies to plan, develop, implement and manage energy efficiency activities and initiatives. Part and parcel of such capacity-building is the professionalization of human resources in the public sector, with a need for dedicated skillsets in areas such as policy design, law, economics, engineering and technology. To be effective, efficiency requirements need to be ambitious yet achievable, as well as enforceable. They require continuous monitoring and enforcement by competent state institutions that have clear mandates to do their job.

Energy users, including industries, commercial entities and private individuals, need to be informed transparently and offered realistic alternatives to current consumption patterns, technology and equipment; even better, they are consulted in the process of designing efficiency codes.[118] This involves strengthening communication channels between government bodies on the one hand and different energy consumer groups on the other. Overcoming inherent obstacles in the way of better energy efficiency regulation also requires a better understanding of the short-, medium- and long-term benefits of the initial investments made, for both industries and private users.

Closely related to information is the parallel issue of energy pricing. Low domestic energy prices make the design of effective schemes to incentivize users to invest in energy efficiency upgrades more difficult. This means that efficiency regulation, energy price reform and the availability of financial resources to help users make the initial investment in energy efficiency need to go hand in hand. This is a particular challenge in Arab LDCs, in conflict and post-conflict countries, as well as in a number of middle-income countries, whose fiscal resources are often already limited and whose more pressing short-term priorities divert focus from policies and investments designed for medium- and long-term results. This state of affairs offers an opportunity for more dedicated aid and development finance by international financial institutions and within the context of inter-Arab development aid flows (see further discussion below).

In recent years, some Arab countries have begun to step up policies promoting energy efficiency. In Jordan, for example, an innovative project was launched in 2010 aimed at turning the focus away from the supply side towards increasing the rate of energy efficient home appliances, such as air conditioners, washing machines, refrigerators and freezers. The project, which was co-funded by the GEF, UNDP and the Jordanian Ministry of Planning and International Cooperation, helped set up the first set of appliance standards and labelling regulations as well as the design and implementation of support programmes and tools for enforcement. The initiative notably included a focus on educating customers on the importance of selecting a high-efficiency appliance to avoid medium- and long-term operating costs. The latter included a media awareness campaign for energy efficiency labels carried out through radio and television,

open days at universities, a social media campaign and an awareness campaign for retailers and stakeholders in Amman, Irbid and Aqaba.[119]

In 2011, Algeria issued its *Renewable Energy and Energy Efficiency Development Plan 2011-2030*, with the aim of expanding the usage of renewable energies and to diversify energy sources in the country. In addition to ambitious targets of some 22 gigawatts (GW) of renewable energy capacity to be installed by 2030, the plan called for increases in energy efficiency in the economy through measures including the improved heat insulation for buildings; the development of solar water heating; the promotion of cogeneration; the development of solar cooling systems; changing desalination technologies through increased use of renewable energy; and the use of low-energy lamps.[120] Energy audits have been mandatory since 2005 for large industrial, transportation and commercial users exceeding certain thresholds of consumption.[121]

Saudi Arabia has focused on energy efficiency policy under its new long-term economic roadmap, Vision 2030. The country's Public Investment Fund (PIF) established the National Energy Efficiency Services Company (National ESCO) in 2017 with the aim of increasing the energy efficiency of buildings and government facilities and supporting the establishment of a national energy efficiency sector in line with Vision 2030 to diversify the economy and drive environmental sustainability. Equipped with a capital of Saudi riyal (SR) 1.9 billion (around $500 million), the company is mandated to finance and manage restoration projects of government buildings and facilities and help reduce government spending on electricity consumption.[122] Saudi Arabia began to implement new energy efficiency labels on air conditioners as part of its strategy to reduce demand for energy consumption over the next 20 years.[123] A 2017 study found that even a basic retrofitting programme that targeted only the existing residential building stock would be cost-effective and could reduce electricity consumption by 10,054 gigawatt hours (GWh) per year, peak demand by 2,290 MW and carbon emissions by 7.611 million tons/year.[124]

The United Arab Emirates was among the first Arab countries to introduce systematic fuel economy standards for the country's vehicle fleet in 2016. Upgrading environmental regulations and standards in the transport sector can take multiple forms, including the implementation of maximum emission levels and smoke standards; fuel efficiency standards; vehicle certification and testing regulations; vehicle durability standards; and fuel quality standards, among many others.[125] The new law mirrors the Corporate Average Fuel Economy (CAFE) standards in the United States, and the Emirati Government expects to deliver annual fuel savings to its households worth United Arab Emirates dirham (Dh) 9.5 billion (about $2.59 billion), representing carbon savings equivalent to removing 4.5 million cars from the United Arab Emirates' roads by 2035.[126]

A so far, untapped policy avenue to increase the Arab region's energy use efficiency is to put greater effort into standardising technology efficiency requirements across neighbouring countries. Examples that could feasibly be harmonised at subregional level, include minimum performance standards for vehicles, transport fuel and spare parts.[127] Intelligent energy technology solutions, such as renewable energy technology, smart grids, smart metering and energy storage are all advancing rapidly and their deployment benefits from laws and regulations that keep pace across neighboring

countries. Shared cross-border regulation and technology standards also help drives system interoperability, a key prerequisite for the expansion of trade, for instance in the case of cross-border electricity transfers. Consumers, too, would benefit from increased levels of quality and safety for consumers; while local businesses and manufacturers of technology equipment could see an expansion of their markets, making regional standardization a potential win-win solution for consumers and innovative businesses alike.[128]

3. Sustainable public transport infrastructure

Public transport infrastructure is a key tool to ensure the dual developmental objectives of ensuring people's mobility while managing domestic energy demand for transport fuels. Providing sustainable public transport solutions is also critical to ensure the mobility of women, who, even as half of the Arab region's population, are often disproportionally affected by the lack of safe transport options to work, school and health centres. Sustainable public transport solutions are also critical to the reconstruction processes underway in those Arab countries currently experiencing or emerging from war and political conflict that has resulted in the systematic destruction of infrastructure. Ensuring that the future transport infrastructure makes the most efficient use of energy and does not impose an economic liability to users and the economy, is critical to ensuring the sustainability of transport infrastructure.

(a) Positive experience in public transport provision and lessons learned

While much scope remains for the improvement of public transport in the Arab region, country- and city-level initiatives from around the region illustrate the dedicated investment that success in this sector entails. Algeria has been actively expanding its public transportation networks and investing in electric rail transport with the aim of increasing access to remote regions and reducing emissions. The Government's goal is to increase the existing 4,000 km of rail track to 11,300 km by 2020. The capital Algiers opened a metro system in 2011, followed by tramway systems in the cities of Oran, Constantine and Setif in 2013. The government also announced $6 billion of dedicated investment in light rail systems across 14 major cities. Expanding the use of renewable energy, some 350m^2 of solar paneling has been installed on the Algiers commuter trains' maintenance sheds with many train vehicles being now powered by electricity.[129] Algeria's National Climate Plan, issued in 2013, enshrines the electrification of railway transport and the intensification of urban public transport links, through metro and tramway infrastructure, into national climate and energy sector planning.[130]

Tunisia has been working to mitigate increased traffic congestion and pollution in the capital Tunis and other cities such as Sfax and Sousse for many years. Public transport accounts for around 30—40 per cent of total traffic. Most transport operators have implemented computer-assisted maintenance management systems enabling them to better manage the preventive maintenance of vehicle engines. This had notably reduced motor failures, reducing wasteful fuel consumption and emissions. The regional transport companies Kairouan and Nabeul are equipped with global satellite positioning (GPS) systems to closely monitor the performance of the bus fleet, for example borrowed circuits, braking, and cornering, which has led to a reduction in energy consumption around 7 per cent.[131]

When hosting the United Nations Framework on Climate Change's 22nd Conference of the Parties (COP22) in 2016, the Moroccan city of Marrakech inaugurated a new bus rapid transit (BRT) system of fully electric buses that connect the city's surrounding areas with several main points in the city centre. The project also included a solar-powered charging station to keep buses topped up. Neighbouring city Casablanca completed its first 31-kilometre tram line in 2012 and has plans for a further 76 km of mass transit operating on its own dedicated infrastructure over the period up to 2022, with the objective of increasing the use of public transport from 13 per cent in 2005 to 21 per cent in 2019. Rabat, the capital of Morocco, has similar plans.[132]

Jordan has substantially invested in its transport sector since the early 2000s, including expanding its road sector, improving urban mobility and developing the Jordan National Railway Network Project. Jordan was also among the first countries in the Middle East to liberalize part of its transport sector with the aim of increasing efficiency and performance.[133]

A 2016 study[134] of public transport in Jordan concluded with some general recommendations relevant to other Arab countries as well:

(a) The prioritization of public transport should be a matter of focus for policymakers;
(b) The subsidization of public transport, whether financed through a fuel tax or a dedicated account, to ensure affordability;
(c) The provision of a clear, streamlined institutional framework governing the public transport sector and ensuring its development along with public needs;
(d) The importance of developing intercity links, as well as better infrastructure suited to connect city centres with surrounding suburbs;
(e) The introduction of smart systems for fare payment and tracking standard across all modes of public transport to ensure fees are collected, helping the financial viability of public transport and improving the quality of service offered;
(f) An efficient, widespread dissemination of information about public transport, including routes, fares and frequency of service.

Increasing the rate of public transport uptake is a critical element of managing congestion and safeguarding mobility, and thus an imperative for Arab economies. This includes the construction of road and rail networks and better integrating transport between Arab countries. When the effective planning, economic provision for and regulation of the transport sector and its use of energy takes high priority, significant benefits for wider socioeconomic development are seen.

(b) Diversifying transport fuel options

There are also a range of technology options for Arab countries to consider, including the greater electrification of transport and the use of natural gas vehicles (NGV) to reduce fuel consumption.[135] Diversifying fuel sources for the transport sector in Arab countries could help reduce fuel consumption and create cleaner and more efficient. Currently, 99 per cent of transport fuel in the Arab region is based on liquid fuels, with transport driving demand for oil and oil products across the region.[136]

Egypt was the first Arab country to use natural gas in the transport sector and has one of the longest experiences globally in this area of gas

utilization. Egypt's relatively successful market uptake of NGV has been driven by the favorable price of compressed natural gas (CNG) relative to gasoline, which provided market incentives for users, especially taxis, to switch vehicle types.[137] Other Arab countries that have successfully adopted NGV technology for part of their vehicle stock include Algeria and the United Arab Emirates.

The United Arab Emirates has also been among a small number of Arab countries investing in infrastructure to develop a market for electric vehicles, for both private and public transport use. Electric vehicles could provide a practical solution to the Arab region's cities, helping reduce pollution and emissions from the transport sector and adding a potential market for more renewable energy-based electricity generation. Dubai has begun to invest significantly in charging station infrastructure and launched a set of incentives to support electric vehicles owners, such as free charging, free parking, free registration fees and free Salik (road toll) tags.[138]

4. Information, awareness and the role of civil society

Access to information is a key element in enabling decision-making by governments, individuals and businesses. Good quality information is comprehensive, non-politicized, credible, accessible and comprehensible to different audiences. Ensuring that high-quality information informs policy and final energy consumer decisions plays a critical role in producing effective outcomes that maximize the value of energy in an economy. Accurate information is essential in setting national priorities; sizing sustainable energy programmes and the means to implement them; and in the monitoring, reporting and verification (MRV) process to measure the progress towards reaching targets and achieving desired goals.

Information is also highly important in dealing with public opinion, such as for the acceptance of and conformity with new legislation and the feasibility of regulatory changes at the outset. In the best-case scenario, information and transparency are supported by a two-way process, which strengthens democratic processes and the involvement of energy consumer groups in the design of policy initiatives, rather than merely informing them at the end. This includes a far greater voice for those such as women and young people who need to live with long-lasting policy decisions than has been the case thus far. A more meaningful public debate around issues such as the sustainability of current energy use models and individual user behaviour could help kindle support for new legislation and the creation of a market for more efficient energy technology.

Anchoring the rational use of energy and the careful management of energy resources in social norms and values is another important element in improving decision-making on energy issues, at personal, policy and business levels. Issues such as wasteful consumption of energy and water, the degradation of environmental resources such as groundwater and coastal waters and food security all link to energy, and thus need to form part of the broader social debate and political priority list.

(a) Data management and improving access to information

Improving the collection and 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.[139] Access to, and in some cases continuous collection of, data on energy and related environmental development aspects in the Arab region remains limited, owing to a combination of factors ranging from a dearth of institutional capacity to intra-institutional deadlock and the politicization of data.

Improving access to data – for policymakers, industries, businesses, research institutions and civil society alike – requires active efforts to ensure that full energy balances are produced on a regular and timely basis by governments to track national energy trends and adopt international methodologies to ensure data comparability. Furthermore, access to data and information could benefit from the development of indicators adapted to future systems, the continuation of the adaptation of data gathering systems (including monitoring, evaluation and gender-disaggregated data) and the development of new indicators that reflect the links between the issues of water, food, climate and investments in clean energy, among others. Lastly, there is a need to reinforce and adequately resource energy statistics programmes that monitor and report comprehensive energy variables and that can be fully integrated with other economic and social national statistical efforts.

Transparent information-sharing through effective channels of communication between institutions is a closely related aspect to managing data at government level. Government bodies such as ministries and municipalities need data and relevant information on a wide range of interrelated factors, both at national and subnational level. Without it, informed policymaking and a rational public and market response to growing problems are difficult. Policies that increase energy access and raise the rate of energy efficiency in the economy and the deployment of renewable energy often entail a combination of changing market regulations, investment models and other incentive structures to secure project finance and change consumer behaviour. This kind of information is rarely readily available in any single governmental institution, which complicates an effective implementation of laws and regulations.

Strengthening intragovernmental channels of communication involves structured reform in the way government institutions work. This ranges from comparably straightforward tasks such as an upgrading and interlinking information technology systems to more comprehensive staffing reform, including the professionalization of the public sector workforce. The distribution of clear mandates between government departments, State- and semi-State-owned companies such as utilities, plays another important role in enabling the collection, analysis and dissemination of data and information within governments and to the public.

A critical pillar of changing energy consumption and production patterns is access to information about energy to final energy consumers. ESCWA observed elsewhere that:

> …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.[140]

Improving communication and information dissemination to final consumers is also critical to effective progress in two key areas: energy efficiency and the deployment of renewable energy. While most 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. Examples include rooftop solar panels and household investment in more efficient home appliances such as air-conditioning systems, retrofitting of homes and the adoption of more fuel-efficient cars. Because benefits such as energy cost savings accrue only in the long term after the initial investment, it is fundamental that consumer groups understand these benefits, through labelling and wider consumer information.

Women are an important group who may benefit substantially from upgraded energy systems in households and improved access to higher quality fuels and energy technologies and may, in some countries, benefit from additional focus from policymakers in making information available to them.

(b) Civil society and the media

Changing consumer behaviour involves illustrating the multiple benefits that sustainable energy systems can have at the individual and community levels and which will strengthen a local culture of respect for the natural environment and the need for the rational management of a country's natural resources. Social debate around these type of core topics is in short supply in the Arab region, making bottom-up change in the area of rational energy use and management more difficult. Consumer protection organisations and civil society initiatives are, in many cases, constrained by strict assembly laws. Control of local media may impair many societies' capacities to effect change in energy consumption behaviour "from below". Strengthening civil society institutions' ability to advocate change from a citizen's perspective can be an important tool in countries' efforts to rationalize the use of energy resources and to combat wasteful consumption.

A related weakness across the Arab region is the limited scope for think tanks and universities. In addition to very real data access constraints, many institutions in the Arab region lack institutional strength and adequate human resources, as well as sufficient funding to fulfil their roles in helping adequately shape informed public debate. Media that are often unable to fulfil their role in offering a forum for constructive but also critical public debate around issues that are of importance for society and economy are a further constraining factor. This also means that, beyond academic research, people's voices – including those of women and the youth – in the debate around socioeconomic issues related to energy and the environment are rarely heard. ESCWA observed in this context that:

> Lack of freedom of science, research and media in many countries also means weak civil society, in addition to weak institutions… 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.[141]

Improving the quality of public debate will involve fundamentally revising the way observers can speak critically about current developments in their countries, including in the area of energy and the environment. Civil society institutions have the potential not only to raise awareness, but to link what may appear to be separate issues into a credible narrative of public interest. Nowhere else is this so relevant as in the context of sustainable energy. Linking socioeconomic development, energy and environmental management and climate change with the message that natural resources need to be managed in a sustainable manner to help societies build lasting wealth is a crucial message to which civil society itself must contribute.

B. Supply-side management

Effective supply-side management is a parallel imperative in the region's endeavour for more sustainable energy systems. The good news is that many good policy routes exist to help countries do more with less, all while serving national socioeconomic development priorities and reducing the region's carbon footprint.

1. Diversifying the Arab region's energy mix

Diversifying the national energy mix has become an increasingly important strategic goal for many Arab countries in recent years. Rising world market prices for oil and gas during the 2000s and early 2010s and the parallel increase in the import and opportunity cost of relying on oil and gas for a high proportion of national energy needs have prompted most Arab countries to look for sustainable energy alternatives as part of their incremental energy supply. The turn to clean energy, in particular renewables, follows parallel reductions in alternative energy technology costs, coupled with a growing number of successful pilot projects in the region, and, in the case of renewables and nuclear power, the appeal of adding new sources of energy to the national energy mix that can be produced domestically, removing the need for imports.

(a) Renewable energy

The Arab region has been slow in taking up renewable energy, for reasons tied to the comparably higher cost of renewables historically vis-à-vis regionally produced fossil fuels.[142] Putting aside conventional biomass that has been used traditionally throughout many parts of the Maghreb and some parts of the Mashreq and Yemen, hydropower used to be the most dominant source of renewable energy in the Arab region, though its use has been concentrated in a handful of countries with significant hydropower resources, in particular Egypt, Iraq, Morocco and the Sudan.[143]

Renewable energy technologies such as wind and solar power hold considerable potential to add to Arab countries' energy mix in the coming decades. The Arab region's resource endowment in sun and wind are excellent, in some countries world class; while the cost of technologies for wind, solar photovoltaic (PV) and concentrated solar power (CSP) has been falling rapidly in recent years.[144]

Consecutive auction rounds for both PV and CSP technology in the United Arab Emirates and Saudi Arabia that scored world record low-cost bids in 2016, 2017 and 2018, have underpinned the vast potential for renewable energy to be an economic and cost-effective energy solution to an increasing number of countries.[145] With solar PV now cost-competitive with most other conventional fuels in the Gulf region,[146] the potential for cost savings through renewables is an important consideration for energy import-dependent countries such as Jordan, Morocco and Tunisia, whose solar resource potential is even higher than in the Gulf States.

Beyond the economic potential in pure cost terms, renewables also promise important wider socioeconomic benefits in the Arab region. This includes the use of renewables for off-grid solutions to help electrify remote areas, in particular in Arab LDCs – women being major beneficiaries of such schemes where they are being applied already.[147] Conflict-affected countries can benefit greatly from renewable energy applications, including from its use for off-grid users (box 5) also offers the Arab region a vital avenue to decarbonise their future energy mix, helping build cleaner, more resilient energy systems, reducing their economies' carbon footprint while powering economic growth.

Renewable energy targets play an important part in most Arab countries' Intended Nationally Determined Contributions (INDCs) to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC).[148] Renewable energy also holds significant potential to contribute to regional efforts supporting new industrial development, helping create jobs and fitting in with wider policy goals promoting more innovative, technology-driven economies.[149]

(i) Positive progress in deployment in recent years

Recent years have seen significant increases in the deployment of renewable energy – in the region, a development that has been mirrored by increased policy focus on the development of national targets for renewable energy enshrined in many recent national economic long-term strategies.[150] The largest additions in supply between 2015 and 2017 have come online in Jordan, followed by Algeria, Morocco, Egypt and the United Arab Emirates, with smaller additions in Mauritania, Saudi Arabia and Tunisia (table 5). Morocco has been among the first Arab countries to systematically invest in utility-size solar and wind projects, supported by international lending groups, and now hosts Africa's single largest windfarm as well as one of the world's largest CSP plants.[151,152] Morocco plans to increase the share of renewables, including hydropower, in its energy mix to 42 per cent by 2020, then rising to 52 per cent (around 10 GW) by 2030.[153]

Egypt has been making parallel inroads into solar and wind power, already hosting Africa's largest dam, the Aswan Dam which has been generating electricity for Egypt since the 1970s. The Egyptian Government's Sustainable Energy Strategy to 2035 confirms the target stated in 2009 of 20 per cent of the country's electricity generation from renewable sources by 2022, with more recent plans for renewable energy to contribute 42 per cent of electricity generation by 2025.[154] Egypt's largest renewable energy project underway is the 1.8 GW Benban PV solar park, a flagship development by the Egyptian Government, which, if it materializes, would be the largest of its kind in the world. With support by the European Bank for Reconstruction and Development (EBRD), Egypt issued several

other tenders for solar PV, CSP and wind projects ranging from 100-250 MW since 2017 and initiated a feed-in tariff scheme for privately owned projects of up to 50 MW for a total 2,000 MW of wind capacity and 2,000 MW of solar capacity.[155]

Table 5. Net renewable energy capacity additions and percentage in electricity generation in the Arab region, 2015-2017

		Net capacity additions (MW)						Total renewable energy capacity (MW), 2017	Share of renewables in total power generation capacity (percentage)
		Hydro	Wind	Solar PV	Solar CSP	Other	Total		
Algeria	2015	-	-	48	-	-	48	312	2
	2016	-	-	170	-	-	170	482	3
	2017	-	-	181	-	-	181	663	3
Egypt	2015	-	200	10	-	-	210	3 713	10
	2016	-		23	-	-	23	3 736	10
	2017	-		121	-	-	121	2 857	6
Jordan	2015	-	117	29	-	-	146	163	4
	2016	-	66	267	-	-	333	496	11
	2017	-	14	100	-	-	114	610	14
Mauritania	2015	-	30		-	-	30	101	n/a
	2016	-		17	-	-	17	117	n/a
	2017	-	50		-	-	50	167	38
Morocco	2015	-			160	1	161	2 304	28
	2016	-	100	2			102	2 407	29
	2017	-	120	4			124	2 530	29
Saudi Arabia	2015	-	-	50	-	-	50	74	0
	2016	-	-		-	-	0	74	0
	2017	-	-	15	-	-	15	92	0
Tunisia	2015	-	7	10	-	-	17	332	6
	2016	-	5	10	-	-	15	348	6
	2017	-		10	-	-	10	358	7
United Arab Emirates	2015	-	-		-	-	0	137	0
	2016	-	-	7	-	-	7	144	1
	2017	-	-	213	-	-	213	357	1

Sources: Based on data from International Renewable Energy Agency, 2018c; Arab Union of Electricity, 2015, 2016b, 2017.
Notes: Data for Mauritania was provided by the Ministry of Petroleum, Energy and Mines for 2017. No data available for total electricity generation capacity installed for 2015 and 2016.

Jordan, too, is seeing rapid growth in renewable energy deployment. Endowed with some of the Arab region's best solar as well as excellent wind resources, the Jordanian government launched its new National Green Growth Plan in early 2018, earmarking renewable energy as a key sector in driving sustainable growth and reigniting the country's stagnated economy. The plan builds on ambitious targets outlined in the National Energy Strategy to scale up renewables to 10 per cent of the total energy mix by 2020.[156] Jordan hosts Tafila Wind Farm, the first privately financed renewable energy project implemented in Jordan, and the first commercial utility-scale wind power project in the Middle East. The 117 MW facility became operational in September 2015 and can power 80,000 homes.[157]

Moving beyond energy import markets in the Arab region, several GCC members have in recent years made important progress in implementing first renewable energy projects that have resulted in world record low cost bids for solar PV and CSP in consecutive auction rounds in the United Arab Emirates and Saudi Arabia. A total of around 7 GW of new solar and wind power-based electricity generation capacity is in the pipeline to come onstream in the GCC countries by the early 2020s.[158] The increasing economic attractiveness of solar and wind technologies in these countries is an important signalling factor for the potential of renewable energy to form part of the Arab region's future energy mix provided the right conditions are set.

Box 5. Renewable energy in conflict-affected countries

Renewable energy has much to offer in conflict-affected countries. The Palestinian Government has recognised that renewable energy could be a potential future growth area for the Palestinian economy and help reduce the State of Palestine's reliance on electricity and fuel imported from or via Israel. Being a domestically produced source of energy, it would also reduce the costs and impact of fluctuations in oil prices on both the Government's and residents' finances. At the same time, the construction of rooftop PV and other large solar farms will provide means by which families and the Palestinian government can save financially. The Palestinian Energy Authority (PEA) published targets in 2012 to generate about 10 per cent of total domestic electricity production and 5 per cent of the total expected consumption using renewable energy sources by 2020.

The Palestinian Government has launched a few solar projects working with international donor entities such as World Bank and European Union which have offered financial and technical support. Noor Palestine Project is a flagship project which entails utility-scale solar parks and a solar rooftop programme. The project's total capacity is 200-megawatt peak (MWp), equivalent to 17 per cent of the State of Palestine's peak demand. The ultimate aim is to replace fuel-generated power generation and electricity imports from Israel, with estimated annual electricity import savings worth around $48 million.[a]

In parallel, the Palestinian Government has made efforts to build and strengthen its regulatory and institutional frameworks supporting renewable energy projects and promoting energy efficiency initiatives. In 2015, the Government adopted Decree no. 14/2015 that encourages alternative and clean energy resources. In 2012, the Palestinian Authority Cabinet approved a strategy specific to energy efficiency: the National Energy Efficiency Action Plan (NEEAP). The Palestinian Energy and Natural Resources Authority (PENRA) was established to oversee the implementation of NEEAP. Besides the promotion of renewable energy, the PEA set an indicative target in energy efficiency and rationalizing electric energy consumption by end user that aims at achieving 5 per cent saving in overall electricity demand by 2020.[b]

Sources:
[a] Massader, n.d.
[b] World Bank, 2016c.

(b) Nuclear power

Besides renewable energy, another alternative source of energy entering the GCC countries' market in the coming years is nuclear power. There is currently no grid-connected operating capacity of nuclear power in the Arab region, but a number of Arab countries have considered including nuclear power as part of their mid-term strategies for their power sector. The most advanced civilian nuclear programme in the Arab region is in the United Arab Emirates. Nuclear power is promoted as part of the United Arab Emirates' long-term vision of diversifying its domestic energy mix to a 50 per cent clean energy share by 2050.[159] Construction of the first of eventually four 1,400 MW reactors at Barakah began in 2011 and power generation at the first unit is expected to commence in late 2019 or early 2020.[160]

Plans for nuclear power exist in other Arab countries, with varying degrees of progress. Saudi Arabia during the 2000s mulled plans for some 16 nuclear power plants over 20-25 years, but recently scaled back its plans to construct two large nuclear power reactors, with potential for an integrated desalination plant as well.[161] Jordan, too, has been planning a nuclear reactor, with plans for a large reactor recently replaced by a smaller, modular reactor, to be built in the coming years.[162] Egypt announced in July 2018 that it would start the construction of its first nuclear reactor within the next two to 2½ years.[163]

(c) Coal power

Coal is not a traditionally widely used source of energy in Arab countries, as the Arab region has no coal resources. Morocco is the only market that currently uses substantial amounts of imported coal for power generation, with small volumes consumed in Algeria and Egypt (figure 11). Clean coal made its ways into policies in several Arab countries since the late 2000s as an alternative to imported natural gas, particularly gas-short GCC countries. The United Arab Emirates[164] and more recently Oman[165] have announced plans to import coal, a decision justified on the basis of coal's contribution to further diversifying the country's future energy mix in lieu of scarcer natural gas. Under the United Arab Emirates' long-term energy strategy, clean coal[166] will account for 12 per cent of the total national electricity generation by 2050, translating into about 11.2 GW.[167]

(d) Overcoming hurdles to the greater diversification of the regional energy mix

Increasing the share of alternative sources of energy has become an increasingly important element in many Arab countries' economic long-term planning for their national energy sectors. Irrespective of national plans and targets, it will likely require significantly more political support and availability of financial resources than is currently available. Below, some of the most important priorities for increased uptake of alternative energy sources are discussed.

(i) Stepping up policy support

Policy support is critical to help scale up investment in alternative energy projects, especially renewable energy. This includes:

(a) The provision of comprehensive and effective legislation that provides clear guidelines for private and public developers in areas such as land acquisition and leasing processes;

(b) Institution-building and mandating, and building capacity in inter-institutional coordination and the dissemination of information and data;
(c) Appropriate, transparent legislation surrounding permits and licenses for private investors;
(d) Continuing the reform of domestic power tariffs.

Governments should be more active users of renewable energy in their own facilities and infrastructure by implementing renewable energy applications in public facilities such as hospitals, schools and public buildings. Moreover, Arab LDCs represent a large potential market for small-scale and decentralised renewable energy technologies.

In many cases, mandating a specialized institution would help promote new energy technologies, including niche markets such as electric vehicles, which could help further push for the adoption of clean energy technologies in Arab power sectors. Prospects for future electricity trade across national borders might similarly increase the attractiveness of alternative energy projects.

(ii) Increasing private sector engagement

To promote renewable energy stepping up incentives for private sector involvement is crucial. This includes:

(a) The provision of transparent legal frameworks;
(b) A business-friendly investment climate in the area of sustainable energy development that helps boost investor confidence and reduces risks associated with sustainable energy projects, including for financial bodies;
(c) Safeguarding access to low-cost capital, whether through private financial or international development-focused financial bodies.

There is a need to review the existing instruments for implementing sustainable energy solutions and consider experiences in the region that involve the development of public structures or of public-private partnerships, allowing an upscaled deployment of clean energy technologies. Programmes targeting public institutions, facilities and vehicle fleets should be a priority. In addition, mapping the geographical distribution of renewable energy resources can help support the case for renewables to investors and inform local communities that might benefit from community projects such as mini-grids based on private rooftop installations. Training to help raise the number of skilled people working in fields related to renewable energy can further help boost the viability of renewable energy projects.[168]

(iii) Overcoming investment hurdles

Accessing financing for sustainable energy solutions is one of the principle obstacles to sustainable energy projects. This is particularly true in LDCs and middle-income countries, where the cost of capital is often high and local financial sectors lack suitable financial instruments for financing new energy technologies, in particular in renewable energy projects. Niche applications such as off-grid projects often entail their own challenges, with limited availability of microfinancing options, and even less information available to potential stakeholders where such financing mechanisms are available.[169]

Solutions to the financing gap for both small- and large-scale energy projects outside the remit of conventional energy technologies require innovation in financial markets, but also focused government work to facilitate financial support for local stakeholders, including by working with the local finance sector and foreign lending bodies.

For small-scale applications, the focus of policy must be to ensure markets are being created for decentralised, renewable energy-based projects in countries with relevant market segments, such as Egypt, Mauritania, Morocco, Tunisia, the Sudan and Yemen. Part of the solution could entail improved cooperation between governments and international lending bodies and donor organisations, particularly in LDCs. Besides clear policy support for such applications, tools include credit guarantees and subsidies, in particular for small-scale projects and upscaling of energy efficiency programmes that contribute towards wider socioeconomic development objectives.

For utility-size projects, mainly in renewable energy, stepping up the exploration and use of international financing available for clean energy projects could help accelerate renewable energy uptake in countries limited by financing options. Multilateral development banks (MDBs), such as the International Finance Corporation (IFC), European Investment Bank (EIB) and the African Development Bank (AfDB), have been playing a major role in facilitating the development of renewable energy projects in a number of Arab countries, including Egypt, Jordan and Morocco (table 6). This backing reinforces the idea that renewable energy projects, despite their high initial capital cost, are bankable.

Table 6. Major renewable energy projects financed by MDBs and development institutions

Project	Location	Type	MW	Date	Financiers
Gebel El Zeit	Egypt	Wind	220	2018	JICA
Gebel El Zeit	Egypt	Wind	160	2018	EU/EIB/KfW
Quweira	Jordan	PV	103	2018	ADFD
Al Rajef	Jordan	Wind	86	2018	EBRD
Noor PV1	Morocco	PV	170	2018	EIB/KfW
Noor II & III	Morocco	CSP	350	2018	JBIC/Int. banks
Gulf of Suez	Egypt	Wind	250	2019	EIB/KfW
Tiskrad	Morocco	Wind	300	2020	EIB/KfW
Midelt	Morocco	Wind	150	2020	EIB/KfW
Jbel Lahdid	Morocco	Wind	200	2020	EIB/KfW
Boujdour	Morocco	Wind	100	2020	EIB/KfW
Tangier II	Morocco	Wind	100	2020	EIB/KfW

Source: APICORP, 2018b.

Intraregional development aid could also play an important role in helping countries without the financial capacity to invest in new technologies to diversify their energy mix. This is particularly important because several Arab countries – notably Kuwait, Qatar, Saudi Arabia and the United Arab Emirates – are significant donors of international development assistance and finance, while several other Arab countries are recipients of such development aid.[170,171] Directing a portion of these funds into projects promoting sustainable energy use in recipient countries, including Arab LDCs, would provide an opportunity to target energy vulnerability within the Arab region's poorest countries. Other cross-regional investment projects could further involve a strengthened focus on sustainable energy, including renewable energy projects and energy-efficiency measures in classical investment sectors such as industry and real estate.

(iv) Institutional capacity-building

Part and parcel of harnessing the opportunities in alternative energy is capacity-building for local institutions. This involves strengthening the capacity of national decision makers in the energy sector and the linked sectors of water, food and environment, building as much as possible on, but not necessarily limiting focus to, existing structures and mechanisms. Further progress builds on:

(a) The promotion of policy dialogues for policy integration across Government departments and between Governments and the private sector through multi-stakeholder partnerships;
(b) The reinforcement of adequate energy statistics programmes that monitor and report comprehensive energy variables, and that integrate fully with other economic and social national statistical efforts;
(c) The establishment of capacity-building and qualification programmes for technicians and workers involved in the design and implementation of energy efficiency and cleaner energy solutions;
(d) The establishment of educational programmes targeting the youth and the development of capacity-building programmes for private stakeholders, including the financial sector;
(e) The initiation of sustainable energy awareness campaigns, including fostering community champions.

(v) Technology innovation

Promoting the diversification of the Arab region's energy mix and benefiting from it requires capital and management skills and increasing capacity for technology innovation. This can happen through pilot projects, competition, investment in research and development and community-based projects. Promoting the commercial introduction of new technologies in related sectors, for instance the electrification of vehicles in Arab countries, could help further increase markets for clean energy, thereby offering greater incentives for investors while offering the economy potential for valuable job creation. Jordan, for instance, already exempts electric vehicles from taxes and fees, and the Jordanian government is committed to building a network of 3,000 solar-powered electric charging stations over the next decade.[172]

(vi) Further market developments

In the longer term, allowing consumers greater choice in more developed markets by unbundling electricity distribution may further add to the attractiveness of alternative energy supply. A residential survey from Saudi Arabia

found that almost one third of participants said they were willing to purchase electricity generated from renewable energy technologies even if these were more expensive than the conventional energy.[173] Similarly, the region has yet to find ways to design national legislation and the absence of deployment instruments in a way that encourages home-based adoption of technology solutions such as rooftop solar panels for electricity generation and water heating, a largely untapped technology option with huge potential to save consumers costs and reduce electricity demand for central grid operators. There is additional potential for these kinds of applications to benefit remote communities in the Arab LDCs. Stepping up energy mix diversification in the coming decade.

(vii) Intraregional cooperation in clean energy

Intraregional cooperation could help spur the deployment of clean energy options to the end of diversifying the Arab region's energy mix in the coming decades. The Pan-Arab Strategy for the Development of Renewable Energy, 2010-2030 adopted in 2013, created a foundation for regional co-operation to drive energy deployment in the Arab region. Regional leaders committed to increasing the region's installed renewable power generation capacity from 12 GW in 2013 to 80 GW in 2030. The Pan-Arab Clean Energy Initiative (PACE), which was included in the roadmap, is a regional initiative that aims to promote the integration of greater shares of renewables into power systems in the Arab region.[174] Supporting and promoting initiatives such as this could help Arab countries significantly increase their electricity system stability, reduce costs, promote alternative energy and improve intraregional integration.

2. Regional energy trade

Intraregional cooperation on energy could be an important factor underpinning more sustainable, resilient and cost-effective energy systems in the Arab region, and in so doing contribute to economic growth, shared prosperity and reduced poverty. Enhancing regional trade in energy between Arab countries would entail substantial benefits for all parties, including greater security of supply, access to cleaner energy – produced in bulk where it is cheapest – as well as considerable potential for job creation from the development of local manufacturing industries for components of technologies whose greater deployment could be driven by increasing regional cooperation, in particular renewable energy.

(a) Natural gas

Natural gas has been one of the foremost energy commodities traded or proposed for trade in increasing volumes between Arab countries. The use of natural gas for domestic energy in Arab countries has increased tremendously since the 1980s, a development that is likely to continue over the coming decades even as the region is expected to increasingly invest in alternative energy.[175] Natural gas is also widely considered to be the cleanest and most efficient fossil fuel available, with important potential for increasing future use in the region's transport sector to replace oil products as part of efforts to build more sustainable transport sectors.[176]

The very unequal distribution of natural gas resources across the region indicates that gas will continue to be imported by an increasing number of Arab countries and in increasing volumes, as discussed in chapter 1. These

countries will need to consider which available import options offer the best value for their economies. Regional pipeline gas imports offer the advantage of typically lower costs compared to imports of LNG from international markets, a pertinent consideration for small- and medium-sized markets given the substantial costs of building regasification infrastructure for LNG. They are also a safe source of natural gas supplies for countries that have otherwise been reliant upon the use of oil for domestic use, particularly in power generation.

A number of regional gas pipeline projects have demonstrated the practical benefits of intraregional trade. The Dolphin pipeline has been linking Qatar to its GCC neighbours since 2008, and an annual volume of around 2 billion cubic feet per day (bcf/d) of natural gas flows from Qatar's North Field to the United Arab Emirates and Oman.[177] For the GCC countries, Qatari pipeline gas is priced at very favourable terms no LNG supplies would ever attain.[178] In turn, both the United Arab Emirates and Oman have been able to supply their own long-term LNG export contracts despite extensive domestic demand for gas, in particular during the summer months. The Dolphin project has been seen as a symbol of successful closer integration of GCC countries' energy markets, with both economic and political benefits for the region.[179]

Another smaller, yet still important, example is the intraregional pipeline gas exports from Algeria to Morocco and Tunisia. Both Maghreb states have been purchasing small volumes from neighbouring Algeria, whose pipelines to Europe pass through both countries' territories – an economic solution for both countries that continue to burn imported oil, and in the case of Morocco, coal, in their power sectors as well. While both countries are compensated in kind for the use of transit land for the Algerian pipelines, they have also been buying additional volumes of natural gas from Algeria. The alternative for both countries would be international gas imports via LNG or relying on the fallback of other fuels for domestic power generation, primarily oil and, in Morocco's case, coal. Natural gas offers both countries a cleaner, lower cost alternative to oil and, since the costs for the pipeline infrastructure have already been amortized, Algeria encounters no additional infrastructure costs to export its gas to its neighbours.

An existing gas pipeline network also exists in the East Mediterranean, running through Egypt, Jordan, Lebanon and the Syrian Arab Republic, with an underwater branch of the pipeline connecting Egypt with Israel between the towns of Al-Arish and Ashkelon. At the time of writing, the pipeline was not in heavy use due to the combination of political turmoil and a shortage of gas supplies to feed into the grid. However, should gas supplies increase, either from regional producers or via LNG supplies, use of the pipeline network could result in substantial economic benefits to all importing countries, particularly for Jordan and the State of Palestine which have acute shortages of natural gas supplies. The idea of a regional "peace pipeline" between Israel and its Arab neighbours and, further north in the East Mediterranean, between Cyprus, Turkey and Lebanon, has generated support in the past.[180] Lebanon itself also has prospects to develop its own natural gas resources in the coming years.[181]

(b) Electricity

Expanding the Arab region's internal trade in electricity is another option with vast potential for economic benefits and savings for all involved. Regional electricity markets exist in

many parts of the world, including Europe and South America, and despite the inherent challenges of integrating multiple national electricity markets at regional level, the benefits outweigh the costs. Potential economic savings come from the pooling of utility sector resources, including power generation capacity. Differences in peak demand and consumption patterns offer important benefits when pooling power resources. Interconnection can considerably alleviate renewable energy intermittence as when supply drops, overproduction (that would otherwise be dumped) can be absorbed in the energy mix. Furthermore, large-scale renewable energy and nuclear power can offer significant economies of scale and having export options for overcapacity could maximize these benefits.

The Arab region has several subregional interconnection systems.[182] The Maghreb region interconnection, which includes Algeria, Morocco and Tunisia, was initiated in the 1950s. Morocco was connected to Spain in the late 1990s and all three countries are now synchronized with the pan-European high-voltage transmission network. In 1988 the Eight Country Interconnection Project (EIJLLPST), followed in the Mashreq to connect electricity grids of Egypt, Iraq, Jordan, Syrian Arab Republic and Turkey, later on joined by Lebanon, Libya and the State of Palestine. Turkey synchronized with the European grid early in 2015, advancing efforts to synchronize the broader EIJLLPST electricity network with the grids in Europe.

In 2011, the six GCC member countries linked their national power grids through the GCC Interconnection Grid. Although it was designed to facilitate commercial trading, as yet it has been used primarily as a cross-regional security mechanism that allows the transfer and exchange of electricity between the interlinked countries' national power systems at times of emergency, such as when domestic reserve or generation capacity is insufficient to supply peak demand, or in response to short-term expected national electricity shortfalls.[183] The GCC Interconnection Authority (GCCIA) estimates that economic savings for its member countries from shared spinning power and occasional electricity exchanges amounted to some $2.2 billion between 2011 and 2017 alone.[184]

Plans for large-scale renewable energy projects in the region would add appeal to the idea of trading electricity across country boundaries. At least a portion of the electricity generated from Saudi Arabia's announced non-binding agreement with Japanese conglomerate SoftBank in March 2018, for instance, could warrant consideration of intraregional trade. The so far non-binding agreement calls for the construction of a total 200 GW of solar power generation capacity in the Kingdom by 2030, the largest solar power project conceived in the Arab region and internationally, which would triple Saudi Arabia's power generation capacity within a period of less than fifteen years.[185]

Exporting a share of the electricity generated by this and similar projects could add new revenue streams to Arab economies and help steer new national industry sectors, while at the same time neighbouring countries would benefit from the availability of lower cost electricity imports at times of surplus-capacity in the regional grid. Pan-Arab projects such as the PACE, discussed in chapter 2 section B.1, could help drive the integration of different subregional interconnected grids in the Arab region to create a pan-Arab electricity grid with multiple benefits for all participants.[186] Projects such as this will benefit from the parallel upgrading of national

grid infrastructure toward the use of smart grids across the Arab region, as discussed in chapter 2 section A.2.

Further electricity trade could reach beyond just neighbouring Arab countries. The Global Energy Interconnection (GEI) Action Plan (box 6) seeks to interconnect power grids globally, thereby expanding the pool of clean energy resources available to countries across the world. This mega-project could benefit Arab countries, who in parallel with the initiative could create a fully interlinked electricity pool between various subregions' interconnected grids. The GEI is intended to optimize the bulk utilization of clean energy and transmission, replacing fossil fuels with renewable energy in countries' power mix, while contributing to electrification in regions with incomplete electricity access. Many Arab countries would be well suited to become bulk suppliers, especially of solar power; while others with smaller renewable energy resources could benefit from low-cost clean electricity. Arab LDCs could find an initiative of this kind a lifeline for cost-effective and secure electricity supply.

Box 6. The GEI Action Plan

The GEI is a vision of globally interconnected power grids, which could become a platform for large-scale development, transmission and consumption of clean, renewable energy worldwide. The idea behind the vision is to generate clean power in bulk in locations where it is plentifully available, which can then be transmitted over long distances to address the geographical mismatch of renewable energy resource centres and load centres. After satisfying local demand, excess electricity generated from clean energy can be traded to remote regions or countries, with minor losses, and economic benefits for both the sending and receiving sides.

A primary benefit is significant cost reductions in utilizing renewable energy. GEI is a cost-effective mean of achieving an optimized renewable energy allocation by combining Smart Grid and ultra-high voltage (UHV) technologies through grid interconnection (expansion).

A "GEI Action Plan to Promote the 2030 Agenda for Sustainable Development" was released in November 2017, together with the United Nations.[a] The next step action items for Governments to help support the project are:

- Further study the option from a global and national point of view, taking into account global renewable resources distribution and electricity demand;
- Develop new business models to attract multi-stakeholder investors to build power grid infrastructure;
- Carry out concerted actions to accelerate power grid interconnection, and disseminate successful experiences of UHV transmission plus Smart Grid technologies for transmitting bulk renewable power over thousands of kilometres;
- Put in place policies and action plans to encourage renewable energy development and utilization on a global level, and promote power transmission across countries or regions, on the basis of win-win cooperation and shared benefits.

Source: United Nations, 2018b.
[a] Global Energy Interconnection Development and Cooperation Organization, 2017.

3. Energy access and the quality of supply

Modern energy access is essential for the achievement of virtually all development goals, including the fight against poverty (SDG 1), the achievement of greater gender equality (SDG 5), decent work opportunities and economic growth (SDG 8) and the development of modern industries, innovation and infrastructure (SDG 9). The United Nations highlighted this when it stated:

> People deprived of modern energy are trapped in a reinforcing cycle with insufficient means to improve their living conditions and basic services, including lighting, education, health and fresh water to meet basic human needs. At the same time, poor households without energy access spend a significant share of their very limited income on expensive, unhealthy, unsafe, time-consuming and inefficient forms of energy. Modern, affordable energy is essential for breaking this cycle.[187]

Making progress in the achievement of universal modern energy access in the Arab region requires significant efforts from governments, particularly in the Arab LDCs, to elevate universal access to electricity to a priority position on the political agenda, backing up commitments with strategic planning, clear policies and dedicated institutions. This includes energy development scenarios, such as charting the expansion of power grids and the integration of decentralized solutions into rural electrification strategies (see chapter 2 section B.4.). Identifying priority areas, such as extending electricity access to schools, health centres and productive sectors, could help maximize social impact even with limited funds.

Countries with complete grid access but uneven supply should prioritize utility sector development and secure electricity access in their policy agendas.

Capacity-building within institutions will form an important part of universalizing secure energy access across the Arab region. Experience in the Arab region has demonstrated the large impact made by dedicated agencies and programmes focused on the extension of electricity access, particularly in rural areas. One example is Morocco's Programme d'électrification rurale global (PERG), launched in 1996, when rural electrification rates in the country were estimated as low as 18 per cent. PERG has since brought electricity access to more than 35,000 villages, comprising some 1.9 million rural households, over a 15-year period.[188] Such programmes require a strong institutional entity, with clear mandates, dedicated resources and accountability for achieving that mandate.

Ensuring secure energy access also involves careful planning and integration of options for the management of electricity markets, including enabling private sector participation and facilitating the use of supporting technological options. For instance, the fundamental role local entrepreneurs can play in extending electricity access via decentralized solutions should not be overlooked; Additionally, the use of off-grid systems (as discussed above) and the further development of electricity storage could help supply remote areas that grids cannot reach. Mandating minimum energy performance standards for lightning and household equipment, such as light-emitting diodes (LEDs), high-energy performance refrigerators and air conditioners, low-power televisions and other types of

equipment, enable access to energy services to higher numbers of end-users. Such schemes can add value to the economy through the creation of local jobs, as long as local skills and competencies are cultivated. Harvesting such opportunities requires programmes that target not only energy access per se, but that aim for a broader agenda that includes the use of demand technologies and the regulation of less efficient goods.[189]

Finally, affordability plays a major role in securing energy access. Particularly in off-grid settings, households may be unable to cover the initial cost of connecting to the system, even though they would be willing and able to pay for the eventual electricity used.[190] The United Nations notes that:

> No country has gone from poverty to prosperity without making electricity affordable and available in bulk for productive uses. Household electrification strategies should take into account other development goals, and opportunities to use electricity access to stimulate inclusive, climate resilient and sustainable economic activity.[191]

Governments can help lower the cost of electricity access to consumers and utilities by creating sound policies and institutions and by subsidizing decentralized connections to ensure affordability and equity between rural and urban households. Subsidizing connection fees, or the upfront costs of equipment and appliances, could be one way of overcoming initial connection hurdles. Separately, recent reforms of utility prices in many Arab countries with large portions of low-income households have raised concerns of affordability and security of access. Ensuring institutions are better equipped to assess the impact of electricity tariff reforms can help in the design of policy solutions, including targeted subsidy schemes or alternative social safety nets that ensure low-income households are not left behind.

4. Decentralized energy supply

Decentralised energy supply has been expanding rapidly at global levels in recent years, primarily owing to rapidly decreasing costs of renewables – in particular solar power-based solutions – and to the establishment of local supply chains making these solutions accessible. The International Renewable Energy Agency (IRENA) estimates that some 133 million people worldwide accessed lighting and other electricity services using off-grid renewable energy solutions in 2016.[192] By far the largest beneficiary group of renewable energy-based off-grid installations however has been industry, commercial users (such as telecommunication companies) and public good end-uses (such as street lighting or water pumping). Energy-efficient appliances have increased the spectrum of electricity services allowing off-grid systems to power at lower installed capacities.

Off-grid systems offer Arab LDCs means to expand electricity access to their rural populations. A number of international donor projects have in recent years picked up on off-grid solutions for electricity access, including the World Bank Group's initiative Lighting Africa, which has been active in Mauritania in partnership with ESMAP, GEF and various European Governments and the United States.[193] Mauritania already hosts countless mini-networks in rural areas as the preferred option to develop electricity access, many of them based on renewable energy. Mauritania's Rural Electrification Agency coordinates the decentralized rural

electrification process and manages the projects and associated programmes.[194]
In April 2018, the World Bank launched the $50 million Yemen Emergency Electricity Access Project, with the objective of improving access to electricity in rural and peri-urban areas in Yemen.[195]

Similarly, off-grid and grid-connected rooftop solar systems are providing economical and dependable renewable energy solutions to expand countries' capacities to provide access to reliable electricity, including in conflict-affected countries. A case study of Yemen (box 7) describes how solar rooftop systems have served as a lifeline for residents in both remote and urban settings, as conflict in the country has been intensifying and prospects for more secure electricity access through the country's main grid have been eroding.

To increase the uptake of off-grid systems in Arab LDCs beyond donor-driven initiatives, it is essential that the region's governments introduce mini-grid and off-grid renewables in national electrification plans, in addition to on-grid capacity to enable the decentralized organization of the energy sector with clear energy access development targets. Regulatory, financial and administrative frameworks will need to be developed accordingly, in order to support community-driven financing and to boost private sector activity in distributing and selling decentralized renewable energy, especially in remote areas. Part and parcel of this effort will be the need to shift government planning from a least-cost focus, to value maximization by off-grid systems that address people's needs and unlock the mutual benefits in other areas of socioeconomic development, such as education and food security.[196]

Box 7. Solar rooftop systems in Yemen

"With the outbreak of war in Yemen, the country plunged into a severe crisis and many services have collapsed. Government power plants have been shut down. The Yemeni capital and many of the country's cities have sunk into total darkness. On the other hand, trade of solar home systems become popular in the market and solar panels have spread over rooftops in almost every city and village, including areas that have not already been connected to electricity".[a] Indeed, the conflict in Yemen, ongoing since 2015, has significantly worsened the already large gap in access to modern energy in Yemen. Solar- powered home systems have been one of a few business sectors that have actually grown in recent years, reflecting their usefulness in homes with no grid-based electricity access. A 2016 market assessment conducted by the Regional Center for Renewable Energy and Energy Efficiency (RECREEE) and commissioned by the World Bank suggests solar PV systems had reached up to 50 per cent of Yemen's households in rural areas and 75 per cent in urban areas by the end of the year.[b] Solar rooftop application has significantly benefited households that would else have otherwise been left with no electricity access at all, offering users the ability to power a fridge and night-time lighting, benefiting also women.[c]

The success of solar panels for households in Yemen has spurred further support for international donors and lending bodies. In 2018, the World Bank approved the Yemen Emergency Electricity Access Project (YEEAP), a $50 million International Development Association (IDA)-funded grant with the objective of expanding access to electricity and electricity-dependent public services for rural and peri-urban populations through the distribution of solar energy systems. The project aims to restore electricity supply to 200,000 households, 400 health facilities and 800 schools, and will engage the local solar equipment supply chain and microfinance institutions, helping to create jobs in parallel.[d]

Sources:
[a] Mahdi, 2018.
[b] Badiei, 2018.
[c] Bekdash and Taylor, n.d.
[d] Badiei, 2018.

5. Value-creation from carbon

CCS, or carbon capture and storage, is the process of separating CO_2 from industrial and energy-related sources, transporting it to a storage location and isolating it from the atmosphere for the long term.[197] CCUS, carbon capture, utilization and storage, includes the utilization of CO_2 captured. The International Panel on Climate Change (IPCC) considers CCS technology one option in the wider portfolio of mitigation actions for stabilization of atmospheric greenhouse gas concentrations, including energy efficiency improvements, the switch to less carbon-intensive fuels, nuclear power, renewable energy sources, the enhancement of biological sinks and the reduction of non-CO_2 greenhouse gas emissions.

In the Arab region, CCUS is of particular interest for oil and gas producers trying to reconcile the so-called "energy trilemma" – the challenge associated with meeting international climate change commitments, keeping the lights on and managing electricity costs, all at the same time.[198] Several Arab countries are experienced with CCS or CCUS projects applications. Table 7 lists some ongoing projects in the Arab region, ranging from research to demonstration to project implementation, and covering a range of industries including oil, gas and petrochemicals.

Saudi Arabia, Qatar and the United Arab Emirates have invested significant resources into CCUS-related research, including in universities such as King Abdulaziz City for Science and Technology (KACST), the King Fahd University of Petroleum & Minerals (KFUPM) and the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia as well as dedicated research units inside Saudi Aramco and King Abdullah Petroleum Studies and Research Centre (KAPSARC) in Saudi Arabia, the Qatar Carbonates and Carbon Storage Research Centre (QCCSRC)[199] and Masdar in the United Arab Emirates.[200] Some oil and gas countries in the Arab region have developed carbon atlases as a major step forward to support their decarbonization. For example, Kuwait developed its first carbon atlas for the country in 2017.[201]

Table 7. CCS, CCUS in INDCs and NCs – Actions by Arab countries (status: end-2018)

Countries	NDCs	NCs	Energy	Oil and gas	Other industries
Bahrain	CCUS				Refinery, Petrochemical
Egypt	CCS	CCS	CCS	EOR	
Iraq		CCS	CCS		Cement, Ammonia, Iron
Kuwait		CCS	CCS	EOR	Desalinated water generation
Qatar		CCS			Research Project on CCS technologies
Saudi Arabia	CCUS	CCUS		EOR	Research Projects; Petrochemical
United Arab Emirates	CCUS	CCUS		EOR	Masdar CCS Network, Steel and Oil Field

Source: E/ESCWA/SDPD/2018/Technical Paper.14.

There are also a number of demonstration projects in the region that have been pointing to the feasibility of CCS technology. In Algeria, In Salah Gas (ISG) compresses and reinjects up to 70 million standard cubic feet per day (scf/d) or 1.2 million tons of produced CO_2 stream per year.[202] In Qatar, the Qatar Fuel Additives Company (QAFAC) commissioned a Carbon Dioxide Recovery (CDR) plant in 2014, which uses produced CO_2 as an input material for methanol production. In addition to increasing methanol production by 250 MT/day and reducing CO_2 emission by 500 MT/day, the CDR plant also reduces water consumption by 10 per cent by recycling recovered water vapour from flue gases and reduces nitrogen oxide (NOx) emissions.[203] In October 2012, Qatar University's Gas Processing Centre (GPC) announced the release of a Carbon Capture and Management Road Map, which outlines key milestones in the CCS technology roadmap for Qatar.[204]

Currently, two of the world's fifteen operating large-scale CCS projects are in Arab countries.[205] The United Arab Emirates started up the world's first fully commercial carbon-capture steel project, Al Reyadah, in 2016. A joint venture between Abu Dhabi National Oil Company (ADNOC) and Masdar, the project, one of 15 large-scale projects worldwide, is the first iron and steel project of its kind in the world.[206] With a capacity for 800,000 metric tons of CO_2 per year, Al Reyadah captures CO_2 at Emirates Steel manufacturing complex, then compresses and transports it, and finally reinjects the captured CO_2 into ADNOC's NEB (Al Rumaitha) and Bab onshore oilfields. In doing so it helps free natural gas for alternative purposes, a factor that makes the project economically feasible.[207]

The United Arab Emirates now plans to expand its carbon capture programme to manage a sixfold increase in the use of CO_2 in Abu Dhabi's maturing oilfields, a measure aimed to free up gas injected into the fields for other industries and to boost oil recovery rates. State oil company ADNOC plans to increase utilisation of CO_2 in 2021 to reach 250 million scf/d by 2027, as part of its plans to increase the oil recovery rate using dedicated Enhanced Oil Recovery (EOR) technologies, including CCUS.[208]

The region's second large-scale CCS project is in Saudi Arabia, which has been running the 800,000 ton-capacity CCS plant at Uthmaniya since 2015. The facility compresses and dehydrates CO_2 from the Hawiyah natural gas liquids recovery facility, which is then transported via pipeline to be injected into the Ghawar field, the world's biggest oil field, for enhanced oil recovery.[209]

ESCWA identified GCC country economies as offering particularly favourable conditions for scaling up CCUS applications, including the very high reliance on fossil fuel-based power generation, concentrated industrial centres suitable for CCS integration, optimal transport infrastructure framework design and the availability of suitable storage sites in the form of depleted reservoirs.[210] Oil and gas producers such as Algeria and Libya may also have good potential.

Reducing market hurdles is critically important for realizing this technology's application potential in the region. Overcoming barriers to more CCS applications across the Arab region includes applying market incentives such as pricing.[211] In addition, CCS in the region will benefit from more demonstration projects that help boost knowledge and experience and the strengthening of national legal, regulatory and financial frameworks that make CCUS more

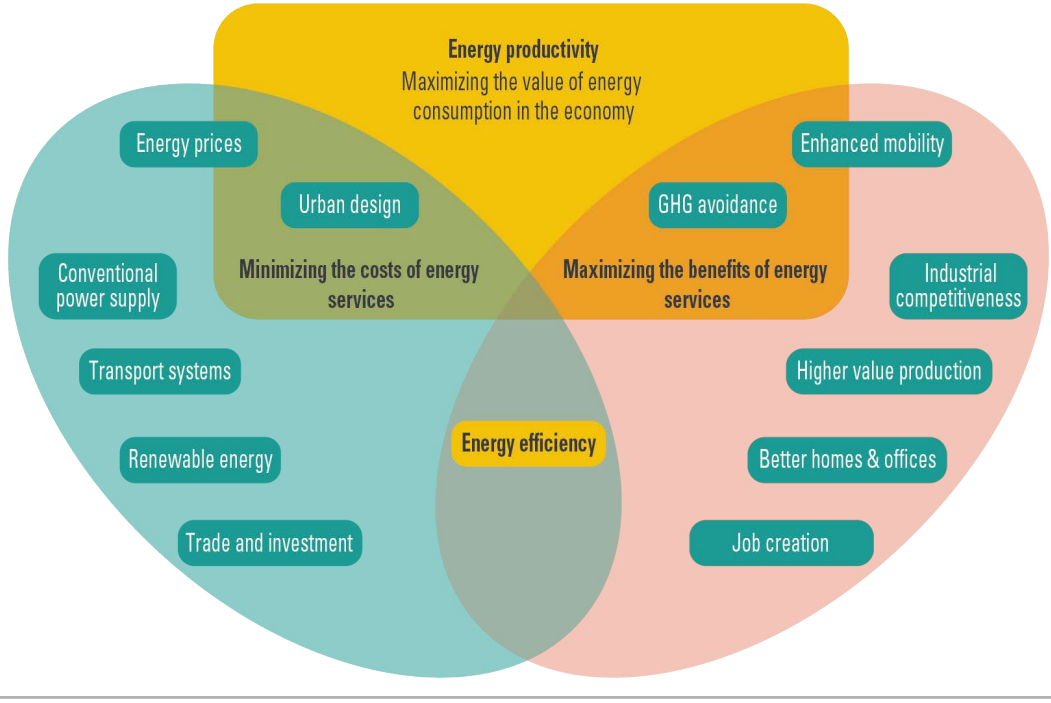
attractive for its target groups inside industries and the power sector.

C. Energy productivity

Energy productivity has been used by policymakers alongside energy efficiency and energy intensity around the world in response to global climate change concerns.[212] While most formal targets have been set in terms of energy intensity,[213] increasing support is found by those who think energy productivity provides a better way forward.[214] At the macro level, energy productivity is the amount of economic output, for instance GDP, achieved per unit of energy consumption – thus, the inverse energy intensity. In practice, energy productivity and intensity are mathematically equivalent, and either can be used for target setting purposes. However, some have argued that energy productivity, with its focus on economic growth, provides a more positive policy narrative especially for countries where energy consumption is rising.[215]

Proponents argue energy productivity provides insight into a country's economic competitiveness, environmental performance, opportunities for improvement and aligns more directly with economic, energy and environmental policy agendas than energy intensity and other measures.[216] Its fundamental requirement is the value from energy consumption through minimizing the costs of energy services and maximizing their

Figure 26. Energy productivity is an integrated economic policy agenda



Source: King Abdullah Petroleum Studies and Research Center and United Nations Economic and Social Commission for Western Asia, 2017.

benefits. The individual elements are defined by each country. Energy vulnerability thus can form a natural part of an energy productivity strategy.

Energy productivity, like energy intensity, is influenced by many factors including the energy efficiency of underlying economic components as well as the structure of an economy, its geography and climate, its natural resource endowments and resulting industrial focus. Fossil fuel-rich economies that produce a larger share of their economic output from energy-intensive sectors – as do many Arab oil- and gas-producing countries with large industries in fertilizers, aluminium and steel – will exhibit lower energy productivity than economies with higher value added sectors, for instance services, that use less energy per unit output of GDP.

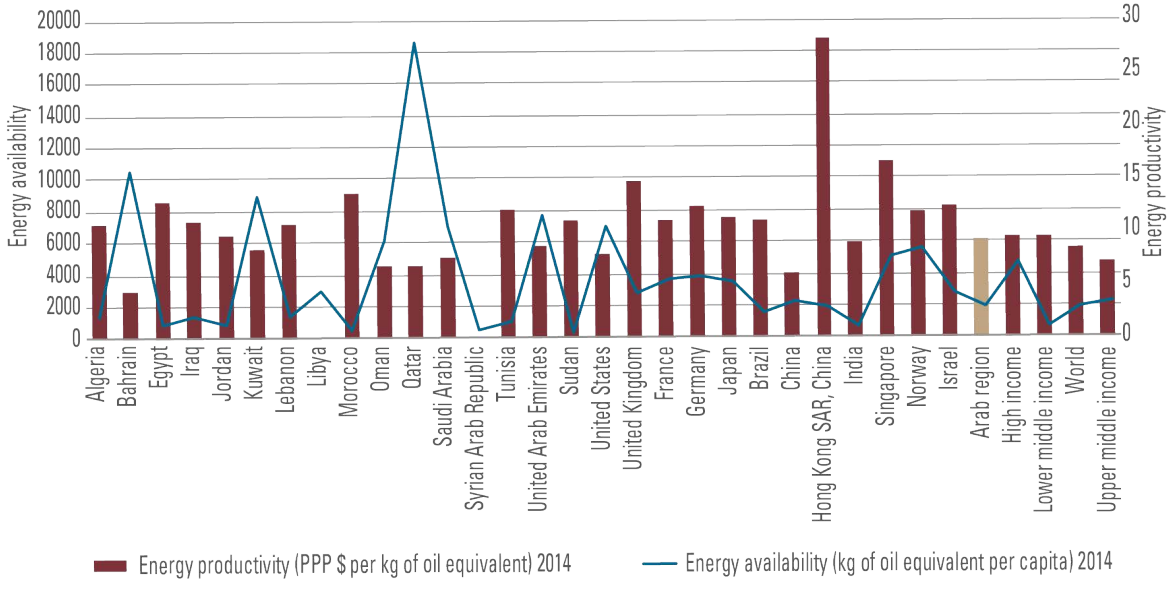
That is why most countries that have seen large energy productivity improvements in recent decades are developed economies with expanding service sectors relative to their manufacturing sectors; by contrast, progress in many developing countries with recent industrialization programmes have been trailing in energy productivity.[217] Arab countries exhibit a wide range of energy productivity levels. At the extremes are the group of Arab countries in conflict (Yemen and Libya) or recently emerged from conflict (Iraq) which experience sharp shifts in energy productivity. Countries not in conflict can be separated into two groups:

(a) Those with energy productivity higher than G20 average of around $9000 per toe, mostly from the Maghreb such as Algeria, Egypt, Lebanon, Morocco, the Sudan and Tunisia;
(b) Oil- and gas-producing Gulf countries such as Saudi Arabia, Oman, Qatar and Kuwait and Bahrain.

While elsewhere world average energy productivity is increasing by around 2-2.5 per cent per annum, the Arab region is notable as one of the few in the world where several countries are experiencing declining energy productivity. These include Algeria, Jordan, Lebanon, Oman and Qatar. Given the differences in economic structure and individual country circumstances, policymakers should focus on the change in energy productivity rather than the absolute level. Declining energy productivity is a concern as it suggests less value is being created in the economy for each unit of energy consumed.

Measuring the increase in energy productivity could provide policymakers in the Arab region with a potent, more positively connotated and more intuitive target indicator for comprehensive improvements in the areas of energy efficiency, structural economic transformations and other factors that feed into countries' energy productivity rates. Achieving this substantial potential will require a full range of price and policy measures, including energy price reforms, a significant effort on the demand side and end-use productivity such as through more competitive products and more effective transportation, and addressing energy availability constraints.

Figure 27. Energy productivity in the Arab region and selected other countries, 2014



Source: Based on World Bank and IEA, 2017.
Notes: Data gaps for Mauritania, Morocco, the Sudan, Tunisia and Yemen mean these countries are not displayed.

Box 8. Should the fossil fuel component of GDP be removed for the calculation of energy productivity?

Some have argued that to produce a more accurate value for energy productivity for large fossil fuel exporting countries, the fossil fuel component of GDP should be removed. This line of argument is since revenue from the export of crude oil or natural gas is associated with little economic added value, and hence distorts the indicator of energy productivity.

A study explored this issue in the context of Saudi Arabia, whose vast oil industry naturally significantly affects its energy productivity rate. The study concludes:

> Saudi Arabia has historically had very high energy productivity, significantly above the G20 average, due to the strong contribution of oil export revenues to overall GDP. The most recent data suggest Saudi Arabia's energy productivity is around $6,000 per metric ton of oil equivalent, which is roughly in line with the G20 average. If the oil-based components of GDP are removed, Saudi Arabia's energy productivity falls by around 40 per cent to just over $4,000 per ton of oil equivalent, just below that of China.

This highlights the importance of accounting for structural change in oil-based GDP when calculating energy productivity for major energy exporters.

Source: KAPSARC and ESCWA, 2017.

1. Establishing sustainable demand-side management systems for domestic energy use

Demand-side management (DSM) aims at modifying the energy consumption levels and patterns at the end-user level. The goal is either to reduce energy demand/consumption or to shift the energy demand/consumption from an initial time of the day of occurrence, usually the time of peak demand, to another time of the day when energy demand is at its lowest. DSM requires a positive intervention through the establishment of demand-side systems, at the level of energy consumer.

DSM involves the combination of specific policy instruments, institutional frameworks and specific technologies. Policy instruments, championed by an adequate institutional framework, consist of various types of regulation and incentives including minimum energy performance standards (MEPS) for buildings and equipment, time-of-day electrical tariffs and financing facilities for energy retrofits and equipment deployments. Indeed, reducing energy demand/consumption involves the promotion of energy efficient equipment and the optimisation of energy consumption for each energy service. Shifting the time of occurrence of energy demand/consumption involves changes, at the end-user level, in the scheduling of certain production tasks and their associated energy services or using storage apparatuses to decouple the time of production of the energy utility from its time of use. For example, in the case of cool storage, where cooling is produced and stored during the time of lowest energy demand and then used as needed during the rest of the day. In such cases, the end-users need to have a proper incentive for investing in the cool storage equipment and the associated changes in the cooling system. Such incentive is mainly obtained through a well-designed time-of-day tariff for electricity, which would involve adapted electric metering equipment. Sustainable DSM programmes can provide a viable alternative for some energy supply by reducing the end-user's energy requirements and can reduce, or postpone, the need for increased electrical capacities by shifting the time of energy use from the peak load time to a time of low energy demand. Indeed, both end-users and the energy system can potentially benefit from DSM: end-users reduce their energy bills by adjusting the timing and amount of energy use and the energy system can benefit from the reduction of energy consumption or its shifting from peak to non-peak hours. In most cases, DSM measures provide the lowest cost of energy supply for end-users and electrical capacity for energy systems. A recent study of Singapore's DSM programme found that every MW reduction of peak demand in Singapore translated to a system-wide savings of over $1 million.[218]

ESCOs can play a major role in implementing DSM programmes, but the market has not quite materialized in the region, despite the many attempts made to activate it over the last two decades. This is mainly due to the energy price distortions at the end-user level and the lack of suitable policy and institutional frameworks, both of which were discussed in previous sections.

However, it was shown that super ESCOs can be effective instruments for stimulating and developing the ESCOs market in the region and overcoming many of the challenges facing the upscale of DSM in Arab countries. Super ESCOs can be an efficient vehicle for channelling public funds in support of DSM programmes and implementing these programmes in the region, in a win-win framework for all relevant stakeholders. Super ESCOs can lead the backing

of local SMEs operating as ESCOs in their respective countries, develop their capacities, create market opportunities for them, and monitor the quality insurance of their interventions. One such super ESCO is the Etihad Energy Services Company (Etihad ESCO), established in the United Arab Emirates in 2013. Etihad ESCO is 100 per cent owned by the Dubai Electricity and Water Authority (DEWA) under the leadership of the Dubai Supreme Council of Energy (DSCE). It is mandated to target 30,000 existing buildings, operating as a Super ESCO on a commercial basis with a goal to generate 1.7 terawatt hours (TWh) of energy savings and reduce CO_2 emissions by 1 million tons by 2030. The annual savings is projected to reach an estimated $270 million by 2030.[219]

As a virtual power plant, super ESCOs have been shown to be the most economical way to address the need for additional power capacities and generation, which most Arab countries are facing, with electric peak loads expected to increase by at least 46 per cent (in Bahrain and Qatar) to as much as 125 per cent (in Oman) between 2017 and 2027. The need for electrical generation is expected to increase over the same period by a similar magnitude of at least 37 per cent in the United Arab Emirates to as much as 128 per cent in Oman.[220] Furthermore, these virtual power plants relieve the burden on governments from solely carrying the investments burden required for the additional power capacity and their associated operating costs, since the DSM investments as well as the totality of their eventual operating costs are largely supported by the end-users, to their advantage. Planned investments in the power sector in the Middle East and North Africa for the period 2017-2021 are estimated to total $ 207 billion,[221] with Arab countries representing over 80 per cent of that total amount.

Further discussion of the important potential of energy efficiency in the Arab region is provided in the GTF report for the Arab region which, in addition to the discussion above, demonstrates the very significant potential of energy efficiency in the Arab region.[222]

2. Implementing large-scale energy efficiency retrofit programmes across all economic sectors

Upscaling energy efficiency across all economic sectors is a major component of any successful and sustainable demand-side management programme. In fact, most benefits that can be potentially harvested in the short and medium terms lay in existing stocks of equipment, buildings, industrial facilities and vehicle fleets.

Upscaling energy efficiency through properly designed energy retrofit programmes offers the fastest and most efficient way to cut energy costs, reduce CO_2 emissions and manage long-term energy demand.

Most Arab countries have already launched national efficiency programmes and many of them have developed a set of policies, regulations and institutional frameworks to support these programmes. However, very few Arab countries have done so to the scale that would substantially reduce the energy consumption of a given economic sector.

In this context, a recent ESCWA study examined ways to improve energy sustainability in the buildings sector in the Arab region.[223] The study reviewed the current energy trends in the buildings sector and assessed its share of national energy consumption in each country. The report concluded that the buildings sector share of the energy use in the region amounts

to 28 per cent of the total primary energy supply (TPES) and over 60 per cent of electrical consumption. It also concluded that large-scale and deep energy retrofits of existing building stocks could reduce the buildings sector's final energy consumption by over 30 per cent by 2050 and by almost 50 per cent when combined with comprehensive MEPS and building energy efficiency codes (BEECs) if energy efficiency programmes targeting the entire buildings stocks were implemented over a 10-year period starting in 2030. In most Arab countries the main challenges to implementing the proposed energy efficiency programmes are low end-user energy prices, the lack of readily available financing mechanisms, lax enforcement procedures for existing standards and regulations and a shortage of skilled labour to design, construct, operate and retrofit sustainable buildings. It should be noted that in addition to the indicated energy savings and the associated reductions in carbon emissions, the proposed energy efficiency programmes are expected to create a significant number of jobs (for example, over 200,000 in Saudi Arabia alone) and considerably reduce the need for future power generation capacity.

The development of super ESCO structures can overcome many of the challenges facing the upscaling of energy efficiency programmes as discussed in the previous section, and as illustrated by the role played by the Etihad ESCO operating in the United Arab Emirates. Another alternative in the absence of a super ESCO is to create ad hoc structures mandated by tailored policies and assigned associated revolving public funds, dedicated to specific energy efficiency upscaling programmes. The ad hoc structures would be managed by dedicated teams with the required managerial and technical skills and supported with adequate funding and financing credit line, to cover the needed capital investments. An example of such ad hoc arrangement is the Palestinian revolving fund created in 2013 for promoting energy efficiency.[224] The fund targets the energy efficiency in existing public sector buildings through the financing of identified energy efficiency projects. The fund is managed by the Division of Energy Efficiency in PENA, which also provides technical assistance to similar projects seeking financial support from the revolving fund. Another example of such ad hoc arrangements are the dispositions included in the intentions of the Tunisian Energy Transition Fund (Fonds de la transition énergétique)[225,226] which is managed by the Agence Nationale de Maîtrise de l'Energie (ANME) and set up to provide financing resources for large scale energy efficiency programmes implemented by ANME.

Such ad hoc arrangements are valuable first steps in initiating the upscaling of energy efficiency programmes. However, these arrangements, which are often set up as project management units in the institutions in charge of energy efficiency in the respective country, are mandated to manage the projects and do not offer sustainable solutions for upscaling energy efficiency in a viable commercial setting. Indeed, to ensure sustainability, these institutions should focus on developing energy efficiency policies, evaluating technologies, conducting pilot programmes, setting up national targets and goals and planning their achievements. With this type of mandate, in addition to requiring a full dedication of these energy efficiency agencies to their associated tasks, the nature of the organisation of these agencies is not suitable for the business models needed for upscaling energy efficiency programmes and going way beyond the stage of pilot projects. This endeavour entails very different business models that allow a dedicated focus on getting large

upscaling of energy efficiency programmes up and running, in a commercial set up that can deal with the technical, financial and organisational requirements, in an environment where conventional energy efficiency services businesses are not yet viable. And super ESCOs can provide the suitable business models to address these issues.

Box 9. Case studies of successful large-scale energy efficiency programmes: Egypt and Tunisia

In Egypt, the Greater Cairo Region (GCR) Old Vehicles Scrapping and Recycling Programme (OVSRP) is a successful large-scale energy efficiency programme designed to replace old inefficient vehicles with new CNG-fuelled vehicles. Following two pilot projects in 2005 and 2009, the programme was commercially implemented using simple procedures and various financial incentives during the period 2010-2014. The programme targeted taxis more than 22 years old in the GCR. The programme succeeded in scraping and recycling 49,608 old taxis replacing them with CNG-fuelled vehicles, saving an estimated 550,000 tons of gasoline in a 10-year period and avoiding 1.7 million tons of CO_2 emissions. This project also contributed to reducing the amount of harmful air pollutants in the GCR and improved the quality of its taxi services. It was structured as a public private partnership and was managed by the Ministry of Finance (MOF). The scheme allowed participating vehicle owners to benefit from various financial incentives. Some of the incentives financed with public funding from the MOF. Incentives included payment for the replaced vehicle and exemption of sales tax and custom fees for new vehicles. Automobile dealers participating in the programme offered 25-30 per cent rebates from the market rate for new vehicles and participating banks offered below market-rate interest loan financing for the acquisition of the new vehicles, with MOF providing a loan guarantee when necessary. The vehicle owners could also participate in an advertising scheme, in which a portion of advertising revenue was directly paid to the lending bank toward vehicle owners' debt service payments. Reduced cost for maintenance and spare parts, along with insurance, was also provided for all new taxi vehicles. The scheme allowed the vehicle owners to pay back their car loan in less than six years, on average.[b] Given how successful it was in achieving its goals, the project's business model could be replicated for similar efforts in the Arab region.

In Tunisia, the Energy Efficiency in Industry Programme (PEEI), funded by GEF and the World Bank[c] is a good case study for upscaling energy efficiency programmes in the industrial sector by addressing the main challenges impeding the development of energy efficiency in this sector and initiating the development of a sustainable market for energy efficiency investments in the industrial sector in Tunisia and accelerating the implementation rate of projects. Tunisia has been a pioneer among developing countries in developing policy and institutional frameworks for promoting efficient and renewable energy from as early as 1985. Instruments it has implemented include mandatory energy audits of industrial facilities, various financial incentives for conducting these energy audits and implementing the identified energy efficiency measures through specific contract programmes with ANME. However, between 1987 and 2004, there were just 117 contracts. It was clear the pace needed to accelerate the pace to substantially increase this number.

The PEEI project, developed to overcome barriers to the development of a sustainable energy efficiency market in the industrial sector, was developed by ANME with a GEF/World Bank funding line amounting of $85 million over 7 years starting in 2005. The project also aimed to promote the Energy Service Companies (ESCOs) as an instrument to boost the energy efficiency market.

The PEEI project focused on the following three components: (a) providing additional subsidies (10 per cent) to investments in energy efficiency, (b) guaranteeing energy efficiency investments implemented through Energy Performance contracts, (c) providing technical assistance to all stakeholders on how such investments could be made.

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In addition to the dedicated management unit created within ANME, three task forces were set up to backstop, accompany and oversee most of the implementation activities of the programme:

- A task force for large industrial energy users, to assist large industrial energy users in their energy conservation efforts, focusing on the 200 most energy consuming companies;
- A task force on cogeneration, with the mandate of supporting the establishment of the required legal and regulatory framework to achieve the cogeneration objectives;
- A task force on natural gas, to encourage the expansion of natural gas use in the industrial sector as a replacement for petroleum products.

The task forces supervised a thorough assessment of the sector's needs in terms of energy efficiency actions which led to the adoption of the following approach: (a) Use of proximity actions (direct contact and repeated in location visits) for all companies for which energy audit was mandatory, to motivate them to conclude energy efficiency contracts programmes; (b) Development of a process of implementation of generic actions applicable to several units belonging to the same branch of the industrial sector, within a fraction of the time required by the energy audit process; (c) Accompanying the implementation of the contracts programmes, resulting from the energy audit or the adoption of one or more generic actions (assistance in the preparation of the technical design and bidding documents and supervision of their implementation, by "relay experts" contracted specifically within the framework of the activities of the project).

By 2010, the number of contracts programmes was multiplied about sixfold reaching 616 (with an average annual rate of 80 contracts programmes in the period 2005-2010). The energy savings amounted to 1.616 million of toe, representing a 10 per cent reduction of the energy consumption in the 320 industrial companies that participated in the programme for a total investment of 336 million Tunisian Dinar (D) including D40 million of public subsidies (provided by the Fonds National de Maîtrise de l'Energie (FNME)) while the rest was invested by the private sector. The programme also resulted in the installation of nearly 55 megawatts electric (MWe) of natural gas operated cogeneration equipment in the industrial sector, with a total investment of 61 million Tunisian Dinar enabling savings in primary energy of 32,000 toe per year. The programme averted an estimated 4.2 million tons of CO_2 over the period 2005-2012.

Both case studies showed substantial success in achieving their energy efficiency goals that were retained and both achieved some degree in the change of scale of the respective energy efficiency programmes. However, both business models were not sustainable enough, and did not create the expected jump-start for to scale up of energy efficiency in their respective sectors.

Sources:
[a] Korkor, 2014.
[b] Energy Sector Management Assistance Program, 2010.
[c] Missaoui, 2014.

Accelerating the pace and effectiveness of energy efficiency regulation and retrofitting targets in the Arab region will require specific institutional and policy frameworks, as well as the development and implementation of suitable business models dedicated to upscaling energy efficiency in a commercially viable manner. Currently, despite widespread political support for energy efficiency, including retrofitting programmes, little practical progress has been made and incentives for energy users typically remain low. Establishing an institutional framework that is empowered to design, develop,

coordinate and promote all energy efficiency activities at national level is one of the immediate priorities for countries in which energy efficiency remains new on the policy and public agenda. International experience from leading countries in energy efficiency field have shown that effective institutional frameworks need to have clear mandate, adequate budgets and professional staff as well as clear regulation and policies. This will entail many new challenges in the Arab region, especially in cash-poor countries with few resources for long-term investments over those in immediate priority areas.

The success of large-scale energy efficiency programmes also requires close collaboration among entrepreneurs, investors, utilities entities, government and non-governmental organizations. In many cases, this would require proactive government efforts in establishing and supporting channels of collaboration across economic actors in the service of progressing the government's energy efficiency agenda.

The private sector, particularly financial institutions, should also lead the way in promoting investment in energy efficiency solutions and technologies by making available financial products suited for their national market and diverse energy user groups. Financial institutions can play a significant role by offering affordable financing solutions for business and home owners to fund these investments in renewable energy and energy efficiency. More efforts should be targeted to reducing the cost of capital for climate-related investments, as well as the creation of loans and investments suitable to the needs of many clients. Governments, as international funding bodies, can play an essential role in supporting financial institutions in this endeavour.

Changing consumption behaviour and culture is also key in promoting energy efficiency and retrofitting practices. Internationally, in those countries that have made substantial progress in energy retrofitting, most programmes were incentive-driven rather than based entirely on obligatory requirements, such as by investing in energy-efficient retrofitting as a measure to save costs in the long-term. Information is a critical tool in helping economic actors make the right decisions. Governments in the region should consider targeted awareness-raising campaigns to educate the public and communities about energy efficiency measures, as well as financing options that are available. The objective should be changing current unconscious energy-wasting habits by a behaviour that values the efficient use of energy.

3. Reprioritizing structural economic diversification

Diversification plays a crucial role in supporting economic development and stimulating the creation of much-needed job opportunities to respond to pressing employment demands in the Arab region. Diversification also attenuates the risks associated with high economic concentration, which induces a high level of vulnerability in the economy to external events, such as changes in the price of the dominant commodity. Furthermore, diversification can substantially improve the performance of the economy, reducing volatility and smoothing the path to sustainable development (SDG8, target 8.2). In fact, the effective development and diversification of high value-added production, associated with an increase in exports of high-quality goods and services, can largely alleviate overall volatility in the economy and its negative impacts. In addition, target 8.3 of and target 9.5 of the SDGs also call for a focus on technological innovations and technology

research and development, which are at the heart of economic diversification and locomotives for socioeconomic development.

Part and parcel of increasing resilience and reducing vulnerabilities related to changing global energy market conditions – including those in consumer markets outside the Arab region – is to diversify Arab oil and gas producers' economies away from fossil fuel-based activities. Reducing reliance on export and government income from oil and gas exports reduces fluctuations in income and creates room for alternative sectors. Throughout Arab fossil fuel producers, this involves service-based industries and the parallel opening up of the economy towards more private sector activity. This diversification process would also induce a higher energy productivity, since high-value-added products require much lower energy resources than energy-intensive products (box 10).

The vast role of fossil fuels played in State finances throughout the region has cemented the central role of State enterprise into many Arab economies. At the same time, the convenience of oil and gas revenues has led to economies in which the State fundamentally relies on this source of income. In recent years many oil and gas producers have begun to focus on diversifying their sources of revenues. For instance, the value added tax (VAT) was introduced in 2017-2018 in several Arab countries, including the United Arab Emirates and Saudi Arabia.[227] This step is expected to provide a substantial new source of government revenue, in addition to other levies introduced in several GCC states in recent years, including municipality fees, customs and other license duties.

Box 10. Energy productivity as a paradigm seeking industrial diversification

According to a study conducted by KAPSARC for Saudi Arabia, when using energy productivity as a paradigm to design development strategies for industrial diversification, it is important to recognize that higher value-added sectors use basic products, including energy intensive ones, in their supply chains. Thus, it is preferable that higher value-added industries be developed using materials that were produced by local, efficient and internationally competitive heavy industrial units. Building complementarity between higher value-added sectors and basic industries by producing energy-intensive commodities domestically and using well managed energy efficient and competitive industrial units, especially in an energy-rich economy, would be the ideal model of diversification. The objective is "maintaining competitive advantage where it exists and building on it to extract more value in the production of downstream high value products and activities".

The study suggests the following approach to develop the diversification strategy in such contexts:

- Ensure the highest energy efficiency for the energy-intensive products produced in the country. This goal should be supported by a comprehensive programme aimed at bringing companies up to, or beyond, related international energy efficiency benchmarks, with companies that fail to make the necessary measures in compliance to these energy efficiency standards being sanctioned;
- Build a national industrial framework using a strong and efficient base of basic industries, including energy-intensive ones, and develop a domestic and international supply chain linkages to set up downstream higher value-added manufacturing and service sectors;
- Gradually strengthen the advanced higher value-added industries by improving their competitive advantages through local capacity-building, technology transfer, international investment, education and training.

Source: based on KAPSARC and ESCWA, 2017.

Another important element in fossil fuel producers' economic policy has been the increasing importance of oil stabilization funds. There are different types of funds in Arab fossil fuel-producing countries that can broadly be summarized into two categories: (a) oil stabilization funds that aim to shield their economies against short-term fluctuations in oil and gas revenues, and are hence used to balance budgets on a year-on-year basis; and (b) sovereign wealth funds (SWFs) with the aim of creating long-term wealth for future generations. Only the latter one can be considered a step into the diversification of fossil fuel-producing economies, whereas the former is mainly a tool to balance budgets in the short-run.

SWFs with long-term value creation potential are valuable tools for oil- and gas-producing states to use today's funds to create income for tomorrow. These can use a parallel approach: invest money now in industries, technologies and projects that create value for the national and international economy today, which at the same time, create long-term returns for future generations. Examples include investment in new technologies whose further development might benefit the creation of local jobs in knowledge-based industries (with immediate benefit for today's generations) or whose development could raise substantial profits in the future (for future benefit). International experience with SWFs and hybrid models includes funds that distribute the annual interest accrued from oil revenues invested by the government to citizens, through a form of citizens' income, like the Norwegian Pension Fund or the Alaskan Permanent Fund.

The Arab region has several stabilization and sovereign wealth funds with substantial value (table 8). The largest accumulation of state investment funds is found in the United Arab Emirates which had an estimated total value of $1.385 trillion as of April 2018, followed by Saudi Arabia ($758 billion) and Qatar ($320 billion). Not all funds listed below are long-term funds, however, and the status of funds popularly thought of as long-term funds – more SWFs than oil stabilization funds – must be seen in many cases as hybrid at best. Since the decline in oil prices in mid-2014, Arab countries have raided their oil funds at rapid rates. Among oil stabilization funds, the Kuwait Investment Authority (KIA) withdrew a total of $55 billion in assets from its fund between October 2014 and November 2017, Saudi Arabia's SAMA Foreign Holdings, withdrew a whopping $243 billion. In turn, Saudi Arabia's PIF, which is similar to an SWF and the centrepiece of the Government's new long-term economic strategy, Vision 2030, received around $219 billion in assets; Abu Dhabi's Investment Authority (ADIA) $55 billion, and Qatar Investment Authority (QIA) $150 billion.[228]

The situation is altogether different in oil and gas producers outside the GCC countries. Algeria nearly depleted its Revenue Stabilisation Fund in just a few years, from Algerian Dinar (DZ) 4,408 billion in 2014 down to its statutory floor of DZ 784 billion in 2016.[229] Situations such as this highlight the very delicate balance required for funds to play a role in helping countries safeguard their wealth for the long-term future, in the face of fluctuating fossil fuel revenues which threaten the fiscal stability of countries whose economies remain so dependent on oil and gas.

Table 8. Sovereign Wealth Funds and revenue stabilization funds in the Arab region

Country		Fund name	Inception	Value (US$ billion)
United Arab Emirates	Abu Dhabi	Abu Dhabi Investment Authority (ADIA)	1976	828
		Abu Dhabi Investment Council (ADIC)*	2007	123
		International Petroleum Investment Company (IPIC)*	1984	66.3
		Mubadala Development Company*	2002	125
	Dubai	Investment Corporation of Dubai (ICD)	2006	209.5
	Sharjah	Sharjah Asset Management	2008	n/a
	Ras Al Khaimah (RAK)	RAK Investment Authority	2005	n/a
	Federal	Emirates Investment Authority	2007	34
	Total			1 385.8
Saudi Arabia		SAMA Foreign Holdings	n/a	494
		Public Investment Fund (PIF)	2008	250
	Total			758.4
Kuwait		Kuwait Investment Authority (KIA)	1953	524
Qatar		Qatar Investment Authority (QIA)	2005	320
Libya		Libyan Investment Authority	2006	66
Oman		State General Reserve Fund	1980	18
		Oman Investment Fund (OIF)	2006	6
	Total			24
Bahrain		Mumtalakat Holding Company	2006	10.6
Algeria		Revenue Regulation Fund	2000	7.6
Iraq		Development Fund for Iraq	2003	0.9
Mauritania		National Fund for Hydrocarbon Reserves	2006	0.3

Source: Sovereign Wealth Fund Institute, 2018.
Notes: Values as of April 2018. *Processed of being merged into Mubadala.

A pivotal role in building resilient, sustainable economies across the Arab region will be the structural diversification of oil- and gas-producing countries' economies, beyond just diversifying revenue streams. A diversified economic base helps to reduce a country's vulnerability to a single business sector or a commodity.

Economic diversification is also beneficial for net fossil-fuel importers' economies in the Arab region, contributing to lowering their energy bills and reducing the risks incurred by their economies during periods when international fossil fuel prices climb.

Most Arab countries realized the importance of engaging in an economic diversification path to generate resilience to economic upsets. In fact, the economic reforms that took place in the Arab region in the last decade accorded a specific attention to economic diversification programmes in response to the fluctuations in international oil prices, as well as fiscal and monetary aspects.[230] But economic diversification is a lengthy process and may necessitate few decades to come to completion.

Many countries in the region started this trend of economic diversification as early as the late 1990s. Indeed, the evolutions of the GDP of Algeria, Oman and the United Arab Emirates over the period 1990-2015 show a clear trend of a decrease in the share of energy-based industries to GDP and an increase in the contribution from tertiary activities. This can also be observed to a lesser extent in Egypt, Saudi Arabia and Tunisia.[231]

Economic diversification has been a primary focus for nearly all Arab countries for many decades. Despite their diversity in size, demographics and wealth, most Arab countries face similar challenges in creating jobs to meet the aspirations of their young and fast-growing population. The social and political unrest that started late in 2010 in the Arab region, mainly triggered by social and economic dissatisfaction of citizens, made economic diversification important for political stability by reducing unemployment.

Indeed, economic diversification plans launched over the last decade across the region were influenced by variety of factors such as geography, climate, population, technology development and availability of natural resources, as well as the nature of existing economic base. Achieving economic diversification will require the continuation of regional reforms, including improving the business climate, opening up the economy to more trade and investment, improving access to finance and developing capital markets, and strengthening the regulatory environment. Increasing the flexibility of labour markets while better matching the skills produced by the educational system to needs of the private sector is also required.

The availability of a skilled workforce is crucial to the success of economic diversification plans. Sectorial strategies that aim for a diversified economic basis should seek to qualify and develop the competencies and skills needed by the private sector. Success is also dependent on investment in key infrastructure projects such as ports, roads, power and designated industrial zones that will logistically help the flourishing of new industries.

Box 11. Economic diversification in Algeria and the United Arab Emirates

Algeria's economy is strongly tied to the hydrocarbon sector. This sector still accounts for an important share of government revenues and represents about a third of the GDP. Furthermore, non-hydrocarbon GDP is largely dependent on revenues generated by public spending: the construction and transport sectors are largely financed by the public sector, and public consumption is a large share of GDP. The hydrocarbon dependency is particularly important with respect to exports.[a]

Nevertheless, Algerian authorities have been pursuing structural reforms aiming at diversifying the economy and promoting a dynamic private sector. The fall in oil prices in 2014 provided a sense of urgency to accelerate these reforms.

In May 2014, Algeria adopted the nation's latest five-year action plan for economic and social development, covering the 2015-2019 period. The public investment and structural reform over the medium term were to cover the main areas of government activity, with "high-level goals and initiatives at the macroeconomic and sector levels, foreshadowing reforms in the financial sector, tax administration, Customs, public-private partnerships (PPPs) and the investment regime, among others, as well as efforts to improve the business environment". The plan aimed to support social and economic development by fostering a dynamic and diversified private sector, including through the promotion of import substitution.

A new growth model was unveiled in July 2016, providing a vision to transform the economy by 2030, as well as a medium-term budgetary strategy for 2016-2019. Key objectives of the new framework included achieving a growth rate of 6.5 per cent in non-hydrocarbons GDP over the next decade until 2030 and doubling the manufacturing sector's contribution to GDP from 5.3 per cent in 2015 to 10 per cent by 2030. Initiatives included the adoption of a new investment code in July 2016, a new customs code in December 2016 and a draft law on public-private partnerships that was developed in 2017.

The new investment code was adopted in July 2016 and made tangible by Algeria's revised investment law (Law No. 16-09) in association with the 2016 Finance Law. The two legislations allowed a sensible revision of the legal framework applicable to investments in the country.

Law No. 16-09 stipulated the removal of many restrictions that had burdened investors and introduced a panoply of new incentives. Investments in new or improved production capacity could benefit from three new schemes which included a range of incentives depending on the nature of the investment, with an additional incentive regime applicable to the tourism, industry and agriculture sectors, as well as for those expected to generate sizeable employment.[b]

The economy in the **United Arab Emirates** has witnessed a rapid transformation over the past several decades by investing a significant portion of oil revenues in non-oil infrastructures, including the creation of leading global transportation companies and infrastructures and the development of free-trade zones. Today, oil accounts for less than 50 per cent of the United Arab Emirates' export revenues, and a diversified fabric of economic activities is now playing an important role in the country's economic prosperity, including supercarrier airlines serving more than 150 destinations, refrigerated storage at Dubai's Jebel Ali, the world's ninth largest container terminal, retailing businesses with about 324,000 people visiting Dubai's two busiest international shopping centres each day, generating an annual total number of over 100 million shoppers and contributing about $55 billion to the economy by 2017.

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Dubai is also developing other activities such as combining travel capabilities with advanced healthcare services carried out by more than 3,000 health facilities, with more than 35,000 health specialists working in the sector (expected to grow to 4,000 health facilities and 40,000 specialists by 2020). Dubai attracted 630,833 medical tourists in 2015 generating $400 million. Finance is another area that received attention, with the development of the Dubai International Finance Centre as a financial hub for the Middle East. The centre aims to become one of the world's top ten financial centres by 2024, increasing the number of firms from 362 in 2014 to 1,000.

The United Arab Emirates is also developing enabling environments and facilities to promote entrepreneurial activities. These include accelerators and incubators designed to help small companies grow. Free zones, such as Dubai Silicon Oasis, encourage technology-based start-ups, providing equity funding along with mentorship and legal support, and helping to build the United Arab Emirates a post-oil future.[c]

The United Arab Emirates vision 2021[d] integrated bringing the diversification process to a higher level into a national agenda aiming "to make the United Arab Emirates among the best countries in the world by the Golden Jubilee of the Union". Indeed, building a competitive knowledge economy is one of the pillars of the 2021 vision and is considered one of six national priorities which represent the key focus sectors of government actions in the coming years. These priorities also include high aspirations for healthcare, education, sustainable environment and infrastructure, public safety and fair judiciary system, cohesion of society and preservation of identity.

Sources:

[a] IMF, 2014.
[b] Oxford Business Group, 2017.
[c] Sharaf, 2016.
[d] United Arab Emirates, 2014.

3. Conclusion

3. Conclusion

Energy has played a pivotal role in driving socioeconomic progress in the Arab region for many decades. The way energy is produced and consumed will also determine whether a whole range of other developmental goals for the future can be reached, from ending poverty, safeguarding universal access to health services and education, to generating economic growth, building sustainable communities, protecting natural resources on land and at sea and fighting climate change. The Arab region's fast socioeconomic growth, flourishing populations and industries and its people's socioeconomic aspirations all challenge the long-standing status quo of energy demand and supply patterns that have prevailed in the past. A change in the patterns of the Arab region's natural and energy resource use is needed to ensure energy systems are safe, sufficient and sustainable for current and future generations.

Challenges in this arena underline the necessity of future governance, but also the role of civil society and businesses, in helping shape economies that can manage resources sustainably and provide opportunities that afford the Arab region's young, increasingly educated and highly ambitious youth with prospects for a successful economic future. The unrelenting consumption of Arab countries' natural resources, and the waste and inefficiencies created as a result, have been revealed to carry a high price tag, including in the political realm.

Systematic policies of regulation to enforce a more efficient energy use and the protection of land and water resources from pollution have been conspicuously absent in the Arab region, with only a few countries beginning to gradually take initial steps in the right direction. Other regulations, such as energy subsidies that made fossil fuels artificially cheap compared to alternatives, have long been a negative influence on energy consumption, leading to distorted energy demand patterns in middle- and high-income countries in particular. At the same time, many countries lack alternative mechanisms to protect the poor – a largely unresolved dilemma, particularly in the Arab LDCs and lower middle-income countries – that will continue to challenge policymakers over the coming decades.

While sustainable energy management has gained popularity as a political concept of late in the Arab region, in many cases, effective management, government legislation and policy action remain overlooked. The same can be said for underlying structural prerequisites, such as more effective management of domestic markets, transport and the environment. Nevertheless, many demonstration and prestige projects across the Arab region have illustrated the success that investment in sustainable energy solutions can have, from rural electrification projects using solar rooftop panels, new public transport systems in cities and nascent energy efficiency improvements in the buildings sector and industries.

Special attention should be given to the links between energy access and the eradication of poverty and inequality, water and food security, heath, education, employment, sustainable cities, climate change, transport and refugees and other situations of displacement.

Prioritizing and investing in actions, policies and programmes that advance the development of sustainable energy systems could and should also be tied to the empowerment of women, and the Arab region's highly educated youth. Women and young people will play a critical role in designing, producing and distributing modern energy services through their technical and business skills, and in establishing financing schemes to support gender- and community-specific programmes and women's access to capital.[232] In order to utilize their capacity, it is important to develop more gender- and youth-responsive policies, ensure equal participation and representation of women and the young, ensuring the future generation's interests are recognized in decision-making bodies in energy institutions.

The wide range of socioeconomic development experiences across the Arab region, ranging from some of the poorest to some of the wealthiest countries in the world, implies there is no "silver bullet" solution to energy vulnerability in the Arab region. For this reason, this report highlighted some of the recommended avenues for intervention whose application can be fostered and tailored to different countries' needs.

Overall, these avenues evolve around the three pillars of (a) more systematic demand management strategies in policymaking, such through more effective pricing policies, energy efficiency regulation, infrastructure investment and information; (b) diversifying the energy supply side, including through clean energy, the greater use of decentralised energy solutions, intensified energy trade and greater value-creation from carbon; and (c) mainstreaming the concept of energy productivity, thereby helping popularise the idea of maximising what energy can do for the economy – doing more with less, and decoupling growth from the consumption of energy for the sake of this and future generations of people. Meanwhile, the glaring gap in energy access must be closed over the coming decade, as a precondition for growth and development in the not only richest, but also the poorest parts of the region.

Building sustainable economies also rests on the acknowledgement – by policymakers, academia, media and civil society – that the Arab region could make much better use of its energy and other natural resources than it currently does. This is particularly relevant to the Arab region's middle- and high-income countries, whose high modern energy access rates, combined with rising incomes, populations, life expectancy and industrial structures, have translated into highly unsustainable energy consumption and production patterns. The parallel destruction of the environment and the pollution of living spaces – especially in Arab cities – is highly concerning from a social point of view and is ultimately unsustainable. The reprioritization of natural resource management, in which energy and water play a major part, presents a major area for stronger bottom-up engagement, given the silence that surrounds environmental issues in many Arab societies.

The Arab region demonstrates that progress on energy issues can no longer be separate from other socioeconomic development goals, but is, rather, a primary condition for sustainably powering progress. Addressing energy

vulnerability in the Arab region is a development priority that is both integral to the success of the 2030 Agenda and spans beyond it. The ability to harness the pool of natural resources through adequate choices of infrastructure, technology, governance and sustainable management practices will be key in creating economic opportunities for young people and improving their living standards; it is a key driver for broad socioeconomic development and for the attainment of gender equality, empowerment of women and intergenerational equity, which are also at the heart of driving long-term prosperity in the Arab region.

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Endnotes

Summary

1. United Nations, 2018a.
2. The sectoral shares of the hydrocarbon sector were calculated based on the fiscal category "Mining and Quarrying". They therefore exclude revenues made separately from energy-intensive industries that use significant values of domestically produced fossil fuels but fall fiscally under manufacturing.
3. It should be noted that not all increases in energy imports in the region stem purely from increases in overall demand, but also from switching the type of fuel, particularly in the case of natural gas. Energy imports are often rational economic choices: as most Arab countries have now switched from oil to natural gas as the preferred fuel for power generation, their natural gas imports have increased, but gas constitutes a far more economic fuel than oil, even if oil is produced domestically and gas is imported. Natural gas has also contributed to significantly reducing emissions from the power sector in these countries. It should also be noted that a further fuel switch, for instance from oil to gas in the transport sector, would translate into more gas imports, rather than a reduction thereof, in countries with insufficient resources of their own.
4. IRENA, 2018b.
5. E/ESCWA/SDPD/2018/Technical Paper.14.
6. Center for Climate and Energy Solutions, 2011.
7. Bean, 2014, p. 3.
8. Bean, 2014; King Abdullah Petroleum Studies and Research Center and United Nations Economic and Social Commission for Western Asia, 2017.
9. Farrell and others, 2008; Bean, 2014; KAPSARC and ESCWA, 2017.

Introduction

10. United Nations, 2018a.

Chapter 1

11. Food and Agriculture Organization of the United Nations, 2016. Jordan, for instance, has seen a doubling of municipal water withdrawals since the 1990s, according to FAO data.
12. E/ESCWA/SDPD/2016/MANUAL.
13. See chapter 1 section B for further discussion.
14. E/ESCWA/SDPD/2017/2.
15. A separate debate has been long ongoing around the definition and measure of the concept of "cost" in oil- and gas-producing countries. This has also been pointed out in a joint report by the IEA, OPEC, OECD and the World Bank in the early 2010s, when no agreement on the definition of the term "subsidy" could be reached (see International Energy Agency and others, 2010). Here, we include in the concept of "marginal cost", both the cost of production of the marginal unit of energy domestically, and the cost of imports by energy-importing countries.
16. Prior to tariff reforms during the latter half of the 2010s, Kuwait's residential electricity tariff of less than one US¢/kWh electricity, for instance, stood out as the world's lowest electricity price, having been in place and unchanged since the 1970s (see El-Katiri, 2014b).
17. IEA, 2017.
18. E/ESCWA/SDPD/2017/2, p. 17.
19. Fattouh and El-Katiri, 2012b.
20. del Granado, Coady and Gillingham, 2010.
21. IEA, 2018a. The IEA estimates energy subsidies based on a price-gap approach.
22. Fattouh and El-Katiri, 2012b.
23. International Monetary Fund, 2018a.
24. Ahram Online, 2016.
25. E/ESCWA/SDPD/2017/2; World Bank, 2016a.
26. World Bank, 2016b.
27. World Bank, 2016b, p. 66.
28. Ibid.
29. E/ESCWA/SDPD/2009/WP.1.
30. Kaisy and Chaaban, 2011.
31. E/ESCWA/SDPD/2009/WP.1, p. 7.
32. E/ESCWA/SDPD/2009/WP.1; World Bank, 2010a.
33. World Bank, 2010b.
34. Badr, 2018.
35. Kaisy and Chaaban, 2011.
36. United Nations Human Settlements Programme, 2013.
37. International Organization of Motor Vehicle Manufacturers, 2015.

38. World Bank, 2018a.
39. Shahbandari, 2015.
40. The sectoral share of the hydrocarbon sector was calculated based on the fiscal category "Mining and Quarrying". It therefore excludes revenues made separately from energy-intensive industries that use significant values of domestically produced fossil fuels but fall fiscally under manufacturing.
41. El-Katiri, 2016.
42. Gulf Petrochemicals and Chemicals Association, 2017.
43. It should be noted that not all increases in energy imports in the region stem purely from increases in overall demand, but also from fuel switching, particularly in the case of natural gas. Energy imports are often rational economic choices: as most Arab countries have now switched from oil to natural gas as the preferred fuel for power generation, their natural gas imports have increased but gas still constitutes a far more economic fuel than oil, even if oil is produced domestically and gas is imported. Natural gas has also contributed to significantly reducing emissions from the power sector in these countries. It should also be noted that a further fuel switch, for instance in transport from oil to gas, this would translate into more gas imports, rather than a reduction thereof, in countries with insufficient own resources.
44. CNN Arabic, 2016.
45. See also footnote 44.
46. OAPEC, 2017.
47. British Petroleum, 2018.
48. Middle East Economic Survey, 2018a.
49. APICORP, 2017a.
50. Butt, 2017.
51. England and Allam, 2010.
52. Lahn and Stevens, 2011.
53. World Health Organization, 2018.
54. E/ESCWA/SDPD/2017/Technical Paper.4.
55. E/ESCWA/SDPD/2017/2.
56. E/ESCWA/SDPD/2017/RICCAR/Report, p. 37.
57. Ibid., p. 325.
58. Ibid.
59. International Energy Agency and others, 2018.
60. Bekdash and Taylor, n.d.
61. IEA and others, 2018.
62. World Bank, 2018b.
63. IMF, 2017f.
64. James, 2014; Ottaway and El-Sadany, 2012.
65. IEA and others, 2018.
66. World Bank, 2018b.
67. United Nations Economic Commission for Africa, 2017.
68. World Bank, 2005a, 2005b; IEA and others, 2018.
69. World Bank, 2005a, 2005b; El-Katiri and Fattouh, 2011.
70. World Bank, 2018b.
71. For a background (see Gunning, 2014; and Bellanca, 2014).
72. UNHCR, 2018d.
73. World Bank, 2017c; IMF, 2017d.
74. World Bank, 2017c, p. 90.
75. Ibid., p. 111.
76. Ibid., p. 110.
77. UNHCR, 2018a.
78. United Nations, 2016.
79. UNHCR, 2018c.
80. UNICEF, 2017; European Commission, 2018; Sharp, 2018.
81. UNHCR, 2018a.
82. UNHCR, 2018b.
83. ESCWA numbers for 2016.
84. UNHCR, 2018a.
85. Ibid.
86. Lebanon, Ministry of Energy and Water and United Nations Development Programme, 2017, p. 10.
87. Ibid., p. 12.
88. Lahn, Grafham and Sparr, 2016, p. 3.
89. Ibid., p. 6.
90. United Nations Office for the Coordination of Humanitarian Affairs, 2013.
91. Ibid.
92. Ibid.
93. Agence France-Presse, 2018.
94. Lieber, 2018.
95. OCHA, 2017.
96. World Bank, 2017a. The Gini coefficient estimates by the World Bank highlight the significant income gaps between income groups, thereby illustrating the vast levels of inequality in a number of Arab countries (see also ILO, 2018).
97. Inchauste and Victor, 2017.
98. International Institute for Sustainable Development, 2016.

Chapter 2

99. IMF, 2017c.
100. IMF, 2017c.
101. Ibid.
102. IEA, 2017, p. 74.
103. El-Katiri, 2016.
104. Griffin, Laursen and Robertson, 2016.
105. E/ESCWA/SDD/2017/Technical Paper.5.
106. Ibid.

107. IMF, 2010.
108. Cuesta, El-Lahga and Ibarra, 2015.
109. Egypt Today, 2018.
110. Fattouh and El-Katiri, 2012b.
111. El-Katiri, 2014a.
112. Fattouh, Sen and Moerenhout, 2016.
113. Sdralevich and others, 2014; E/ESCWA/SDD/2017/Technical Paper.5.
114. Ibid.
115. Oxfam International, 2014; E/ESCWA/SDD/2017/Technical Paper.5.
116. Verdeil, 2014, discusses these issues in the context of recent protests in Tunisia and Jordan.
117. United Nations,2018b.
118. E/ESCWA/SDPD/2017/2, discusses these points in detail.
119. Aggarwal, 2015.
120. Nachmany and others, 2015.
121. Ibid.
122. Saudi Gazette, 2017.
123. United Nations Development Programme, n.d.
124. Krarti, Dubey and Howarth, 2017.
125. E/ESCWA/SDPD/2009/WP.1.
126. Baldwin, 2016.
127. IEA, 2013.
128. International Renewable Energy Agency, 2013.
129. Nachmany and others, 2015.
130. Ibid.
131. Derbel and Boujelbene, 2016.
132. Union Internationale des Transports Publics, 2016.
133. Jordan, Ministry of Transport, 2014.
134. Al-Asad, 2017.
135. E/ESCWA/SDPD/2017/Technical Paper.4.
136. Ibid.
137. Ibid., pp. 15-16.
138. Middle East Solar Industry Association, 2018.
139. E/ESCWA/SDPD/2017/2.
140. Ibid., p. 155.
141. Ibid., p. 156.
142. El-Katiri, 2014b.
143. IRENA, 2018c.
144. IRENA, 2018a.
145. IRENA, 2018e.
146. IRENA, 2019.
147. El-Katiri, 2014a; see also Alstone and others, 2011.
148. The full list of INDC submissions under the Paris Agreement is available on the UNFCCC's website at https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx.
149. IRENA, 2018d.
150. IRENA, 2016b.
151. APICORP, 2018a.
152. Graves, 2017.
153. Le Matin, 2018.
154. Feteha and El Wardany, 2017.
155. European Bank for Reconstruction and Development, 2018.
156. Jordan, Ministry of Water and Irrigation, 2015.
157. Masdar, 2015.
158. IRENA, 2019.
159. United Arab Emirates, 2018.
160. Langton, 2018.
161. World Nuclear Association, 2017.
162. Ghazal, 2018.
163. Reuters, 2018.
164. Mills, 2017.
165. MEES, 2018b.
166. Meaning that technologies will be used to capture the carbons created during coal production.
167. Mills, 2017.
168. See E/ESCWA/SDPD/2017/CP.6; E/ESCWA/SDPD/2017/CP.8.
169. E/ESCWA/SDPD/2017/CP.6.
170. Organisation for Economic Co-operation and Development, 2017; see also Luomi, 2017.
171. OECD, 2018.
172. E/ESCWA/SDPD/2017/CP.9.
173. Alrashe and Asif, 2015.
174. IRENA, n.d.
175. Fattouh and Stern, 2011.
176. E/ESCWA/SDPD/2017/Technical Paper.4.
177. http://www.dolphinenergy.com/#. Accessed on 15 August 2018.
178. El-Katiri, 2013. Dolphin gas Phase I exports were linked to a base price of between $1.25 and $1.35/MMBtu (c.i.f., subject to an annual escalation).
179. World Bank, 2010b; see also Dargin, 2008.
180. Darbouche, El-Katiri and Fattouh, 2012; Sartori, Colantoni and Paceviciute, 2016; Zemach, 2016.
181. Barrington, 2018.
182. World Bank, 2013.
183. Al-Alawi, Sud and McGillis, 1991; Al-Asaad, 2008; El-Katiri, 2011.

184. Gulf Cooperation Council Interconnection Authority, 2017, p. 26.
185. Nereim and Cunningham, 2018.
186. World Bank, 2013; Leal-Arcas, Akondo and Rios, 2017; Camos and others, 2018.
187. United Nations, 2018b, p. 15.
188. E/ESCWA/SDPD/2017/2.
189. United Nations, 2018b.
190. Households' willingness to pay (WTP) for better electricity access has been examined in a number of developing country contexts outside the Arab region, with overall positive results (see, for example Choynowski, 2002; Hensher, Shore and Train, 2014).
191. United Nations, 2018b, p. 16.
192. IRENA, 2018b, p. 1.
193. World Bank, 2018c. For a background on existing off-grid systems in Mauritania (see IRENA, 2015).
194. United Nations Economic Commission for Africa, 2017.
195. World Bank, 2018d.
196. IRENA, 2016; United Nations, 2018b.
197. Intergovernmental Panel on Climate Change, 2005.
198. E/ESCWA/SDPD/2018/Technical Paper.14.
199. http://www.imperial.ac.uk/qatar-carbonates-and-carbon-storage/.
200. Ustadi, Mezher and Abu-Zahra, 2017.
201. Al-Mutairi, 2017.
202. E/ESCWA/SDPD/2018/Technical Paper.14, p. 23.
203. Qatar Fuel Additives Company Limited, 2018.
204. Meltzer, Hultman and Langley, 2014.
205. For a full list of large-scale CCS projects and their definition (see Global CCS Institute, 2018).
206. McAuley, 2016.
207. Masdar, 2016.
208. Saadi, 2018.
209. Global CCS Institute, 2017.
210. Sleiman and El Andaloussi, 2013.
211. Center for Climate and Energy Solutions, 2011.
212. Bean, 2014, p. 3.
213. This includes the Global Tracking Framework (GTF), which uses energy intensity as the underlying proxy measure for improvements in energy efficiency (see World Bank and IEA, 2017).
214. Bean, 2014; KAPSARC and ESCWA, 2017.
215. Bean, 2014.
216. See for example Farrell and others, 2008; Bean, 2014; KAPSARC and ESCWA, 2017.
217. Bean, 2014.
218. https://www.ema.gov.sg/Demand_Side_Management.aspx (accessed on 15 August 2018).
219. ECONOLER, 2016.
220. Based on published figures in Arab Union of Electricity, 2016b.
221. APICORP, 2017b.
222. E/ESCWA/SDPD/2017/2.
223. ESCWA, 2018d.
224. سلطة الطاقة والموارد الطبيعية الفلسطينية، 2013; Palestinian Energy and Natural Resources Authority, 2013.
225. Tunisa, 2013.
226. تونس، 2017.
227. IMF, 2017b.
228. MEES, 2017.
229. IMF, 2017a.
230. Arab Monetary Fund, 2017.
231. United Nations, 2017.

Chapter 3

232. United Nations, 2018b.

This publication seeks to identify sources of energy vulnerability in the Arab region that prevent member States' ability to ensure universal access to affordable, reliable and modern energy services for current and future generations. It also assesses strategies to tackle energy vulnerability effectively while at the same time providing perspectives on how different groups can contribute to solving these issues. Building on the Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development, the publication aims to move beyond the 2030 horizon to mainstream the concept of sustainable long-term energy management in the Arab region and address vulnerabilities that result from the continuation of a business-as-usual scenario.

This publication demonstrates that progress in the Arab region on energy issues can no longer be addressed separately from other socioeconomic development goals, but rather, is a primary condition for sustainably powering progress. Addressing energy vulnerability in the Arab region is a development priority that is both integral to the success of the 2030 Agenda for sustainable development and spans beyond it. The ability to harness the pool of natural resources in the Arab region through adequate choices of infrastructure, technology, governance and sustainable management practices will be key in creating economic opportunities for young people and improving their living standards; it is a key driver for socioeconomic development and the attainment of gender equality, empowerment of women and intergenerational equity, which are at the heart of driving long-term prosperity in the Arab region.

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