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IRENA
International Renewable Energy Agency

REN21
Renewable Energy
Policy Network
for the 21st Century

MENA
RENEWABLES STATUS REPORT

MENA 2013

MENA Renewables Status Report

For the sake of comparison, the 21 MENA countries were clustered into two sub-groups:

NET OIL-EXPORTING COUNTRIES (NOEC):
Algeria, Bahrain, Egypt, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, and Yemen, and

NET OIL-IMPORTING COUNTRIES (NOIC):
Djibouti, Israel, Jordan, Lebanon, Malta, Morocco, Palestine, and Tunisia.

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The Ministry of Foreign Affairs' Directorate of Energy & Climate Change (DECC) is the UAE's international lead on energy and climate change issues, simultaneously working with domestic stakeholders on the country's green growth and energy investment strategy. Among key portfolios, DECC is responsible for the United Nations Framework Convention on Climate Change, the post-2015 development agenda, the Clean Energy Ministerial, the Global Green Growth Institute, the International Energy Agency, Sustainable Energy for All, bilateral clean energy and climate agreements, and hosting the International Renewable Energy Agency.

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The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low carbon economic growth and prosperity.

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REN21 is a global multi-stakeholder network that connects a wide range of key actors from governments, international organisations, industry associations, science and academia as well as civil society to facilitate knowledge exchange, policy development and joint action towards a rapid global transition to renewable energy. REN21 promotes renewable energy to meet the needs of both industrialised and developing countries that are driven by climate change, energy security, economic development, and poverty alleviation.

REN21 is committed to providing policy-relevant information and research-based analysis on renewable energy to decision makers from both public and private sectors to catalyse policy change. REN21 also provides a platform for interconnection between multi-stakeholder actors working in the renewable energy field worldwide, and works to bridge existing gaps to increase the large-scale deployment of renewable energy worldwide.

www.ren21.net

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Executive Summary

Renewable energy markets and policy frameworks in the Middle East and North Africa (MENA)[i] have evolved rapidly in recent years, with an increasing amount of investment and a burgeoning project pipeline to harness the region's abundance of renewable energy resources. Current signs suggest a significant shift in the region's diversification efforts over the next decade, especially in the Gulf Cooperation Council (GCC) countries.

This report provides a comprehensive and timely overview of developments in renewable energy markets, industries, policies, and investments in the MENA region, drawing on the most recent data available, provided by a network of more than 50 contributors and researchers from the region and synthesised by a multi-disciplinary authoring team. The report covers recent developments in renewable energy, current status and announcements, and key trends; by design, it does not forecast the future. As such, this report will serve as a benchmark for measuring progress in the deployment of renewable energy in the MENA region.

RENEWABLE ENERGY GROWTH IN THE MENA REGION

The marked expansion of the region's renewable energy market, as well as the diversity of countries now participating in it, is driven by a number of key factors: energy security enhancement; major energy demand growth due to population increases, urbanisation, and economic progress; and water scarcity. With high fossil fuel prices resulting in both steep bills for net oil-importing countries (NOIC) and opportunity costs for net oil-exporting countries (NOEC), renewables have become an increasingly attractive alternative to domestic oil and gas consumption. Renewable energy is also cited as a potential means of industrial diversification, new value-chain and employment activities, technology transfer, and improved environmental footprints.

From 2008 to 2011, non-hydropower renewable power generation in the region more than doubled to reach almost 3 terawatt-hours (TWh) and grew at a much faster pace than conventional energy sources. Although wind has become the largest renewable energy source after hydro, solar power generation has seen higher growth in recent years, first through photovoltaic (PV), and then with the commissioning of large concentrating solar power (CSP) plants in Algeria, Egypt, Iran, and Morocco as well as, most recently, the world's largest CSP plant in the United Arab Emirates. This trend is expected to continue in the foreseeable future. As of April 2013, there were 106 renewable energy projects in the pipeline in the region, totalling over 7.5 GW of new electric generation capacity—an almost 4.5-fold increase over existing non-hydro renewable capacity.

Solar water heating (SWH) systems are also a key element in the deployment of renewables in the region. Today, they account for about 9 million square metres (m^2) of collector area, representing 6.3 gigawatts-thermal (GW_{th}) of installed capacity. Most SWH systems are located in the NOIC so far, where a number of exemplary promotional schemes, in particular the PROSOL programme in Tunisia and the PROMASOL programme in Morocco, have been implemented.

Shams 1 Concentrated Solar Power Plant, Abu Dhabi, UAE

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i - For the sake of comparison, the 21 MENA countries were clustered into two sub-groups: Net Oil-Exporting Countries (NOEC): Algeria, Bahrain, Egypt, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, and Yemen, and Net Oil-Importing Countries (NOIC): Djibouti, Israel, Jordan, Lebanon, Malta, Morocco, Palestinian Territories, and Tunisia.

These trends have been accompanied, and caused in part by, a rapidly changing set of policies, targets, regional cooperation activities, and institutions in the MENA. New or expanding regional cooperation and institutional activities related to renewable energy include: the establishment of the 160-member country International Renewable Energy Agency (IRENA) in Abu Dhabi; the development of the Masdar renewable energy development and investment cluster in Abu Dhabi, and of the King Abdullah City for Atomic and Renewable Energy (K.A.CARE) in Saudi Arabia; the establishment of the Regional Center for Renewable Energy and Energy Efficiency (RCREEE), based in Egypt; as well as linkages with Europe through the MENAREC, MSP, Desertec, RES4MED, and MEDGRID, to name a few.

A DYNAMIC POLICY LANDSCAPE

Policy deployment and target-setting are now a widespread phenomenon across the region. As of May 2013, all 21 MENA countries have renewable energy targets (19 of which have specified targets by technology), up from just five countries in 2007. If realised, the targets would result in 107 GW of installed capacity in the MENA region by 2030. Reflecting the momentum of renewable energy in the oil-exporting countries, eight of the 13 NOEC countries introduced targets in 2012, with Saudi Arabia alone aiming for a staggering 54 GW of renewable energy by 2032.

Moreover, at least 18 of the 21 MENA countries had some type of renewable energy promotion policy in place to help achieve those targets. Currently, FITs have been adopted in at least seven MENA countries and are under consideration or development in three NOEC. Seven countries have net metering in place, and 11 countries have some form of renewable energy fiscal incentive, including capital subsidies and tax or production credits or reductions. However, of all the policies employed by national governments to promote renewable electricity, the most common was public competitive bidding for fixed quantities of renewable energy and public financing, including grants and subsidies. At least 15 MENA countries have direct or indirect public funding or public competitive bidding processes in place.

The majority of targets and policies place a priority on solar PV, CSP, and SWH, in part reflecting the high-quality solar energy resources in the region, and decreasing technology costs. Wind is the next most popular technology choice. However, the rising interest and activity in renewable energy occurs at a time of ongoing regional political uncertainty in some countries, raising concerns about the financing of renewables.

INVESTMENT TRENDS

The MENA region is one of the few regions in the world where renewable energy investment seems to be weathering the global economic crisis. New investment in renewables in the region totaled USD 2.9 billion in 2012, an increase of almost 40% over 2011 and a 6.5-fold increase from 2004. The development of the region's renewable energy sector saw heightened investor interest from 2009 to 2012, best illustrated by the entrance of some of the world's largest energy players, especially national and international oil and gas companies, into the solar market. However, several challenges remain to be addressed to decrease the reliance on public and soft financing, and to foster private investment in the region. These include regulations and market-based policies, energy subsidies, public awareness, political unrest, financial uncertainty, and policy risk. The region also awaits with interest the operational details and implementation of the new Green Climate Fund.

RURAL RENEWABLE ENERGY

The MENA countries have made great strides in rural electrification, and electrification rates are now 99% or more in 11 of the 19 countries for which reliable data are available. However, rural areas specifically remain underserved in some countries, including Yemen and Djibouti. In all, an estimated 20 million people in the region are without access to electricity, while at least 12 million use traditional biomass for cooking and heating, with attendant health and environmental problems. Renewable energy off-grid solutions, especially solar PV, are often seen as competitive and at the correct scale for remote rural communities for which grid access would be very costly.

LOCALISING THE RENEWABLE ENERGY VALUE CHAIN

There is growing interest in developing the renewable energy value chain in the MENA region, and several countries already have developed policies to stimulate local manufacturing and innovation, and to generally promote higher local content in both renewable energy hardware and ongoing maintenance of plants and equipment. Apart from the need to maximise the local value-added from renewable energy deployment, the countries all have an interest in creating more skilled employment and more business opportunities for local entrepreneurs. Saudi Arabia, the United Arab Emirates, Egypt, Morocco, and Tunisia provide examples of different approaches to developing this value chain, with considerable scope for appropriate policies and instruments to localise the value chain despite the various challenges related to global competition, intellectual property rights, and capacity needs.

Egypt's Zafarana wind farm along the Red Sea

01

Regional Market and Industry Overview

The renewable energy market in the Middle East and North Africa (MENA) region is expanding rapidly, with a diverse range of countries announcing projects and policies to harness the region's abundance of renewable energy resources for economic growth and energy security enhancement. While capacity additions and investment remain below those of other regions, recent years have seen a groundswell of government and commercial interest.

Among contributing factors, marked increases in energy demand are particularly catalytic. Strong demographic growth, urbanisation, and economic expansion, as well as water scarcity, have resulted in urgent needs for additional energy supplies. With high fossil fuel prices (resulting in both steep bills for importing countries and opportunity costs for exporting countries), renewable energy has become an increasingly attractive alternative to domestic oil and gas consumption. Renewable energy is also cited as an opportunity for electricity exports, industrial diversification, new value-chain activities, technology transfer, and better environmental footprints.

TRENDS IN FINAL CONSUMPTION

The MENA region's Total Primary Energy Supply (TPES) reached about 800 million tonnes of oil equivalent (Mtoe) in 2010. This was an increase of 14.9% compared to 2007 (15.3% in the Net Oil-Exporting Countries (NOEC) and 10.5% in the Net Oil-Importing Countries (NOIC), respectively), or an average annual growth of 4.7% over the period. Increased energy consumption in the region is due largely to population growth, with related increases in demand for liquid fuels and electricity for domestic use and devices, heating, cooling, and desalination of water. Renewable energy use increased 27.6% in the NOIC from 2007 to 2010, and gained market shares over conventional energy sources.[1]

The share of renewable energy in the MENA region's TPES remained about 1% from 2007 to 2010, with the dominant renewable energy sources being hydropower for electricity generation and traditional biomass for cooking and heating.[2] It is interesting to note, however, that in the NOIC the share of renewables increased from about 5% in 2007 to almost 6% in 2010, led by renewables use in Tunisia (14% of total energy), Israel, and Morocco (approximately 5% each).[2] However, given the declining cost of modern renewable energy technologies and the increasing costs of fossil fuels, technologies such as wind and solar have been considered to meet growing energy needs in all countries of the region, and are likely to be the preferred technologies in the foreseeable future. Thus, the shift is occurring in NOEC as well. While historically more reliant on traditional renewables, most announced projects in NOEC are solar and wind.

POWER SECTOR

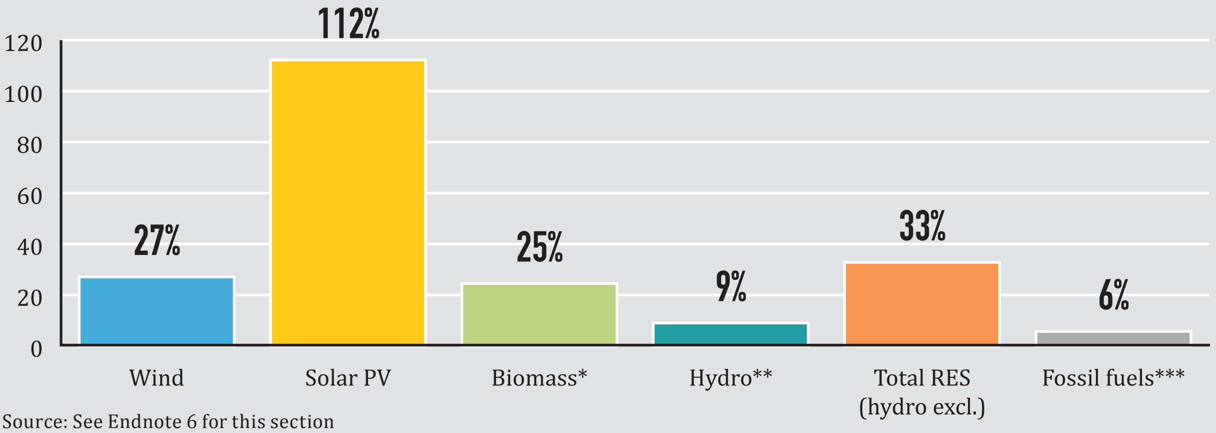
Substantial renewable energy deployment is well under way in the MENA region and is likely to continue for the next couple of decades, as evidenced by the number of projects in the pipeline and their scale (see Table 2 on page 12), as well as the targets set by most of the countries (see Chapter 2, Policy Targets section).

The trend is already evident in recent data. In 2011, power generation reached about 1,200 TWh in the MENA region, a 20% increase compared to 2008.[4] The share of renewable energy reached 3.3%, an increase of 0.4% percentage points, over the same period. While this may be seen as small progress, it must be noted that renewable power generation gained shares over conventional power sources despite a strong growth in electricity demand, which makes this growth meaningful and worth highlighting. More recently, Morocco, Lebanon, and Tunisia saw their renewable energy shares increase by at least 4 percentage points in the last two years, to reach 33%, nearly 12%, and 6%, respectively, in 2012.[5]

Both NOEC and NOIC generate approximately the same share of their electricity from renewables. However, only 5% of the renewable power in the NOEC is generated from modern renewables, whereas this share reaches 28% in the NOIC. Nevertheless, in both the NOEC and the NOIC, modern renewable electricity production has risen at a much faster rate than conventional energy sources since 2008.

Solar has seen the highest average annual growth in power generation in the region.[6] (See Figure 1.) This is due to a significant increase in photovoltaic (PV) installed capacity

Figure 1. Annual Average Growth Rate of Electricity Production by Source in the MENA Region, 2008–2011



Source: See Endnote 6 for this section

In 2010, Iran and Morocco started to operate the first CSP plants in the MENA region, and in 2011, Algeria and Egypt started to operate their first CSP plants; therefore, it is not possible to calculate the average annual growth rate for CSP power generation from 2008 to 2011

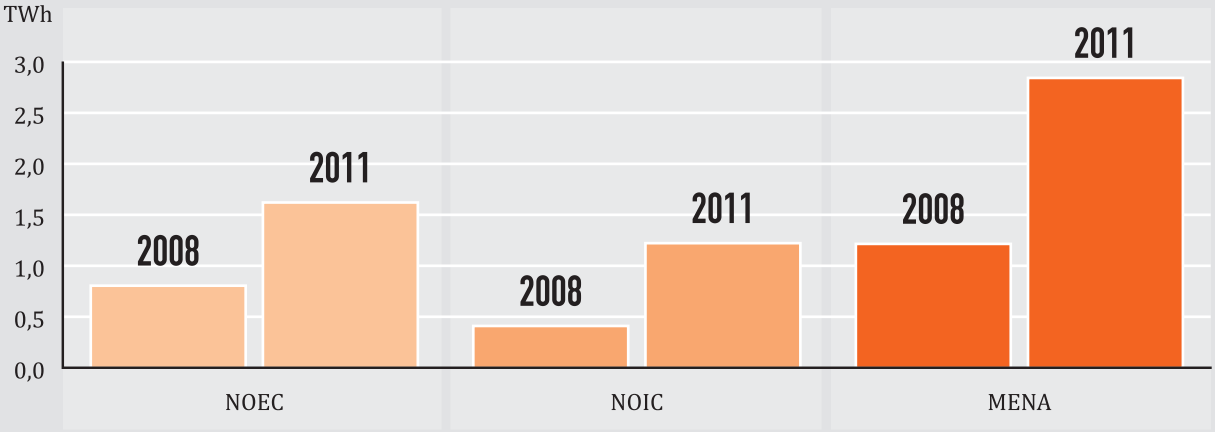
*Average annual growth rate for biomass power generation is from 2009 to 2011.
** Average annual growth rate for hydropower generation includes 2010 data for Lebanon and Syria.
*** Average annual growth rate for fossil fuel power generation includes 2010 data for Lebanon, Syria, and Yemen.

and production from a low starting base, and to the recent introduction of concentrating solar power (CSP). Wind comes second with average annual growth of 27%, almost five times higher than fossil fuels, while remaining in first place in terms of total non-hydro renewable installed capacity.

Growth in renewable energy generation is now occurring in both the NOIC and the NOEC, albeit for different reasons.[7] (See Figure 2.) In the NOIC, energy security and reduced dependence on expensive imported oil are key priorities, resulting in the highest renewable energy growth rates to date. In the NOEC, there is growing recognition of the opportunity cost of oil and gas used for domestic purposes, especially electricity production, desalination, and air conditioning, all of which are experiencing rapid increases in demand, driven by rising GDP, urbanisation, and population growth in much of the region.

In terms of absolute numbers, hydropower remains the primary renewable energy source for power generation in the region today.[8] (See Table 1, page 11.) Iran and Egypt are the leaders in installed capacity with 9.5 GW and 2.8 GW, respectively.[9] Other countries with over 1 GW of installed capacity are Iraq, Morocco, and Syria.[10] Hydropower generation showed a total increase of almost 30% from 2008 to 2011 (or a 9% average annual growth rate), 11 percentage points more than fossil fuel sources.[i] This growth has been led mainly by Iran and Iraq, which together generated over 16.9 TWh in 2011, more than 46% of the MENA hydropower production.[11] Prospects for further hydropower development, however, are not as bright as for other technologies, given its relatively limited further resources to exploit in the region.

Figure 2. Non-hydro Renewable Electricity Production in the MENA Region, 2008 and 2011



Source: See Endnote 7 for this section.

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[i] - Hydropower generation fluctuates depending on rainfall. As a result, interpreting variation of hydropower generation, especially for a short period of time, may in some cases be irrelevant. In the case of the MENA region, however, hydropower generation increased each year from 2008 to 2011. And this happened despite a decrease in hydropower generation in Egypt, the second largest hydropower producer in the region. This continuous growth has been led by Iran, where hydropower capacity increased by about 2 GW since 2008,

Beyond hydro, wind energy is the most common source of renewable electricity production in the region, especially in Egypt, Morocco, and Tunisia.[12] At least eight MENA countries had wind power capacity, for a total of almost 1.1 GW, by the end of 2012.[13] (See Figure 3.) Egypt is the leader in the region with 550 MW of installed capacity, followed by Morocco with 291 MW and Tunisia with 154 MW.[14] Tunisia has experienced strong growth over the last five years, with wind power capacity increasing eightfold from 2008 to 2012.[15] In contrast, Iran, an early leader in the region with 91 MW wind power capacity in 2009, has seen flat growth in recent years.[16]

The strongest growth in wind power occurred between 2005 and 2010, with a more than fourfold increase in total installed capacity. Recent socio-political events linked to the Arab Spring in some parts of the MENA region seem to have slowed down the promising and rather widespread development of wind.[17]

Although the share of solar PV electricity remains relatively modest in the region's power-generation mix today, PV is experiencing rapid growth due to its tremendous potential and continuously decreasing technology costs. From 2008 to 2011, the average annual growth rate of solar PV production was at least 112%. Focusing only on the number of countries with solar PV installed capacity, it is evident that this technology is more widespread than wind power in the region. Indeed, all countries use solar PV to meet a part of their electricity demand, whereas by the end of 2012, only around 40% of the MENA countries harnessed the power of wind.

Following four years of tremendous growth, Israel's PV capacity reached almost 270 MW at the end of 2012 (up from 21 MW in 2009 and 66 MW in 2010).[18] The United Arab Emirates (UAE), which approximately doubled its installed capacity over the last two years, came in second, with 22.5 MW, up from about 11 MW in 2010 and 19.5 MW in 2011.[19] Egypt, which has tripled its capacity over the last three years, and Morocco, each with 15 MW of installed capacity, are the other leaders in the MENA region.[20] Saudi Arabia has 7MW of installed capacity; Bahrain and Libya have around 5 MW of installed capacity each.[21]

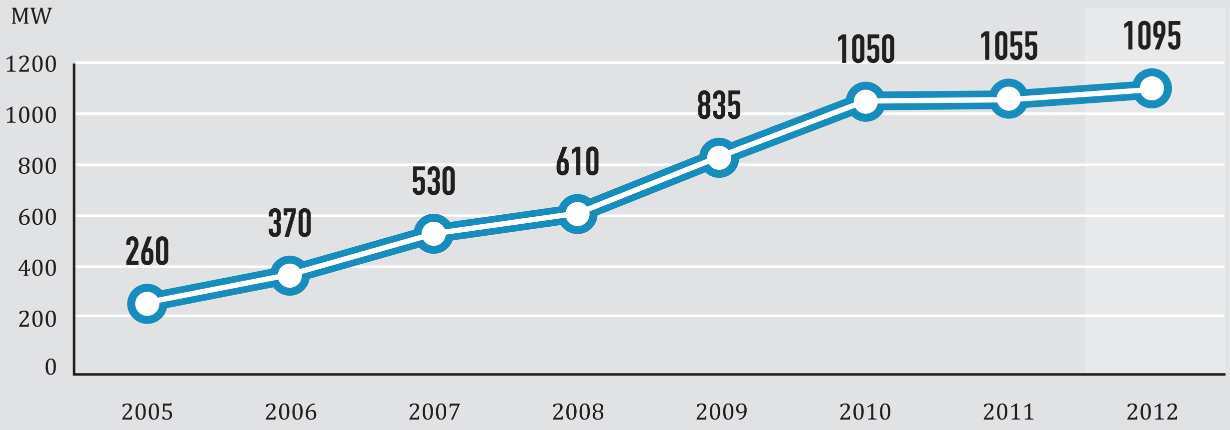
In addition, solar PV has an important role to play in the electrification of rural areas, and notably it already does so in Morocco in the framework of the Programme d'Electrification Rurale Global (PERG), where it replaces expensive, inefficient, and polluting off-grid diesel generators. (See Chapter 4.) The decentralised nature of some solar PV applications, however, makes data monitoring of installed capacity rather challenging; the lack of up-to-date data most likely results in an under-assessment of the technology's actual deployment.

Rooftop PV in Tunisia, Prosol Elec photovoltaic programme for the residential sector

CSP contributes significantly to the growing share of solar energy in the region. In 2011, 40% of the countries operating CSP plants were located in the MENA region, namely: Algeria, Egypt, Iran, and Morocco.[22] In 2013, these countries were joined by the UAE. The country became a major player in the CSP market when Shams 1, the world's largest CSP plant with an installed capacity of 100 MW, started operation in March 2013.[23]

Modern biomass and geothermal for power are the least exploited energy sources in the region. Israel, Jordan, Qatar, and the UAE are the only countries currently producing electricity from modern biomass, with the UAE and Saudi Arabia planning large-scale waste-to-energy projects. The Palestinian Territories is currently the only country with geothermal, although Algeria, Djibouti, Iran, Saudi Arabia, and Yemen have plans in the pipelines. Compared to wind and solar, the deployment of these technologies is not currently expected to expand significantly, although waste-to-energy projects will become more important within the constraints of the available resources.

■ Figure 3. Installed Wind Power Capacity in the MENA Region, 2005–2012



Source: See Endnote 13 for this section.

Note: Capacity data are rounded to the nearest 5 MW.

Table 1. Installed Renewable Energy Capacity in the MENA Countries

INSTALLED CAPACITY (MW)

	Solar		Wind	Biomass and Waste	Geothermal	Hydro	**Total**
	PV	CSP					
Algeria	7.1[c]	25[a]	0[a]	0[b]	0[b]	228[a]	**260.1**
Bahrain	5[b]	0[b]	0.5[a]	0[b]	0[b]	0[b]	**5.5**
Egypt	15[a]	20[a]	550[a]	0[b]	0[b]	2,800[a]	**3,385**
Iran	4.3[c]	17[b]	91[a]	0[b]	0[b]	9,500[a]	**9,612.3**
Iraq	3.5[d]	0[b]	0[b]	0[b]	0[b]	1,864[a]	**1,867.5**
Kuwait	1.8[c]	0[b]	0[b]	0[b]	0[b]	0[b]	**1.8**
Libya	4.8[a]	0[b]	0[b]	0[b]	0[b]	0[b]	**4.8**
Oman	0.7[c]	0[b]	0[b]	0[b]	0[b]	0[b]	**0.7**
Qatar	1.2[c]	0[a]	0[a]	40[a]	0[a]	0[a]	**41.2**
Saudi Arabia	7 (2013)	0[b]	0[b]	0[b]	0[b]	0[b]	**7**
Syria	0.84[c]	0[b]	0[b]	0[b]	0[b]	1,151[c]	**1,151.84**
UAE	22.5[a]	100 (2013)	0[b]	3[a]	0[b]	0[b]	**125.5**
Yemen	1.5[a]	0[b]	0[b]	0[b]	0[b]	0[b]	**1.5**
Total NOEC	**75.24**	**162**	**641.5**	**43**	**0**	**15,543**	**16,464.74**
Djibouti	1.4[c]	0[b]	0[b]	0[b]	0[b]	0[b]	**1.4**
Israel	269[a]	0[b]	6[b]	27[a]	0[b]	7[d]	**309**
Jordan	1.6[a]	0[b]	1.4[a]	3.5[a]	0[b]	10[a]	**16.5**
Lebanon	1[a]	0[b]	0.5[a]	0[b]	0[b]	282[a]	**283.5**
Malta	12[b]	0[b]	0[b]	0[b]	0[b]	0[b]	**12**
Morocco	15[a]	20[a]	291[a]	0[b]	0[b]	1,745[a]	**2,071**
Palestinian Territories	1[a]	0[b]	0[b]	0[b]	0.023[a]	0[c]	**1.023**
Tunisia	4[a]	0[a]	154[a]	0[b]	0[b]	66[a]	**224**
Total NOIC	**305**	**20**	**452.9**	**30.5**	**0.023**	**2,110**	**2,918.42**
TOTAL MENA	**380.24**	**182**	**1,094.4**	**73.5**	**0.023**	**17,653**	**19,383.16**

Source: See Endnote 8 for this section.

[a] 2012 [b] 2011 [c] 2010 [d] 2009

As of April 2013, the region had 106 renewable energy projects in the pipeline,[ii] totaling over 7.5 GW—an almost 4.5-fold increase over existing renewable capacity (hydropower excluded).[24] Around 85% of these projects are wind and solar, totaling 4.7 GW and 2.3 GW, respectively.[25] (See Table 2.) Wind accounts for over 42% of the projects and 63% of the renewable energy capacity in the pipeline.[26] (See Figures 4 and 5.) Solar makes up nearly 42% of the projects and almost one-third of the renewable energy capacity, and biomass and (bio) waste-to-energy projects account for over 11% of the projects but only 3% of the capacity, due to the fact that most projects are small scale. A few projects exist in geothermal (Djibouti and Iran), marine (Israel), and small hydro (Egypt).

Although the NOEC have more ambitious renewable energy targets than the NOIC, it is interesting to note that there are more renewables projects in the latter; more than 60% of the 106 projects in the pipeline are located in NOIC, resulting in more pipeline renewable energy capacity.[27] This can be explained by the fact that, with the exception of Egypt, the NOEC have committed more recently than the NOIC to developing renewable energy technologies. Acknowledging NOEC's ambitious plans and targets, especially in Saudi Arabia, this landscape will probably change significantly in the near future. (See Chapter 2.)

In terms of renewable energy capacity in the pipeline, Morocco, Israel, and Egypt stand out with 1.7 GW, 1.4 GW, and 1.2 GW, respectively. However, other countries, notably Saudi Arabia, also have very significant programmes under way.[28] (See Sidebar, page 13.)

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ii - The following figures are provided by Bloomberg New Energy Finance (BNEF). Pipelines projects include projects announced or for which planning have begun (some preliminary development work has been done on the project and/or it has received preliminary approval from local authorities), projects permitted, and projects which financing has been secured or is under construction.

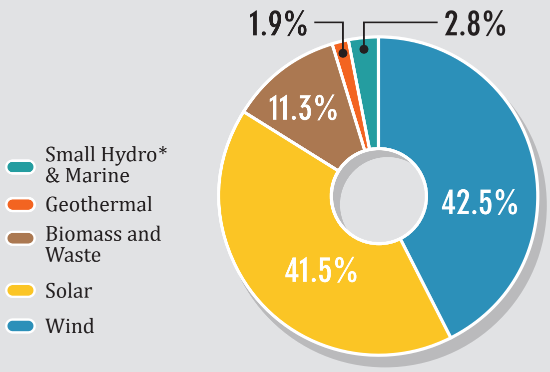
Table 2. Capacity Estimates for Renewable Energy Projects in the Pipeline, by Technology

CAPACITY IN THE PIPELINE (MW) (NUMBER OF PROJECTS)

	Solar	Wind	Biomass and Waste	Geothermal	Small Hydro	Marine	**Total**
Algeria	175 (5)	20 (2)					**195 (7)**
Bahrain			25 (1)				**25 (1)**
Egypt	106 (2)	1,070 (5)			32 (1)		**1,208 (8)**
Iran		93 (2)	2.6 (2)	55 (1)			**150.6 (5)**
Libya		610 (5)					**610 (5)**
Oman	407 (2)						**407 (2)**
Saudi Arabia	125 (4)						**125 (4)**
Syria		290 (3)					**290 (3)**
UAE	113.8 (3)	30 (1)	101 (2)				**244.8 (6)**
Yemen		60 (1)					**60 (1)**
Total NOEC	**926.8 (16)**	**2,173 (19)**	**128,6 (5)**	**55 (1)**	**32 (1)**	**0 (0)**	**3,315.4 (42)**
Djibouti				50 (1)			**50 (1)**
Israel	842.25 (20)	441.1 (6)	14.5 (5)			60 (2)	**1,357.85 (33)**
Jordan	400 (4)	360 (4)					**760 (8)**
Malta		109.45 (3)	78 (1)				**187.45 (4)**
Morocco	172.7 (3)	1,553.07 (12)	1.6 (1)				**1,727.37 (16)**
Tunisia	5 (1)	100 (1)					**105 (2)**
Total NOIC	**1,419.95 (28)**	**2,563.62 (26)**	**94.1 (7)**	**50 (1)**	**0 (0)**	**60 (2)**	**4,187.67 (64)**
TOTAL MENA	**2,346.75 (44)**	**4,736.62 (45)**	**222.7 (12)**	**105 (2)**	**32 (1)**	**60 (2)**	**7,503.07 (106)**

Note: Figures only include renewable energy power generation sectors for projects greater than 1 MW.
Source: See Endnote 25 for this section.

Figure 4. Pipeline Projects by Technology

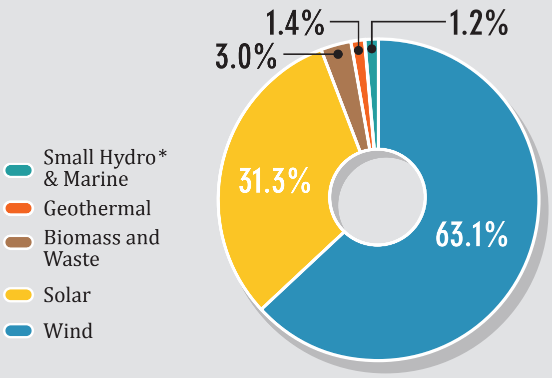


There are 106 renewables projects in the pipeline in the MENA Region.

Source: See Endnote 26 for this section.

* The BNEF database only provides data for small hydropower projects.

Figure 5. Pipeline Projects Capacity by Technology



There are over 7.5 GW renewables capacity in the pipeline

Source: See Endnote 27 for this section.

* The BNEF database only provides data for small hydropower projects.

SIDEBAR. SAUDI ARABIA'S LARGE-SCALE RENEWABLE ENERGY PLAN

In 2012, Saudi Arabia unveiled its ambitious renewable energy capacity targets: 25 GW of CSP, 16 GW of solar PV, 9 GW of wind, 3 GW of waste-to-energy, and 1 GW of geothermal by 2032. In February 2013, the country released a White Paper detailing the proposed competitive procurement process of its K.A.CARE programme. Over the next two or three years, the programme plans three tendering rounds: the introductory round, then the first and second procurement rounds. Together, they will account for about 7 GW of renewable energy projects.

In the introductory bidding round, scheduled for the first half of 2013, K.A.CARE is targeting 500–800 MW of renewable energy projects. In the first round, it is targeting 2–3 GW of renewables capacity, of which 1,100 MW will be solar PV and 900 MW CSP, and in the second round, it is targeting 3–4 GW of renewables capacity, of which 1,300 MW will be solar PV and 1,200 MW CSP. The timing for the sequential rounds after the introductory round will be determined based on the length of each preceding round. It is expected that a single procurement round will last between six and 10 months.

Although these plans are well under way, they are not included in this section as projects in the pipeline due to the fact that the tenders have not yet been launched. Nevertheless, once these projects come on line they will significantly affect the dynamics of renewable energy markets in the region. By 2030, Saudi Arabia is expected to become not only the leader of the MENA countries in terms of renewable energy capacity, but also a major player in the world.

In addition, the multiple impacts of this plan are not limited to Saudi Arabia's borders. Over the next few years, the region's renewable energy landscape is expected to change significantly, with NOEC taking the lead. Although the figures for projects in the pipeline provided in this section indicate the NOIC as leaders today, there are clear signs that political momentum in favour of renewable energy is growing in the NOEC and that the very promising ambitious plans recently adopted by these countries will make the shift occur.

Source: See Endnote 28 for this section.

HEATING AND COOLING SECTOR

Solar water heating (SWH) systems play an important role in the region, with about 9 million square metres (m^2) of collector area, representing 6.3 gigawatts-thermal (GW_{th}) of installed capacity, most of which is in the NOIC.[29] (See Table 3.) It is worth noting that the energy equivalent of SWH installed capacity in the MENA is already more than triple that of all other non-hydro renewable energy. The variation in installed capacity among the MENA countries—especially the differences between the most advanced NOIC countries such as Israel, Palestinian Territories, Tunisia, and Jordan, and the others—indicates very substantial scope for further increases in SWH applications.

SWH has been a success story in a handful of MENA countries, with several exemplary promotional schemes, in particular the PROSOL programme in Tunisia and the PROMASOL programme in Morocco, both in place for some years now. Jordan, Israel, Egypt, and Syria are also good examples of countries that have taken advantage of SWH.[30] (See Table 4.) With its relatively low user cost, simple technology, and quick payback period, SWH is a "low-hanging fruit" of solar energy.

In addition, much of the SWH equipment is manufactured in the region, and installation costs that account for about half of the total capital cost accrue to local businesses and employees. The local value added and employment related to SWH is therefore significant. NOEC have been slower to adopt SWH, but some scattered actions, such as mandatory SWH for new buildings in the Emirate of Dubai, indicate potential growth in the subsector.

Solar water heating systems on residential rooftops

TRANSPORT SECTOR

The only MENA region country with any significant biofuel production in 2010–11 was Israel, with a total equivalent to 100 barrels per day.[31] Prior to 2010, Malta also produced biofuels with an average of 20 barrels per day.[32] No other MENA country had any significant biofuel production as of 2011, making this type of renewable energy a largely unexploited alternative to the much more abundant fossil fuels in the region. However, biofuel projects are currently under preparation in Egypt.

Table 3. Solar Water Heating Installed Capacity in the MENA Countries

		Total Capacity (MW$_{th}$)	**Total Collector Area** (m^2)
NOEC	Algeria (2012)	0.21	300
	Egypt (2012)	525.0	750,000
	Libya (2012)	0.021	30
	Syria (2010)	420.0	600,000
NOIC	Israel	2,917.8	4,168,245
	Jordan (2012)	350.0	500,000
	Lebanon (2012)	245.0	350,000
	Malta (2011)	35.952	51,360
	Morocco (2012)	245.0	350,000
	Palestinian Territories (2012)	1,120.0	1,600,000
	Tunisia (2012)	437.5	625,000

Sources: See Endnote 29 for this section.

Table 4. Solar Thermal Industry Sector in the MENA Countries

		Industry Association	**Number of Manufacturers**	**Number of Retailers**	**Number of Installers**
NOEC	Algeria	None	2	n/a	n/a
	Egypt	Solar Egyptian Development Association (SEDA)	4	14	5
	Syria	None	25	8	n/a
NOIC	Israel	Renewable Energy Association of Israel (REAI)	10	6	n/a
	Jordan	None	3	10	13
	Lebanon	Lebanese Association of Solar Industrialists (LASI)/ Lebanese Solar Energy Society (LSES)	12	100	105
	Morocco	Association Marocaine des Industries Solaires et Eoliennes (AMISOLE)	2	50	200
	Palestinian Territories	None	15	n/a	n/a
	Tunisia	Chambre Syndicale Nationale des Energies Renouvelables (CSNER)	10	49	1,150

Source: See Endnote 30 for this section.

Note: Yemen, which is not included in the table above, also has three plants for the manufacture of SWH systems.

IRENA Second Session of the Assembly, January 2012, Abu Dhabi UAE

OVERVIEW OF EXISTING REGIONAL COOPERATION IN THE ENERGY SECTOR

Interest in renewable energy in the MENA countries has been stimulated by the development of several important regional and regionally based institutions. These include: the International Renewable Energy Agency (IRENA), a 160-member country intergovernmental organisation headquartered in Abu Dhabi; the League of Arab States, headquartered in Egypt, which carries out a series of energy activities; the Regional Centre for Renewable Energies and Energy Efficiency (RCREEE), also based in Egypt; the Masdar initiative in Abu Dhabi; the King Abdullah City for Atomic and Renewable Energy (K.A.CARE) in Saudi Arabia; and the Qatar Foundation and Qatar National Food Security Programme (QNFSP), which have programmes on renewable energy; and the Mediterranean Renewable Energy Center (MEDREC), based in Tunisia.[33]

Furthermore, there are several initiatives being undertaken in the region to facilitate the deployment of renewable energy. Since 2004, for example, the Middle-East and North Africa Renewable Energy Conference (MENAREC) has been organised by a country of the MENA region in partnership with the German Federal Ministry for Environment, Nature Protection and Nuclear Safety (BMU) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).[iii] The MENAREC serves as a dedicated framework to promote and strengthen regional partnerships on renewable energy development; foster the development of the most promising renewable energy technologies; discuss the national renewable energy programmes of the MENA countries; and identify barriers and obstacles that so far hinder the renewable energy development in these countries and search for potential solutions.

The Mediterranean Solar Plan (MSP), launched in 2008 in the framework of the Union for the Mediterranean (UfM), aims to establish—together with the 43 member states, the European Union, the Arab League, and other stakeholders— an enabling policy framework for the stepped-up and large-scale rollout of renewable energy and energy efficiency technologies at the regional level. It has two main objectives to be achieved by 2020: developing an additional 20 GW of renewable energy production capacity, and achieving significant energy savings throughout the region.

Furthermore, several initiatives aim at enhancing renewable energy developments in the MENA region.

- Dii, the Desertec Industrial Initiative, is a joint venture by a number of private sector actors with a strong interest in promoting renewable energy in the MENA region. Dii is fully funded by the private sector and promotes the creation of markets for solar and wind energy in MENA for domestic use and export to Europe.

- The MEDGRID consortium aims to develop the necessary grid infrastructure (high-voltage, direct current) to provide the basis for large-scale renewable energy deployment to happen.

- The recently launched Renewable Energy Solutions for the Mediterranean (RES4MED) initiative, created in 2012, aims to promote renewable energy, broaden the range of proposed energy solutions, and analyse the required conditions for an integrated electricity market in the Mediterranean area. To fulfill this objective, RES4MED's role is notably to be a "network of networks" that facilitates dialogue among the various existing institutional and industrial initiatives in the region.

- The Mediterranean Ring (MedRing) project aims to provide interconnection of electric power transmission grids among the countries that encircle the Mediterranean Sea in order to increase energy security and enable more efficient power flows at lower costs in the area.

CONCLUSION

The trends presented in this chapter evidence the increasing contribution of modern renewable energy sources to meet the MENA region's energy needs in both the NOEC and NOIC. In terms of non-hydropower generation, wind dominates renewable energy production and also leads the way when it comes to pipeline projects. Solar growth is expected to be strong both in CSP and PV and may surpass wind by 2020, especially with Saudi Arabia's large scale solar plans. For heating and cooling, SWH has seen significant growth in the MENA region, especially in the NOIC. The capacity of the installed SWH in MENA is estimated at 6.3 GWth, which compares with installed non-hydro renewable energy power capacity of 1.7 GW.[iv]

[iii] - MENAREC 1 was organised in 2004 in Sanaa, Yemen; MENAREC 2 in 2005 in Amman, Jordan; MENAREC 3 in 2006 in Cairo, Egypt; MENAREC 4 in 2007 in Damascus, Syria; and MENAREC 5 in 2012 in Marrakech, Morocco.

[iv] - The 1.7 GW of non-hydro renewable energy capacity is an estimate from an aggregation of data ranging from 2010 to early 2013. Thus, it is not possible give a precise year for this figure. However, it is accurate enough to show the scale of the current deployment of modern renewables in the MENA region today.

02

Policy Landscape

As of mid-2013, all 21 MENA countries had introduced a renewable energy policy target (up from five countries with policy targets in 2007), and 18 countries had introduced renewable energy promotion policies to help achieve those targets.[1] (For an overview of renewable energy supports and policies in the region, see Table 5.)

In most cases where renewable energy targets and policies exist in the MENA region, their goal is primarily to reduce dependence on fossil fuels, especially in the NOIC. NOEC, however, are concerned about the rapid growth in domestic fossil fuel consumption for electricity, water desalination, and transport, and recognise that this increased consumption means a loss of export revenues. Recent estimates even indicate that if Saudi Arabia continues its growth in domestic fossil fuel consumption, it would lose the ability to export oil by 2020 and become a net importer by 2038, what has made significant waves among NOEC, especially in the Gulf Cooperation Council (GCC) countries.[2]

As noted in Chapter 1, policymakers in the region are increasingly aware of the wide range of benefits from renewable energy deployment, including energy security, reduced import dependence, reduction of greenhouse gas emissions, improved health, job creation, manufacturing opportunities, rural development, and energy access—leading to greater adoption of renewable energy support policies in the MENA countries. The opportunity to localise the renewable energy value chain and to create domestic industries and jobs is of considerable interest in the region, and some countries, such as Egypt, Morocco, Saudi Arabia, Tunisia, and the UAE, are enacting policy provisions to capture these benefits. (See Chapter 5.)

The majority of targets and policies place a priority focus on solar PV and CSP, reflecting in part the high-quality solar energy resources in the region, and the quickly declining costs of these technologies due to substantial technological advances and strong surplus manufacturing capacities in China and elsewhere. There is currently very little policy activity around renewable energy for transportation in MENA countries; however, SWH has been one of the policy success stories in the region. SWH manufacturing has become well established in a number of countries, based largely on the development of domestic demand and the corresponding policy schemes. (See Chapter 5.)

Successful policies depend on predictable, transparent, and stable framework conditions, as well as on good design. Policy developments help expand renewable energy markets, encourage investment, and stimulate industry developments, but not all policies are equally effective or efficient at achieving these goals. This report does not evaluate or analyse policies; rather, it aims to capture the status of renewable energy targets, programmes, and policies in the power generation, heating and cooling, and transport sectors of MENA countries.

POLICY TARGETS

By early 2013, policy targets for renewable energy existed in all 21 MENA countries, including two sub-national jurisdictions. More than half of the policy targets are for shares of electricity production, typically 10–20%, but they range from 2% by 2020 in Qatar to 40% of electricity generation in Algeria by 2030.[3] (See Table 6.) Other targets are for shares of total primary or final energy supply, heat supply, total amount of energy production from renewables, or installed electric capacities of specific technologies. Most targets aim for the 2020–2030 timeframe.

The region saw significant developments in 2012 as eleven countries introduced new policy targets. Reflecting the increasing momentum in the NOEC, all but three new targets were in these countries.

The Egyptian Solar Plan, approved in July 2012, set a target for 2,800 MW of CSP and 700 MW of solar PV by 2027; Iraq announced a target of 400 MW of wind and solar capacity by 2016; Saudi Arabia set a target of 25 GW of CSP, 16 GW of PV, 9 GW of wind, 3 GW of waste-to-energy, and 1 GW of geothermal by 2032 (representing 20% of total electricity production); Qatar set a target of 2% renewable electricity by 2020 and introduced a plan to add 640 MW of solar PV by 2020; Yemen added targets of 400 MW of wind and 6 MW of biomass capacity to its 2009 National Renewable Energy and Energy Efficiency Strategy, which aims to produce 10–15% power generation from renewables by 2025; Libya's 2012 plan includes a gradual increase in its renewable electricity target from 3% by 2015 to 7% by 2020 and 10% by 2025; and both Kuwait and Oman announced targets for 10% of electricity generation from renewables, by 2030 and 2020, respectively.[4]

Table 5. Renewable Energy Support Policies and Targets in the MENA Countries

■ National Level

□ State Level

				Regulatory Policies						Fiscal Incentives				Public Financing	
		Renewable Energy Targets	Renewable Energy Strategy or Plan	FIT (incl. premium payment)	Electric utility quota obligation/RPS	Net metering	Biofuels obligation/mandate	Heat obligation/mandate	Tradable REC	Capital subsidy, grant, or rebate	Investment/production tax credits	Reduction in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants (incl. R&D)	Public competitive bidding
NOEC	Algeria	✓	✓	■											■
	Bahrain	✓													
	Egypt	✓	✓	D		■				■		■		■	■
	Iran	✓	✓	■	■						■		■	■	
	Iraq	✓	✓												
	Kuwait	✓												■	■
	Libya	✓										■			
	Oman	✓								■	■		■	■	■
										□	□		□	□	□
	Qatar	✓												■	
	Saudi Arabia	✓		D										■	■
	Syria	✓		■		■					■			■	■
	UAE	✓	✓	D	□			□		□			□	□	□
	Yemen	✓	✓												■
	Total NOEC	**13**	**6**	**3 3D**	**2**	**2**	**0**	**1**	**0**	**3**	**2**	**2**	**3**	**8**	**8**
NOIC	Djibouti	✓	✓												
	Israel	✓	✓	■				■						■	■
	Jordan	✓	✓	■		■	■					■		■	■
	Lebanon	✓	✓			■						■			
	Malta	✓	✓	■		■				■		■			
	Morocco	✓	✓											■	■
	Palestinian Territories	✓	✓	■		■						■	■		■
	Tunisia	✓	✓			■				■		■		■	
	Total NOEC	**8**	**8**	**4**	**0**	**5**	**1**	**1**	**0**	**2**	**0**	**5**	**1**	**4**	**4**
TOTAL MENA		**21**	**14**	**7** **3D**	**2**	**7**	**1**	**2**	**0**	**5**	**2**	**7**	**4**	**12**	**12**

Note: "D" stands for "under discussion."

Sources: See Endnote 1 for this section.

Table 6. Overall Renewable Energy Share Targets in the MENA Countries

		Renewable Energy Targets and Target Dates
NOEC	Algeria	6% of electricity generation by 2015; 15% by 2020; 40% by 2030, of which 37% is solar (PV and CSP) and 3% is wind
	Bahrain	5% by 2020
	Egypt	20% of electricity generation by 2020, of which 12% is wind
	Iran	—
	Iraq	2% of electricity generation by 2016
	Kuwait	5% of electricity generation by 2020; 10% by 2030
	Libya	3% of electricity generation by 2015; 7% by 2020; 10% by 2025
	Oman	10% by 2020
	Qatar	At least 2% of electricity generation from solar by 2020
	Saudi Arabia	—
	Syria	—
	UAE	Dubai: 5% of electricity by 2030; Abu Dhabi: 7% of electricity generation capacity by 2020
	Yemen	15% of electricity by 2025
NOIC	Djibouti	30% of rural electrification from solar PV by 2017 100% renewable energy by 2020
	Israel	5% of electricity generation from renewables by 2014; 10% by 2020
	Jordan	7% of primary energy by 2015; 10% by 2020
	Lebanon	12% of electrical and thermal energy by 2020
	Malta	10% of final energy from renewables by 2020; 14% of electricity by 2020; 6% of heating and cooling by 2020; 11% of transport by 2020
	Morocco	42% of installed power capacity by 2020
	Palestinian Territories	25% of energy from renewables by 2020; 10% (or at least 240 GWh) of electricity generation by 2020
	Tunisia	11% of electricity generation by 2016; 25% by 2030; 16% of installed power capacity by 2016; 40% by 2030.

Source: See Endnote 3 for this section.

In the NOIC countries, the Palestinian Territories set a target of 10% renewable share of electricity generation by 2020 as well as capacity targets; Lebanon targeted 40 MW of hydro, 15–25 MW of biogas, and 60–100 MW of wind capacity by 2015 and Djibouti, which had no renewable power capacity in 2009, announced a target of 100% renewable energy by 2020.[5]

Nineteen of the 21 MENA countries have set renewable energy capacity targets specified by technology, including SWH.[6] (See Tables 7 and 8.) Taken together, the targets indicate an additional capacity of more than 50 GW by 2020 and 107 GW by 2030.[7] (See Figure 6.) This compares with non-hydro renewable energy capacity of some 1.7 GW at present, and indicates the scale of the region's renewable energy ambitions.

When overall targets are examined by technology, wind and solar are clearly the primary technology choices, reflecting the quality of these renewable resources in the region. In the choice of solar technologies, CSP comes ahead of PV—despite CSP's higher current cost per unit of energy—owing mainly to its energy storage potential.

A number of countries are also setting targets for waste-to-energy, hydro, and geothermal energy. Targets for solar heating and cooling do not often appear in the policy documents for renewable energy, as these are often seen as energy efficiency measures. However, it is clear that a number of countries have increasingly ambitious SWH programmes, including targets.[8] (See Table 8.) The available targets for 2020 indicate that SWH capacity in the region is planned to increase by at least an additional 3 million m^2 (2 GWth equivalent), most of which will be in the NOIC, which have already developed a sound policy framework as well as a local manufacturing and installation sector.

Overall, NOEC have much more ambitious renewable energy targets than NOIC, suggesting that NOEC will rapidly become the leading countries in the region for new renewable energy investment, capacity, and production. This can be attributed in part to the fact that, with the exception of Tunisia, NOIC have not yet set renewable energy capacity targets beyond 2020, and that NOEC are generally in a more favourable position to finance renewable energy projects in the region. Among NOEC, Saudi Arabia has by far the most ambitious target (54 GW by 2032), followed by Algeria (12 GW by 2030) and Egypt (10.7 GW by 2027). Among the NOIC, Morocco targets 4 GW of non-hydro renewable energy capacity by 2020, and Israel targets almost 2.8 GW by 2020.

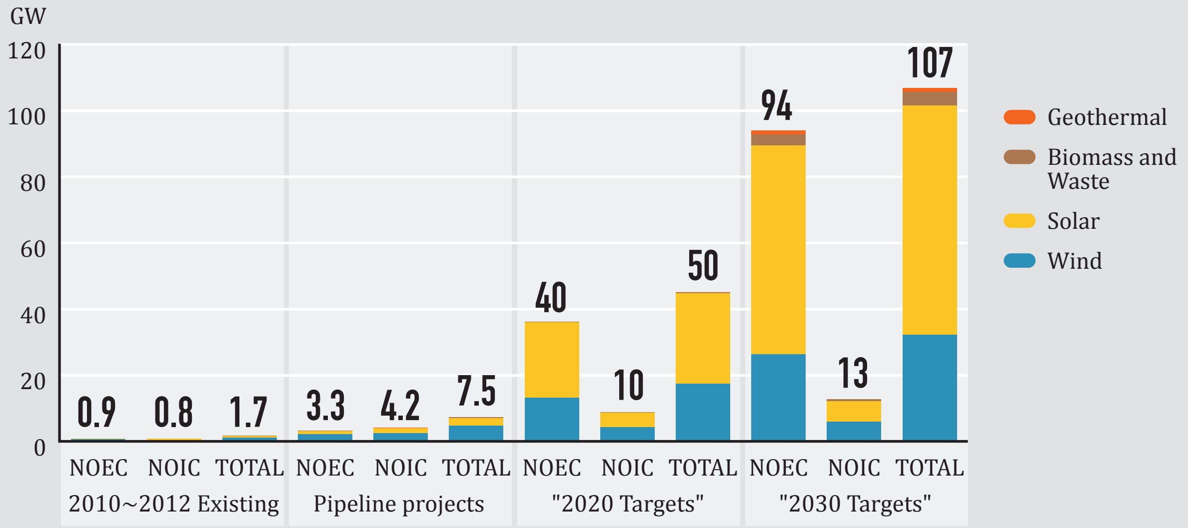
Table 7. Renewable Energy Capacity Targets by Technology in the MENA Countries

		Solar		Wind	Biomass, Geothermal, and Hydro	**TOTAL**
		PV	CSP			
NOEC	Algeria					
	by 2013	6 MW	25 MW	10 MW	—	41 MW
	by 2015	182 MW	325MW	50 MW	—	557 MW
	by 2020	831 MW	1,500 MW	270 MW	—	2,601 MW
	by 2030	2,800 MW	7,200 MW	2,000 MW	—	12,000 MW
	Bahrain	—	—	—	—	—
	Egypt					
	by 2020	220 MW	1,100 MW	7,200 MW	—	8,520 MW
	by 2027	700 MW	2,800 MW	—	—	10,700 MW
	Iran					
	by 2013	—	—	1,500 MW	—	1,500 MW
	Iraq					
	by 2016	240 MW	80 MW	80 MW	—	7,700 MW
	Libya					
	by 2015	129 MW	—	260 MW	—	389 MW
	by 2020	344 MW	125 MW	600 MW	—	1,069 MW
	by 2025	844 MW	375 MW	1,000 MW	—	2,219 MW
	Kuwait					
	by 2030	3,500 MW	1,100 MW	3,100 MW	—	7,700 MW
	Oman	—	—	—	—	—
	Qatar					
	by 2020	640 MW		—	—	640 MW
	Saudi Arabia					
	by 2022	17,350 MW		6,500 MW wind/waste-to-energy/geothermal		23,850 MW
	by 2032	16,000 MW	25,000 MW	9,000 MW	3,000 MW waste-to-energy 1,000 MW geothermal	54,000 MW
	Syria					
	by 2015	45 MW	—	150 MW	—	195 MW
	by 2020	380 MW	—	1,000 MW	140 MW biomass	1,520 MW
	by 2025	1,100 MW	50 MW	1,500 MW	260 MW biomass	2,910 MW
	by 2030	1,750 MW	—	2,000 MW	400 MW biomass	4,200 MW
	UAE	—	—	—	—	—
	Yemen					
	by 2025	4 MW	100 MW	400 MW	6 MW solid biomass; 200 MW geothermal	710 MW
NOIC	Djibouti	—	—	—	—	—
	Israel					
	by 2020	1,750 MW		800 MW	210 MW biogas and biomass	2,760 MW
	Jordan					
	by 2020	300 MW	300 MW	1,200 MW	—	1,800 MW
	Lebanon					
	by 2015	—	—	60–100 MW	15–25 MW biogas; 40 MW hydro	115–165 MW
	by 2020	—	—	400–500 MW	—	455–565 MW
	Malta					
	by 2020	28 MW	—	110 MW	7 MW biogas; 15 MW solid biomass	160 MW
	Morocco					
	by 2020	2,000 MW		2,000 MW	2,000 MW hydro	6,000 MW
	Palestinian Territories					
	by 2020	45 MW	20 MW	44 MW	21 MW solid biomass	130 MW
	Tunisia					
	by 2016	140 MW	—	430 MW	40 MWsolid biomass	610 MW
	by 2030	1,500 MW	500 MW	1,700 MW	300 MW solid biomass	4,000 MW

Note: Algeria targets in Table 7 only include targets for renewable energy capacity for domestic use. The country also targets another 10,000 MW of renewable energy capacity by 2030 for export.

Source: See Endnote 6 for this section.

Figure 6. Projected Non-Hydro Renewable Energy Capacity in the MENA Region



Notes: "2020 Targets" include targets up to 2020 and Saudi Arabia 2022 target; "2030 Targets" include targets up to 2030 and Saudi Arabia 2032 targets. Saudi Arabia 2022 target for wind, waste-to-energy, and geothermal is not broken down in the "NOEC 2020 Targets" and "TOTAL 2020 Targets" bars, but is included in the sums above the bars.

Source: See Endnote 7 for this section.

Table 8. Solar Water Heating Targets in the MENA Countries

		SWH Target
NOEC	Algeria by 2015 by 2020	70,000 m^2 of collector area 490,000 m^2 of collector area
	Libya by 2015 by 2020 by 2025	80 MW of installed capacity 250 MW of installed capacity 450 MW of installed capacity
	Syria	Installation of 100,000 m^2 of collector area per year
	UAE (Dubai)	For all new villas and labour accommodations, a SWH system must be installed to provide 75% of domestic hot water requirements.
	Yemen	230 GW_{th} of generation per year
NOIC	Jordan by 2015 by 2020	25% of households equipped (from 14% in 2011) 30% of households equipped
	Lebanon by 2020	1.05 million m^2 of collector area
	Morocco by 2020	1.7 million m^2 of collector area
	Tunisia by 2016	1 million m^2 of collector area

Source: See Endnote 8 for this section.

POWER GENERATION POLICIES

At least 18 of the 21 MENA countries had some type of policy to promote renewable energy power generation by early 2013, with more than half of these countries in the NOEC, a significant increase over the past few years. (See Table 5.) Power generation policies are more elaborated and better developed in the NOIC, since these countries have had strong incentives to develop alternative sources of energy for many years. However, the NOEC have also developed renewable energy power generation policies in recent years, and there are several indications that they are in fact catching up.

Feed-in-tariffs, or FITs (also called premium payments, advanced renewable tariffs, and minimum price standards) are a common policy type in the electricity sector worldwide, and several countries in the MENA region have adopted or proposed FITs as an important mechanism to meet the ambitious targets that have been launched in the past few years. Currently, at least seven MENA countries have adopted FITs, and the policies are under consideration or development in three NOEC.

In 2012 the Palestinian Territories implemented a new FIT with technology-differentiated tariffs to support wind, PV, CSP, biomass, and biogas projects; Syria enacted a new FIT to complement the 2010 renewable energy law; Israel revised its FIT to reduce solar and wind tariffs, although it increased the eligible size and raised caps on total installations; and Jordan enacted a new FIT in late 2012 to complement the Renewable Energy and Energy Efficiency Law passed earlier in the year.[9] In addition to Malta (2009) and Algeria (2004), Iran enacted a FIT scheme in 2009; the tariffs are fixed annually and are differentiated by the time of day generation for peak, normal, and low loads.[10]

Saudi Arabia is discussing a proposed FIT for small-scale projects that would include a number of renewable technologies, as an important mechanism to meet the country's new targets (see Policy Targets section); Egypt is currently developing FITs for small-scale solar (less than 50 MW); and the Emirate of Dubai is reportedly contemplating the introduction of green tariffs (project-specific tariffs already are offered in Abu Dhabi).[11]

In addition to FITs, Israel enacted renewable energy quota obligations in 2011, setting requirements for the addition of 110 MW of on-site generation from decentralised renewable systems, as well as up to 800 MW of large wind plants, 460 MW of large solar systems, and 210 MW of biogas and waste generation plants, all to be grid-connected by 2014.[12] In the UAE, the Emirate of Dubai in 2012 introduced a SWH regulation that requires new buildings to meet 75% of their water heating requirements with solar power.[13] In Oman, the Authority for Electricity Regulation (AER) passed a new requirement in 2013 that necessitates the inclusion of a renewable energy component (solar or wind) in each new power project in rural areas; if such a component is not included in a funding application, companies will be required to explain why and to provide supporting analysis to confirm the techno-economic infeasibility.[14]

Across the policy landscape, MENA countries are using or debating many other types of policies to promote renewable electricity, including fiscal incentives and net metering. Seven countries have net metering in place: Egypt and Palestinian Territories introduced net metering in 2012, and Jordan, Lebanon, Malta, Syria and Tunisia had implemented it previously.[15] Eleven countries have some form of renewable energy fiscal incentive, including capital subsidies and tax or production credits or reductions.

Of all the policies employed by national governments to promote renewable electricity, however, the most common was public competitive bidding for fixed quantities of renewable energy and public financing policies, including grants and subsidies. At least 15 MENA countries have direct or indirect public funding or public competitive bidding processes in place.

A number of countries have established special renewable energy funds to finance investments directly, provide low-interest loans, or facilitate markets in other ways, such as through research, education, and standards. In 2013, Jordan launched its Renewable Energy and Energy Efficiency Fund, providing loans and grants to small and medium-scale renewable energy initiatives; interest rate subsidies on commercial loans; research and technical cooperation grants for targeted programmes and feasibility studies; and a renewable energy guarantee facility to ease credit access for developers.[16]

The UAE has created Masdar and Taqa as privately structured, government-backed entities that channel government funds into renewable energy projects worldwide and within the country. Masdar, for example, commenced commercial operation of the 100 MW Shams 1 CSP plant in 2013, and is in planning stages for both the 100 MW Noor 1 PV plant and the approximately 30 MW Sir Bani Yas wind farm. In addition to a range of grant-funded renewable energy projects executed by Masdar on behalf of the UAE government in the Pacific, Seychelles, Mauritania, and Afghanistan, the Abu Dhabi Fund for Development also sets aside USD 350 million in soft loans for renewable energy projects in developing countries that are members of IRENA.[17]

In 2009, Algeria's Ministry of Energy and Mines implemented a National Renewable Energy Fund to support the country's target of 22,000 MW of additional renewable installed capacity by 2030, with 12,000 MW intended to meet domestic electricity demand. The fund is provided by a 0.5% levy on oil tax revenues.[18] In Iran, in 2012, the government made USD 675 million of the National Development Fund available to renewable energy projects; this is in addition to the 2011 subsidy reform plan, which anticipates a savings of USD 100 billion in food and energy subsidies within 3–4 years, and mandates that 30% of this savings be spent on grants, low-interest loans, and subsidies for energy efficiency, water, and the expansion of renewable power.[19] In Tunisia, the Fonds National pour la Maîtrise de l'Energie was created by law in 2005 to finance renewable energy and energy efficiency projects. For instance, in the framework of the PROSOL - ELEC programme for small scale, distributed, grid-tied PV, the fund subsidises up to 30% of PV system costs with a maximum amount of 1500 EUR per kW, in addition to the incentives provided by IMELS through UNEP; a 10% capital cost subsidy and a full interest rate subsidy for loans provided by local commercial banks.[20]

Several state-owned energy companies have created renewable energy investment units, as seen in Algeria, Israel, Kuwait, Morocco, Qatar, Saudi Arabia, Syria, and Tunisia. Saudi Arabia's national oil company, Saudi Aramco, announced a renewable energy investment unit in 2012; Qatar General Electricity and Water Corporation announced a USD 125 billion investment programme for alternative and renewable energy, USD 22 billion of which is set aside for electricity and water infrastructure expansion and renovation projects; and the Kuwait Investment Authority plans to invest in solar energy.[21]

From 2012 to early 2013, several countries started public competitive bidding processes. In 2013, the Saudi municipality of Mecca opened a tender for contracts to build and operate a 100 MW renewable energy power plant, which will be transferred to the city once the contractors recuperate their investments.[22] Egypt moved ahead with a bidding process for the Kahramaa construction of a single wind farm to provide 1,000 MW of new capacity by 2016, and the country announced a second international tender, based on an auction system, for six 15-km^2 plots of land dedicated to wind farm construction in the Gulf of Suez to provide 600 MW of additional capacity.[23] Algeria launched tenders for the development of two geothermal power plants, including a 5 MW plant in the region of Guelma, and Gas Natural Fenosa Engineering won a EUR 2.2 million competitive bid for engineering assistance in the construction of solar plants and wind farms.[24] In Morocco, a consortium led by the Saudi Arabian project developer, investor, and operator ACWA Power International won the tender organised by the Moroccan Agency for Solar Energy (MASEN) to build and operate a 160 MW CSP plant in Ouarzazate; the country's solar energy agency is now soliciting bids for the development of a 300 MW solar facility.[25] [i]

Investors, researchers, and international organisations (such as the IEA) cite the prevalence of energy subsidies, especially in the NOEC, as one of the constraints to the development of renewable energy and energy efficiency measures in the MENA region.[26] (See Table 9.) Reducing energy subsidies is politically challenging and requires a pragmatic approach, which could include increasing spending on education, health, and social welfare as compensation for potentially higher energy prices. Examples include Iran's subsidy reform plan, mentioned above, and Egypt's recent announcement of several subsidy reforms that are under consideration.

Subsidies can be an incentive for governments to back renewable energy projects as well, however. Because governments, especially those in the GCC, incur particularly high subsidy costs for domestic oil consumption, they would theoretically have interest in prioritising oil exports at international prices and supporting renewables, which would result in lower subsidies and thus financial savings. At the same time, however, subsidies reduce the attractiveness of individual consumer investments in renewable energy, such as home solar rooftop installations, as consumers have no financial incentive to switch supply options.

GRID INFRASTRUCTURE

Apart from meeting a growing electricity demand, the MENA grid infrastructure will need to be scaled up to provide a reliable supply of power[ii] and to integrate an increasing share of power from variable renewables. The regional grid infrastructure is owned largely by public utilities, a situation that facilitates regional interconnections. A number of actions are ongoing and planned to extend internal grid capacity as well as interconnections both within the region and between the region and southern European countries, such as Spain and Italy.[27] (See Table 10 for a summary of the main grid ownership and existing and planned interconnections in the MENA.)

Recent regional initiatives include the multi-billion dollar Gulf States Cooperation Council power grid project, which

Table 9. IEA Estimates of Subsidy Rates for Fossil Fuel Consumption as a Share of the Full Cost of Supply in Selected NOEC, 2011

	Average Subsidisation Rate (%)	Subsidy (USD per person)	Subsidy by Fuel (Billion USD)			
			Oil	Gas	Electricity	**Total**
Algeria	50.7	372.2	11.3	0.0	2.1	**13.4**
Egypt	54.2	296.5	15.3	3.8	5.4	**24.5**
Iran	70.0	1,102.2	41.4	23.4	17.4	**82.2**
Iraq	64.3	722.5	20.4	0.3	1.6	**22.2**
Kuwait	87.8	3,729.3	4.3	2.1	4.7	**11.1**
Libya	76.9	487.3	2.3	0.2	0.7	**3.1**
Qatar	78.6	3,622.0	2.0	1.9	2.1	**6.0**
Saudi Arabia	79.5	2,291.2	46.1	0.0	14.8	**60.9**
UAE	69.1	4,172.1	3.9	11.5	6.4	**21.8**

Source: See Endnote 26 for this section.

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[i] - Later in 2013, IRENA is releasing a dedicated report, *Tariff-based Support Mechanisms: An Assessment of Auctions*, that covers the role of auctions to support the deployment of renewable energy.

[ii] - Security of supply to meet seasonal peak demand in summer remains an issue in the MENA region today. According to MEED, a provider of business intelligence on the MENA, reserve margins across the region are thinner than minimum industry norms of at least 10–15%; for example, MEED estimated the reserve margins in 2009 as 3% in Syria and Kuwait, and 8% in Saudi Arabia and Oman. For many countries across the region, this results in daily power outages and brownouts in the peak summer season, per The Economist Intelligence Unit, "Securing MENA's electric power supplies to 2020" (Geneva, London, Frankfurt, Paris, Dubai: 2011), at www.masdar.ae/assets/downloads/content/321/eiu-masdar_securingmenapower_web.pdf, viewed 14 May 2013.

has created an integrated electricity network between Saudi Arabia, Qatar, Bahrain, Kuwait, Oman, and the UAE. More than 10 contracts worth over USD 1 billion were awarded in the first phase of the project linking Saudi Arabia with Kuwait, Bahrain, and Qatar.[28] In addition, the Seven Countries Interconnection Project (SCIP), launched in the early 1990s, will interconnect the grids of Libya, Egypt, Jordan, Syria, Iraq, Turkey, and Lebanon.

Further plans include enlarging the Seven Countries Power Grid to link it with Europe via Morocco in the west and Turkey in the north.[29] Within the region, an HVDC line is planned between Saudi Arabia and Egypt; it aims to provide the two countries with necessary flexibility to share their capacity and trade energy in a commercial manner during normal operation and to provide mutual back-up assistance during emergency operating conditions.[30]

Beyond these actions leading to a larger and more integrated MENA power grid, there is also a capacity-building programme—the ReGrid programme—dedicated specifically to the integration of large amounts of renewables in the region's electricity network. Through trainings, networking, and exchange of experiences, the programme aims to empower professionals such as grid operators in Algeria, Egypt, Jordan, Lebanon, Morocco, Syria, and Tunisia to be able to cope with high volumes of renewable power in their electricity systems.[31]

Progress is therefore being made in the creation of regional institutions and interconnections relevant for the growth in renewable energy, although these will require considerable investments to be realised in the years to come.

Table 10. MENA Grid Ownership and Interconnections

Country	Transmission Operator	Interconnections with
Algeria	SONELGAZ (state-owned utility for electricity and gas distribution)/ GRTE (subsidiary of SONELGAZ)	Tunisia (300 MW capacity; new interconnection line in 2012 complements four existing interconnections and more than doubles capacity) Morocco (800 MW capacity; no extension until 2020 or beyond) Spain and Italy (feasibility studies done but no decisions)
Egypt	EETC (Egyptian Electricity Transmission Company)	Jordan (550 MW capacity, with plans to double this) Palestinian Territories (Gaza; small capacity now but an estimated 150–200 MW is in the pipeline) Saudi Arabia (3,000 MW HVDC link planned)
Libya	GECOL (General Electricity Company of Libya; state-owned monopoly for generation, transmission, and distribution)	Egypt (180 MW capacity; new 400+ MW connection planned)
Saudi Arabia	Saudi Electricity Company	
Syria	PEDEEE and PEEGT (state monopolies that control distribution, generation, and transmission of electricity)	Turkey Lebanon Jordan
Israel	IEC (controls transmission)	Palestinian Territories HVDC link to Greece under consideration
Jordan	NEPCO (National Electricity Power Company; state owned)	Syria Palestinian Territories
Lebanon	EDL (Électricité du Liban; public utility for generation, transmission, and distribution)	Syria
Morocco	ONE (Office Nationale d'Électricité)	Spain (1.400 MW capacity; plans to add a third AC cable undersea in 2020 or later) Tunisia (via Algeria) Algeria (800 MW capacity; no addition planned before 2020)
Palestinian Territories		Israel Syria Egypt (17 MW connection to S. Gaza Strip; plans for 150–200 MW)
Tunisia	STEG (Société Tunisienne d'Électricité et du Gaz)	Morocco Algeria (300 MW capacity) Libya (currently disconnected) Italy (plans for 1,000 MW of HVDC, linked to decision on 1,200 MW production pole in Tunisia)

Source: See Endnote 27 for this section.

HEATING AND COOLING POLICIES

SWH has been a success story in several MENA countries, with exemplary promotional schemes such as the PROSOL programme in Tunisia and the PROMASOL programme in Morocco in place for some years now. Egypt, Jordan, Israel, and Syria are also good examples of countries that have taken advantage of SWH. For a summary of some of the key SWH parameters and policy information for the southwest and southeast Mediterranean countries of the MENA region, where SWH is the most developed, and for the Emirate of Dubai, see Table 11.[32]

Israel and Jordan were early leaders in stimulating SWH installation in the region, starting in the 1980s. Israel was the first to establish solar energy ordinances for new buildings in 1980; today, more than 90% of Israel's solar thermal market is beyond what is required by ordinance for new buildings such as retrofits to existing buildings, or systems larger than those required by law.[33] In 2008, Jordan established a solar thermal obligation for new buildings, and in October 2012 the government announced new regulations that mandate all new commercial and residential buildings to install SWH systems, taking into account the roof space challenge and conflicting use of space.[34]

Tunisia initiated the PROSOL programme in 2005 to disseminate SWH systems, in collaboration with the Italian Ministry of the Environment for the Protection of Land and Sea (MATTM) and UNEP. Designed for the residential sector, the programme aims to accelerate the penetration of SWH by engaging local financial institutions to provide credit lines to consumers.[35] It includes an interrelated set of measures, among them a 20% subsidy on SWH capital costs, an interest rate subsidy, accreditation schemes, capacity building, and awareness-raising campaigns.[36] Loans to end-users are financed through local banks, and repayments are made over five years through electricity bills, with the utility acting as the debt collector, guarantor, and enforcer.[37] Due to the success of the PROSOL

SWH on hotel rooftop in Tunisia, Prosol Tertiary SWH programme

Table 11. Heating and Cooling Support Policies in the MENA Countries

🟧 National Level

▨ State Level

		SWH Targets	Regulatory Policies		Fiscal Incentives					Educational incentives			
			Building regulation/code	Equipment standards	Capital grant subsidy	Operation grant subsidy	Tax incentive	Lowering/exemption of customs duties	Soft loan and loan guarantee	Technical assistance	Labelling	Training programme	Awareness raising programme
NOEC	Algeria	✔			🟧								
	Egypt		🟧	🟧	🟧	🟧		🟧					
	Libya	✔											
	Syria	✔		🟧	🟧				🟧				
	UAE (Dubai)	✔	▨	▨								▨	▨
	Yemen	✔											
NOIC	Israel		🟧	🟧									
	Jordan	✔	🟧	🟧			🟧	🟧					
	Lebanon	✔	🟧	🟧	🟧				🟧				
	Morocco	✔	🟧	🟧	🟧		🟧				🟧		🟧
	Palestinian Territories			🟧									
	Tunisia	✔	🟧	🟧	🟧		🟧	🟧	🟧	🟧	🟧	🟧	🟧

Source: See Endnote 32 for this section.

programme, the Tunisian Fund for Energy Conservation (AMNE), MATTM and UNEP supported two new initiatives to extend the financing mechanism was from households to commercial and more energy intensive industries. In 2007, Prosol Tertiary was launched, targeting the tourism sector and hotels; in 2009 Prosol Industry launched to incentivise SWH uptake in the textile, chemical and food industries. The key difference is found in the industry programme in which neither the utility, nor an equivalent entity, is involved to minimise default risk and incentivise commercial investment.[38]

Morocco's PROMASOL programme, started in 2002, was similarly successful in rapidly increasing the uptake of SWH. The programme started with SWH for collective buildings in health, education, and tourism and succeeded in increasing the number of SWH systems from 56,000 m^2 in 2001 to 231,000 m^2 in 2008 and 350,000 m^2 in 2012.[39] The original objective of the programme was to install 100,000 m^2 by 2008.[40] Unlike Tunisia's PROSOL programme, PROMASOL provides no capital cost subsidies to final purchases of SWH. The programme aims to improve the supply chain by training accredited SWH consultants and establishing SWH quality norms and testing; easing access to services and local bank financing by providing credit guarantees for investors; and instituting awareness-raising activities. PROMASOL is expected to have installed 1.7 million m^2 by 2020.[41]

Egypt has ambitions for SWH as well, but realising them has been more difficult due to the country's high energy subsidies. Nevertheless, as in the other countries of the region, there is considerable scope for future deployment of SWH, with the added advantage that local manufacturing and installation skills can be developed readily with significant economic and employment benefits, as demonstrated elsewhere in the region.

One of the barriers to increased adoption of SWH is the quality of some products. The Solar Heating Arab Mark and Certification Initiative (SHAMCI) of the League of Arab States, the Arab Industrial Development and Mining Organisation (AIDMO), and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) are in the process of establishing a regional certification scheme for SWH.[42]

TRANSPORT POLICIES

Renewable energy policies related to the transport sector are largely absent in the MENA region. The main exceptions to this are Malta and Jordan, both of which have biofuel blending mandates. Malta has adopted a target of 11% renewable energy to meet transport needs by 2020.[43] Elsewhere, Egypt, Israel, Jordan, Qatar, Saudi Arabia, and the UAE are financing and deploying demonstration projects (generally small scale) and adopting plans to promote greater renewable integration in the transportation sector, including both biofuels and electric vehicles.

Egypt is planning to develop a biofuels industry aimed at the transport sector. The Ministry of Petroleum has issued a strategy that foresees the use of agricultural wastes or non-edible plants— such as jatropha, treated wastewater, and sugar beet—to develop possible products including bioethanol, biodiesel, and bio-jet fuel. To assess the potential for biodiesel production from jatropha, Egypt established a partnership with Sudan. The government also engaged the Japanese Development Institute (JDI) to develop a biofuel market model and polices. The JDI proposed a biofuels development model aimed at meeting growing EU biofuels demand as a result of the RED Directive 2009, and the legislation to include aviation in the EU Emissions Trading System. The proposal envisages parallel efforts from the public sector to promote infrastructure development and biofuel policy frameworks; and from the private sector to develop and manage a jatropha bio-jet fuel supply chain.[44]

Test tubes in an algae lab which hold lipids, or oils, extracted from algal strains

In the GCC countries, the national airline Qatar Airways which is 50% government owned, is leading an ambitious initiative to develop aviation biofuels, backed financially by the State of Qatar. Qatar Airways, together with Airbus, Qatar Petroleum, Qatar University Science and Technology Park, and Rolls-Royce, have formed the Qatar Advanced Biofuel Platform, a consortium to develop the first large-scale algae bio-jet fuel value chain in the world. In the first phase of the project, Qatar University undertook a research and technology study on local micro-algae species and developed a lab-scale biofuel production facility, which is now moving into a demonstration phase.[45] In the UAE, Etihad Airways has partnered with Abu Dhabi's Masdar Institute to explore algal biofuels, while a firm in Dubai has opened a small facility to convert waste cooking oil into lorry fuel.[46]

National authorities and companies in the region are also taking action to promote electric vehicles, but to a very small degree. Israel, Jordan, and Saudi Arabia, all countries with renewable energy targets, already have financed some limited charging infrastructure.[47] (See also Chapter 3, Status and Evolution of Investments in Renewable Energy section.)

CONCLUSION

Advancements in renewable energy policies and targets, as well as encouraging signs of rapidly expanding activity among the NOEC, suggest that there is strong support across the MENA region for renewable energy as a means to diversify the energy mix and stimulate industrial development. Indeed, the renewable energy targets, if realised, will result in 107 GW of installed capacity in the region by 2030, with the NOEC emerging as the leaders. It remains to be seen the extent to which government ambitions, currently supported largely through public financing, will lead to transparent, long-term, market-driven policies and incentive mechanisms that encourage private sector involvement in deploying renewable generation capacity.

03

Investment Trends

Strong economic and demographic growth associated with rapid urbanisation are leading to increasing energy demand to meet electricity, air conditioning, desalinated water, and transport needs in the MENA region. The World Bank estimates that by 2040, the region's total investment needs in the energy sector will exceed USD 30 billion a year, about 3% of the projected regional GDP.[1] A recent study of energy investment over a shorter period, from 2013 to 2017, estimates that investment of USD 147.5 billion in power generation will be needed, of which USD 63.1 billion will be in the GCC, USD 21.4 billion in Iran, and at least USD 53 billion in the combined other countries of the region.[2]

At current rates of growth in energy consumption, significant investments will be required in renewable energy production capacity, as well as in grid and related infrastructure. In addition to strong energy demand growth, the fast-growing youth population in the region and the need to secure more jobs through local economic activity generated by renewable energy technology deployment are also accelerating investment.

STATUS AND EVOLUTION OF INVESTMENTS IN RENEWABLE ENERGY

According to Bloomberg New Energy Finance (BNEF), new investment in renewables in the MENA region totaled USD 2.9 billion in 2012, an increase of almost 40% over 2011 and a 6.5-fold increase compared to 2004.[3] [i] (See Figure 7.)

The regional investment increase between 2011 and 2012 was due largely to new projects in Morocco, which included the 160 MW capacity CSP plant at Ouarzazate, valued at USD 1.16 billion and owned by the Saudi Arabian project developer, investor, and operator ACWA Power International. This project has also received World Bank financing through the Climate Technology Fund (one of the Climate Investment Funds). The 300 MW wind farm at Tarfaya in Morocco also obtained debt financing, to the tune of USD 563 million from the Banque Centrale Populaire and the Attijariwafa Bank, as well as equity funding from Nareva Holdings SA in 2012. This project is being developed by the Moroccan company Nareva Holdings SA and International Power plc.

Development of the MENA region's renewable energy sector saw heightened investor focus from 2009 to 2012. Perhaps the best illustration is the entry of some of the world's largest energy players, especially oil and gas companies (both national and international), into the solar market. Over the last three years, Saudi Aramco, Saudi Arabia's flagship oil and gas company, financed either entirely or partially (with the King Abdullah Petroleum Studies and Research Center in the case of the Riyadh plant), the development of three solar PV projects in the Kingdom for a total of at least 17 MW installed capacity. Among the international oil and gas companies, France's Total SA has a 20% stake in the world's largest CSP plant in operation, the UAE's 100 MW Shams 1 project, valued at USD 765 million; and Royal Dutch Shell plc, through its Japanese subsidiary Showa Shell Sekiyu KK, financed the development of the 0.5 MW Farasan Island PV plant in Saudi Arabia.

Oil and gas companies are not the only ones interested in increasing their renewable energy activities in the region. Indeed, Electricité de France SA (EdF), the world's largest electric utility company, invested about USD 72 million in the development of an 18 MW solar PV power plant in Israel. Among other international companies taking part in the growth of the solar market in the region, the Spanish company Abengoa also has a 20% stake in Abu Dhabi's Shams 1 project.

Investments in wind power are led mostly by national companies and renewable energy authorities. For instance, state-owned Sonelgaz financed the development of a 10

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[i] - This section is derived from Bloomberg New Energy Finance (BNEF) Clean Energy Investment Trends and Asset Finance Records for MENA Region datasets (2013). Figures are based on the output of the Desktop databases of BNEF unless otherwise noted. Only renewable energy power generation projects greater than 1MW are included. Programmes for grid access and/or residential PV schemes or solar water heating are not within the scope of the BNEF database and are therefore excluded here.

[ii] - Egypt's new Electricity Law, which is in the process of ratification, addresses the replacement of the current Single-Buyer Model and allows for third-party access to the electricity grid based on published tariffs and long term EPAs. In 2002, Algeria authorised the private generation of renewable energy, via Law No 02-01 on electricity and distribution of gas, Article 26: "in application of Energy Policy the Commission of regulation can take measures to organise the market to ensure the normal flow, with minimum price of a minimum volume of electricity from renewable energy sources or cogeneration systems." Palestinian Territories and Kuwait are introducing liberalisation laws under consideration. Some countries, like Bahrain and Morocco, have a history of independent power producers (IPPs). Bahrain liberalised its power sector in 2000; today, 80% of the Kingdom's electricity is produced by IPPs. Morocco law 13-09 provides grid access, although the utility is still the single buyer. In Libya, all power companies remain state-owned; however, a new electricity law is under preparation thar will allow private-sector producers to generate electricity.

MW wind farm in Adrar, Algeria. The Société Tunisienne de l'Electricité et du Gaz (STEG) financed the development of a 34.3 MW wind farm in Sidi Daoud, Tunisia. Egypt's New and Renewable Energy Authority (NREA) has secured USD 455.5 million from a consortium of banks to develop the 200 MW NREA and KfW Gulf of El Zeit Wind Farm. Prior to the change of government in Libya, the Renewable Energy Authority of Libya (REAOL) announced that it would finance Phase I of its planned 120 MW wind farm in Darnah with a disclosed value of USD 127 million; 60 MW is currently under preparation.[4]

Although the renewable energy sector has continued to grow since 2009, political instability in some parts of the region and the lack of comprehensive renewable energy policy frameworks and incentive schemes continue to remain barriers to investment. Egypt, Libya, and Tunisia saw declining investment following the Arab Spring and due to the scarcity of stable, long-term transparent policies, such as FITs.[5] (See Table 12.) Further, energy subsidies for fossil fuels remain a key challenge, particularly in net-oil exporting countries, as they distort the energy markets by negatively affecting the price competitiveness of renewable energy sources. As a result, government investment and finance from development banks continue to dominate in the region.

PUBLIC AND PRIVATE INVESTMENTS

Government ministries and publicly owned electricity generation companies are taking the lead on renewable energy investment, often with the support of development banks, including the World Bank Group. However, while public sector investment has dominated so far, the potential opening of the electricity markets, reflected in new liberalisation policy proposals in recent years,[ii] together with the opportunities for off-grid energy projects, are widening the scope for private-sector participation.

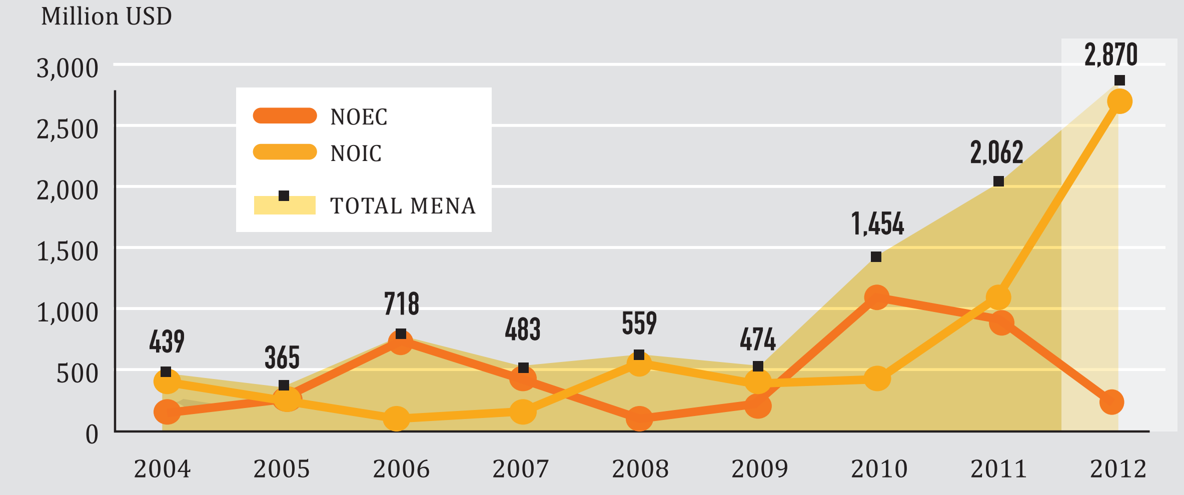
The role of private households and enterprises is particularly important in the significant development of SWH in the region, as well as in developing off-grid solutions for small communities and farmers, as well as for irrigation and water desalination. In 2012, for example, the German

Table 12. New Investment in Renewable Energy, by Country, 2009–2012 (Million USD)

	2009	2010	2011	2012
Algeria	—	—	33	—
Bahrain	—	—	—	—
Egypt	—	923	—	—
Iran	—	—	—	136
Iraq	103	—	—	—
Kuwait	—	—	—	—
Libya	—	132	—	—
Oman	—	—	—	—
Qatar	—	—	—	—
Saudi Arabia	—	15	47	22
Syria	—	—	—	—
UAE	52	20	843	—
Yemen	—	—	—	—
Total NOEC	155	1,091	923	158
Djibouti	—	—	—	—
Israel	263	355	830	814
Jordan	—	—	—	—
Lebanon	—	—	—	—
Malta	—	—	—	—
Morocco	—	8	309	1,898
West Bank & Gaza	—	—	—	—
Tunisia	57	—	—	—
Total NOIC	320	363	1,139	2,712
Total MENA	474	1,454	2,062	2,870

Source: See Endnote 5 for this section.

Figure 7. Investments in Renewable Energy in the MENA Region, 2004–2012



Source: See Endnote 3 for this section.

renewables specialist Juwi constructed its first off-grid renewable energy project in Egypt. The installation in the rural Wadi El Natrun includes a 50 kW PV system, four small wind turbines, and a battery storage system to provide 24-hour power, to desalinate groundwater and provide water for irrigation.[6]

PROJECT FINANCING

Renewable energy projects commissioned or in the pipeline in the MENA region indicate that concessionary finance involving long-term, low-interest loans remains an important source for many renewables projects. KfW, the European Investment Bank (EIB), the Agence Française de Développement (AFD), and the World Bank group are significant players in the region. Climate finance, the United Nations Development Programme (UNDP), and the African Development Bank also play a significant role in the region.

Some local regional funding is also emerging, most notably from the Abu Dhabi Fund for Development. In the majority of cases, the project partner is the state utility. Proposed reforms of the power market in the region may open up space for more independent power producers (IPPs) to generate power and feed it into the grid either at specific tariffs, under quotas, or through power purchase agreements (PPAs) set through negotiations or tender procedures, as well as reverse auctions to select IPPs, as seen in Morocco and Saudi Arabia. Where this is the case, however, the state-owned utility is often running the tender, and many of the IPP deals also have the state buying a share of the solar PV.[7] As of late 2010, the World Bank had 17 investment projects under supervision in MENA, totaling some USD 2.1 billion and including both conventional and renewable energy projects.[iii] The World Bank also has been active in analysis and advisory work in the region.[iv] In addition to concessionary finance from the World Bank and its affiliates (the EIB, UNEP, and UNDP), equity and private venture capital, family funds, bonds, and debt all play an important role in financing renewable energy projects in the MENA countries.

As highlighted earlier, regionally based funding institutions are now also entering the scene. Most notably, the Abu Dhabi Fund for Development continues to expand its renewable energy concessionary loan portfolio, including hydropower in Algeria and geothermal in Yemen, as well as a USD 350 million soft-loan facility for renewable energy projects in countries that are members of IRENA.[8] The UAE also has rapidly scaled up renewable energy in its regional grant aid programme, including a 15 MW solar project in Mauritania in 2013 and plans for projects in Bahrain.[9]

The long-term private capital for large-scale capital intensive renewable energy projects such as wind and solar comes mainly from asset and debt financing, whereas equity-type capital is usually a small share of the total. Much of the renewable energy investment in the region is made by the governments or their public utility companies. Solar thermal projects are increasing in frequency and scale in the region, and this trend is expected to continue in the future. The recent tender for Morocco's 160 MW Ouarzazate project was awarded in September 2012 to ACWA Power, which offered a price of 19 U.S. cents per kWh, compared with the 24 U.S. cents per kWh offered by the other consortiums which bid.[10] The project funding came from the African Development Bank ADB, the EIB, the International Bank for Reconstruction and Development (IBRD), the German development bank KfW, the French development agency AFD, and the Clean Technology Fund (CTF). The IBRD also subsidised the costs of generation. The significance of the World Bank Group, the EIB, the CTF, and other soft sources of finance does, however, raise questions about project replicability. Nevertheless, the case of the Ouarzazate CSP plant indicates that there is competition among bidders, which results in lower CSP power costs.

CLEAN TECHNOLOGY FUND

The Clean Technology Fund is one of four Climate Investment Funds administered through the regional development banks (e.g., the African Development Bank and the European Banks for Reconstruction and Development, EBRD) and the World Bank Group (IBRD, International Finance Corporation, International Development Association). The CTF has USD 5.2 billion in pledges from the contributor countries.[11] Five MENA countries—Algeria, Egypt, Jordan, Morocco, and Tunisia—plan to use USD 750 million from the CTF in conjunction with other funding sources to support the deployment of roughly 1 GW of CSP capacity.[12] For instance, the CTF provides USD 197 million to promote the development of Morocco's Ouarzazate I CSP project.[13]

The CTF provides grants and/or concessionary loans to renewable energy projects and programmes to encourage scaling up of resource exploitation. The World Bank and the African Development Bank are assisting a number of countries to prepare business plans for greenhouse gas reduction, including Egypt, Morocco, and Tunisia. The CTF's concessionary finance support combined with the feed-in-policies reduces the payback period of the renewable energy projects by 50%.[14]

THE POTENTIAL OF CLIMATE FINANCE

Among emerging climate finance sources, the Green Climate Fund (GCF), established in 2011 by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), may be a promising source of finance for investment in renewable energy in the MENA region. The GCF aims to channel support to the developing world to address climate change, with the goal of mobilising USD 100 billion annually in climate finance by 2020 from both public and private investors.[15]

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iii - These include: the Djibouti Power Access and Diversification project, the Egypt El-Tebbin project, the Egypt Ain Sokhna Power project, the Egypt Natural Gas Connections project, the Egypt Giza North Project, the Egypt Wind Power Development project, the Yemen Power Sector project, the Yemen Rural Energy Access project, the Iraq Dokan and Derbandikhan Emergency Hydropower project, the Iraq Emergency Electricity Reconstruction project, the Iraq Integrated National Energy Strategy, the Lebanon Emergency Power Reform, the West Bank and Gaza Electric Utility Management project, the Morocco ONE Support project, and the Tunisia Energy Efficiency project.

iv - These include: Djibouti's energy sector master plan; Egypt's commercial wind framework, energy pricing, design of a load management program, and review of risk allocation for the private sector; Syria's strategy for the electricity sector; Jordan's financial and institutional framework for overall energy strategy and energy efficiency; Lebanon's power sector reform; Tunisia's developing energy efficiency and renewable energy activities and review of energy management policy; Morocco's framework for wind power, energy supply strategy, and related investment plan; Palestinian Territories electricity sector lending; and Yemen's institutional framework for energy efficiency, gas sector development, gas-to-power models, and energy subsidy reform.

Tanger Wind Farm, Morocco

So far, progress is being made in the definition of the GCF business model framework. In March 2013, its Board agreed that the "Fund should follow a country-driven and owned approach as a core principle, and should leverage additional resources, including through a private sector facility."[16] However, the GCF will not be operational for several months, and it is still unclear how much money will be channeled through it. Nevertheless, this amount is likely to be significantly higher than the World Bank's Climate Investment Funds, the largest climate financing funds to date. With the GCF not yet finalised, it is difficult to anticipate the extent to which MENA countries will benefit from it.

Another emerging carbon market financing mechanism is Nationally Appropriate Mitigation Actions (NAMAs) to finance energy efficiency and renewable energy projects.[17] The concept of NAMAs was first introduced at the 13th Conference of the Parties to the UNFCCC, held in 2007 in Bali, Indonesia. A NAMA specifies voluntary activities to mitigate greenhouse gas emissions in developing countries that are not subject to mitigation commitments, and these actions can be supported by industrialised countries through financing, technology transfer, or capacity building.

There are three types of NAMAs; Unilateral, Supported, and Credited. The Unilateral NAMAs are implemented using only domestic resources and finance; the Supported NAMAs are implemented with international support though traditional means such as grants, loans, and capacity building programmes; and the Credited NAMAs are supported by creating and selling carbon credits. Some MENA countries, such as Egypt, Jordan, Morocco, and Tunisia, have communicated NAMAs covering renewable energy projects to the UNFCCC.[18]

CONCLUSION

Renewable energy investments in the MENA region have been increasing in recent years, and continued to accelerate in 2012. The number and scale of projects in the pipeline suggests that this is set to continue, and existing targets for 2020 and beyond imply a significant increase in the next 5–20 years. Much of the increase will come from the net oil-importing countries, which are also likely to be best placed to find internal sources of finance. However, the net oil-exporting countries are also poised for significant increases in renewable energy investment and production, and it is here that climate finance and private capital are likely to play the largest role in achieving the set targets.

Several challenges remain to private investment in the region, including regulations, policies, energy subsidies, public awareness, and the level of political and policy risk and uncertainty. However, as reported in Chapter 2, recent trends indicate that the MENA countries are working to address these challenges through the adoption of adequate renewable energy support policies and the associated restructuring of their markets, which will lead to a strong investment environment in the region.

04

Rural Renewable Energy

Most of the MENA countries have high electrification rates—99% or more in at least 11 of the 19 countries for which data are available.[1] (See Table 13.) In rural areas, however, only five countries have 99% or more access, and four have less than 90% access. The most serious problems of electricity access in rural areas are in Yemen and Djibouti. Based on IEA data, about 20 million people in the MENA region lacked electricity access in 2010, most of them in rural areas.[2]

The overall trend for electricity access has been positive, with notable cases being Iraq, Qatar, and Morocco, where substantial improvements have been achieved. Although recent data on rural electrification rates are not available, the IEA gives rural electrification rates of 79.9% for North Africa and 76.6% for the Middle East in 2000.[3] This suggests that significant improvements have taken place in rural electrification rates.

The countries of North Africa have successfully connected most rural areas to the grid or deployed off-grid solutions for remote communities. However, extending grid access is a very expensive option where villages are remote, terrain is mountainous or otherwise difficult to cross, or conflict situations are present or likely. In these situations, off-grid renewables are attractive options.

The IEA estimates that total investment of nearly USD 1 trillion (USD 979 billion) would be required to achieve the United Nations' goal of universal energy access by 2030—an average of USD 49 billion per year from 2011 to 2030. Globally, 1.3 billion people do not have electricity today, and 2.6 billion people still rely on the traditional use of biomass for cooking. Although the MENA region is in a relatively good position compared with sub-Saharan Africa, the fact that 20 million people in the region lack electricity and a higher number still use traditional biomass for cooking presents a major challenge for the near future.[4]

RURAL RENEWABLE ENERGY TECHNOLOGIES

Solar PV and solar water heating are common off-grid solutions for light, battery charging, and heat at the household level, as well as for refrigeration and for use in schools and small clinics. These technologies are typically used in rural areas and in the countries where a significant number of people or villages lacks grid access. In 2012, Libya had 725 kWp installed capacity of PV systems dedicated to rural electrification.[5] In other countries of the region, including Djibouti, which has set a target of achieving electrification of 30% of the rural population with solar PV by 2017, there are several villages using solar PV systems to meet their electricity needs.[6]

In the framework of the Programme d'Electrification Rurale Global (PERG) launched by the Office National de l'Electricité (ONE) in 1996, the Moroccan government made the decision to partly meet the growing electrification needs of the countries rural areas through decentralised system of electrification based on mini-networks driven by wind and hydroelectric power or individual PV systems.[7] The initial investment budget for solar electrification projects was over USD 35 million.[8] An equipment grant from ONE, mainly financed by international agencies, including notably KfW and the AFD, covered 66% of the systems cost.[9] As evidenced by the following figures, this programme has been a success: In Morocco in 2010 solar PV represented 2.6% of electrification among households, and 10% for village electrification in Morocco.[10]

Hybrid mini-grid system powered by wind and solar

Tunisia's 2008 Renewable Energy Plan included a major effort to develop renewable energy applications for rural electrification, as well as for use in the agricultural sector. Specific objectives included: installation of 63 pumping

Table 13. Electrification Rates and Rural Electrification, MENA Countries, 2005 and 2010

		Electrification Rate (%)		Rural Electrification Rate (%)
		2005	**2010**	**2010**
NOEC	Algeria	98.1	99.3	97.9
	Bahrain	99.0	99.4	94.7
	Egypt	98.0	99.6	99.3
	Iran	97.3	98.4	94.5
	Iraq	15.0	98.0	94.1
	Kuwait	100.0	100.0	100.0
	Libya	97.0	99.8	99.1
	Oman	95.5	98.0	92.9
	Qatar	70.5	98.7	68.8
	Saudi Arabia	96.7	99.0	94.4
	Syria	90.0	92.7	83.5
	UAE	91.9	100.0	100.0
	Yemen	36.2	39.6	23.1
NOIC	Djibouti	n/a	50.0	n/a
	Israel	96.6	99.7	96.3
	Jordan	99.9	99.4	98.7
	Lebanon	99.9	99.9	99.2
	Malta	n/a	n/a	n/a
	Morocco	85.1	98.9	97.4
	Palestinian Territories	n/a	n/a	n/a
	Tunisia	98.9	99.5	98.5

Source: See Endnote 1 for this section.

stations and water desalination; installation of 200 water pumping stations for irrigation systems using hybrid technologies; equipping of 200 farms with biogas units for domestic use; installation of two industrial units connected to the network for combined heat and power from biogas; electrification of 1,000 rural households by hybrid systems; electrification of 1,700 rural households by PV systems; and electrification of 100 farms and tourist centers by hybrid systems.[11]

In those areas that lack access to energy, the use of solid fuels in open stoves remains an important source of energy for cooking. In North Africa, some 4 million people used biomass resources as their primary fuel for cooking in 2004.[12] In the MENA region, at least 12 million still use primary biomass for cooking today, especially in rural areas.[13] The use of biomass resources for cooking and heating has adverse impacts on human health and the environment, and leads to wastage of time for those (often women) who collect biomass for domestic purposes.[14] Although biomass for solid fuel stoves is regarded as "renewable," in many countries over-harvesting of biomass has led to environmental degradation with negative effects on soil water retention, water tables, micro-climate health, and biodiversity.

CONCLUSION

Most of the MENA countries have reached high electrification rates. In rural areas, however, there is still room for improvement. Modern renewables play an important role in providing energy services to the people in rural areas who depend on traditional sources or inefficient, polluting, and costly diesel generators, not only by countering the health and environmental hazards associated with non sustainable energy sources, but also by increasing the quality and efficiency of providing basic necessities like lighting, communications, heating, and cooling.

Furthermore for a majority of very remote and dispersed users, decentralised off-grid electricity is less expensive than extending the existing power grid.

Modern renewable, and especially solar PV and solar water heating, is thus increasingly being deployed throughout the region. This trend is expected to continue thanks to cost reduction and policy makers who are increasingly supporting decentralised technologies harnessing solar energy.

05

Country Best Practices to Localise the RE Value Chain

Countries in the MENA region are increasingly implementing policies not only to facilitate the rapid uptake of renewable energy, but also to promote local economies along the renewables value chain. This interest is amplified by widespread concern to provide more domestic employment opportunities in the context of expanding populations. Governments recognise the renewables industry as a promising source of sustainable job creation, particularly given the diverse renewable energy supply chain from technology to deployment. The interest is strong in both NOEC and NOIC.

The development of local renewable energy supply chains in the MENA region has progressed in recent years; however, many challenges still remain. Wind and solar PV markets, although at different stages of development, can be considered relatively mature and competitive, presenting barriers to the entry of new firms. In the growing CSP market, opportunities exist at the lower end of the value chain, but the high-value components remain subject to patents; the few large international companies that own the intellectual rights to these technologies are reluctant to licence them or to establish local manufacturing plants. Further, the renewable energy innovation system in the region is still far from having reached its full potential, despite encouraging signs of new institutions like Masdar.

This chapter provides an overview of the different approaches undertaken to foster domestic renewable energy industries in five MENA countries: Saudi Arabia, the United Arab Emirates, Egypt, Morocco, and Tunisia.

SAUDI ARABIA

The Kingdom of Saudi Arabia is advancing local-content provisions in line with its wider objective of developing a local renewable energy industry with a focus on domestic training, job localisation, and research and development (R&D). In February 2013, Saudi Arabia released a White Paper detailing the proposed competitive procurement process of its K.A.CARE programme, which aims to install 54 GW of renewable energy by 2032.[1] Local content is a key criterion in the evaluation of project bids during the various K.A.CARE tendering rounds and will increase from 50% or higher, depending on the item or service introductory call, to 60% or higher in the first round, and 70% thereafter.

The importance of domestic sourcing is evident in the White Paper, which states that "while K.A.CARE is aggressively pursuing the development of the local value chain, projects will be expected to escalate their local content inclusion accordingly."[2] Each project bid will be assessed based on price as well as "rated criteria," which include the developer's financial capability, experience, development status, and the project's local content. The scoring will be 70% weighted towards price and 30% weighted towards the rated criteria. Local content will be evaluated based on dollars spent locally compared to total project cost, with maximum points given for systems with 60% local content initially.[i] Meeting the K.A.CARE local-content requirements will most likely require joint ventures with technology companies that may be encouraged to establish a local manufacturing plant to meet the planned scale of deployment.

Saudi Arabia's programme also requires developers to invest back into the local economy through the provision of training, research advice, and procurement from local manufacturers. Project revenues will be taxed by 1% for a Solar Energy Training Fund to train local employees on solar PV and CSP technologies, and 1% for the Solar Energy Research Fund for local renewable energy research and development projects. Similar to Ontario's feed-in tariff programme, K.A.CARE also provides fiscal incentives for employing the domestic labor force. Developers who are in the top 5% in terms of job localisation in Saudi Arabia will be paid above average for each employee.[3]

Although Saudi Arabia is a latecomer to renewable energy, with K.A.CARE being established only in 2010 and the national strategy and White Paper only announced in 2013, the volume and value of proposed investments over the period to 2032 could act as a powerful lever to the establishment of relevant value-chain activities in the Kingdom in the coming years.

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i - Local-content requirements are expected to apply only under the second full-scale procurement round, although developers that use local content in either of the introductory or first full-scale rounds will receive a higher ranking.

Engineers from NREL and K.A.CARE installing a rotating shadowband radiometer near Riyadh.

UNITED ARAB EMIRATES

Although without a unified federal energy policy, the efforts of the Emirate of Abu Dhabi have laid the foundations for a “hub” approach in the United Arab Emirates, namely through Abu Dhabi’s state-owned vehicle Masdar. The Emirate’s financing for renewable energy projects has seen, for instance, 66 local companies participate in the 100 MW Shams 1 CSP plant, the majority of which did not exist before.[4] The local renewable energy investment community has also grown as Masdar and state-backed Taqa have become active global investors, with Masdar notably taking stakes in the London Array, the world’s largest offshore wind farm, and Gemasolar, the Spanish CSP project that uses breakthrough energy storage technology.[5]

At the same time, the state has fostered R&D and “thought leadership” through the Masdar Institute and by hosting IRENA, the 159-member country international organisation. Masdar Institute has already produced the region’s first-ever patents in clean tech, some with start-up company potential.[6] The Masdar City sustainable development and free zone also has brought a raft of renowned renewable energy industry leaders, such as Siemens and General Electric, to establish their regional headquarters in the UAE.[7] The Emirate of Dubai’s plans for 1,000 MW of solar have further reinforced the “hub.”[8]

The northern Emirate of Ras Al-Khaimah has pursued a similar approach on a smaller scale with the establishment of a clean-tech campus by Switzerland’s respected École Polytechnique Fédérale de Lausanne and a related clean-tech research and demonstration centre run by the Swiss outfit CSEM.[9]

Nonetheless, given the limited market size at the moment, the UAE has focused more on investing in overseas manufacturing (such as in Germany) than on developing a local industry.[10] With Saudi Arabia looking to take the production lead in the GCC, the United Arab Emirates might well have to forgo a traditional local-content focus. However, given Dubai’s large financial industry and Abu Dhabi’s innovation efforts and state funds, the UAE might see a more white-collar approach to “local content” emerge: a nation of fund managers instead of factory workers.

EGYPT

Egypt has established several institutions to develop its local renewable energy industry: first in the early 1990s through the establishment of a Wind Energy Technology Centre (WETC) and a National Renewable Energy Development Organisation (REDO), and then in 2000 through the creation of the Industrial Modernisation Centre (IMC).[11] The WETC is responsible for technical evaluation, testing, R&D, and certification of wind turbines, and also aims at undertaking training in operation and maintenance. The REDO is responsible for testing and certification of renewable energy systems, including wind energy and PV.

The IMC aims at facilitating the development of local markets. It has developed a specific programme dedicated to the development of the Egyptian local renewable energy value chain: the Renewable Energy and Environment Protection Programme.[12] This programme supports industrial establishments technically and financially by providing information on renewable energy (availability, current and future uses) and conducting feasibility studies, which notably include technical capabilities, investment needs, and associated operation and maintenance. Furthermore, the programme engages in stimulating, proposing, and participating in discussions related to existing and proposed procedures and logistics, with the goal of deploying renewable energy and providing technical assistance to developers in obtaining the required licenses, in accordance with the electricity market regulations in Egypt.

Egypt has several local supply-chain manufacturers in the wind sector. This includes the former state-owned company Ferrometalco, the Arab Organisation for Industrialisation (AOI), and the Sewedy Wind Energy Group (SWEG). SWEG has a joint-venture tower production facility with SIAG Schaff Industries AG, as well as a stake in M Torres, the Spanish turbine manufacturer, which provides access to its turbine technology and experience. Sewedy manufactures wind turbine blades and is in the process of localising its supply chain.[13] Considerable potential still remains for the development of a local market. According to NREA, 30% of components used in existing wind projects are locally produced, and that share could reach 70%.[14]

The PV market in Egypt is dominated by local system integrators including Middle East Engineering & Technology (MEET), Arabian Solar Energy & Technology Co (ASET), and suppliers that carry out design, installation of components, and operation and maintenance. About 25% of the PV modules used in Egypt are locally manufactured.[15] However, significant potential exists to locally manufacture plastic composites, specialised glass, electronics, switch gear, aluminum frames, and other system auxiliaries required for integrated PV systems.[16]

In 2011, Egypt started to operate its first CSP plant in Kuraymat. About 40% of the value of the solar field was generated locally; NREA suggests that this could increase to 60% in the future.[17] A barrier to further growth in manufacturing CSP plants locally is related to the accessibility of sensitive knowledge concerning the highest-value components: the parabolic mirrors, the parabolic-trough receiver, and the heat transfer fluid.[18]

Notably, Egypt and Algeria have the only manufacturing plants that are able to produce float glass in the MENA region; however, they have not yet met the quality and technical requirements for CSP parabolic mirrors.[19]

Nevertheless, several local companies produce piping and insulation systems believed to be suitable for CSP, while steel and cement are also produced locally. Moreover, there is scope for development of "niche" CSP technologies in Egypt, for example in salt water desalination. Finally, the experience gained from building the first CSP plant in Egypt suggests that relevant local capabilities exist in engineering, procurement, and construction activities.[20]

Al Kuraymat Hybrid CSP plant, Cairo, Egypt

MOROCCO

Morocco is enabling the creation of a local renewable energy sector through the development of national industrial capacity to support its ambitious renewable energy programme, which targets 42% of installed capacity by 2020, including 2 GW of solar and 2 GW of wind.[21] The country is prioritising the manufacturing of components for PV solar (films, cells, panels, etc.), solar thermal (flat mirrors, control systems, condensers), and SWH.[22] The government is providing various fiscal incentives to encourage local manufacturing, including low-cost land and related services as well as free-trade-zone status.[23]

Further, Morocco has established several educational, training, and research institutions to create local expertise including: the National Agency for Renewable Energy and Energy Efficiency (ADEREE), which provides training programmes and R&D activities; MASEN, whose main role is to coordinate and implement solar projects in the country; l'Institut de Recherche en Energie Solaire et en Energies Nouvelles (IRESEN), a dedicated institute for research into solar and new energy launched in 2011 with the aim of creating synergies between universities and industrial partners and RD&D opportunities; and the Societé d'Investissement Energétique (SIE), which invests in key renewable energy projects.[24]

Morocco's PROMASOL programme for SWH proved particularly successful in promoting the rapid uptake of the technology and in developing local industry through capacity-building efforts. (See Chapter 2 for programme details.) Launched in 2002, the programme trained and certificated over 200 installers and specialised companies, and saw an increase in the number of companies importing and/or manufacturing SWHs from five to more than 40 by 2011, with three major manufacturers operating in Morocco: Tropical Power, Mafec, and Capsolair.[25] Following this success, PROMASOL 2, which aims to implement 1.7 million m^2 of SWH by 2020 and is expected to create 13,000 new jobs, has been launched.[26]

Morocco is also advancing local-content provisions; the calls for tenders within the Moroccan Solar Plan and Wind Energy Programme have stipulated local content as a key criterion in the evaluation of project bids. The extent of local content proposed by a developer is a deciding factor in whom is awarded; for example, the recent tender for a 160 MW CSP plant near Morocco's Ouarzazate was awarded to ACWA Power, which plans to build the plant with almost 42% local content.[27] Wind project developers must include a plan to develop a domestic manufacturing and/or an assembly industry for wind components.[28]

TUNISIA

Tunisia's PROSOL programme, launched in 2005, revitalised the country's solar thermal market; nearly 10 times more solar water heaters were installed in 2011 than in 2004 (before the scheme was launched), and the national market turnover of the solar thermal industry was estimated at USD 25 million in 2011. The programme, carried out in cooperation with the Italian Ministry for the Environment and the United Nations Environment Programme, was followed up with various initiatives for the residential, tourism, and industrial sectors.[29]

The programme's success was accompanied by the development of a local supply chain: 80% of the systems sold in Tunisia are not imported. This can be explained by the rapid adoption of the technology and the government's decision to mandate a quality labelling system called "Qualisol" for installers who want to operate under the PROSOL scheme. To use the label, installers undergo training provided by the National Chamber of Renewable Energies (CNSEnR), after which they will have to pass an exam. The Centre Technique des Matériaux de Construction de la Céramique et du Verre laboratory and the laboratory of "Ecopark de Borj Cedria" are the two testing facilities for accreditation, which is overseen by the National Institute for Standardisation and Industrial Property.[30]

Successive PROSOL programmes have thus led to a rapid increase in the number of market actors; eligible SWH suppliers rose from six in 2005 to 49 in 2011 (of which 10 are manufacturers), and today there are over 400 "Qualisol systems" qualified installers. As a result, an estimated 7,000 direct jobs have been created since the start of PROSOL.[31]

CONCLUSION

In the MENA region, an increasing number of countries are advancing diverse measures and strategies to localise the renewable energy value chain, particularly for solar and wind. A large focus has been placed on the establishment of various education, training and research institutions to develop local expertise and technological capabilities with respect to production, project execution, and innovation capabilities. Alongside the creation of these institutions, countries are also implementing favorable policy frameworks to create large local markets, engage private sector investment and thereby foster the emergence of industrial and technological hubs.

ENDNOTES, CHAPTER 1

1 International Energy Agency (IEA), *Renewables Information 2009* (Paris: IEA/OECD, 2009); IEA, *Renewables Information 2012* (Paris: IEA/OECD, 2012).

2 The United Nations Sustainable Energy for All initiative has identified replacement of traditional biomass with modern RE services as an international priority; see www.sustainableenergyforall.org.

3 IEA, op. cit. note 1.

4 Renewable power generation data in this section are estimates aggregated from BP, *Statistical Review of World Energy 2012* (London: 2012), and from EurObserv'ER, "La production d'Electricite d'origine renouvelable dans le Monde" (Paris: 2012). Data also from Kingdom of Bahrain Electricity and Water Authority, Oman Authority for Electricity Regulation, and World Bank.

5 IEA, *Electricity Information 2012* (Paris: IEA/OECD, 2012). Other sources include Regional Center for Renewable Energy and Energy Efficiency (RCREEE), Moroccan Ministry of Energy Water and Environment, Lebanese Center for Energy Conservation, and Tunisian Ministry of Industry and Technology, personal communications with REN21.

6 Figure 1 from the following sources: BP, op. cit. note 4; Kingdom of Bahrain Electricity and Water Authority; EurObserv'ER, op. cit. note 4; Oman Authority for Electricity Regulation; World Bank. In 2010, Iran and Morocco started to operate the first CSP plants in the MENA region, and in 2011, Algeria and Egypt started to operate their first CSP plants; therefore, it is not possible to calculate the average annual growth rate for CSP power generation from 2008 to 2011. The annual growth rate from 2010 to 2011 was over 350%. Iran from CSP World, "Yazd ISCC," at www.csp-world.com/cspworldmap/yazd-iscc, viewed 22 April 2013; Morocco from U.S. National Renewable Energy Laboratory (NREL), "ISCC Ain Beni Mathar," SolarPaces, 24 January 2013, at www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=43; Algeria from NREL, "ISCC Hassi R'mel," SolarPaces, 12 February 2013, at www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=44; Egypt from NREL, "ISCC Kuraymat," SolarPaces, 12 February 2013, at www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=65.

7 Figure 2 from the following sources: BP, op. cit. note 4; Kingdom of Bahrain Electricity and Water Authority; EurObserv'ER, op. cit. note 4; Oman Authority for Electricity Regulation; World Bank.

8 Table 1 based on the following sources: REN21; Algeria, Bahrain, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine, Tunisia, and Yemen from RCREEE; Iraq from League of Arab States. Solar PV capacity for 2010 is in MWp, per "Global cumulative installed photovoltaic capacity and respective international trade flows," preprint to be published in the proceedings of the 26th European Photovoltaic Solar Energy Conference, 5–9 September 2011, Hamburg, Germany, available at www.q-cells.com.

9 See "Iran's Hydropower Production Capacity Hits 9,500 MW," *Fars News Agency*, 28 November 2012, at http://english.farsnews.com/newstext.php?nn=9107122764; Egypt's hydropower installed capacity from RCREEE and Egyptian New and Renewable Energy Authority (NREA), personal communications with REN21.

10 Iraq from League of Arab States, personal communication with REN21; Morocco from RCREEE and Moroccan Ministry of Energy, Water and Environment, personal communications with REN21; Syria from Mohammed Mostafa El-Khayat, NREA, "Solar Energy Conservation and Photoenergy Systems – Renewable Energy Potential in the Arab Region," www.eolss.net/Sample-Chapters/C08/E6-106-46.pdf, viewed 3 April 2013.

11 BP, op. cit. note 4; Kingdom of Bahrain Electricity and Water Authority; EurObserv'ER, op. cit. note 4; Oman Authority for Electricity Regulation; World Bank.

12 Ibid, all references.

13 Figure 3 from the following sources: Egypt, Iran, Morocco, and Tunisia data for 2005 from GWEC, *Global Wind Report 2006* (Brussels: 2007); Israel and Jordan data for 2005 from WWEA, *World Wind Energy Report 2008* (Bonn: 2009); Egypt, Iran, Morocco and Tunisia data for 2006 from GWEC, *Global Wind Report 2007* (Brussels: 2008); Israel and Jordan data for 2006 from WWEA, op. cit. this note; Egypt, Iran, Morocco, and Tunisia data for 2007 from GWEC, *Global Wind Report 2008* (Brussels: 2009); Israel and Jordan data for 2007 from WWEA, *World Wind Energy Report 2011* (Bonn: 2012); Egypt, Iran, Morocco, and Tunisia data for 2008 from GWEC, *Global Wind Report 2009* (Brussels: 2010); Israel and Jordan data for 2008 from WWEA, *World Wind Energy Report 2011* (Bonn: 2012); Egypt, Iran, Morocco, and Tunisia data for 2009 from GWEC, *Global Wind Report Annual Market Update 2010* (Brussels: 2011); Israel and Jordan data for 2009 from WWEA, *World Wind Energy Report 2011* (Bonn: 2012); Egypt, Iran, Morocco, and Tunisia data for 2010 from GWEC, *Global Wind Report Annual Market Update 2010* (Brussels: 2011); Israel and Jordan data for 2010 from WWEA, *World Wind Energy Report 2011* (Bonn: 2012); Egypt, Iran, and Morocco data for 2011 from GWEC, *Global Wind Report Annual Market Update 2011* (Brussels: 2012); Israel and Jordan data for 2011 from WWEA, *World Wind Energy Report 2011* (Bonn: 2012); Tunisia data for 2011 from GWEC, "Interactive Map," at www.gwec.net/global-figures/interactive-map/#map_top, viewed 23 April 2013; Egypt, Iran, and Morocco data for 2012 from GWEC, Global Wind Statistics 2012 (Brussels: 2013); Jordan data for 2012 from RCREEE, Jordanian Ministry of Energy & Mineral Resources, personal communication with REN21; Tunisia data for 2012 from RCREEE and Tunisian Ministry of Industry and Technology, personal communications with REN21.

14 Egypt and Morocco from GWEC, *Global Wind Statistics 2012*, op. cit. note 13. Tunisia from RCREEE and Tunisian Ministry of Industry and Technology, personal communications with REN21.

15 Tunisia data for 2012 from RCREEE and Tunisian Ministry of Industry and Technology, personal communications with REN21; Tunisia data for 2008 from GWEC, *Global Wind Report 2009*, op. cit. note 13.

16 Iran data for 2012 from GWEC, *Global Wind Statistics 2012* (Brussels: 2013); Iran data for 2009 from GWEC, *Global Wind Report Annual Market Update 2010* (Brussels: 2011).

17 GWEC, op. cit. note 13; WWEA, op. cit. note 13, all references.

18 Israel data for 2012 from Union for the Mediterranean (UfM), personal communication with REN21; Israel data for 2009, 2010, and 2011 from European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics until 2016* (Brussels: 2012).

19 UAE data for 2011 and 2012 from UAE Ministry of Foreign Affairs, Directorate of Energy and Climate Change, personal communication with REN21.

20 Egypt and Morocco from RCREEE, NREA, and Morocco's Agence Nationale pour le Developpement des Energies Renouvelables et de l'Efficacite Energetique (ADEREE), personal communications with REN21.

21 Bahrain and Libya from RCREEE, Electricity and Water Authority of Bahrain, and Renewable Energy Authority of Libya (REAOL), personal communications with REN21; Saudi Arabia data estimated from Wael Mahdi and Marc Roca, "Saudi Arabia Plans $109 Billion Boost for Solar Power," Bloomberg.com, 11 May 2012, and from Matt Carr, "Photovoltaic opportunities in Saudi Arabia growing," RenewableEnergyWorld.com, 5 February 2013.

22 REN21, *Renewables 2012 Global Status Report* (Paris: 2012).

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LIST OF ABBREVIATIONS

BNEF	Bloomberg New Energy Finance
CHP	combined heat and power
CO_2	carbon dioxide
CPV	concentrating solar photovoltaics
CSP	concentrating solar (thermal) power
EJ	exajoule
EU	European Union (specifically the EU-27)
EV	electric vehicle
FIT	feed-in tariff
GACC	Global Alliance for Clean Cookstoves
GHG	greenhouse gas
GJ	gigajoule
GSR	Renewables Global Status Report
GW/GWh	gigawatt/gigawatt-hour
IRENA	International Renewable Energy Agency
kW/kWh	kilowatt / kilowatt-hour
m^2	square metre
MoFA	Ministry of Foreign Affairs, United Arab Emirates
mtoe	million tonnes of oil equivalent
MW/MWh	megawatt/megawatt-hour
MSW	municipal solid waste
NGO	non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PJ	petajoule
PV	solar photovoltaics
REN21	Renewable Energy Policy Network for the 21st Century
RPS	renewable portfolio standard
SHS	solar home system
SPS	solar pico system
TJ	terajoule
TW/TWh	terawatt/terawatt-hour

POWER CONVERSION FACTORS (ELECTRICAL AND THERMAL)

multiply by:	kW	MW	GW
kW	1	10^{-3}	10^{-6}
MW	10^{3}	1	10^{-3}
GW	10^{6}	10^{3}	1

CONVERSION FACTORS

- **ETHANOL VOLUME:** Ethanol data have been converted from cubic metres (m3) into litres (L) using a conversion ratio of 1,000 L per m^3.
- **BIODIESEL MASS:** Biodiesel data have been converted from litres (L) into kilograms (kg) using a density of 0.88 kg/L.
- **SOLAR THERMAL HEAT SYSTEMS:** Solar thermal heat data have been converted by accepted convention, 1 million m^2 = 0.7 GW_{th}.

MENA 2013

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