CHAPTER 3

Renewable Energy

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The renewable energy (RE) market in the Arab region has evolved rapidly in recent years with a diverse range of countries announcing projects and policies.

Hydro for electricity generation and biomass for cooking and heating are the two dominant RE sources. However, declining cost of modern renewables and increasing costs of fossil fuels foster the promotion of technologies like wind and solar to meet growing energy needs.

With a total of 1 GW of installed capacity, wind is the second largest power source in the region. Egypt is the leader with 550 MW.

Similar to global trends, solar PV has been growing most rapidly in the region, although its share of the total demand is still modest. The United Arab Emirates is the leader in the region in PV electricity generation with 22.5 MW of installed capacity. Egypt, Mauritania, and Morocco follow with about 15 MW each. Algeria, Bahrain, Libya, and Saudi Arabia have around 5 MW of installed capacity.

In 2011, 30 percent of the countries operating CSP plants in the world were located in the Arab region: Algeria, Egypt and Morocco. In 2013, they were joined by the UAE which operates the world's largest CSP plant, Shams 1.

Solar Hot Water Heating accounts for about 4.8 million square meter of collector area, representing 3.3 GWth of installed capacity, most of which is in the net oil importing countries NOIC thanks to successful promotional schemes such as PROSOL and PROMASOL in Tunisia and Morocco.

As of April 2013, 64 projects, totaling almost 6 GW of new renewable capacity were in the pipeline (large hydro excluded) – a 4 fold increase over existing capacity.

As of early 2013, 16 of the 22 Arab countries had enacted at least one RE enabling policy, such as feed-in tariffs, fiscal incentives, and public financing, and 20 now have policy targets, up from 5 in 2007.

New investment in the Arab countries totaled USD 1.9 billion in 2012, a 6 fold increase compared to 2004.

Saudi Arabia, UAE, Egypt, Morocco and Tunisia, in particular, have developed policy frameworks to stimulate local manufacturing and innovation.

The Arab countries RE market is far from having reached its full potential. Today we notice promising signs of development through pipeline projects and increasing political commitments. However, the rising interest and activity in renewables occurs at a time of ongoing regional political uncertainty, raising concerns about the financing of RE. Moreover, several challenges remain to be addressed to decrease reliance on public and soft financing, and foster private investment. If the current efforts are continued, progresses should follow and lead to massive introduction of renewables that will change the energy landscape of the region within the next decades.

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I. INTRODUCTION

The renewable energy (RE) market in the Arab countries[1] is rapidly expanding, with a diverse range of countries announcing projects and policies to harness the region's abundance of RE resources for economic growth and energy security enhancement. While capacity additions and investment remain below those of other regions, recent years have seen a sea-change in government and commercial interest. Significantly, RE is also emerging as a complement to oil and gas reserves for exporting countries. With their strong demographic growth, urbanization, expanding economy, and growing energy intensity, as well as high temperatures and scarce water, the Arab countries are experiencing marked increases in energy and electricity demand. This growth is projected to become even more pronounced over the coming years and puts considerable stress on both domestic fossil fuel imports and export oriented hydrocarbon resources. RE accordingly offers a potentially significant supplement to energy supply, as well as opportunities for economic and social development, industrial diversification, electricity exports, better environmental and carbon footprints, new value-chain activities, a higher value adding use of existing fossil resources, and/or reduced reliance on imports (and exposure to climbing fossil fuel prices).

II. REGIONAL MARKET AND INDUSTRY OVERVIEW

A. Trends in Final Consumption

Total Primary Energy Supply (TPES) reached about 580 Million tons of oil equivalent (Mtoe) in the Arab countries in 2010, a 14.7% increase compared to 2007 (14.7% in the net oil exporting countries (NOEC) and 15.1% in the net oil importing countries (NOIC) respectively), or a 4.7% annual average growth rate over the period. The drivers of increased energy consumption in the region are population growth and increased prosperity, with related increases in demand for liquid and electric fuels, and electricity for domestic use and devices, heating, cooling and desalination of water. RE use increased by almost 20% in the NOIC over the same period of time, and gained market shares over conventional energy sources.

In 2010 the share of renewables in the Total Primary Energy Supply (TPES) of the Arab countries was about 3%. A notable difference existed between NOEC and NOIC. The share of renewables in the TPES of the NOEC was only 2.8%, what was mainly due to Sudan's strong reliance on traditional biomass, whereas this share reached 6.3% in the NOIC. See Table 1.

Biomass for cooking and heating and hydro for electricity generation are the two dominant RE sources in the region. However, not all Arab countries rely on traditional biomass, which has undesirable health and environmental impacts[2] or have access to low cost, baseload hydro power sources. Given declining cost of modern RE technologies and increasing costs of fossil fuels, technologies such as wind and solar have quickly been brought into consideration to meet growing energy needs in the region. Not surprisingly, interest in RE is particularly strong in the NOIC such as Jordan, Morocco, and Lebanon, where price exposure is highest.

The NOEC are more reliant on traditional renewables; hydropower (Iraq and Syria) and biomass (Algeria, Libya, Sudan, and Yemen) to meet their energy needs than the NOIC. Indeed, with the exception of Egypt (wind), growth in modern renewables, essentially wind and solar, is mainly notable in Morocco and Tunisia.

B. Power Sector

As evidenced by the number of projects coming, and their scale (see Table 3), as well as the targets set by most of the countries (see III. Policy Landscape, B. Policy Targets), substantial RE deployment is well underway in the Arab countries for the next two decades. However, for new projects to be successfully implemented and therefore leading to reaching the countries' ambitious goals, transparent, stable and incentivizing policy frameworks are required to reduce uncertainty, and offer mid- to long-term visibility and profitability for investors.

Hydropower is the primary RE source for power generation in the region today. For instance, Egypt has about 2.8 GW of installed capacity and some other countries over 1.5 GW; Iraq, Morocco, and Sudan. Hydro being a mature

TABLE 1 **SHARE OF RENEWABLE ENERGY (RE) IN TOTAL PRIMARY ENERGY SUPPLY (TPES) OF THE ARAB COUNTRIES (2010)**

	TPES (Mtoe)	Renewables (Mtoe)	Share of Renewables in TPES (%)
Algeria	40.4	0.1	0.2
Bahrain	9.8	0.0	0.0
Egypt	73.3	2.8	3.8
Iraq	37.8	0.4	1.2
Kuwait	30.8	0.0	0.0
Libya	21.1	0.2	0.8
Oman	20.0	0.0	0.0
Qatar	47.5	0.0	0.0
Saudi Arabia	149.0	0.0	0.0
Sudan	16.2	11.4	70.7
Syria	23.1	0.2	1.0
United Arab Emirates	61.2	0.0	0.0
Yemen	7.2	0.1	1.5
Total NOEC	**537.4**	**15.2**	**2.8**
Comoros	no data	no data	no data
Djibouti	no data	no data	no data
Jordan	7.2	0.1	1.9
Lebanon	6.4	0.2	3.3
Mauritania	no data	no data	no data
Morocco	16.5	0.8	5.1
Palestine	no data	no data	no data
Somalia	no data	no data	no data
Tunisia	9.5	1.4	14.4
Total NOIC	**39.6**	**2.5**	**6.3**
TOTAL	**577.0**	**17.7**	**3.1**

Source: IEA/OECD (2012). Renewables Information 2012. International Energy Agency, Paris.

technology and its potential relatively limited to exploit in the region, prospects for its further development are not as bright as for other technologies.

Beyond hydropower, wind energy was the most common source of renewable electricity production in the region (Egypt, Morocco, and Tunisia). As of the end of 2012, at least 7 Arab countries had wind power capacity. With 550 Megawatts (MW), Egypt is the leader in the region. It is now followed by Morocco, more than 290 MW, and Tunisia 154 MW, which has experienced strong growth over the last five years with wind power capacity increasing 8-fold from 2008 to 2012.

Although solar energy share remains relatively modest today, it is rapidly growing in the region due to its significant potential. All countries use solar photovoltaic (PV) to meet a part of their electricity demand. The United Arab Emirates is the leader in the region with 22.5 MW of installed capacity. Egypt, Mauritania, and Morocco follow with about 15 MW each. Algeria, Bahrain, Libya, and Saudi Arabia have around 5 MW of installed capacity. It must be noted here that the lack of recent data for solar

TABLE 2 **INSTALLED RENEWABLES CAPACITY DATA IN THE ARAB COUNTRIES**

		Installed Capacity (MW)					
		Solar		Wind	Biomass & Waste*	Geothermal	Hydro
		PV	CSP				
NOEC	Algeria	7***	25*	0*	0**	0**	228*
	Bahrain	5**	0**	0.5**	0**	0**	0**
	Egypt	15*	20*	550*	0**	0**	2,800*
	Iraq	3.5****	0**	0**	0**	0**	1,864*
	Kuwait	1.8***	0**	0**	0**	0**	0**
	Libya	4.8*	0**	0**	0**	0**	0**
	Oman	1***	0**	0**	0**	0**	0**
	Qatar	1***	0*	0*	40*	0*	0*
	Saudi Arabia	~7 (2013)	0**	0**	0**	0**	0**
	Sudan	2***	0**	0**	55.5**	0**	1,590*
	Syria	1***	0**	0**	0**	0**	1,151***
	UAE	22.5*	100 (2013)	0**	3*	0**	0**
	Yemen	1.5*	0**	0**	0**	0**	0**
NOIC	Comoros	0***	0**	0**	0**	0**	1****
	Djibouti	1***	0**	0**	0**	0**	0**
	Jordan	1.6*	0**	1.4*	3.5*	0**	10*
	Lebanon	1*	0**	0.5*	0**	0**	282*
	Mauritania	~15 (2013)	0**	0**	0**	0**	30*****
	Morocco	15*	20*	291*	0**	0**	1,745*
	Palestine	1*	0**	0**	0**	0.023*	0***
	Somalia	0***	0**	5*		0**	
	Tunisia	4*	0*	154*	0**	0**	66*

Source: REN21
*2012 data
**2011 data
***2010 data are rounded to closest MW
****2009
*****2008
Note: 2010 solar PV capacity are Megawatt peak (MWp)

PV, which is notably due to its decentralized characteristic, drives us to an under assessment of its current real development.

Concentrating Solar Power (CSP) will also contribute to the growing share of solar energy in the region. In 2011, 30% of the countries operating CSP plants in the world were in Arab countries, namely: Algeria, Egypt, and Morocco. In 2013, these countries were joined by the United Arab Emirates. The country became a major player in the CSP market when Shams 1, the world's biggest CSP plant with an installed capacity of 100 MW, started operation in March 2013.

While growth of solar technologies is expected to be significant, they will need to overcome environmental challenges; especially water scarcity. Indeed, CSP plants often use water for cooling at the back-end of the thermal cycle and for cleaning dust and sand accumulated on mirrors. Solar panels efficiency is also affected by dust and sand. These requirements may result in

TABLE 3 **PIPELINE PROJECT CAPACITY ESTIMATES BY TECHNOLOGY**

Installed Capacity in the Pipeline (MW) (number of projects)

	Solar	Wind	Biomass & Waste	Geothermal	Small Hydro	TOTAL
Algeria	175 (5)	20 (2)				195 (7)
Bahrain			25 (1)			25 (1)
Egypt	106 (2)	1,070 (5)			32 (1)	1,208 (8)
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)**	**2,080 (17)**	**126 (3)**	**0 (0)**	**32 (1)**	**3,164.8 (37)**
Djibouti				50 (1)		50 (1)
Jordan	400 (4)	360 (4)				760 (8)
Morocco	172.7 (3)	1,553.07 (12)	1.6 (1)			1,727.37 (16)
Tunisia	5 (1)	100 (1)				105 (2)
Total NOIC	**577.7 (8)**	**2,013.07 (17)**	**1.6 (1)**	**50 (1)**	**0 (0)**	**2,642.37 (27)**
TOTAL	**1,504.5 (24)**	**4,093.07 (34)**	**127.6 (4)**	**50 (1)**	**32 (1)**	**5,807.17 (64)**

Source: Bloomberg New Energy Finance BNEF (2013) dataset, Clean Energy Investment Trends.
Notes: These figures only include renewable energy power generation sectors for projects greater than 1MW. 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. The BNEF dataset does not provide data for Comoros, Mauritania, Somalia, and Sudan.

difficulties in arid areas, in particular in countries where water use is essential for agriculture.

Modern biomass and geothermal for power are the least exploited energy sources in the region. Jordan, Qatar, Sudan and the United Arab Emirates are the only countries with installed capacity for biomass. Palestine is currently the only country with geothermal although Algeria, Djibouti, Saudi Arabia, Sudan, and Yemen have plans in the pipelines. Compared to wind and solar, the deployment of these technologies is not currently expected to expand significantly.

Over 60 active RE projects are under-construction or being planned throughout the Arab countries for a total of almost 6 Gigawatts (GW)[3]. The large majority are wind and solar projects: 4.1 GW from wind and almost 1.5 GW from solar. See Table 3.

Projects in the region are dominated by Wind: about 53% of projects and over 70% of renewables capacity in the pipeline, and Solar: 38% of projects and over one-fourth of capacity in the pipeline. Biomass and waste-to-energy projects account for 6% of projects, but only 2% of installed capacity in the pipeline due to the fact that half of them are small scale. There are a few projects in small hydro and geothermal.

Morocco and Egypt noticeably have the greatest projected growth in RE capacity over the coming years, with a mixed wind-solar program in Morocco, and new wind energy capacity installations in Egypt's El-Zeit and Suez areas.

C. Heating and Cooling Sector

Solar Water Heating (SWH) systems play an important role in the region, with about 4.8 million square meters of collector area, representing over 3.3 gigawatt thermal (GWth) of installed capacity, of which most are in the NOIC. It is worth noting that the energy equivalent of SWH installed capacity in the Arab

TABLE 4 **SOLAR WATER HEATING INSTALLED CAPACITY DATA IN THE ARAB COUNTRIES**

		Total Capacity (megawatt thermal MWth)	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	Jordan (2012)	350.0	500,000
	Lebanon (2012)	245.0	350,000
	Morocco (2012)	245.0	350,000
	Palestine (2012)	1,120	1,600,000
	Tunisia (2012)	437.5	625,000

Sources: Regional Center for Renewable Energy and Energy Efficiency RCREEE (2013) except for Syria from OME (2012). Solar Thermal in the Mediterranean Region: Solar Thermal Action Plan. Observatoire Méditerranéen de l'Energie. Observatoire Méditerranéen de l'Energie, Nanterre, France.

countries is already more than double that of all other non-hydro RE. The variation in installed capacity between the Arab countries - especially the differences between the most advanced NOIC such as Palestine and Tunisia, and the others – indicate very substantial scope for further increases in SWH applications.

SWH has been a success story in some of the Arab countries, with some exemplary promotional schemes, in particular the PROSOL program in Tunisia and the PROMASOL program in Morocco, both in place for some years now. Jordan, Egypt, Syria are also good examples of countries that have taken advantage of SWH. With its relatively low user cost, simple technology, and quick pay-back period, SWH is a "low hanging fruit" of solar energy. In addition, much of the SWH equipment is manufactured in the region and installation cost accounting for about half of total capital cost accrue to local businesses and employees. The local value added and employment related to SWH is therefore significant.

D. Overview of Existing Regional Cooperation(s) in the Energy Sector

Interest in RE in the Arab countries has been stimulated by the development of some important regional and regionally-based institutions, including the Masdar project in Abu Dhabi; the International Renewable Energy Agency, 159 member countries intergovernmental organization headquartered in Abu Dhabi; the King Abdullah City for Atomic and Renewable Energy (K.A. CARE) in Saudi Arabia; the Qatar Foundation and Qatar National Food Security Programme (QNFSP), which have programs on RE; and RCREEE (Regional Centre for Renewable Energies and Energy Efficiency) based in Egypt. Finally, there are several active NGOs in the region, most of which are concerned mainly with the environmental aspects of RE.

JORDANIANS SELL SOLAR ELECTRICITY TO THE GRID

Khaled Al Khawaja

A new bill allows citizens, factories and institutions to install affordable solar systems and sell their surplus to the Jordan Electric Power Company (JEPCO), making the generation of solar power a new trend in Jordan

Engineer Basman Smeirat can now sell power for 12 piastres per 1 kilowatt, after he installed 16 solar panels at his two-story house in Al Fuheis city near Amman,. The panels can supply all his electric appliances and air conditioners, and even the solar heater, with electricity.

During sunny days, the mirrors can potentially produce up to 4 kilowatts, enough to supply an average household, with the surplus sold to Jordan Electric Power Company (JEPCO). Smeirat, an engineer, says that JEPCO installed a special device to monitor his household electricity consumption and the amount of electricity the panels provide to JEPCO. The electricity which JEPCO provides is consumed at night and during snowfalls, as the solar system is not fully efficient at these times.

Smeirat clarifies that installing the panels cost JD5600 (1JD equals 1.4 USD), to be paid within 5 years. The system would work for more than 25 years and require nothing more than dusting its panels. He indicates that waiving income and sales taxes off these panels helped encourage his family and relatives to install them. The cost used to exceed 10,000 JD, which means that waiving taxes cut 45 percent off the total cost.

Not only did the new system decrease power consumption costs, it has also become a source of income. In the past, the power bill used to range between 75 and 110 JD per month. It has now decreased to less than 13 JD.

Smeirat is not the only producer and seller of solar power in Jordan. In May 2013, seventy five other citizens and institutions were doing the same, pumping 15,000 kilowatts of solar power to JEPCO, and the number is increasing.

Smeirat could not sell power until Article 6 of the new energy bill (number 13, 2012) was issued. This Article permits anyone to directly submit an offer to the ministry or to whomever the government commissions, to invest in renewable energy. Article 10 also states that "any person, building or small renewable energy plant that generates power from renewable energy systems is authorized to sell power to those licensed to provide power, whether wholesale or retail."

There is a demand from citizens and companies to own this free power. However, tax exempts are valid for just the panels, while control devices, cables and panel holders are still taxable. Total dependency on solar power will not be completely realized unless batteries are installed to store power for nights and cloudy weather. This requires the government to decrease their high prices in order to provide an integrated power system.

Scientific studies have shown that solar radiation on each square meter in Jordan generates as much power as one barrel of oil per year. That means each square kilometer can generate as much power as one million oil barrels annually - and one day of solar radiation in the Ma'an governorate can fulfill the world's power needs for one day.

In Jordan, Philadelphia factory is the only producer of solar panels, but most of its production is exported due to low local demand and higher costs its products compared to Chinese products. Jordan generates around 2600 megawatts of electricity. Official statistics show that its power bill reached 3.6 billion JD in 2011 - 18 percent of Jordan's GDP - and had increased to 4.7 billion JD in 2012. Due to the suspension of Egyptian natural gas exports following a series of bombings targeting the Jordanian pipeline in 2011, the government estimated that additional costs of heavy fuel use in power production would be between 3 and 4 million JD daily.

Studies by Electricity Regulatory Commission (ERC) show that if 40 percent of household subscribers install solar power systems of 2 kilowatts each, their total generated power could reach 1750 megawatt/hour, resulting in saving 176 million JD annually, which is 12 percent of total government subsidies to the sector.

ERC states it is leading a "progressive revolution" to install solar panels. Following state universities and facilities and big factories, the government will start installing them in public buildings. A comprehensive media campaign is being run, urging all parties to benefit from these systems. The government has also allocated 66 million JD for renewable energy projects during 2013.

Khaled Al Khawaja is a Jordanian Journalist. The article was published in Al-Bia Wal-Tanmia, June 2013

TABLE 5 **RENEWABLE ENERGY SUPPORT POLICIES AND TARGETS IN THE ARAB COUNTRIES**

National Level State Level

				Regulatory Policies						Fiscal Incentives				Public Financing	
		RE targets	RE Strategy or Plan	FIT (incl. premium payment)	Electric utility quota obligation/RPS	Net metering	Biofuels obligation/mandate	Heat obligation/mandate	Tradable REC (Renewable Energy Credit)	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	X	X	■											■
	Bahrain	X													
	Egypt	X	X			■				■		■		■	■
	Iraq	X	X												
	Kuwait	X												■	■
	Libya	X										■			
	Oman	X								■			■	■	■
										■			■	■	■
	Qatar	X												■	
	Saudi Arabia	X												■	■
	Sudan	X	X									■			
	Syria	X		■		■					■			■	■
	UAE	X	X		■			■					■	■	■
	Yemen	X	X												■
	Total NOEC	**13**	**6**	**2**	**1**	**2**	**0**	**1**	**0**	**3**	**1**	**3**	**2**	**7**	**8**
NOIC	Comoros														
	Djibouti	X	X												
	Jordan	X	X	■		■	■					■		■	■
	Lebanon	X	X			■						■			
	Mauritania	X													
	Morocco	X	X											■	■
	Palestine	X	X	■		■						■	■		■
	Somalia														
	Tunisia	X	X			■				■		■		■	
	Total NOEC	**7**	**6**	**2**	**0**	**4**	**1**	**0**	**0**	**1**	**0**	**4**	**1**	**3**	**3**
TOTAL		**20**	**12**	**4**	**1**	**6**	**1**	**1**	**0**	**4**	**1**	**7**	**3**	**10**	**11**

Source: REN21

Three closely linked initiatives in the Arab countries are the DESERTEC Industrial Initiative[4], the MEDGRID consortium, and the Mediterranean Solar Plan (MSP). The DESERTEC initiative aims to export solar power from North Africa to Europe. The MEDGRID consortium aims to develop the necessary grid infrastructure (High Voltage, Direct Current) to allow this to happen. The MSP was launched in 2008 in the framework of the Union for the Mediterranean (UfM). It has two main objectives to be achieved by 2020: developing an additional 20 GW of RE production capacities and achieving significant energy savings throughout the region. Recent socio-political events linked to the Arab Spring in some parts of the Arab countries may, however, temporarily slow down the development of these promising schemes.

III. POLICY LANDSCAPE

A. Overview

A growing number of regional decision makers are aware that RE offers opportunities to renew their energy systems in a way that is safe, secure, non-polluting, non exhaustive, and increasingly accessible, while helping to meet the rising energy

TABLE 6 **OVERALL RE SHARE TARGETS IN THE ARAB COUNTRIES**

		RE overall 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
	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	20% electricity generation by 2032
	Sudan	--
	Syria	--
	UAE	Dubai: 5% of electricity by 2030, Abu Dhabi: 7% of electricity generation capacity by 2020
	Yemen	15% of electricity by 2025
NOIC	Comoros	--
	Djibouti	30% of rural electrification from solar PV by 2017 100% renewable energy by 2020
	Jordan	7% of primary energy by 2015; 10% by 2020
	Lebanon	12% of electrical and thermal energy by 2020
	Mauritania	15% of primary energy (excluding biomass) by 2015; 20% by 2020
	Morocco	42% of installed power capacity by 2020
	Palestine	25% of energy from renewables by 2020; 10% (or at least 240 GWh) of electricity generation by 2020
	Somalia	--
	Tunisia	11% of electricity generation by 2016, 25% by 2030; 16% of installed power capacity by 2016, 40% by 2030.

Source: REN21

TABLE 7(1) **RE CAPACITY TARGETS BY TECHNOLOGY IN THE ARAB COUNTRIES**

		Solar		Wind	Biomass, Geothermal, and Hydro
		PV	CSP		
NOEC	**Algeria**				
	by 2013	6 MW	25 MW	10 MW	--
	by 2015	182 MW	325MW	50 MW	--
	by 2020	831 MW	1,500 MW	270 MW	--
	by 2030	2,800 MW	7,200 MW	2,000 MW	--
	Bahrain	--	--	--	--
	Egypt				
	by 2020	220 MW	1,100 MW	7,200 MW	--
	by 2027	700 MW	2,800 MW	--	--
	Iraq				
	by 2016	240 MW	80 MW	80 MW	--
	Kuwait				
	by 2030	3,500 MW	1,100 MW	3,100 MW	--
	Libya				
	by 2015	129 MW	--	260 MW	--
	by 2020	344 MW	125 MW	600 MW	--
	by 2025	844 MW	375 MW	1,000 MW	--
	Oman	--	--	--	--
	Qatar				
	by 2020		640 MW	--	--
	Saudi Arabia				
	by 2022		17,350 MW	6,500 MW Wind/ Waste-to-energy/ Geothermal	
	by 2032	16,000 MW	25,000 MW	9,000 MW	3,000 MW Waste-to-energy, and 1,000 MW Geothermal
	Sudan				
	By 2031	250 MW	50 MW	320 MW	150 MW Biogas, Solid biomass 80 MW, and 54 MW Hydro
	Syria				
	by 2015	45 MW	--	150 MW	--
	by 2020	380 MW	--	1,000 MW	140 MW Biomass
	by 2025	1,100 MW	50 MW	1,500 MW	260 MW Biomass
	by 2030	1,750 MW	--	2,000 MW	400 MW Biomass
	UAE	--	--	--	--
	Yemen				
	by 2025	4 MW	100 MW	400 MW	6 MW Solid biomass, and 200 MW Geothermal

demand of their rapidly growing populations and potentially offering new economic and social development opportunities.

Twenty out of the 22 countries have RE targets, and a smaller number have established RE support policies, such as feed-in tariffs (FIT) or fiscal incentives. Specific rural electrification policies are mainly found in countries with low rural electrification rates. Other policies include direct state or state agency investment with or without external partners, and various kinds of R&D or scoping work. SWH policies have been important in these countries and have led to significant uptake in most cases, as well as the development of domestic manufacturing and supply chain activities in the region. Systems are low cost and pay-back for consumers are typically rapid.

TABLE 7(2) **RE CAPACITY TARGETS BY TECHNOLOGY IN THE ARAB COUNTRIES**

		Solar		Wind	Biomass, Geothermal, and Hydro
		PV	CSP		
NOIC	**Comoros**	--	--	--	--
	Djibouti	--	--	--	--
	Jordan by 2020	300 MW	300 MW	1,200 MW	--
	Lebanon by 2015 by 2020	-- --	-- --	60-100 MW 400-500 MW	15-25 MW Biogas, and 40 MW Hydro --
	Mauritania	--	--	--	--
	Morocco				
	by 2020		2,000 MW	2,000 MW	2,000 MW Hydro
	Palestine by 2020	45 MW	20 MW	44 MW	21 MW Solid biomass
	Somalia	--	--	--	--
	Tunisia by 2016 by 2030	140 MW 1,500 MW	-- 500 MW	430 MW 1,700 MW	40 MW Solid biomass 300 MW Solid biomass

B. Policy Targets

Over three-fourths of the Arab countries have RE share targets, which vary considerably from a country to another, and fifteen of them have targets by technology. See Tables 6 and 7.

Within the NOEC, Algeria, Egypt and Saudi Arabia are notable in having the most ambitious targets.

When overall targets are examined by technology, it clearly appears that wind and solar are seen as the main promising technologies, largely reflecting the quality of the RE resources in the region. In the choice of solar technologies, CSP, despite its higher current cost per unit of energy, is leading over PV. 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 RE, as they are often seen as energy efficiency measures. However, it is clear that a number of countries have increasingly ambitious SWH programmes, which have targets.

EGYPT'S FIRST CSP POWER PLANT IN KUREIMAT

Ibrahim Abdel Gelil

The Solar Atlas of Egypt was issued in 1991, indicating that Egypt, as one of the sun-belt countries, is endowed with high intensity of direct solar radiation ranging between 1970–2600 kWh/m^2/year from North to South. The sunshine duration ranges from 9–11 hours with few cloudy days all over the year.

In February 2008, the Supreme Council of Energy of Egypt, headed by the Prime Minister, approved an ambitious plan to have 20 percent of the total energy generation capacity from renewables by year 2020. As an incentive for the development of renewable energy, the government established a financial mechanism called the Petroleum Fund, where producers of non-fossil fuel electricity receive about 0.33 US cents/kWh. This mechanism accelerates development of renewable energy by sharing with developers the additional export revenues generated from fuel savings derived.

A site at Kureimat, nearly 90km South Cairo, was selected to construct the first Concentrated Solar Power Plant (CSP) in Egypt. The site, which comprises an uninhabited flat desert area, as selected for its high intensity direct solar radiation which reaches 2400 kWh/m^2/year, proximity to the extended unified power grid as well as natural gas pipelines, and proximity to water sources (primarily the Nile River). The project uses parabolic troughs for Integrated Solar Combined Cycle (ISCC) power plant. The trough tracks the sun and focuses solar energy on an absorber pipe located along its focal line to produce the required heat. The entire collector field has to be washed once a week with distilled water. The ISCC project consists of Combined Cycle Island (120 MW) and Solar Island (20 MW) with a total gross power capacity of approximately 140 MW. The project, including equipment,, facilities, interfaces and connections to the Grid, has recently started commercial operation. This resulted in a reduction in carbon dioxide emissions estimated at 20,000 tons per year.

Generally, solar thermal power plants are not yet competitive because of high capital costs and incomplete learning resulting due to the low level of deployment globally. Hence Global Environment Facility (GEF) support through a grant of US$ 49.8 million will help Egypt to cover the incremental cost of the project and bring down the long-term cost of the technology.

The construction of the ISCC Kureimat power plant started in January 2008 and reached commercial operation as a whole in June 2011. The plant is owned by the New and Renewable Energy Authority (NREA) of the Ministry of Electricity and Energy in Egypt. The total installed cost of the plant was about $290 million based on bids awarded and financed by the World Bank, GEF, and Japan Bank for International Cooperation (JBIC).

During construction, most labor force was hired locally and both the Combined Cycle Island as well as the Solar Island contributed to job creation. Road works and modifications of the main access roads, earthwork of leveling the site to erect the steel structures, civil engineering, erection of the solar collectors and excavation works of the electrical building in the Solar Island, were all performed with local manpower. In operation, the plant employs 220 local full time staff, including highly skilled engineers as well as unskilled laborers.

The project was designed to integrate conventional combined cycle gas turbines and solar thermal technology, with the strategic view of contributing towards introducing renewable energy in developing countries. It also aims at demonstrating how de-carbonizing the power sector could be facilitated by the large-scale development of new energy production technologies. It sets a precedent in introducing CSP technology in developing countries through the ISCC configuration, including making a substantial financial contribution to this project. The significant contribution made by the Government demonstrates its ownership of this Project[1]. The ISCC plant brings useful lessons in the introduction of CSP technology through hybridization in developing countries by bringing down overall costs to 6-7 US cents/kWh.

Dr. Ibrahim Abdel Gelil, Professor of Sheikh Zayed Chair for Energy and Environment at Arabian Gulf University (AGU) in Bahrain, was CEO of the Egyptian Environmental Affairs Agency (EEAA) and Chairman of the Egyptian Organization for Energy Planning (OEP).

1. World Bank. 2004. Egypt - Solar Thermal Project (GEF). Washington D.C. - The Worldbank. http://documents.worldbank.org/curated/en/2004/02/3521140/egypt-solar-thermal-project-gef

TABLE 8 **SOLAR WATER HEATING TARGETS IN THE ARAB COUNTRIES**

NOEC	**Algeria**	
	by 2015	70,000 m² of collector area
	by 2020	490,000 m² of collector area
	Libya	
	by 2015	80 MW of installed capacity
	by 2020	250 MW of installed capacity
	by 2025	450 MW of installed capacity
	Syria	Installation of 100,000 m² 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 GWth of generation per year
NOIC	**Jordan**	
	by 2015	25% of households equipped (from 14% in 2011)
	by 2020	30% of households equipped
	Lebanon	
	by 2020	1,050,000 m² of collector area
	Morocco	
	by 2020	1,700,000 m² of collector area
	Tunisia	
	by 2016	1,000,000 m² of collector area

Source: REN21

C. R&D Programmes

Throughout the region, R&D programmes for renewable energy begin to emerge. The section below describes the most relevant approaches in the region:

i. Saudi Arabia

Saudi Arabia will tax 1% of renewable energy projects to finance the Solar Energy Research Fund for local renewable energy research and development projects.

ii. United Arab Emirates

- Abu Dhabi has fostered R&D through the Masdar Institute, which has already produced the region's first-ever patents in clean tech, some with start-up company potential. The Masdar Institute of Science and Technology, in collaboration with IRENA and other partners, commissioned the UAE Solar Atlas.

- The northern Emirate of Ras Al-Khaimah has established a clean-tech campus with Switzerland's respected École Polytechnique Fédérale de Lausanne and a related clean-tech research and demonstration centre run by the Swiss outfit CSEM.

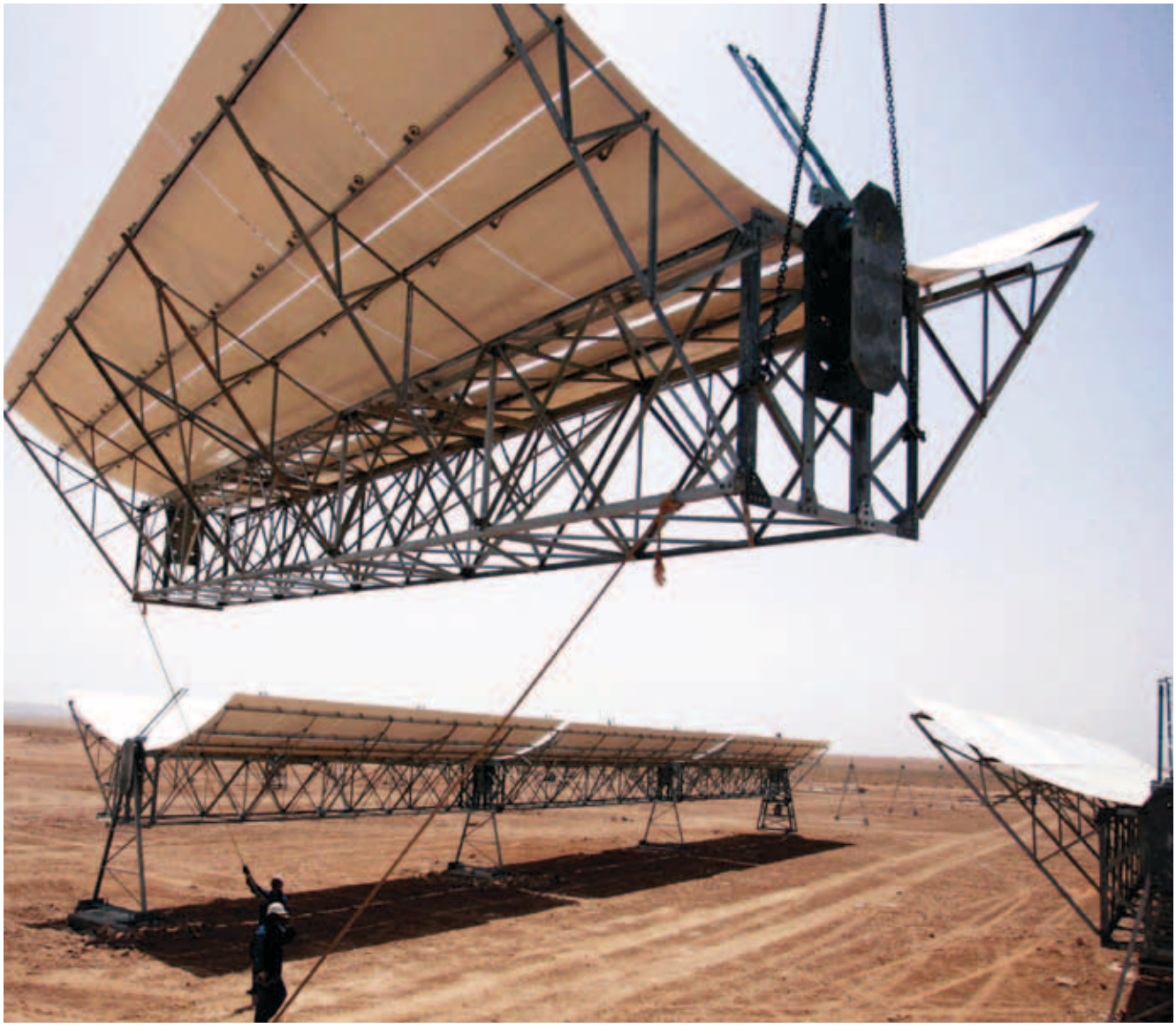
iii. Morocco

Morocco has established several educational, training, and research institutions to create local expertise including:

- 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;
- 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.

iv. Egypt

In Egypt the New and Renewable Energy Authority (NREA) is responsible for technical



evaluation, testing, R&D, and certification of wind turbines, and also aims to undertake training in operation and maintenance.

IV. ARTICLE 9 OF THE EU RENEWABLE ENERGY DIRECTIVE

The Directive of the European Parliament and of the Council (2009/28/EC) on the promotion of the use of energy from renewable sources indicates that one or more EU Member States may cooperate with one or more third countries on all types of joint projects regarding the production of electricity from renewable energy sources. Such cooperation may involve private operators.

Electricity from renewable energy sources produced in a third country shall be taken into account only for the purposes of measuring compliance with the requirements of this Directive concerning national overall targets if the following conditions are met:

a. the electricity is consumed in the Community,

b. the electricity is produced by a newly constructed installation that became operational after 25 June 2009 or by the increased capacity of an installation that was refurbished after that date, under a joint project and

c. the amount of electricity produced and

TABLE 9 **ELECTRIFICATION RATES AND RURAL ELECTRIFICATION, ARAB 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
	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
	Sudan	30.0	35.9	28.1
	Syria	90.0	92.7	83.5
	UAE	91.9	100.0	100.0
	Yemen	36.2	39.6	23.1
NOIC	Comoros	-	46.0 (a)	-
	Djibouti	-	50.0 (b)	-
	Jordan	99.9	99.4	98.7
	Lebanon	99.9	99.9	99.2
	Mauritania	-	-	-
	Morocco	85.1	98.9	97.4
	Palestine	-	-	-
	Somalia	-	-	-
	Tunisia	98.9	99.5	98.5

(a): Electricity access rate for Comoros is for 2009 and from IRENA (2011). Renewable Energy Country Profiles Africa. International Renewable Energy Agency, Abu Dhabi.
(b): Electricity access rate for Djibouti is from World Bank (2009). Least Cost Electricity Master Plan, Djibouti (Volume 1 of 2: Main Report).
Sources: IEA/OECD (2006). World Energy Outlook 2006. International Energy Agency, Paris. And IEA/OECD (2012). World Energy Outlook 2012 (Electricity Access Database, Tables 2 and 5). International Energy Agency, Paris.

exported has not received support from a support scheme of a third country other than investment aid granted to the installation.

This provision will potentially have an impact on the development of dispatchable renewable electricity in the MENA countries in the coming years. However, a series of regulatory barriers on both sides of the Mediterranean still need to be overcome.

V. INVESTMENT FLOWS

According to Bloomberg New Energy Finance (2013), new investment in renewables in the Arab countries totaled 1.9 billion USD in 2012, an increase of 56% over 2011 and a 6-fold increase compared to 2004.

RE investments currently show the fastest rate of growth in the energy sector. However, investments in conventional energy will remain very important for the foreseeable future in the Arab countries.

Much of the investment in RE in the region is undertaken by the state or state-owned power companies, sometimes with donor support, especially in the Mediterranean countries. There are, however, also notable cases of joint ventures and some private activity, mainly for public clients and self-production, some of it on a very

large scale. For example, Terra Nex Financial Engineering AG (a wealth management company based in Switzerland) is involved in a large PV project in Oman (400 MW); Italgen SpA (an Italian based producer and distributer of electricity established by Italcementi, one of the largest cement manufacturers in the world) is in a 400 MW wind project in Egypt; France's hydrocarbon supermajor Total and Spain's Abengoa have 20% stakes in the recently commissioned 100 MW Shams 1 CSP project in the UAE. In Morocco, a consortium of Spanish companies, ACWAPower International (a Saudia Arabian company) and the Moroccan Agency for Solar Electricity (MASEN) are advancing a large solar-thermal project (160 MW). The Mediterranean Solar Plan (MSP) and the Desertec Foundation (a German-based foundation supported by 12 major German engineering, finance and utilities companies with RE interests, as well as the German Government[5]) are promoting the idea of significant future exports of surplus electrical energy to the European Union.

The MSP has galvanized support for RE from both sides of the Mediterranean. Since June 2008, over € 5 billion have been made available through the Neighborhood Investment Facility (NIF) for 12 projects in the region. In addition to this, the European Commission provides financial support to the European Investment Bank's Facility for Euro-Mediterranean Investment and Partnership (FEMIP).

VI. OFF-GRID RENEWABLE ENERGY

Most of the Arab countries have high rates of electrical access – 99% or more in 10 of the 19 countries for which data are available. See Table 9. However, only 5 countries have electricity access rates of at least 99% in rural areas, and 6 countries have less than 90% access in rural areas. The most

LOCAL MANUFACTURING AND VALUE CHAINS IN RE

Local content requirements for RE projects are increasingly discussed in the Arab countries. The reason is that employment creation, especially for youth, is one of the drivers of RE in the region. However, policy makers recognize the highly capital intensive nature of most RE, especially solar PV, CSP and Wind which are seen as the main RE technologies for the future in the region. As a result, there is a considerable interest in developing the supply chain and related innovations in RE technologies. This interest is particularly strong in the UAE, Saudi Arabia, Egypt, Tunisia and Morocco.

For instance, in the UAE 66 local companies participated in the construction of Shams 1 CSP plant. In February 2013, Saudi Arabia released a White Paper detailing the proposed competitive procurement process of its K.A.CARE program. 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 percent or higher, depending on the item or service introductory call, to 60 percent or higher in the first round, and 70 percent thereafter. In 2011, Egypt started to operate its first CSP plant in Kuraymat; about 40 percent of the value of the solar field was generated locally. In Tunisia, 80 percent of SWH systems sold are not imported, what can be notably explained by the government's decision to mandate a quality labelling system called "Qualisol" for installers who want to operate under the PROSOL scheme. In Morocco, the recent tender for a 160 MW CSP plant near Ouarzazate was awarded to ACWA Power, which plans to build the plant with almost 42 percent local content.

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.

serious problems of electricity access in rural areas are in Sudan (28%) and Yemen (23%), Comoros and Djibouti.

Off-grid RE is a logical and frequently used solution for remote and rural areas, where providing grid access would be very costly, financial resources are scarce, and there are attractive RE resources.

The success of SWH in several countries with notable financial support models such as PROMASOL in Morocco and PROSOL in Tunisia, can be noted as a kind of off-grid solution since it typically concerns domestic, and sometimes office building, heat rather than electrical power. Donor agencies are also active in this field.

Because viable RE resources are typically located in rural regions, decentralized solutions, especially for serving small communities, are often to preferred on both economic and environmental grounds. Under the right conditions, the RE resources can also be used as a rural economic and social development tool through community ownership and management of energy production and related distribution and maintenance. However, this requires a very deliberate policy design, which thus far has not been given notable consideration in the Arab countries and worldwide.

VII. CONCLUSION

The Arab countries RE market is far from having reached its full potential. Today we notice promising signs of development through pipeline projects and increasing political commitments, which are the first steps towards a sustainable energy future. If the current efforts are continued, investments and progresses should follow and lead to massive introduction of renewables that will change the energy landscape of the region within the next decades.

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NOTES

1. For the sake of comparison, the 22 Arab countries were clustered into two sub-groups, namely:
Net Oil Exporting Countries (NOEC):
Algeria, Bahrain, Egypt, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Sudan, Syria, United Arab Emirates, Yemen, and
Net Oil Importing Countries (NOIC):
Comoros, Djibouti, Jordan, Lebanon, Mauritania, Morocco, Palestine, Somalia, Tunisia.

2. The United Nations Sustainable Energy for All Initiative has identified replacement of traditional biomass with modern RE services as an international priority.

3. The following figures are provided by Bloomberg New Energy Finance (BNEF). Pipelines projects include projects announced or which planning has 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.

4. Desertec promotes the idea of generating sustainable power from the sites where renewable sources of energy are most abundant, like this is the case, with solar particularly, in the MENA region. According to calculations clean power from the deserts could supply around two-thirds of the MENA region's rising energy demand, while still leaving enough electricity for export, meeting 15% of European consumption. This vision of exporting the benefit of Desertec is sensitive and faces some hostility from local populations.

5. http://www.desertec.org/global-mission/milestones/. In 2009, the Desertec Foundation established the industrial initiative Dii GmbH together with partners from the industrial and finance sectors. Its task is to accelerate the implementation of the Desertec Concept in the EU-Middle East and North Africa region. As a shareholder, the Desertec Foundation closely cooperates with Dii GmbH and its additional shareholders and partners.

THE FUTURE OF ENERGY IN SAUDI ARABIA

Khalid Al Sulaiman

Saudi Arabia's sustainable energy vision, strategy, and execution roadmap together form potentially the cornerstone for energy sustainability in the region, and beyond.

Creating a better future for children and grandchildren, in Saudi Arabia and, indeed, everywhere else in the world, mandates that a workable energy future for all is created; an energy future that has several distinct characteristics. First, it has to be a collective effort. Second, it must be widely accessible. Third, it has to be affordable; and fourth, it must be sustainable.

These unique future energy attributes are exactly what characterizes Saudi Arabia's Vision for the future energy ecosystem that culminated in the creation of King Abdullah City for Atomic and Renewable Energy (K.A.CARE).

1. Collective Effort

From the beginning, an energy future for Saudi Arabia was formulated that is both interlinked and dynamically responsive to the regional as well as the global energy ecosystems, starting with the GCC region, the MENA region, and then the EUMENA region. The value proposition is one of collective effort, and is built upon an economically viable solution for all. Working together is in the best interest of the Saudi energy future, as well as that of the entire world.

The key challenge that the Saudi electricity sector faces is that during the offseason, in winter and parts of the spring and fall, 45% of the installed generation capacity remains idle. This is because cooling constitutes the largest single component of electricity demand, amounting to more than 50% during peak season, and significantly decreases during the offseason. That means that by 2030, when the peak demand will reach 100 Gigawatts (GWs), a whopping 45 GWs of installed capacity, at least, will remain idle.

One approach to tackling this issue is to deploy technologies that peak during the peak season and reduce their output during the off season. Solar energy has this very characteristic, and is an excellent candidate to mitigate part of this challenge. Yet, it cannot do it on its own.

Therefore, we have explored the potential of exporting electricity from the dormant capacity during our offseason to countries with peak demand was explored. Studies showed that grid investments required to wheel electricity generated in Saudi Arabia to the European Union does not exceed 18% of the total investment required to install the generating capacity.

If such a strong interconnection is realized, the overall economic benefits are stark and compelling. If we collectively reduce the need to install generation capacity by, 10-20% with the ability to trade energy collectively, the savings are tremendous.

Energy trading is only one facet of energy cooperation, but is a very important one.

This is the vision of the DESERTEC project that aims to produce renewable energy out of the Arabian deserts, delivering to the local market, and exporting the surplus to Europe. And we, In Saudi Arabia, we are capable of supporting this vision and putting it into practice as part of a collaborative effort.

2. Making it Affordable, Accessible, and Sustainable

Accessible: Practically speaking, there is no location on earth that has no supply of renewable energy; it is only a matter of properly and economically harvesting, transmitting and connecting it.

This is a fundamental premise of profound implications: Energy, in some form or another, is abundantly available in its raw nature, be it sun rays or wind gusts or ocean currents.

Affordable: Sunshine is basically cost-free. Yet, if a country does not develop its own solar energy harvesting systems, or a significant part thereof, that country would essentially be importing solar energy.

It is fortunate that it is not too difficult to make energy harvesting systems affordable for all. This is primarily because a large part of the solar harvesting systems' cost is consumed in the service component of the value chain, including design, engineering, procurement, construction, assembly, operation and maintenance.

For Saudi Arabia, our analysis showed us that we can

localize more than 85% of the overall value chain of renewable energy capacity deployed in Saudi Arabia over the next 20 years.

Sustainable: It is natural to think of sustainability as synonymous to the basic concepts of environmental stewardship, human development, and economic viability Sustainability, however, can be even more than that. If the development of the national value chain is done properly, sustainability here means the "security of energy supply". It also means efficiency and conservation, and could be an enabler of other sectors' development.
For example, renewable energy can play a very important role in making water desalination sustainable for countries with no fresh water sources.

For Saudi Arabia, as for many other nations, renewable energy, on utility scale, is a new strategic sector. The opportunity presents itself to maximize and smartly optimize economic development.

One glaring conclusion is clear: no single energy solution fits all situations. However, it is not uncommon to hear strong advocacy of one particular generation technology vis à vis others. This advocacy may very well be good-intentioned.

3. Energy from the Desert

The proposed "2050 Desert Power" document reports the forecasted cost of electricity for the EUMENA region. However, the technology solutions proposed grouped solar and wind generation technologies together.

This merits a revisit. Since wind technology is practically mature, huge cost reductions in CAPEX is not much expected over the next 30 years. If we add to that the fact that high potential wind sources locations are limited, this will surely mean that once the best suitable locations for wind harvesting have utilized, the cost of generating electricity from wind will increase, as is actually shown in the report.

This is not the case for solar energy. The solar resource quality in the solar belt spanning all of the MENA region is rather uniform, and it is among the best in the world. Coupled with this favorable resource condition is the fact that CAPEX of both photovoltaics (PV) and concentrated solar power (CSP) is decreasing rapidly, which means that the more Terawatt-hours one generates from solar energy, the less the cost of electricity would be.

This is in no way a vote of no confidence in wind. On the contrary, we believe that wind technology, especially in our part of the world, lends itself most favorably for coupling with water desalination requirements. The demand on desalinated water is volume-dependent and not time-dependent. And the desalination process boasts of inherent storage feature thereby allowing for wind energy harvesting to take place whenever wind blows across the blades, with hardly any need for active load management or additional storage, that otherwise would have been required for grid stability if wind was to be used for the conventional utility application.

4. Nuclear and Renewable Energy

K.A.CARE was tasked by the Saudi government to introduce renewable and nuclear energy, sustainably, to the Saudi energy landscape, in partnership with other key stakeholders in Saudi Arabia, and beyond.

It is estimated that Peak demand in Saudi Arabia will exceed 120 GWs in 20 years.
However, factoring in the need for respectable operating reserves may keep the required installed generation capacity greater than 120 GWs by 2032.

As mentioned earlier, the key challenges that the Saudi electricity sector faces are the 45% idle installed generation capacity during the off season, and that cooling constitutes 50% of electricity demand during peak season.

Given all those realities and the need for sustainable and economically viable solutions, the comprehensive proposed solution for Saudi Arabia calls for producing 50% of the total energy generated in Saudi Arabia by 2032, from non fossil sources, namely nuclear and renewable energy, thereby reducing total hydrocarbon consumption in the power and desalination sectors by 50% in 20 years.

The total generation capacity that this scenario calls for is to connect to the grid in 20 years 54 GWs of renewable capacity, composed of 41 GWs solar, 9 GWs wind, 3 GWs waste-to-energy, and 1 GW geothermal.

HE Dr. Khalid Al Sulaiman is Vice President for Renewable Energy, King Abdullah City for Atomic and Renewable Energy (K.A.CARE). The text, published in Arabic in Al-Bia Wal-Tanmia in January 2013, was based on a statement by Dr. Al Sulaiman at 2012 DESERTEC conference in Berlin.