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Sustainable Energy in the Middle East

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Abstract

The main purpose of this paper is to illustrate and show the differences and capabilities if renewable energy sources in the Middle East region and how using renewable energy will affect the future of the community.

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Keywords

Renewable energy

1. Introduction

Sustainable energy system is the future energy and the core of the future town’s energy source, its free and environmental friendly and permanent sources. And according to the increasing needs in the Middle East for large population , the price of energy , the lack of resources in remote areas and the need to improve the living conditions, so what sustainable energy system offer for this problems?

2. Overview of wind energy resources

The Middle East region renewable energy potential is high, particularly for wind and solar projects. Most Arab countries are part of the SunBelt1, and benefit from solar insolation levels that are among the highest in the world (as high as 6.5 kWh/m² per day). This shows that despite favorable natural conditions for renewable energy development, there is much room for progress in utilizing these resources.

Renewable power: Installed capacity in Arab countries (2015)

	Wind	PV	CSP	Hydro	Other	Renewables excluding hydro (2015)		Total Renewables including hydro (2015)	
	[MW]	[MW]	[MW]	[MW]	[MW]	[MW]	[%]	[MW]	[%]
Algeria	10	270	25	228	-	305	2.2	533	4.1
Bahrain	0.5	10	-	-	-	10.5	0.27	10.5	0.27
Egypt	245	90	20	1,874	-	855	2.63	3,729	11.48
Iraq	-	35	-	2,519	-	35	0.01	2,545	9.83
Jordan	197	16	-	11	3.5 ¹	215.5	4.39	227.5	4.66
Kuwait	-	18	-	-	-	18	0.01	18	0.01
Lebanon	-	20	-	280	-	20	0.74	300	11.07
Libya	-	5	-	-	-	5	0.05	5	0.05
Mauritania	34.4	18	-	80	-	52.4	12.38	82.4	19.46
Morocco	790.5	15	183	1,770	-	988.5	12.05	2,758.5	33.63
Oman	-	-	7	-	-	7	0.08	7	0.08
State of Palestine	0.7	4	-	-	0.2 ¹	4.7	3.38	4.9	3.38
Qatar	-	12	-	40 ¹	-	12	0.4	35.6	0.4
Saudi Arabia	-	23.2	-	-	-	23.2	0.05	23.2	0.05
Sudan	-	12	-	1,593	-	12	0.38	1,605	50.89
Tunisia	245	20	-	66	-	265	5.82	331	7.37
UAE	0	33	100	-	1 ¹	133	0.46	135	0.46
Yemen	-	5	-	-	-	5	0.2	5	0.2
Arab region	2,023	544.7	135	11,090	44.7	2,647.5	1.27	13,443	4.1

¹ Geothermal ² Waste to energy
This table is limited to known data in the Arab region and is not exhaustive.
Source: Arab Union of Electricity (AUE), RENAISSANCE LASFORREZ (2016)

Figure 1.

3. Wind and Solar Atlases in the Arab Region

The Arab region’s renewable energy potential is high, particularly for wind and solar projects. Most Arab countries are part of the SunBelt1, and benefit from solar insolation levels that are among the highest in the world (as high as 6.5 kWh/m² per day). This shows that despite favorable natural conditions for renewable energy development, there is much room for progress in utilizing these resources.

Wind and solar atlas coverage in Arab countries

	Solar Atlas	Wind Atlas
Algeria	Yes	Yes
Bahrain	Resource assessment completed in 2012	Resource assessment completed in 2012
Egypt	Yes	Yes
Iraq	No	Measurement ongoing
Jordan	Yes	Yes
Kuwait	Yes	Yes
Lebanon	No	Yes
Libya	Preliminary data, 2004-2010	Preliminary data, 2006-2007
Mauritania	No	No
Morocco	Yes	Yes
Oman	No	Yes
Qatar	Resource mapping ongoing	Resource mapping ongoing
Saudi Arabia	Yes	Yes
State Of Palestine	Yes	Yes
Sudan	Yes	Yes
Syrian Arab Republic	Unverified	Unverified
Tunisia	No	Yes
United Arab Emirates	Yes	Yes
Yemen	Unverified	No

Latest information available; Atlas status in each country as reported by relevant authorities or institutes
¹ A geographical region consisting of countries that are situated between 35°N and 35°S and generally characterised by high solar irradiation (Hauff, J. et al (2010), Unlocking the Sunbelt Potential of Photovoltaics, Second Edition, A.T. Kearney, European Photovoltaic Industry Association, Alliance for Rural Electrification).

Figure 2.

4. Renewable Energy targets

Most of Middle East countries have set targets as part of their national renewable energy plans or sustainable energy strategies, be these medium-term (2020s) or long-term (2030s) targets. Such targets demonstrate a political commitment to the transition towards renewables. Many targets can be seen as relatively ambitious, considering the high and ongoing reliance on fossil fuels in most of the region. In many Middle East countries, especially those with a degree of experience in installing and operating utility-scale projects, the targets have been scaled up to correspond to domestic needs and circumstances.

Renewable energy targets in the Arab region

	Renewable Energy Targets							Target Date
	Wind	PV	CSP	Biomass	Geothermal	Total		
	MW	MW	MW	MW	MW	MW	%	
Algeria	1,010	3,000	-	360	5	4,375	15	2020
Bahrain	5,010	13,575	2,000	1,000	15	21,600	37 ¹ /27 ²	2030
Djibouti	-	-	-	-	-	250	5 ³	2030
Egypt	300	200	-	-	500	1,000	100 ⁴	2025
Iraq	7,200	2,300 +	-	-	-	9,500	20 ⁵	2022
Jordan	-	300	-	-	-	300	1 ⁶	2020
Kuwait	800	800	100	50	-	1,750	10 ⁴	2020
Lebanon	700	4,600	5,700	-	-	11,000	15 ²	2030
Libya	400	150-100	-	-	-	950-900 ³	12 ²	2020
Morocco	600	344	125	-	-	1,069	7 ²	2020
Mauritania	1,000	844	375	-	-	2,219	10 ²	2025
Morocco	30	30	-	-	-	60	20 ²	2020
Qatar	2,000	2,000	-	-	-	6,000 ⁸	42 ¹	2020
Saudi Arabia	4,200	4,560	-	-	-	10,090	52 ¹	2030
State of Palestine	44	45	20	21	-	130	10 ²	2020
Saudi Arabia	-	-	-	-	-	1,800	20 ¹	2030
Saudi Arabia	9,000	16,000	25,000	3,000 ⁷	1,000	54,000	30 ¹	2040
Sudan	680	667	50	68	54	1,582 ⁸	11 ¹	2020
Syrian Arab Republic	1,000	1,000	100	-	-	2,100	20 ²	2030
Tunisia	1,000	2,000	1,300	250	-	4,550	30	2030
UAE	1,755	1,510	460	-	-	3,725	30 ¹	2030
UAE	-	-	-	-	-	-	7 ³	2020
UAE	-	5,000	-	-	-	5,000	25 ²	2030
Yemen	400	8.25	100	6	200	714.25	15 ¹	2025

¹ Including hydro ² Electricity generation ³ Installed capacity ⁴ Primary energy ⁵ Including 400 MW hydro ⁶ Including 2,000 MW hydro ⁷ Waste to energy ⁸ Including additional 63 MW hydro
 Sources: IRENA (2016b); IAS/RCREEE (2016b)

Figure 3.

4.1. Sustainable energy solutions

The Sustainable energy Systems offers the perfect solution for most of the Middle East problems and needs by offering free energy sources wind and sun energy, creating new futuristic energy stations to absorb the free energy and produce renewable power to be used as fuel for transportation, sustenance requirements and also industry.

4.2. Sustainable Energy Consumption

The use of the sustainable energy in the Middle East until 2015 is bet. 0.1% to 20% of the Renewable energy Capacity and with the minimum Technologies and according to the topographic location and climate condition. In Other hand if we took a look at the maps and decided to reevaluate our resources according to the latest condition, to improve the Geographical extension of capital cities.

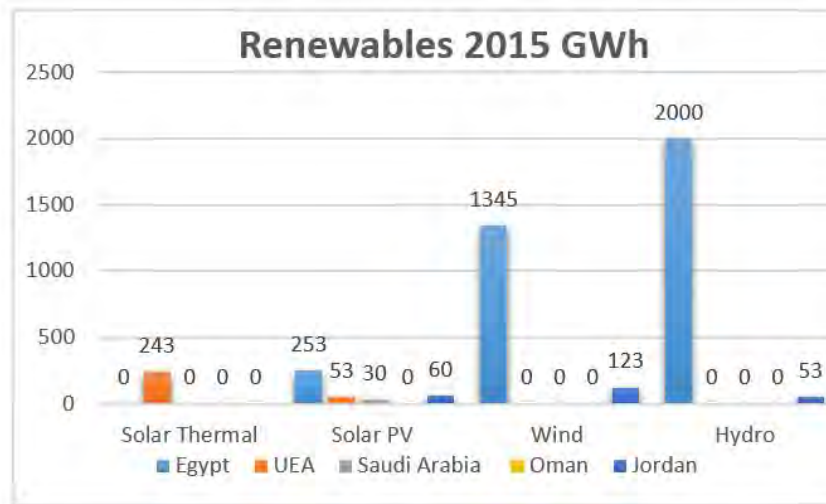


Figure 4.

4.3. Middle East Solar Resources

According to the latest solar maps and measurements illustrated in the following map shows us the amount of solar power produced per 1sqm/y in the Middle East zone.

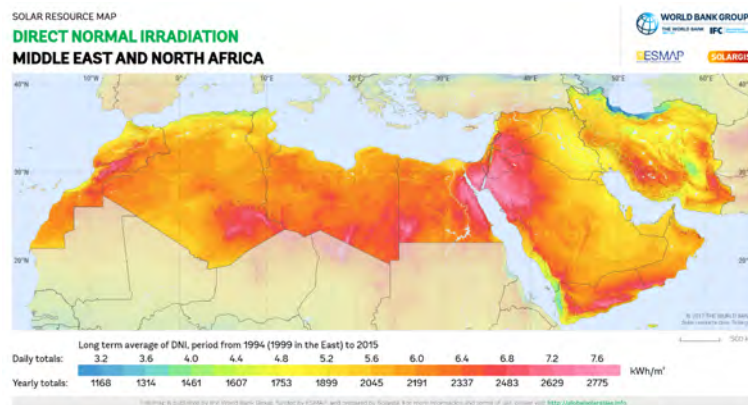


Figure 5.

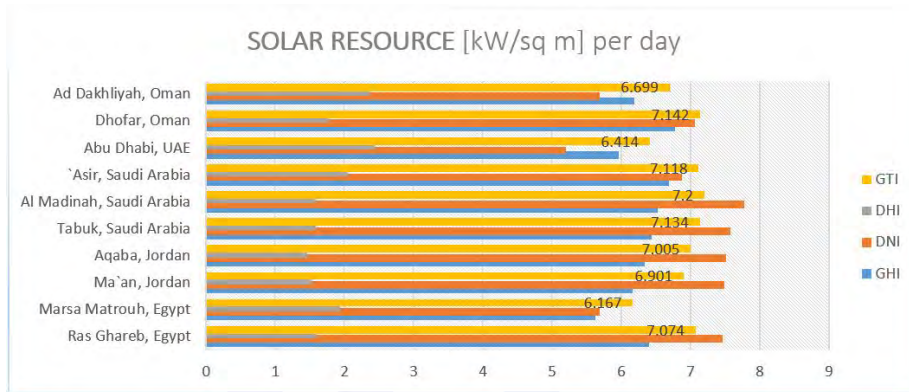


Figure 6.

4.4. Middle East wind Resources

Wind atlas in the Middle East shown that Wind vitiate between 5m/s to 10m/s

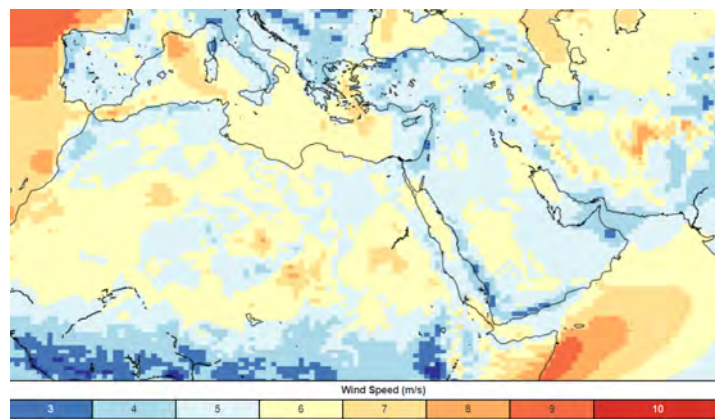


Figure 7.

4.5. Wind Power

Conclusions should state concisely the most important propositions of the paper as well as the author's views of the practical implications of the results.

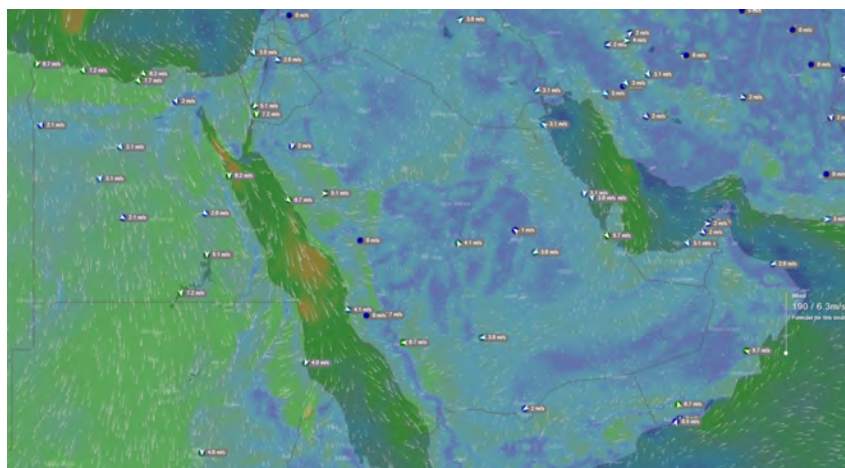


Figure 8.

4.6. Energy assessment

Power of the wind could be calculated by the following equation $P_{WT} = \frac{\rho}{2}AV^3$

Wind power P_{WT} calculated by ρ the density of the medium, A the reference area, V^3 the wind speed, so if the wind speed increased by one unit the total generated power will increase 8 times.

4.7. Energy production

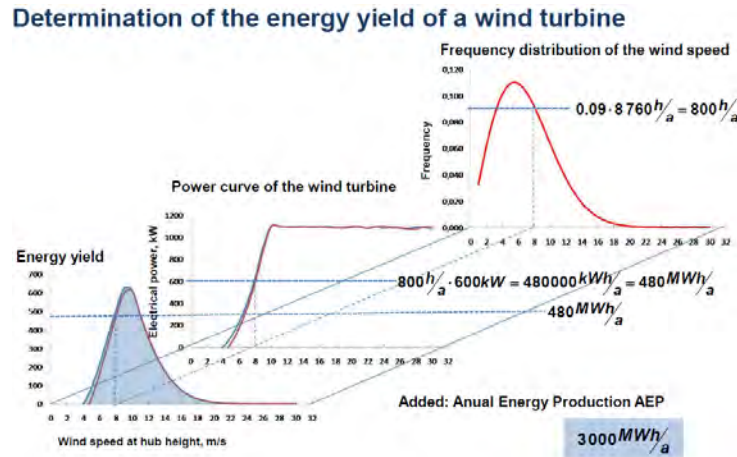


Figure 9.

As Shown we could use the wind power at each speed if we used the right wind turbine.

4.8. Conclusion

The renewable energy is rich in the Middle East region solar and wind energy could support and offer a lot of work opportunities .

5. References

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