Juniper Online
Journal Material Science
ISSN: 2575-856X

Research Article
Volume 6 Issue 2- August 2020
DOI: 10.19080/JOJMS.2020.06.555688

JOJ Material Sci

The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries

Nashwa Shiqwarah*

Architect- Lecturer, Ajman University, UAE

Submitted: August 06, 2020; **Published:** August 26, 2020

***Corresponding author:** Nashwa Shiqwarah, Architect- Lecturer, Ajman University, UAE

Abstract

Most of today's power generation is achieved by consuming stored fossil fuel or nuclear energy non-renewable sources that can provide electricity. Consuming those stored energy reserves of the Glob resulted in quick depletion and their remains contaminate the planet. However, the renewable energy (RE) supply comes with a variety of benefits beyond the satisfaction of energy needs. It has a long-term cost advantage. Although the investment in RETs is still high as compared to the conventional fossil fuels usage, but according to the latest statistics it will be competitive even before 2025. Therefore, a renewable energy partnership shall be established between countries having good RE resources and countries with high electric energy consumption Europe, Middle East and North Africa. This paper aims to describe the scenario of the partnership between Europe, Middle East and North Africa (EUMENA) and experience their roles. This research shed the light on the main factors affecting electricity and water consumption, available resources & technology options, the advantages and obstacles facing MENA countries.

Keywords: Renewable energy; EUMENA; MENA countries; Fossil fuel; Electricity; High electric energy; Sea desalination

Introduction

World background

Today's power generation is achieved by consuming stored fossil fuel or nuclear energy non-renewable sources that can provide electricity. Consuming those stored energy reserves of the Glob resulted in quick depleted and their remains contaminate the planet. The total Global spending on Oil and Gas imports is forecast to more than doubles from USD 1.2 trillion in 2010 to USD 206 trillion in 2035. Those primary Global energy demands will increase 36 percent between 2008 and 2035. That is why, most of the world's economies are currently facing changing and conflicting energy needs which is threaten the economic growth. However, the renewable energy (RE) supply comes with a variety of benefits beyond the satisfaction of energy needs. It has a long-term cost advantage. Although the investment in RETs is still high as compared to the conventional fossil fuels usage, but according to the latest statistics it will be competitive even before 2020. The earth receives an incredible supply of Renewable energy (solar power)-the sun provides enough energy in one minute to supply the worlds energy needs for a full year. In one day, it provides more energy than current population would consumes in 27 years [1-3].

Focusing on Europe (EU), it consumes about 2450 Ton Watt Hourly (TWH) of electricity per year and will increase and stabilize at 4000TWH per year. Water resources are nearly completely used for electricity production. Large sites with wind energy of high potential are available but affected highly by the northern European weather [4].

Recent MENA situation

On one hand, the analysis shows that 2050 electricity consumption in the Middle East and North Africa is likely to be around 3000TWH per year, which is comparable with what is consumed in Europe today. There will be an increasing demand for sea desalination. On the other hand, with the great potential for solar and wind energy in MENA regions, the huge deserts will offer enormous solar power sources. The area receives in six hours as much energy from the sun as humankind consumes in one year. Those resources will allow the local MENA countries to generate renewable energy and by this supply their growing energy demand which makes economic sense to utilize in country and export the balance to Europe. It will supply enough electric energy and offers the option of desalination of seawater-from their waste heat-at a reasonable price. This would contribute to cover the increasing water demand too in MENA [2,4,5].

This paper aims to describe the scenario of the partnership between Europe, Middle East and North Africa (EUMENA)

and experience their roles in section 2. Explaining the main factors affecting electricity and water consumption in section 3. Mentioning the available resources and technology options in section 4. Focusing on Concentrating Solar Power (CSP) in section 5. Then analyse its impact on MENA countries advantages and obstacles in section 6. Finally, some conclusions contribute in defining the value and the results expected from this partnership experience.

The Main Scenario for the Partnership

This renewable energy partnership shall be established between countries having good RE resources and countries with high electric energy consumption Europe, Middle East and North Africa. The long term goal is to provide a substantial part of the energy needs of the MENA countries as well as to meet about 15-20 percent of Europe's electricity demand by 2050 by renewable energy generated in the MENA region, whereas transportation lines with High Voltage Direct Current (HVDC) would enable the transfer at reasonable costs [4,5]. At present time, Europe consumes about 2450 TWH of electricity per year and will increase and stabilize at 4000TWH per year. Water resources are nearly completely used for electricity production. Large sites with wind energy of high potential are available but affected highly by the northern European weather [4]. MENA situation in 2050: the region will need an amount of electricity that is nearly equal to European consumption now. It will also need larger quantities of water-around 3 times the size of the river Nile-and this amount can be obtained only by seawater desalination. The fossil fuel used to produce such an amount from desalination will be depleted significantly, using the solar energy will be the solution for clean energy production [6].

Dr. Eng. Hani Nokracshy – Vice chairperson of the Supervisory Board of the DESERTEC Foundation- says: "This project is based on cooperation and partnership. It will put us on the way to avoid a lot of natural disasters caused by climate change". This partnership is not to generate electricity in MENA to just export to Europe but to generate renewable energy in the rich sun of MENA region, consume what makes economic sense to utilize in-country and export the balance which shows in Figure 1 [6,7].

According to Dr. Eng. Nokraschy this partnership planned to propose

Harvest wind power of high potential (10m/s) from the Gulf of Suez and the Moroccan Atlantic coast.

Harvest Solar Power of high potential (up to 3000kWh/m^2/y) from nearly everywhere in the North Africa Sahara. Transmit the harvested clean electricity to Europe via HVDC lines at a reasonable cost of about 0.02$/kWh. Mutual benefit for all partners in this co-operation, which shows in (Figure 1).

Source: (Nokraschy, 2010) [4].
Figure 1: Concept of "EUMENA Super grid", the Symbols for Power Sources and Lines Typical Locations.

The framework suggested as followed:

- A European company establishes together with a company from MENA a low-cost solar power station located in MENA countries.
- Solar Hybrid concept (using fossil fuel in the night) is preferred to ensure supply on demand, until the technology of heat storage is commercially available.
- The solar electricity share at least 20 percent will be transmitted to Europe while the conventional share will be consumed in the MENA country.
- Beside electricity, desalted water will be produced from the waste heat of the power station, thus boosting the economies [4].

This huge project in-order to be achieved some, specific actions shall be considered:

- Strong support-at the start phase-from the European countries to MENA countries will accelerate the development.
- Clean electricity from MENA shall cover-in the first stage- only 10 percent of Europe's total consumption.

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688

Europe role will be:

- Technical knowledge.
- Engineering and design capabilities.
- Key components for example in Concentrating Solar Power (CSP) such as turbine, mirrors and tubes.
- Experience of human resource and capacity building.
- To cover the cost of the production and the transmission.
- The experience of structuring/marshalling finance [4,7].

MENA role will be:

- The fuel (the sun).
- Offer free land and infrastructure.
- Local knowledge of the legal framework, capacity to accommodate and mitigate in country risk.
- Buy the conventional electricity share (For example: 0.025$/kWh depending on fuel price)
- Buy the desalted water produced from waste heat (for example: 0.05$/$m^3$)
- Free from taxes for the first 10 years [4,7].

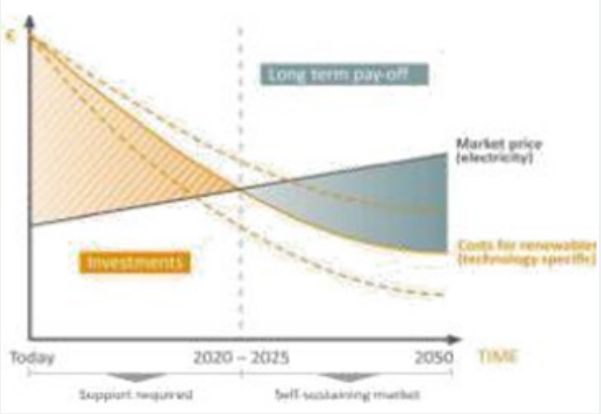
This partnership has three phases to build up until 2050:

i. **Reference projects phase:** Desert power contributes to nuclear phase-out.

ii. **Scale-up phase:** For example: CSP can complement other Photo Voltaic (PV) and Wind sources in Germany and EU for a more balanced RE mix.

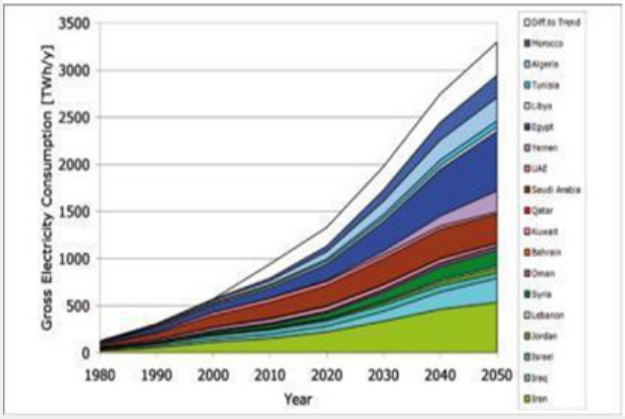
iii. **Market driven build-up:** Joint EU-MENA RE market will develop.

No additional governmental financial support necessary [8] as shown in (Figure 2).



Source: (Son, 2011) [8].
Figure 2: The Three Phases of the Partnership.

Main factors Affects the electricity and water consumption in EUMENA



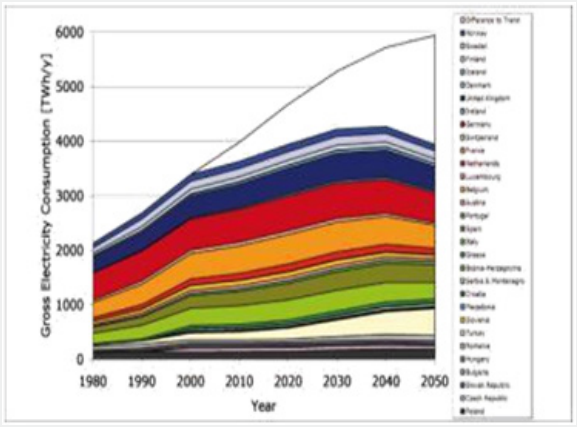
Source: (Trieb F, 2007) [2].
Figure 3: Electricity Demand Scenario for the MENA countries.

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688

Some analysis done by German Aerospace Center (DLR), Institute of Technical Thermodynamics, shows that by 2050 electricity consumption in the MENA countries is going to be around 3000TWh/year (Figure 3), which is comparable with what is consumed now in Europe. However, European countries' consumption is going to increase and stabilize at a value of about 4000TWh/year (Figure 4). It also shows that the GCC economies capacity to generate electricity has increased in the recent decades due to escalated domestic demand. The largest market is the largest market is Saudi Arabia, with some 76 GW of installed power generation capacity, followed by the UAE and Kuwait (Figure 5). Nearly all this capacity is powered by fossil fuels, mainly natural gas, but also oil products-and even, at peak times, crude oil-in Saudi Arabia and Kuwait (Figure 6). Less than 1% of current installed capacity is based on renewable energy. Similar analysis for water sector in MENA has been done by the German Aerospace Center (DLR), Institute of Technical Thermodynamics, shows the difference between the available sources of fresh water that are renewable and growing demands for water leads to the water shortfall in (Figure 7).

Population Growth

Is One of the main factors that affects the electricity and water consumption. Relating to the World Population Prospect of the United Nations the population of the European region will stabilize at around 600 million while MENA will grow from 300 million in the year 2000 to a similar 600 million in 2050 [2].



Source: (Trieb F, 2007) [2].
Figure 4: Electricity Demand for the European Countries.

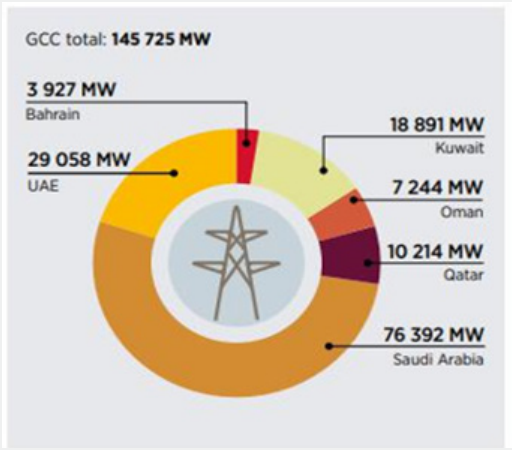
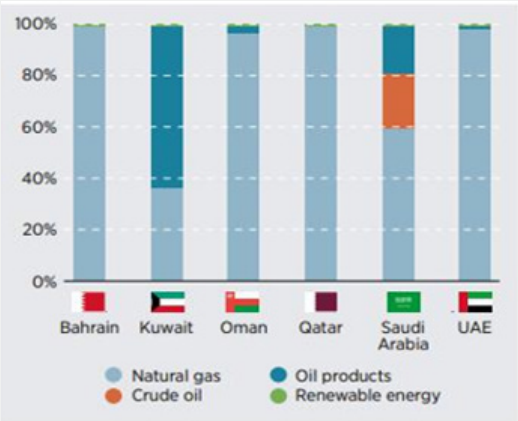


Figure 5: Installed capacity by country in 2017.

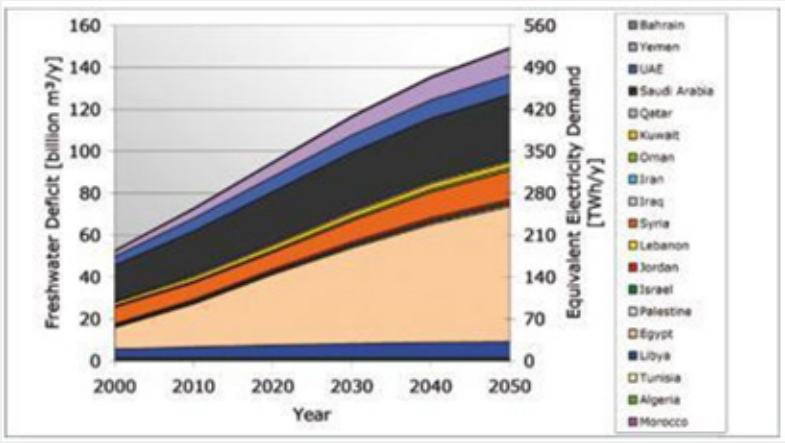
Economic Growth

Another main factor that influences the energy and water demand is the Economic Growth. When the demand increases as a result to the request of new services within a developing economy, production efficiency, distribution and final use should be improved. In order to get to the efficiency level, some procedures must be accomplished and that what is in progress now in EUMENA countries [2].

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688



Source: IEA, 2018a; IRENA, 2018a) [3].
Figure 6: Electricity Generation Capacity by Fuel Source as a Percentage of the total in 2016.



Source: (Trieb F, 2007) [2].
Figure 7: Freshwater Deficit defined as the Difference between Water Demand and Renewable Freshwater Resources for each of the MENA countries, and Equivalent Electricity Demand for Seawater Desalination.

Available Resources & Technology Options

Fossil Fuels

On one hand, the prices of fossil fuels energy have been increased several times since year 2000. Burning such energies is contaminated the global environment in a very risky way and it will be depleted soon. Those energy technologies still receive 75 percent of current energy subsidies. On the other hand, if their consumption reduced to be used only as complement to the RE mix for balancing power and for grid stabilizing, then their cost will be reduced, and their environmental impact will be minimized. In addition, their availability will be extended for decades [2].

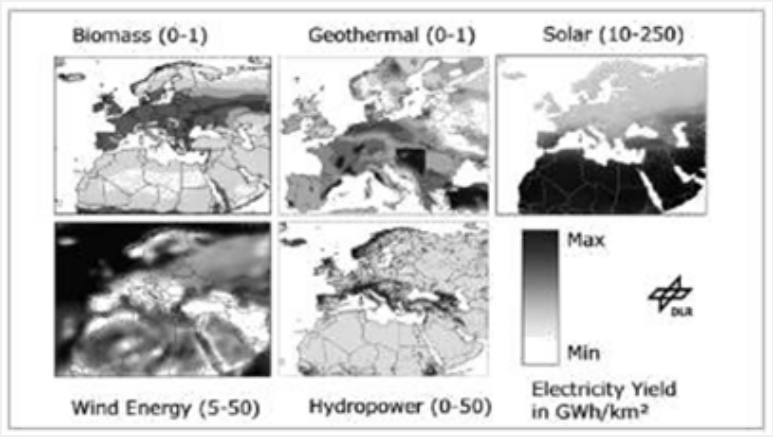
Renewable Energy

The long- term economic potential of RE in EUMENA is much larger than present demand. Each square kilometre of land in MENA receives solar energy amount equals to 1.5 million barrels of oil. Dr. Trieb and Professor Muller-Steinhagen say" A concentrating solar collector field with the size of Lake Nasser in Egypt (Aswan) could harvested energy equivalent to the present Middle East oil production" [2].

The RETs available in EUMENA regions are geothermal (hot dry rock) systems; Hydropower plants; Wind turbines; Biomass plants; Concentrating Solar Power plants (CSP) best suited for high demand urban areas; and photovoltaic systems, which employed to serve rural demand. However, each renewable energy resource has a specific geographic distribution (Figure 8) where each country will have a mix of RETs, hydropower, biomass and wind energy being preferred sources in the North, solar and wind energy being best sources in the South of EUMENA [1,2].

The above table presents some characteristics of contemporary power technologies. The technical electricity potential in EUMENA that can be exploited in the long term at competitive cost considering each technologies learning curve. In the case of PV only the demand-side potential used until 2050 was assessed; the technical potential is comparable to that of CSP [2] (Table 1).

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688



Source: (Trieb F, 2007) [2].

Figure 8: Renewable energy resources maps for EUMENA, showing the Minimum and the Maximum. Annual Electricity Yield that can be harvested by each technology from 1km2 of land area.

Table 1: RETs Specifications.

RETs	Potential	Type of Resource	Application	Comment
Geothermal	1100	Heat from hot dry rocks of more than 1000 Depth	Electricity and heat	No fluctuations, power on demand
Hydro-power	1350	Kinetic and potential energy from water flows	Electricity	Seasonal fluctuations, good storability in dams, used as pump storage for other sources
Wind	1950	Kinetic energy of the Wind	Electricity	Fluctuating, supply defines by source
Biomass	1350	Municipal and agricultural organic waste and wood	Electricity and heat	Seasonal fluctuations, good storability in dams, used as pump storage for other sources good storability, power on demand
CSP	630,000	Direct irradiance on a surface tracking the sun	Electricity and heat	Fluctuations are compensated by thermal storage and (bio) fuel, power on demand
Photovoltaic	325	Direct and diffuse irradiance on a surface	Electricity	Fluctuating, supply defines by source

Concentrating Solar Power CSP as one of the Main Sources of RETs

GCC countries vary in having areas with excellent resources for CSP (Figure 9) traces levels of direct normal irradiation (DNI), the relevant resource for CSP, shows major intra-regional variation. The northwestern region of Saudi Arabia and the southwestern Dhofar region of Oman have some of the best DNI readings in the GCC, as well as Egypt and Jordan. Bahrain, Kuwait, Qatar and the UAE best locations in DNI readings, line those in Jordan, and Morocco [9].

Direct sunlight, measured as direct normal irradiation (DNI), is solar radiation traveling from the sun in a straight line, without any scattering from particles in the earth's atmosphere, to a surface perpendicular to the sun's rays. Concentrated solar power (CSP) technologies (parabolic troughs, solar towers, etc.) depend on DNI because they cannot concentrate scattered sunlight. Sunny

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688

days with clear skies lead to high DNI and GHI, resulting in high outputs for both CSP and PV. Bad weather conditions-including dust particles, fog, clouds and humidity-tend to diffuse and reduce the concentration of solar irradiance, using a more severe effect on DNI [9].

CSP plants can provide power directly by using sunshine during the day, consuming the thermal energy storage facilities during the night and if it stays without sunshine for a longer period, using a fossil fuel or biomass as backup heat source. CSP plants have an availability that is near to 100 percent but with great lower fuel consumption. Another main feature of CSP is the possibility of combined generation of electricity and heat to get to the highest possible efficiencies for energy alteration (Figure 10). In addition, CSP plants can deliver steam for absorption chillers, industrial process heat or thermal seawater desalination.

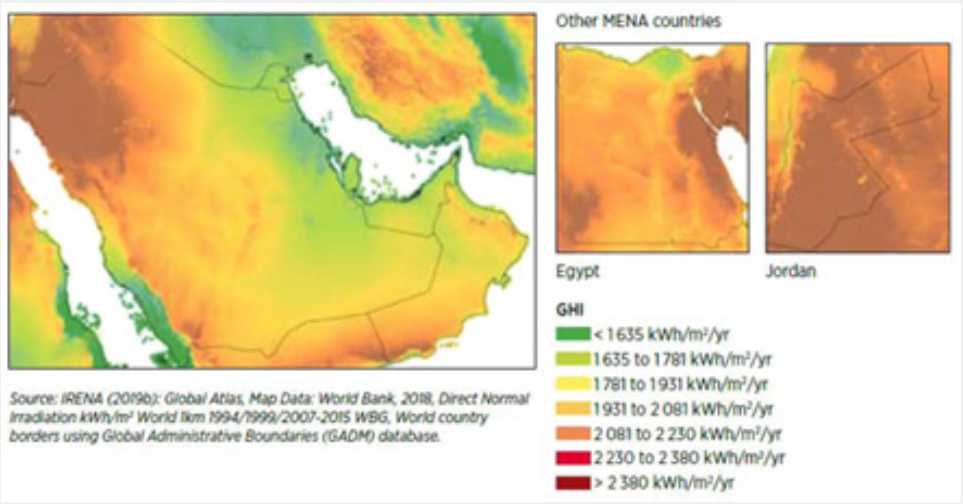
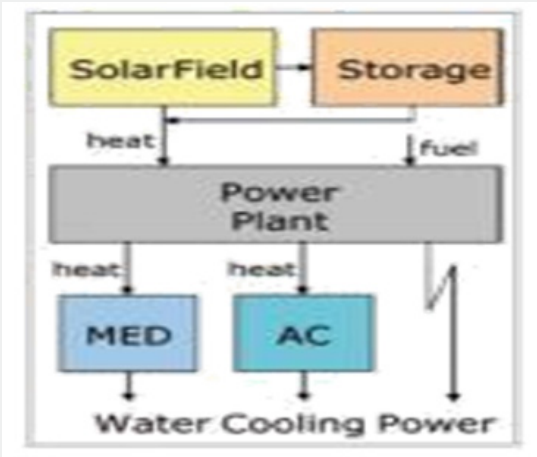


Figure 9: Direct Normal Irradiation (kWh/m2/yr).



Source: (Trieb F, 2007) [2].
Figure 10: Configuration of a concentrating Solar Power station for combined generation of Electricity and heat for absorption cooling (AC) and Multi-Effect Seawater Desalination.

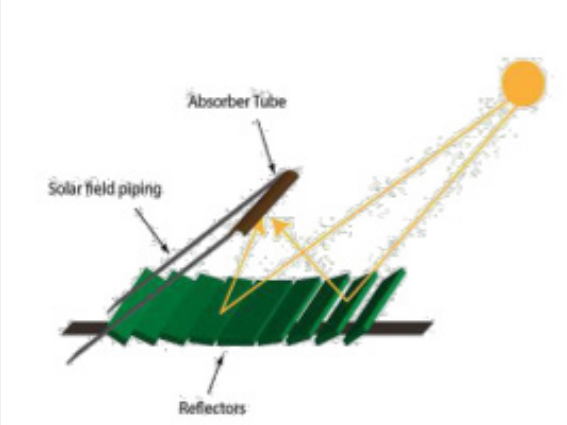
On one hand, using CSP in Europe is subject to significant seasonal fluctuations. On the other hand, due to the higher, solar irradiance in MENA, the cost of concentrating solar power there is usually lower and its possibility of usage is better than Europe.

The main two Line-Concentrating solar thermal collector technologies that will be used:

i. Linear Fresnel Concentrating Solar Thermal Collector (LFCSTC) (Figures 11 & 12).

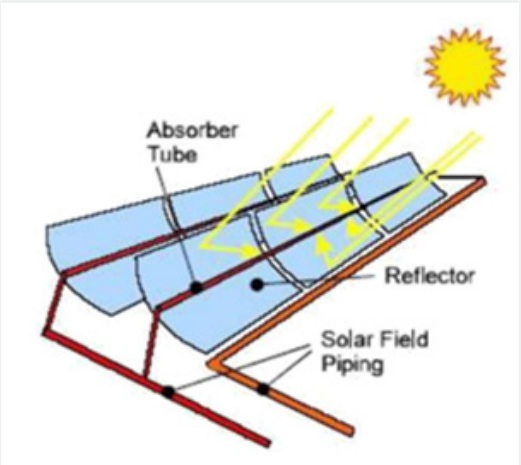
ii. Parabolic Trough Concentrating Solar Thermal Collector (PTCSTC) (Figures 13 & 14).

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688



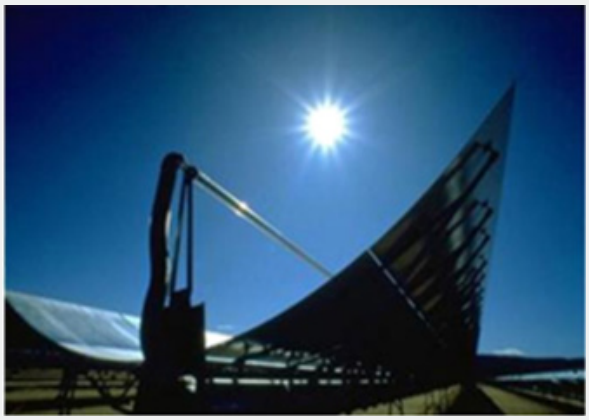
Source: http://www.greenrhinoenergy.com
Figure 11: LFCSTC diagram.

Source: http://www.kcet.org
Figure 12: LFCSTC.



Source: http://irishenergynews)
Figure 13: PTCSTC Diagram.

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688



Source: http://solarcellcentral.com
Figure 14: PTCSTC.

Advantages and Obstacles facing MENA

The spread of using RETs in MENA countries will help encourage the economic development:

i. Cooperate to build truly sustainable capacity in country.

ii. Progressively develop local manufacturing and indeed technology development capability.

iii. Solar energy could provide the region with its own necessities in lighting, communications, heating and cooling technology.

iv. Providing rural areas with electricity to improve their livelihoods.

v. Increasing exports.

vi. Developing the infrastructure and industry on a much larger needs platform than what exists today.

vii. Providing enough amount of water for drinking and for agriculture.

viii. Increasing the level of stability in the region [4,6,7,10,11].

It will also help improving the socioeconomic impacts in the region:

i. The operation, management and maintenance of renewable installations will offer sustainable, local jobs for periods of 20 years and more.

ii. This will help in raising the level of education, the level of schooling for the children, the awareness and acceptance for democracy.

iii. Allowing the people in the rural areas to engage in economic activity, there by promoting rural development in general [6,7,10,11].

The obstacles that facing the MENA region:

i. The major one is slow decision-making end.

ii. The general cost of setting up and running renewable energy installations.

iii. The problem of electrical storage because some of the natural flows of energy must be stored with a reasonable technical effort for a limited time span, but others must be taken as provided by nature.

iv. Transport and general infrastructure issues.

v. To maximize the regional benefit of renewable energy, grids should be transnational, and markets should be fully open to entry to private investors.

vi. The lack of appropriate policies for promoting the introduction of renewable energy in the MENA region.

vii. The combination of dust and high levels of humidity along the region's Gulf coast affect DNI rates and can influence the choice of CSP technology best suited for these locations [7,9,10,11,12].

Conclusion

The main purpose of this research was to describe the scenario of the partnership between Europe, Middle East and North Africa (EUMENA) and experience their roles. Then analyse its impact on MENA countries the advantages and the obstacles.

This partnership will have a significant effect in all fields for EUMENA countries.

i. Although the investment in RETs is still high as compared to the conventional fossil fuels usage, but according to the latest statistics it will be competitive even before 2020.

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688

ii. By applying renewable sources to energy production in the MENA countries, the life of fossil fuels will be expanded for future generations decreasing carbon emissions.

iii. It can be observed also that MENA countries have the highest potential for desert power generation and export to Europe.

iv. The potential of using CSP in MENA region (as one of the main RETs) is in general higher than in Europe, as well as it is more secure and can be easily stored.

v. The installation of renewable power plants in the desert will increase the economy; in addition, it will improve the socio-economic aspect by adding new direct and indirect jobs.

vi. It enhances the upgrading of the existing grid and construction of new ones in rural areas to assist in the transmission of electricity between MENA countries and export to Europe, thus introduce a large market for electricity.

vii. It will improve the general infrastructure required for the installation of the renewable power plants and make use of the electricity and heat produced from these power plants in the manufacturing of products and services to the desert.

viii. Politically, this project will play a main role in making the MENA region more stable and secure.

ix. The obstacles that are facing this partnership to be achieved should be taken into consideration in order to get to the maximum benefits.

x. This project can be achieved in MENA countries if all levels in the community are participating and co-operating in it. The governments assigned a regulatory context; the investors finance it and the public consume electricity and energy efficiently.

References

1. Peter Meisen LH (2007) Renewable Energy Potential in the Middle East, North Africa vs The Nuclear Development Option. GENI, Global Energy Network Institution, pp. 1-33.
2. Trieb F, Mueller S (2007) The DESERTEC Concept Sustainable Electricity and Water for Europe, Middle East and North Africa. In: Gerhard Knies, Uwe Möller, Michael Straub (eds.), Germany, pp. 1-21.
3. Irena (2018) Global Energy Transformation- A Road Map to 2050. International Renewable Energy Agency, pp, 1-76.
4. Nokraschy HE (2010) Renewable Energy Partnership Europe-Middle East-North Africa. Renewable Energy Partnership EUMENA, pp. 1-7.
5. Shaaban MA (2011) Examination of Impacts that Desert Power Generation has on EU/MENA Countries. Pp. 1-140.
6. Hani Nokrashy VC (2009) DESERTEC will allocate 80% of the production of solar energy for development in the countries of the region.
7. Padmanathan P (2011) International Corporation for Desert Energy_ The Way Forward. ACWA Power.
8. Son PV (2011) Renewable Energy Partnership for Shared Prosperity. European Energy Forum, p. 1-3.
9. IRENA (2019) Renewable Energy Market Analysis: GCC 2019. IRENA, pp. 1-154.
10. Theiman A (2010) Spurring growth of renewable energies in MENA through Private Sector Investment. MENA -OECD Business Council: Task Force on Energy and Infrastructure, pp. 1-19.
11. Jalilvand DR (2012) Renewable Energy for the Middle East and North-Africa, Polices for a Successful Transition. Friedrich-Ebert-Stuftung, Germany, pp. 1-24.
12. Jimmy Eriksson PF (2012) Mena Region: Time to go For Renewable Energy.

DOI: 10.19080/JOJMS.2020.06.555688

How to cite this article: Nashwa S. The Renewable Energy Partnership Experience EUMENA & Its Impact on MENA Countries. Oils. JOJ Material Sci. 2020; 6(3): 555688. DOI: 10.19080/JOJMS.2020.06.555688