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Analysis of New Energy Technologies and sector in Egypt,

Jordan, Malta and Tunisia

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ACRONYMS

AFD	Agence Française de Développement
BOO	Build Operate Own
BOOT	Build Operate Own Transfer
CSP	Concentrated Solar Power
EBRD	European Bank for Reconstruction and Development
EE	Energy Efficiency
EIB	European Investment Bank
EGP	Egyptian Pound
EPC	Engineering, Procurement and Construction
EU	European Union
FiT	Feed in Tariff
GW	Gigawatt
GWh	Gigawatt hours
ILO	International Labour Organization
IPP	Independent Power Producers
kW	Kilowatt
kWh	Kilowatt hours
kWp	Kilowatt peak
MENA	Middle East and North Africa
m/s	metres per second
Mtoe	Million Tonnes of Oil Equivalent
MW	Megawatt
NG	Natural gas
PPA	Power Purchase Agreement
PV	Photovoltaics
RE	Renewable Energy
SME	Small and Medium Enterprise
SWH	Solar Water Heater
TVET	Technical and Vocational Education and Training
USD	US Dollars

Executive Summary

Renewable energy developments in the Arab world have gained momentum in recent years. The main driver behind these developments is the strong support from governments that recognise the urgency of tackling rising demand for energy and are attracted by the declining costs of solar PV. In addition, multilateral development banks and development agencies have played a critical role in financing projects in Egypt, Jordan, and Morocco at a time when international banks were reluctant to invest.
To support their renewable sectors, countries have introduced several supporting mechanisms including competitive bidding, feed in tariffs (FiTs), tax exemptions, and power-purchase agreements, in addition to land and financial incentives.

On the European level, The European Union has always been on the forefront in the battle against Climate Change and has set itself a number of headline targets for 2020 and as of 2014, also for 2030. The EU's target as a whole is to obtain 20%of energy from renewable sources by 2020 and at least 32 per cent by 2030. Each EU Member States should publish a National Renewable Energy Action Plan (NREAP) explaining how the national overall renewable energy target and the transport target shall be achieved.

In this report, the energy sector of 4 countries are analysed; Egypt, Malta, Jordan and Tunisia. The sector is analysed taking into account the characteristics of the electricity market, the Renewable energy potential and market, the policy framework, financing mechanisms and job creation. At the end of the report, a comparative table summarized the main findings of the study.

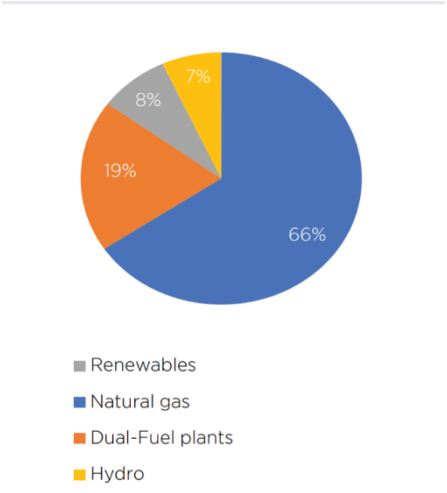
All 4 countries have strategies and RE objectives by 2020 and/or 2030 and beyond. This demonstrates the importance of RE in electricity mix and the vision that each country has about energy security and diversity.
However, in terms of realizations Jordan and Egypt are more advanced than Tunisia and Malta. This is due to the fact that they both have RE policies that attract foreign investors and developers and ensure project bankability. For Malta, land restrictions seem to be the main reason that is slowing down RE projects as for Tunisia, the lack of regulator makes the process less transparent.

ENERGY SITUATION IN EGYPT

Both oil and natural gas (NG) can be considered as the main energy sources in Egypt, meeting around 95%of national energy needs. Production of crude oil and NG, either from Egypt or partners is around 35 and 43 million tons respectively. According to the current estimations, reserves of crude oil are expected to sustain for 15 years. Meanwhile, around double the period is expected for NG. Although until 2010 Egypt was an exporter of oil and gas, it is now trying to meet the domestic demand despite the increasing rate of daily production.

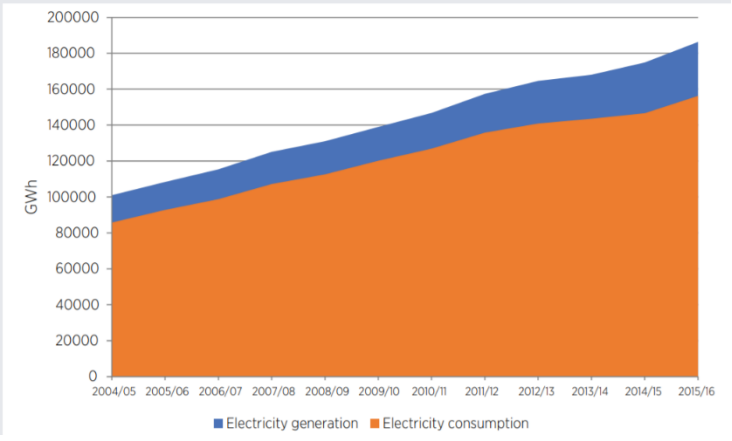
Electricity Market in Egypt

Total installed electricity generation capacity in the year 2015/16 amounted to 38,857 MW comprising mainly of natural gas and dual fuel plants as highlighted in Figure 1. The private sector contributed 2048 MW through the BOOT scheme for thermal electricity generation capacity.



Egypt's power demand has grown consistently over the past decade, recording an annual growth rate of 6% In 2016, the peak load demand was close to installed capacity. In 2014, the Ministry of Electricity and Renewable Energy (MOERE) initiated plans to add 51.3 GW of conventional and renewable sources to respond to the growing power needs. Given the increase in installed capacity, total electricity generation in 2015/16 amounted to 186,320 GWh, whereas total electricity consumption was 156,300 GWh in 2015/16, resulting in sufficient reserves of over 16.11% to meet electricity demand surges (Figure 2).

Figure 1: Electricity generation and sources in Egypt in 2015



The production cost of electricity in Egypt averaged USD 0.045 (EGP 0.855) per kWh in 2017, up from USD 0.04 (EGP 0.64) per kWh in 2016. In comparison to other countries in the region, electricity tariffs are considered to be low. Electricity tariffs in Egypt vary according to feeding voltage level and type of consumer group, amount of consumption and time of usage (peak/off-peak) periods.

Figure 2: Evolution of Electricity generation and consumption in Egypt from 2004 to 2016

A five-year plan to phase out internal subsidies in the electricity sector was officially endorsed in 2014, which includes annual tariff increases for most user segments on 1 July each year until 2018. While the annual tariff increase has allowed the government to save EGP 18 billion from the electricity subsidy bill, the government has recently extended the subsidy to 2022 to ensure the protection of low-income consumers, while compensating for the accelerated increase in the sector 's expenditure on new plants, taking into account the changes in the USD exchange rate.

RE Market size

Potential and Resources

Egypt enjoys an abundance of renewable energy resources – solar, wind, biomass and hydro.

- Average daily sunshine totals about 9 to 11 hours per day, with **solar** direct radiation intensity of about 2 000–3 200 kWh/m^2 per year that can be utilised for both power generation and thermal applications with an average production of more than 1800kWh/kWp (Figure 3)
- In addition, Egypt is endowed with vast **wind** resources, with average annual speeds reaching 8–10 metres per second (m/s) by the coast of the Red Sea and 6–8 m/s along the south-west Nile banks and in the south of the Western Desert, which can be utilised for electricity generation (Figure 4)
- More than 30 million tonnes of solid **biomass** waste are also produced annually from both agriculture and municipal resources.

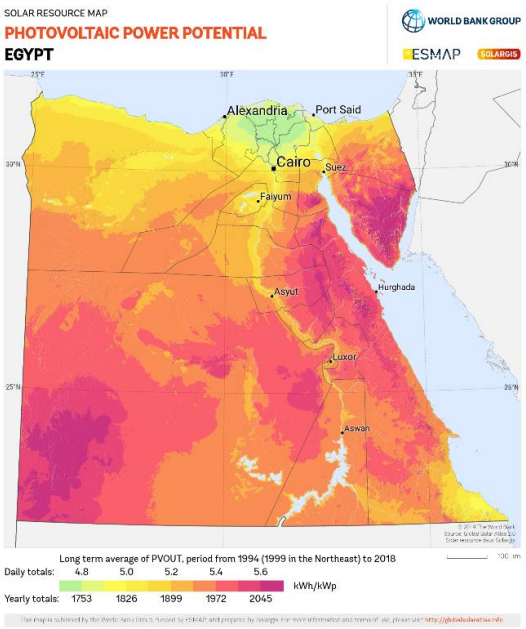
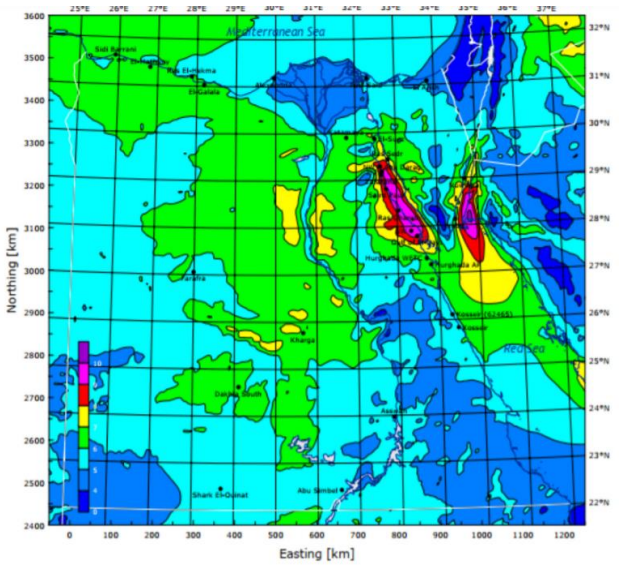


Figure 4: Egypt Solar Resource Map



The map shows the mean wind speeds in [ms-1] at a height of 50 m over the actual (model) land surface. The horizontal grid point resolution is 7.5 km.

Figure 3: Egypt Wind Atlas

Roadmap and objectives

To meet burgeoning energy demand, the Egyptian government has pursued an energy diversification strategy, known as the Integrated Sustainable Energy Strategy (ISES) to 2035, to ensure the continuous security and stability of the country's energy supply. This strategy involves stepping up the development of

renewable energy and energy efficiency, in part through vigorous rehabilitation and maintenance programmes in the power sector.

The country aims to reach the participation of renewable energy in the national energy mix to ***20%by 2022 with the possibility of doubling it by 2035 (Figure 5 and 6).*** The total installed capacity of renewable energy sources is expected to reach 19.2 GW by 2021/22 and increase to 49.5 GW and 62.6 GW in years 2029/30 and 2034/35 respectively.

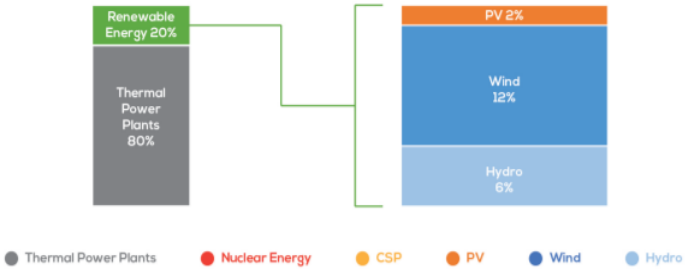


Figure 6: Electricity Production by 2022

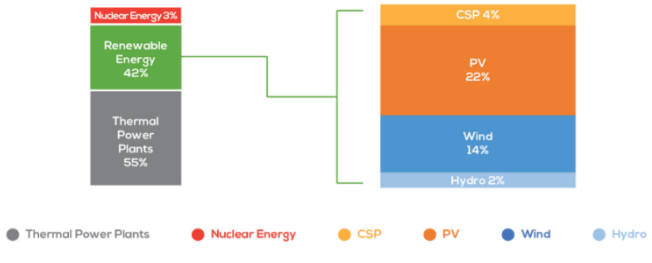


Figure 5: Electricity production by 2035

Key Achievements

In its 2019 Annual Report, the New and Renewable Energy Authority (NREA) published that the total installed RE capacity is around 6000MW, with 2832MW from hydro, 1375MW from wind, 1587 MW from PV, 140MW from CSP and 11.5 MW from biomass. Almost 60% of the installed capacity is state owned particularly hydro, wind and CSP, although the private sector has mainly invested in PV.

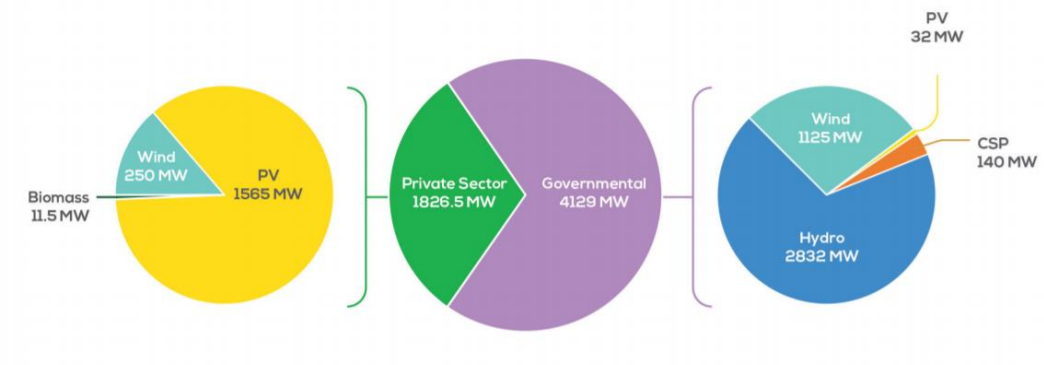


Figure 7: Owership of RE projets per technology as of 2019

By the end of 2019, Egypt has successfully reinforced the participation of the private sector in the renewable energy sector. This is demonstrated in Benban Solar complex, which has been established with a total capacity of 1465 MW of PV. The project was awarded two international prizes; (1) the Global Award for Multilateral Deal of the Year 2017 by Project Finance International, and (2) the best-project award for the year 2018 by the World Bank Group.

The first wind power project constructed under the BOO scheme with the participation of the private sector with a total capacity of 250 MW in the Gulf of Suez, an area enjoyed with high wind speed, is close to Gabal El Zayt wind energy complex, with a total capacity of 580 MW owned by NREA.

During the past two years, the private sector investments exceeded USD 3 billion, with the contribution of USD 2 billion allocated for Benban complex.

Existing policies and RE mechanisms

The orientations towards RE in Egypt began with the creation the New and Renewable Energy Authority in 1986. Then, the New Electricity Law No. 87 of 2015 was promulgated to provide legislative and regulatory frameworks for the RE in Egypt.

Within the regulatory framework described above, the following schemes are applied for the implementation of renewable energy projects in Egypt:

- Tenders under EPC: Governmental projects tendered and owned by NREA for design-supply and construction of projects.
- BOO: the Egyptian Electricity Transmission Company (EETC) invites private investors to submit their offers for specific capacities and the award will be made to the lowest kWh price.
- Feed in-tariff: EETC invites private sector company to bid for projects and sell electricity to the grid at a fixed already known price
- Net metering: Grid-connected solar PV projects up to 20 MW for self-consumption and own usage.
- Independent Power Producers (IPP): Projects implemented by private sector investors either to feed their own loads or to sell it to their own consumers.

The below figure shows the installed capacity in solar and wind per mechanism:

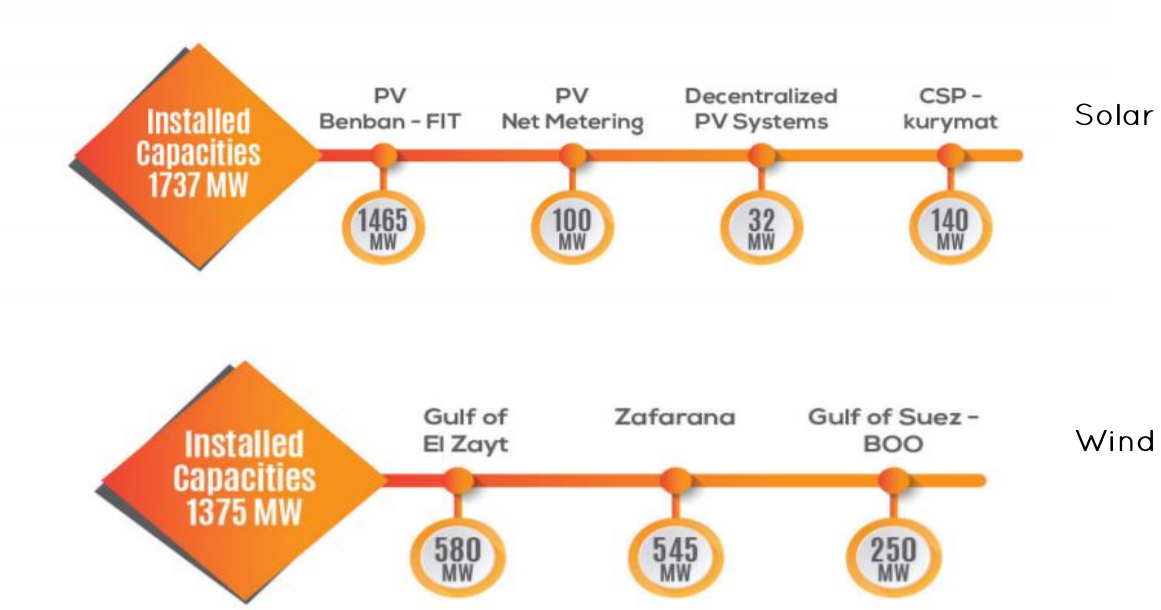


Figure 8: Installed RE capacity per mechanism

Stakeholder Mapping

The Ministry of Electricity and Renewable Energy (MOERE)	The Ministry develops and implements the national energy strategy and governs and gives inputs to EEHC, EgyptERA and NREA.
New and Renewable Energy Authority (NREA)	Since 1986, NREA; affiliated with MoERE, has been acting as the national focal point for expanding efforts to develop and introduce renewable energy technologies on a commercial scale. For a long period, NREA has been active mainly in promoting large scale wind and solar energy projects
The Egyptian Electricity Regulatory and Consumer Protection Agency (EgyptERA)	National Regulatory Agency regulating and supervising all electricity generation, transmission, and distribution. EgyptERA licenses to private actors, monitors and sets electricity tariffs and is responsible for ensuring supply security.
Egyptian Electricity Holding Company (EEHC)	State-owned company which owns and operates almost the entire generation as well as transmission and distribution grids through its subsidiaries.
Egyptian Electricity Transmission Company (EETC)	Affiliate company of EEHC in charge of managing, operating and maintaining the transmission network across the country. For renewable energy, EETC is the main off-taker and Power Purchase Agreement (PPA) counterparty for wind and solar power under the FIT.

Financing schemes

Credit lines to banks by development institutions

The European Bank for Reconstruction and Development (EBRD) is supporting green technologies investments by Egyptian private sector businesses, by providing a loan of US$ 15 million to the Arab African International Bank (AAIB). It is Co-financed by US$ 15 million from the Agence Française de Développement (AFD).

In addition, Egypt Sustainable Energy Financing Facility (EgyptSEFF) is a new credit line dedicated to energy efficiency and renewable energy investments in Egypt. The credit line was developed by the EBRD and is currently available to clients in Egypt through the National Bank of Egypt (NBE). EgyptSEFF offers a one-stop-shop solution to the nation's energy conscious business community to develop their sustainable energy projects. In addition to providing multicurrency loans worth up to five million dollars with flexible repayment periods of up to five years, EgyptSEFF also offers free technical assistance and investment incentive grants (depending on the loan and project conditions) to assist Egyptian businesses in managing their energy consumption.

Furthermore, the EBRD is boosting small businesses and green investments in Egypt with a US$ 17 million loan to QNB Alahli, under the Green Economy Financing Facility (GEFF) for Egypt.

Job creation and education system

According to RCREEE recently published study, since 2015, there has been an increase in the number of jobs created by the RE sector. It increased from 4,995 in 2014 to 6,995 in 2015. In 2018, there has been a great increase in the total number of jobs created, as it increased to 14,344, which is, approximately, the double of the number of jobs created in 2017. Figure 9, shows that the number of jobs created by the RE technologies were, approximately, the same from 2010 to 2014. In average, this accounted for 5,096 jobs created per year. In 2015, this number increased by 28%compared to the previous year. However, in 2018 the annual growth rate was 87.8% reaching a number of 14,345 direct jobs created. In 2019, this number increased to 16,383.

The pattern of jobs created by renewable energy has changed during the past ten years. In 2010, 78%of direct jobs were created by hydropower, while solar water heaters (SWH) represent 12.36% In 2018, 7629 direct jobs were created, the hydropower sector contributed to 39,70%of them and SWH contributed to 35,35%

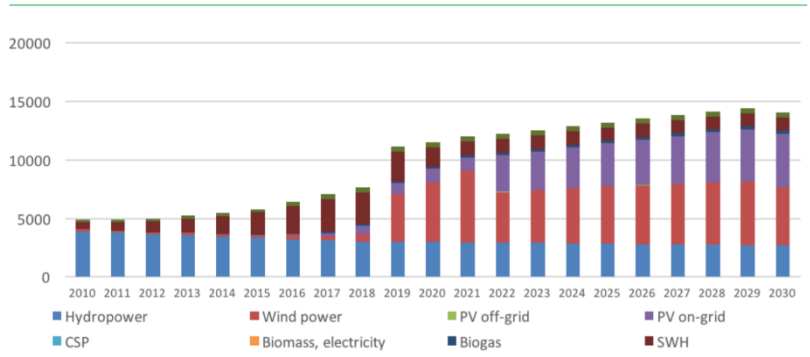


Figure 9: Direct jobs created by RE sector per technology in Egypt from 2010 to 2030 (RCREEE)

Egypt has implemented a cooperation protocol with private firms to implement the 'Egypt Makers' initiative, and other programmes, in cooperation with the Federal Ministry for Economic Cooperation and Development of Germany (BMZ). This initiative focuses on technical education, training and employment, qualification of both trainers and trainees and the improvement of SMEs. In addition to the Ministries of Education, of Higher Education and of Trade and Industry, which are the main TVET institutions, there are also 15 public and private public and private entities that provide RE and EE training. There is a great variety of RE and EE courses in Egypt, mainly provided by universities, research centers and associations. The level of most courses is 'adequate' or 'high', whilst the training on RES technologies, and the market size for both RES and EE are evaluated as 'very high'[1]

[1] Full list of training courses available in this RCREEE report https://www.rcreee.org/sites/default/files/a21_marketsurveytraining-final.pdf

ENERGY SITUATION IN JORDAN

In 2018, Jordan imported 94%of its energy needs, which constitute nearly 10%of the country's gross domestic product (GDP), leaving it vulnerable to variations in fuel prices. Jordan's power demand is also growing in part due to the flux of 750,000 Syrian refugees entering the country over the last seven years.

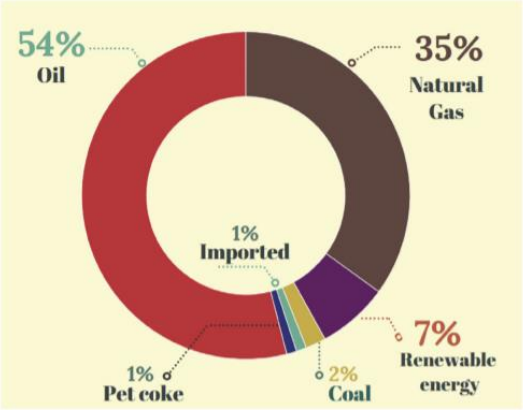


Figure 10: energy production per source

Jordan faces two significant challenges in its energy sector, the rising energy demand, and limited domestic resources to meet the country's needs. Imported oil and natural gas comprise the largest share at 87% of the total energy need, while domestic resources account for 7.8% of energy supply, including the 7% obtained from renewable energy.

Electricity Market in Jordan

Jordan's electricity demands are rising fast and paving the road to attract overseas investments, providing the capital and additional capacity to meet the growing demand. As per figure 11, in 2018, electricity generation was 5,236.4 MW from 3,312 MW in 2012 and is anticipated to reach 5,770 MW by 2020.

Table 2. Generation growth (in MW) by source 2012–2018 [15].

Generation Source	2012	2013	2014	2015	2016	2017	2018
Steam	925	787	787	787	605	605	605
Gas turbine (N. Gas)	499	618	618	332	307	228	83
Gas turbine (Diesel)	134	27	27	27	27	-	-
Combined cycle	1,737	1,737	1,614	2,044	2,044	2,044	2,740
Diesel/(HFO + N. Gas)	-	-	814	814	814	814	814
Hydro	12	12	12	12	12	12	12
Wind	1.4	1.44	1.44	118.4	198.4	198.4	280.4
Biogas	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Solar		-	-	5	285.5	395.5	698.5
Total	3,312	3,186	3,876.9	4,142.9	4,269.4	4300.4	5,236.4

Figure 11: Generation growth in MW by source from 2012 to 2018

Most of the country's power stations are state-owned; however, large industrial enterprises, such as potassium, phosphate, and cement companies generate their electricity via company-owned power plants.

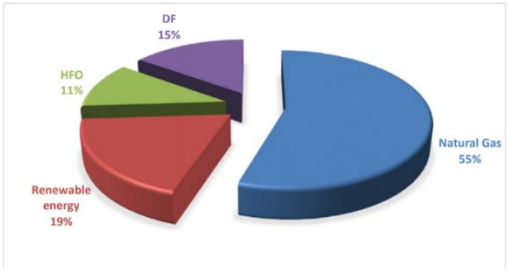


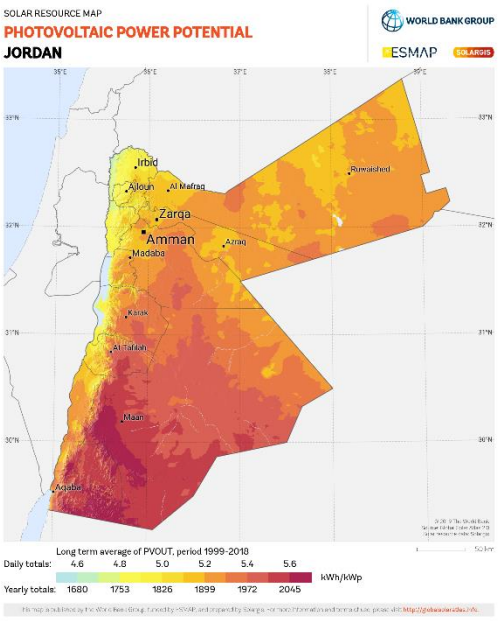
Figure 12: Electrical power generation by source in 2018

Natural gas share was 55% of the energy input in power plants, 11%from Heavy Fuel Oil (HFO), 15% from Diesel Fuel (DF), and the renewable energy representing its largest share for the first time at 19%

In 2015, the electricity subsidies generated a public deficit of $ 1.22 billion. To alleviate the deficit, electricity tariffs were adjusted in 2016 to reduce government subsidies. All fuel subsidies were gradually eliminated by 2012, and the electricity subsidies were gradually removed by 2017, which enabled NEPCO to cover its cost by the end of 2017.

RE Market size

Potential and Resources



Many regions in the north western and southern parts of the country are suitable for electricity generation with wind speed ranging from 7 m/s to 11 m/s. Thanks to Danish RISO research center, a Wind Atlas, which has been available since 1989, is updated regularly with support from Jordanian agencies to provide the most recent data measurement.

Jordan is blessed with a 5 to7 kWh/m2 direct solar radiation intensity and averages 310 sunny days annually. The annual daily average of global solar irradiance on a horizontal surface is around 5.6 kWh/m^2 day and the total annual irradiance is between 1800-2700 kWh/m^2 which translates into an average annual production of solar PV systems of more than 1700 kWh/kWp, according to the figure 13.

Figure 13 Jordan Solar Atlas

Biomass energy from agriculture waste, animal manure, urban wastes, and organic industrial wastes have substantial promise. Unfortunately, due to the semi-arid climate, vegetation covers less than 5%of the land; this limits the potential use of horticulture biomass in energy generation on an economical scale. On the other hand, huge energy potential can be obtained from household garbage, which has an organic matter content of 60% Projections place municipal solid waste and cattle/poultry farming energy potential at up to 60 MW.

Roadmap and objectives

Energy security and the increasing cost of imported energy pushed the government to draft a National Energy Strategy Plan for the years 2007–2020. Renewable energy became the main concern under this plan, with the government seeking an ambitious $ 20 billion investment in energy development by 2020. Under this strategy, the power supply from renewable energy sources will increase from current measures of 7%in 2018 up to 10%by 2020. The National Energy Strategy Plan seeks to produce 2,000 MW from direct investment in wind and solar energy by 2020. As a result, Jordan has ranked first in the MENA region in renewable energy adoption and clean energy growth and ranked third globally, according to a Bloomberg report in 2017.

Key Achievements

Following the reform of the electricity market, the government announced:

- The first round of tender in 2012. The auction awarded 12 PV projects, with a cumulative capacity of 200 MW, and 2 wind power plants. The 20-years PPAs for the wind projects have been signed at 0.12 USD/kWh while for PV plants they were closed at 0.169 USD/kWh.
- A second round of tender was issued in 2013 and awarded 4 PV projects of 50 MW each at the beginning of 2015, totalising 200 MW. The awarded tariffs were among the lowest ever recorded in the world (0.0613-0.0767 USD/kWh)
- At the end of 2016 a third round of tender was launched, planning to develop 200MW of solar PV and 100MW of wind projects in the Ma'an area and in the south of the country, respectively.

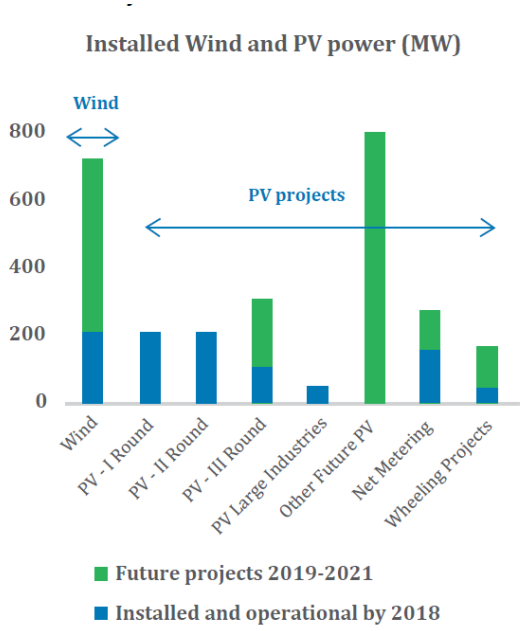


Figure 14: Installed Wind and PV power (MW)

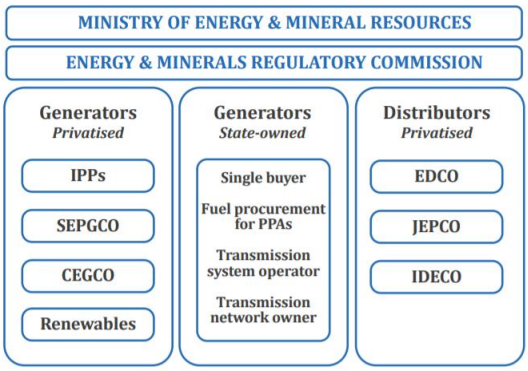
As of today, RE installed capacity accounted for 600 MW on a total of 4300 MW. Considering the capacities expected to go on- line by 2018 and already planned projects, as listed by the NEPCO Annual Report 2017, total installed renewable capacity should reach 2,726 MW by the end of 2021.

If all those projects will effectively come on- line, Jordan will be able to overcome its 2020 targets, installing over 1.5 GW of solar PV plants, 723 MW of wind power and 447 MW of distributed electricity generation under net Metering and Wheeling mechanisms.

Future plans consist of hybrid CSPs with a total capacity of 100–250 MW and three windmills with a capacity of 125–150 MW. 60% of the wind turbine parts are expected to be fabricated by local wind turbine manufacturers. At the same time, many investors are looking to manufacture photovoltaic and CSP parts in Jordan, thanks to generous taxes and customs exemptions, and solid industrial infrastructure, such domestic production is possible. All combined, this makes Jordan a regional hub for renewable energy resources training, capacity building, and technology transfer.

Existing policies and RE mechanisms

To supervise the RE market development and ensure the achievement of those targets the institutional, legislative and regulatory frameworks were adapted and dedicated authorities and entities have been conceived to support the integration of RE in Jordan.



- The Renewable Energy and Energy Efficiency Law (REEEL) was established in 2012, providing a legal framework for RE and EE development, With REEEL, the Ministry of Energy and Mineral Resources (MEMR) becomes responsible for the identification of compliant sites to be allocated for RE projects and the issuing of public tenders on competitive and transparent basis for clean electricity capacities,
- Establishing Jordan renewable energy and energy efficiency fund (JEEEF) which aims to leverage RE and EE measures penetration across all the country's sector (residential, commercial, industrial governmental buildings, hospitals and etc.). The Fund provides grants for energy projects and guarantees investors' funding requirements.
- Establishing a reference (ceiling) price list for renewable energy technologies: Investors can use this list as the Feed-in Tariff to evaluate their proposal investment in the RE sources. The developers can bid under this upper limit, considering that there is an extra 15%tariff that will be awarded if the winning bidder installs a fully local renewable energy supply. This will encourage technology transfer and boost the renewable energy industries in the country
- A direct proposal regime/ unsolicited submission for private companies to allow investors to identify and develop grid-connected electricity-production projects through unsolicited or direct proposal submission
- Enabling the development of distributed electricity generation under the Net Metering and Wheeling mechanisms, allowing small RE installations, for residential, commercial or industrial use, to sell the exceeding electricity to the grid at the same purchasing price established by the Regulator
- Exempting Renewable Energy and Systems and Energy Saving Equipment from Custom Fees and Sales Tax (Bylaw No. 13 of 2015).

Stakeholder Mapping

Ministry of Energy and Mineral Resources (MEMR)	Responsible for the strategic vision of the country in terms of energy policies and targets for developing the national energy system.
Energy and Minerals Regulatory Commission (EMRC)	Regulator of the electricity market. EMRC is responsible for setting the electricity tariffs and awarding licences to power providers and distributors
National Electric Power Company (NEPCO)	Jordan electricity market operates as a single buyer model where the power generation and distribution are privatized sectors while transmission is held by the NEPCO, the single state owned transmission system operator and the only authorized energy off-taker.
INDEPENDENT POWER PRODUCERS (IPP)	IPP are private companies that sell electricity to NEPCO at a fixed price through a Power Purchase Agreement.

Financing schemes

Credit lines to banks by development institutions

AFD has made available through SUNREF (Sustainable Use of Natural Resources and Energy Finance), a soft credit line valued at USD53 million to two local partner banks (Cairo Amman Bank and Capital Bank of Jordan), for onward lending to businesses and households. The European Union has supported this SUNREF program by implementing a grant through which up to 5‰on the AFD loan amount can be paid back to the final beneficiary.[2]

The EBRD is planning to launch a Green Economy Financing Facility in Jordan (GEFF). It will provide financing of up to USD 60 million to Participating Financial Institutions ("PFIs"), including banks, microfinance and leasing companies. These loans shall be dedicated to finance private sector sub-borrowers (Corporate, SMEs and households) in Jordan for investment in green technologies and services supporting Green Economy Transition.

Jordan renewable energy and energy efficiency fund (JEEEF)

The fund was set up by REEEL and was launched in 2013 by MEMR. The fund provides grants for energy projects and guarantees investors' funding requirements. It is financed by national and international institutions, has a legal identity and is financially and administratively independent. Both national and foreign private companies are allowed to apply for the fund's support. It provides

- Renewable energy investment subsidies;
- Interest-rate subsidies on commercial loans;
- A public equity fund;
- A renewable energy guarantee facility to ease credit access for energy efficiency and renewable energy project developers;
- Research, technical Cooperation grants for targeted programmes; and feasibility studies.

Job creation and education system

Although Jordan does not have any formal vocational and educational training schemes, the Vocational Education Corporation has 42 training centers across the country. These centers only provide training programmes that are related to RES and/or EE and are only given to the students that have failed in obtaining a High School Certificate. Furthermore, a private college offers an educational programme in renewables. These options have not been considered as structures in RES/EE training schemes yet, although there is a perspective for such development in the future. Finally, according to the evaluation of the existing trainings in Jordan, and in spite of the small number of courses offered, their quality has been characterized as 'high' to 'very high', with a clear emphasis on RES technologies and applications.[3]

[2] https://www.sunref.org/en/projet/green-lending-programme-supporting-sustainable-energy-and-environment-protection-in-jordan/

[3] Full list of training courses available in this RCREEE report https://www.rcreee.org/sites/default/files/a21_marketsurveytraining-final.pdf

ENERGY SITUATION IN MALTA

In Malta, the Energy sector is the largest contributor to total national greenhouse gas emissions, with energy industries and transport being the activity categories with the highest share of sector and national emissions.

Malta has no indigenous fossil-based energy resources and depends on imported fuels and electricity, and on any indigenous generation from renewable resources, for all its energy needs. Petroleum exploration efforts, started in the 1950's continue to the present, mainly offshore. To-date, no commercially viable discoveries have been made which would provide an opportunity for reducing the country's dependence on foreign sources for such energy resources, though reliance on refinery facilities in other countries would remain.

Electricity Market in Malta

As shown in figure 15, until recent years, the sourcing of electricity was fully dependent on local generation capacity, primarily based on coal (in the seventies, eighties and early nineties), then oil.

Since 2017, natural gas-fired plant has come into operation and now meets a substantial part of electricity demand of the country. The existing conventional power generation capacity is complemented by a 200MW submarine cable laid between Malta and Sicily (Italy), providing greater flexibility in the sourcing of electricity within the context of security of supplies. The first sourcing of electricity through this interconnector was in 2015, peaking in 2016, and then decreasing somewhat as the new local generation plants came into operation.

Renewable energy sources have seen a steady growth. The share of electricity production from renewable energy in relation to total electricity consumption was 7.4%in 2017, an increase from 6.4%from the previous year.

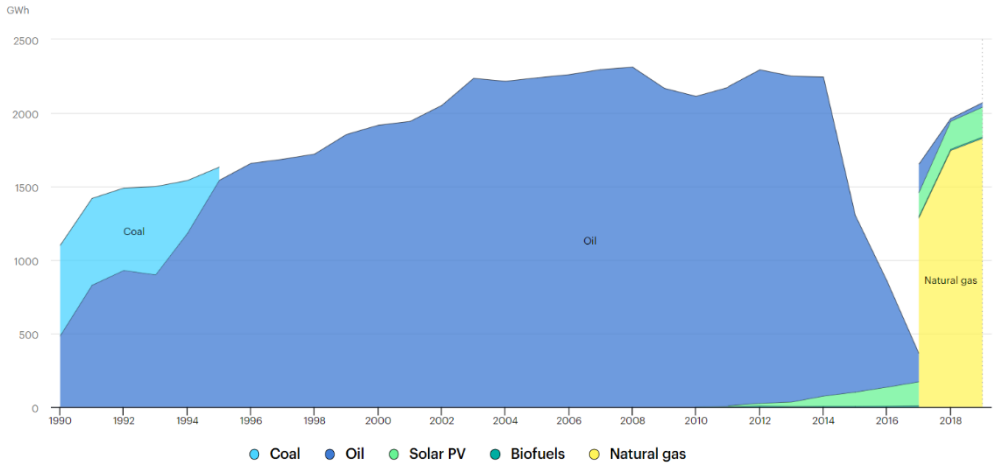


Figure 15: Electricity generation by soucre, Malta 2009-2019 (IEA)

RE Market size

Potential and Resources

Solar radiation is very stable and predictable in Malta. Solar intensity is also high – amongst the highest in the EU with annual global solar irradiation on a horizontal surface is circa 1825kWh/m^2. Yield of PV systems is amongst the highest in Europe with an average of 1700 kWh/kWp.

Wind energy is another potentially significant source of energy. Large wind farm installations could have a significant contribution towards meeting Malta's renewable energy targets; however, proposals made to-date have been shown to not be financially or environmentally feasible. Uptake of micro or medium sized win turbine technology has been limited mainly to a number of installations for research purposes, with further uptake constrained by uncertainties about energy yields, relatively high installation costs and planning permitting issues.

Deriving energy from waste is an important aspect of waste management. In fact, this has been reflected in Malta's Waste Management Plan adopted in January, 2014, which aims to move waste management in Malta up the waste hierarchy through increased prevention, re-use, recycling and recovery, and minimize disposals. Current waste assets with the potential to generate RE in Malta include:

- Landfills at Għallis and Żwejra operated by WasteServ Ltd are equipped with gas extraction systems;
- The biological treatment plant at the Sant Antnin Solid Waste Treatment Facility also operated by WasteServ Ltd;
- CHP plant at Ta' Barkat sewage treatment plant (STP) operated by Water Services Corporation

Roadmap and objectives

The European Union has always been on the forefront in the battle against Climate Change and has set itself a number of headline targets for 2020 and as of 2014, also for 2030. The EU's target as a whole is to obtain 20%of energy from renewable sources by 2020 and at least 32 per cent by 2030. Malta has a target of 10%by 2020.

Each EU Member States should publish a National Renewable Energy Action Plan (NREAP) explaining how the national overall renewable energy target and the transport target shall be achieved. Malta submitted its first NREAP in 2011. However, technological advancement, studies and experience prompted the Government to update Malta's national plan. The document issued in 2017 presents a revised

National Renewable Energy Action Plan for Malta, incorporating new priorities, projects and initiatives put forward for the energy sector.

Malta's energy strategy is being implemented through a clear roadmap which includes a number of important milestones. These include:

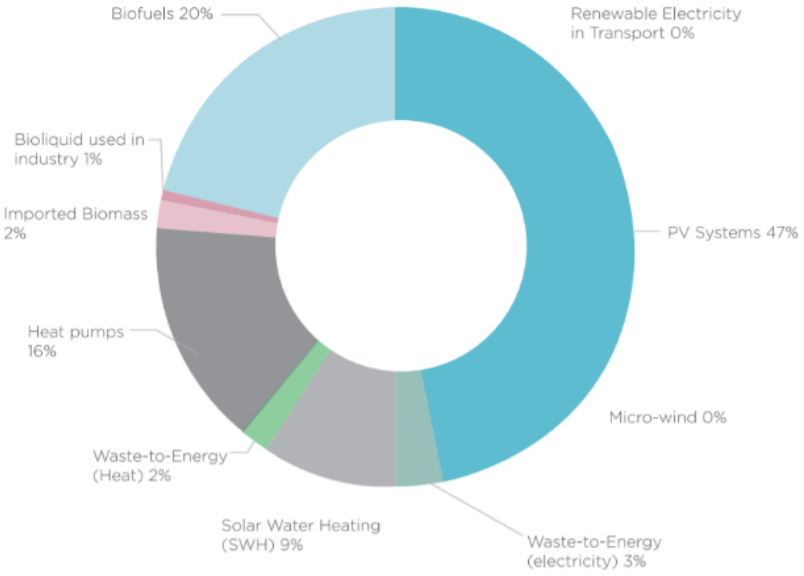


Figure 16: Contribution by technology as a percentage share of the overall target by 2020

- Switch from heavy fuel oil to a much cleaner fuel, natural gas;
- Upgraded and more efficient generation capacity to ensure sufficient electricity to meet future demand, increased efficiency and significantly lower emissions;

Interconnection with mainland Europe for both electricity, which was energized in 2015, and also through a planned gas pipeline, which the European Commission has recognized as a Project of Common Interest;

- Support for renewable energy and energy efficiency projects to meet the 2020 targets and beyond

Key Achievements

Efforts to increase the renewable energy share are ongoing; however, the full exploitation of RE within the technical and geographical limitations of a small country with a high population density is not enough to keep up with the steep increase in demand, due to the increase in population, increased tourism activity and relatively high economic growth.

In Malta, sourcing of energy from indigenous renewable energy sources is mainly via electricity generation by solar photovoltaics. PV technology was demonstrated to be the most robust and fastest-growing of all technologies, owing much to the characteristics of Malta in relation to solar intensity but also to the successful history of public and Government initiatives to promote the technology. There was a sharp increase in the uptake of PV between 2010 and 2017, with the total cumulative installed capacity at the end of 2017 standing at just over 112 MWp. Successful PV deployment has happened largely due to national incentives offered through various schemes, including ERDF (European Regional Development Fund) co-financed grants and attractive feed-in-tariffs.

Solar water heaters offer another opportunity for investment in RES. In fact, a number of grant schemes facilitated a high rate of installations of solar water heaters every year, though this has seen a gradual decrease in recent years, primarily due to increased preference for PVs and market saturation.

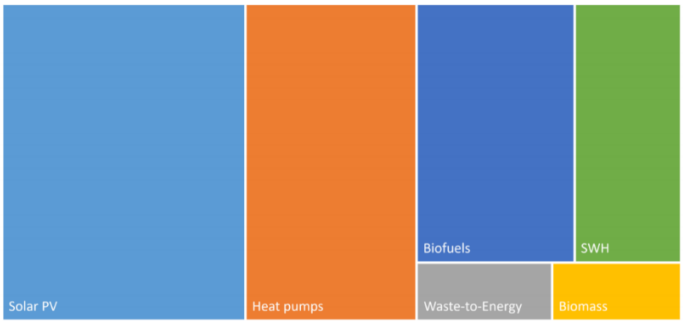


Figure 17:Share of RES technologies in consumption in 2017

Figure 17 provides a visualisation of the share of renewables in final energy consumption by technology in 2017. The largest contribution of renewable energy is provided by solar PVs (36%), followed by heat pumps (25%), the use of biofuels (19%) in the transport sector and solar water heaters (13%). While there has been a continued increase in the use of heat pumps for heating and cooling, and biofuels used in the transport sector, the installation of new solar water heaters in recent years has slowed down.

Existing policies and RE mechanisms

The introduction of a feed-in tariff for PV systems has addressed a financial barrier holding back the further penetration of PV. The Subsidiary Legislation 545.27 titled Feed-in tariffs scheme Regulations (enacted in September 2010 by Legal Notice 422 of 2010) sets feed in tariffs for the electricity generated by PV connected to the grid, including those systems benefitting from a capital grant. Below in figure 18, the most recent FiT for residential and non-residential were published by the Regulator.

Sector	Period of approval of FIT	Feed-in tariff -FIT	Cap on total units/annum for payment of the FIT	Legislation
Residential and non Residential	2 January 2019 to 30 December 2019	14c5/kWh for 20 years for new approved applications received till 30 Nov 2018; 14c/kWh for 20 years for application received after the 30 Nov 2018	40 GWh (25MWp) per annum (plus the applications received before 17-Dec-2019 when the scheme was oversubscribed and allocated a feed-in tariff under LN94 of 2020)	LN 2 of 2019
Residential	2 January 2019 to 30 December 2019	16.5c/kWh for 6 years	None	LN 2 of 2019
Residential and non Residential	2 January 2020 to 30 June 2020	15.5c/kWh for 20 years	6.4Gwh (4MWp)	LN 94 of 2020
Residential and non Residential	2 January 2020 to 30 June 2020	14c/kWh for 20 years	8Gwh (5MWp)	LN 94 of 2020
Residential	2 January 2020 to 30 December 2020	10.5c /kWh for 20 years	N/A	LN 94 of 2020

Figure 18: FiT in Malta 2019-2020

Since the introduction of support schemes in the form of feed-in tariffs, Malta's regulatory framework supported self-consumption. Systems which prioritise self-consumption face no additional charges when selling their excess production of renewable electricity to the grid. Self-consumption is promoted as a way in which consumers can offset their consumption of electricity from the grid (in real time) and thus, reduce their electricity bills, particularly in cases where such offsetting places the consumer in a lower electricity tariff band.

In addition, a major part of the uptake of the PVs on residential premises took place from 2009 onwards mainly as a direct result of €15m EU funds grant schemes covering the period 2014-2020 and enabling households to benefit from up to 50%of the initial capital investment, capped at €2,300. A same grant scheme is allocated to SWH covering 50%of costs capped at €700.

Stakeholder Mapping

The Ministry for Energy and Water Management	The Ministry was set up in June 2017, following the General Elections on 3rd June same year. The responsibilities of the Ministry include the development of alternative energy sources, Energy Policy, Water Policy and Energy and Water Services.
ENEMALTA	Enemalta Corporation is the main producer of electricity in Malta. There is no transmission system and no transmission system operator in Malta. The function of the distribution system operator is being carried out by Enemalta. The latter is also responsible for the implementation of the electricity interconnection Malta-Sicily.
Regulator for energy and water services Malta (REWS)	Is in charge of the regulation of practices, operations and activities in the energy and water sectors. Grant schemes for domestic PV and solar water heaters are among the functions of REWS. Energy efficiency, renewable sources of energy regulations are among the functions of the Energy and Water Agency.

Financing schemes

European Structural and Investment Fund by EIB[4]

The ESIF (European Structural and Investment Fund) Maltese Energy Efficiency (EE) and Renewable Energy (RE) fund is a new EIF (European Investment Fund) backed financial instrument dedicated to facilitate access to finance for both households and enterprises in relation to EE and RE investments in Malta.

Financial intermediaries (banks) selected through standard Call for Expression will benefit from an EIF guarantee in the form of an interest rate subsidy in order to reduce the cost of debt for households and enterprises.

Financial intermediaries independently decide on the EE and RE investments that they will finance. Furthermore, they will receive a technical assistance package from the Maltese Authorities in cooperation with the Advisory Services of the EIB, in order to support the implementation of this financial instrument

The approval of this Call for Expression of Interest to Banks on 14 January 2020 completes the first phase of the fund activation, amounting to EUR 15 million and expecting to create loan portfolios of EUR 60 million for EE and RE investments in Malta.

[4] https://www.eif.org/what_we_do/resources/esif-eerem/index.htm

Job creation and education system

Business in PV systems is ideally suited for Maltese SMEs. Many small retailers have entered the field favouring competition and hence higher market penetration. No high engineering expertise is necessary for deploying PV systems; a short period of training is sufficient to train competent installers. In line with the requirements of Directive 2009/28/EC, as from 31st December 2012 installers of solar photovoltaic and solar thermal systems must be certified. Courses approved by the Regulator for Energy and Water Services (REWS) for installers are organised by the University of Malta and the Malta College for Arts, Science and Technology (MCAST).

Following the successful completion of such a course, the candidate would have to apply for Certification of Installers as requested in legislation under the REWS Act. The Certification is valid for five years and can be extended following the successful outcome and attendance of refresher courses. The list of Certified Installers is then published on the Regulator's website. [5]

[5] https://www.rews.org.mt/#/en/a/81-providers-res-and-energy-audits

ENERGY SITUATION IN TUNISIA

Tunisia's energy situation is marked by limited energy resources, a decline in energy production and a strong increase in demand. This gap between energy production and national demand for hydrocarbons has showed a deficit in the primary energy balance which reached ***49%in 2018 against 15%in 2010.***

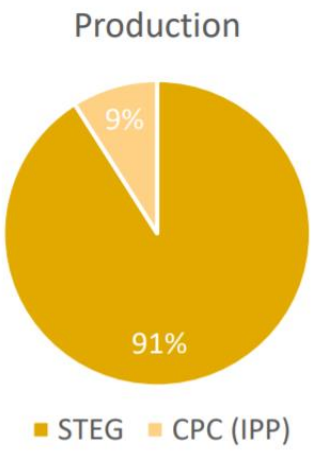
- Over the period 1990-2018, primary energy consumption more than doubled, from 4.4 Mtoe to 9.5 Mtoe.
- At the same time, primary energy production fell from 5.4 Mtoe in 1990 to 4.6 Mtoe in 2018.
- This deterioration in the energy balance has especially accelerated since 2010; the country's **energy independence has thus decreased from 93%in 2010 to 51%in 2018.**

This situation of energy dependence led to major challenges related to energy security and the country's economic competitiveness. The increase in imports of energy products affects the national trade balance and the country's foreign exchange earnings.

Electricity Market in Tunisia

At the end of 2018, the total installed capacity of electricity was 5,476 MW, of which 5,005 MW owned by STEG (Societe Tunisienne d'Electricité et de Gaz), the public utility, and 471MW to a single private producer (Carthage Power Company). The production of electricity increased from 12,091 GWh in 2005 to 18,988 GWh in 2018, recording a growth rate annual average of 4%

The electricity sector in Tunisia is mainly made up of thermal power stations, being therefore the largest consumer of gas natural; which represents 97%of source of electricity as shown in figure 20.



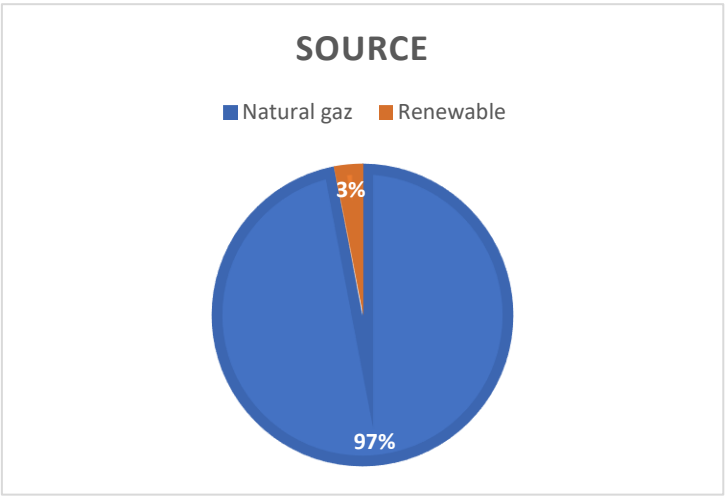


Figure 19: Electricity Production by producer

Figure 20: Electricity production by source

Given the evolution of natural gas prices, the electricity sales tariffs were subject to several increases. As an example, the prices charged for electricity to companies connected to the medium voltage network and having subscribed to the uniform tariffs have witnessed an increase of around 41%since 2010.

RE Market size

Potential and Resources

Tunisia has significant renewable energy resources, particularly in solar energy and wind energy. The exploitable potential of photovoltaics in Tunisia is estimated by ANME (Agence NAtionale pour la MAitrise de l'Energie) to be several hundreds of GW. The average global horizontal radiation (GHI) is the order of 1850 kWh/m^2 , which translates into an average annual production of solar PV systems of around 1650 kWh/kWp.

The country has a significant wind potential according to the Wind Atlas developed by ANME. The Atlas indicates that the wind conditions are good (speed greater than 7m / sec at 60 meters height) in the region of Nabeul and Bizerte and in the central zone of Kasserine, Tataouine, Médenine, Gabès. This Atlas will help in the choice of wind potential sites to carry out a measurement campaign and will allow the reduction of wind farm construction times. The potential is estimated at 8,000 MW.

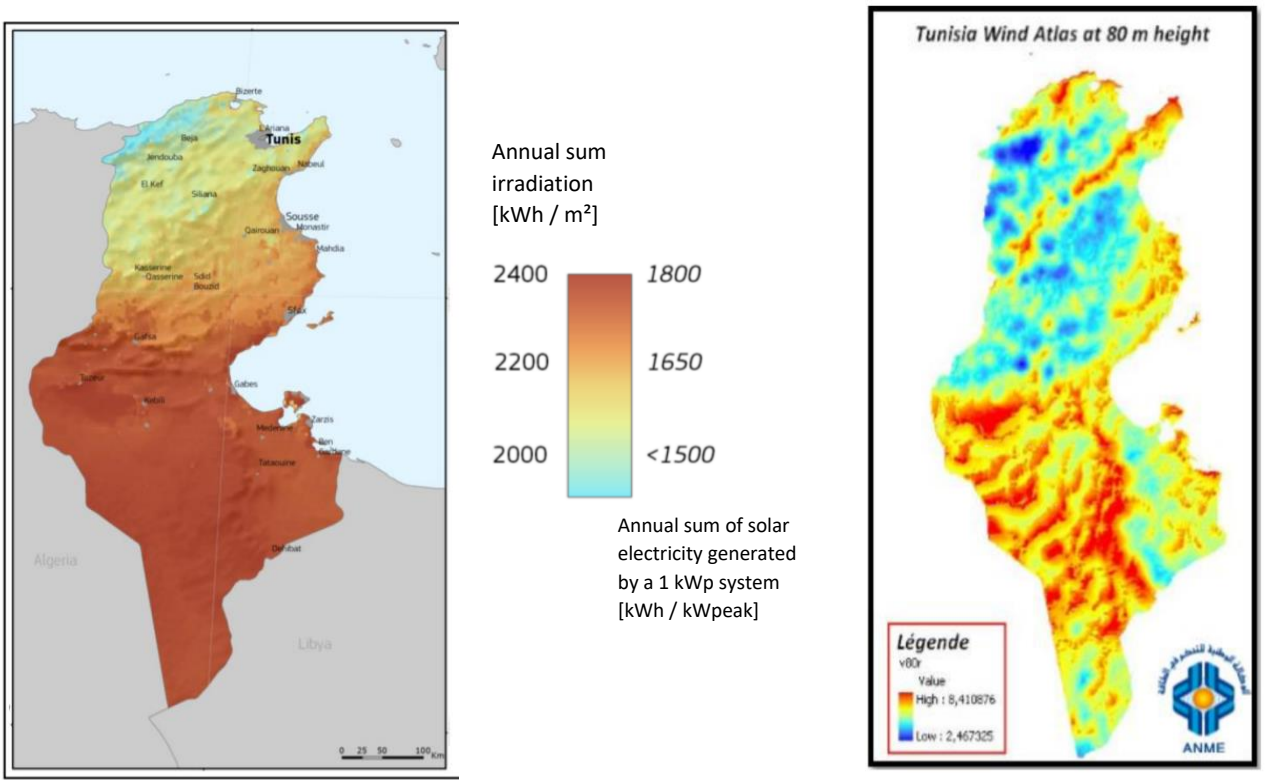


Figure 21: Global Irradiation and solar potential and Wind Atlas

Key Achievements

Despite the importance of these resources, the harnessing of renewable energies remains limited at present (at the end of 2018) in Tunisia and achievements in this area are summarized as follows:

- Construction of two wind farms with a total capacity of 245 MW in the north of the country;
- The installation of a total power of more than 55 MW of solar PV energy as part of self-consumption electricity projects connected to the network (mainly connected to the Low Voltage network);
- The installation of a total hydropower capacity of 62 MW;

- The installation of a total surface area of around 980,000 m^2 of solar collectors for heating sanitary water.

Roadmap and objectives

To deal with its energy situation, Tunisia has adopted a strategy of energy transition which is based on two axes including in particular:

- The rational use of energy, with the objective of reducing 30%of its primary energy consumption by 2030, and
- A policy of diversifying its energy mix that is essentially based on the development of energy renewable.

The Tunisian Solar Plan is the national program that helps achieve the objectives of the renewable energy development strategy. It aims to increase the share of renewable energies in **total electricity production from 3%currently to 30%in 2030**. By 2030, the objective of the Tunisian Solar Plan is to install different sources of renewable energy to provide an additional installed capacity of 3,815 MW. The distribution between the different technologies is as follows:

- 1510 MW for solar PV energy,
- 1,755 MW for wind power,
- 450 MW for CSP solar, and
- 100 MW through power plants using biomass resources.

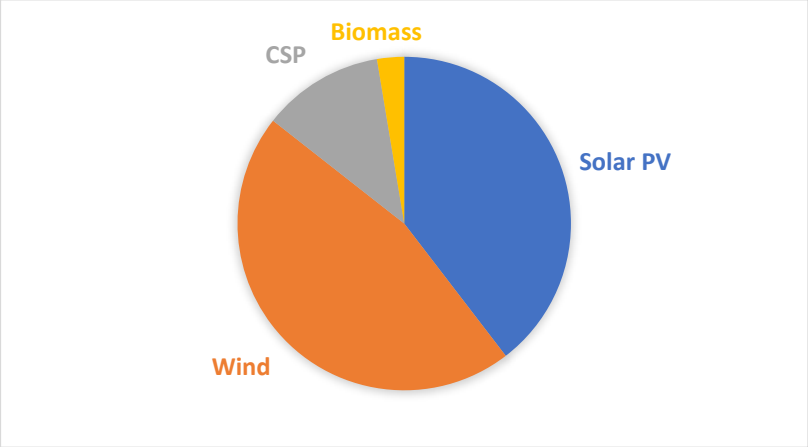


Figure 22: Tunisian Solar Plan by 2030

Existing policies and RE mechanisms

To enable renewable energy development, the Tunisian government passed Law No. 12 on renewable electricity production in 2015. The law provides the framework for large-scale renewable energy projects with three main areas for support:

- Generation for export to other countries (currently not applicable);
- Self-consumption and sale of surplus (net billing and net metering); which allows residential and commercial customers who generate their own electricity from solar power to sell the electricity they aren't using back into the grid.
- Generation to meet domestic needs under a PPA between STEG and private solar developers. The contract runs for 20 years whereby STEG buys the electricity at a fixed price.

Tunisia's PPAs fall into two groups:

a) the authorisation regime, covering projects below 10 megawatts (MW) for solar and 30 MW for wind, awarded through simple tenders; and

b) the concession regime, covering projects over 10 MW for solar and over 30 MW for wind, awarded via competitive concessions.

As a consequence of these policies, in September 2020, Tunisia's Ministry of Energy, Mines and Renewable Energies has kicked off a fourth tender to develop and build several solar power plants for a total capacity of 70 MW in size. In its first tender in May 2017, the Tunisian government contracted seven 10 MW projects from domestic companies and Tunisian-international consortia.

The government launched a second tender for 70 MW of solar last year. The authorities decided on six 10 MW projects proposed by Tunisian and international developers. The government launched a third tender in July 2019, and finalized a 500 MW solar tender in December 2019.

In 2019, Tunisia has granted licenses to four European firms (ABO WIND AG, UPC Tunisia Renewables, LUCIA HOLDING and VSB Energies Nouvelles) worth $134m for the production of 120MW from wind

Stakeholder Mapping

Ministry in Charge Of Energy	It is both the granting and regulatory authority. Its main mission is to define the strategic orientations of the energy sector, to set energy prices, the prices for the sale of surplus electricity from auto/producers and the price of transport. Within the Ministry in charge of Energy, the Directorate General of Electricity and Renewable Energies (DGEER) is in charge of issues relating to renewable energies. In particular, it publishes the various calls for projects or calls for tenders in the sector.
Technical Commission For Private Electricity Production From Renewable Energies (CTER)	Its mission is to issue an opinion on the applicants for tenders on renewable energies, as well as the extension and withdrawal of authorization.
National Agency For The Rational Use Of Energy (ANME)	It is a public establishment placed under the supervision of the Ministry in charge of energy. ANME designs and runs energy efficiency and renewable energy development programs. Its mission is to implement the State policy in the field of rational use of energy by studying and promoting energy efficiency, renewable energies and energy substitution.
The Tunisian Company Of Electricity And Gas (STEG)	It is the public company of electricity in Tunisia. Initially a vertically integrated monopoly, it is today a dominant player in production, is the sole buyer for all electrical energy produced in Tunisia and has a monopoly on the transport, distribution of electricity in Tunisia.
Independent Power Producers (IPP)	Carthage Power Company is the only IPP present and in the operating phase in Tunisia to date. Its activity is dedicated to the resale of electricity to STEG. In 2017, it represented 8.9%of the total installed capacity in Tunisia, i.e. 471 MW. However, the number of IPPs is set to increase significantly in the coming years, depending on the progress of the RE projects under authorization and concession mechanisms.

Financing schemes

Credit lines to Tunisian banks by development institutions

- Between 2017 and 2018, a total of 40 million euros **from the SUNREF credit line** was granted by AFD to three major Tunisian banks; UBCI, UIB and Amen Bank. The credit line is dedicated to finance green projects. Projects dedicated to the production of electricity from renewable energy (IPPs, connected to the grid) and other projects renewable energies (in particular solar PV for self-consumption or irrigation and solar water heaters, wind power, etc.) are eligible for funding supported by SUNREF, as the program primarily targets SMEs.
- The International Finance Corporation (IFC), a subsidiary of the World Bank, has lent 40 million euros to Attijari Bank Tunisia. The loan agreement was concluded in October 2018. This credit will be used to finance and support small and medium-sized enterprises (SMEs) in the energy sector renewable.

Tunisian Investment Fund (FTI)

The Fund is created by Law No. 2016-71 of September 30, 2016 and exercises its missions under the control of a supervisory commission, chaired by the minister of investment. The resources of the fund consist of state resources, loans and grants from inside and outside. Its interventions include:

- The release of investment subsidies t priority sectors including the production of electricity from renewable energies.
- Equity participation

Job creation and education system

According to ILO recent study, up to 10,000 additional jobs can be expected from the Tunisian Solar Plan if large parts of the systems have to be imported. However, if the Tunisian economy achieves higher integration rates and manages to produce most parts of the RE systems within the country, employment may increase by almost 30,000 jobs.

Green jobs are created in construction, the electronics industry, construction materials and the electricity sector itself. The impact on construction derives from investment in wind farms and other RE-based electricity generation systems, as well as from the increased energy efficiency of homes.

Concerning the RES trainings, there is a variety of relevant courses in the country, delivered both by private and public training institutes. Most of the registered courses, are organized by ANME within the framework of the international cooperation projects, and in collaboration with the key players in the sector (professional, academic, private sectors etc.) [6]

[6] Full list of training courses available in this RCREEE report https://www.rcreee.org/sites/default/files/a21_marketsurveytraining-final.pdf

CONCLUSION: COMPARATIVE ANALYSIS BETWEEN THE COUNTRIES

Country		Egypt	Jordan	Malta	Tunisia
Electricity Market	Market structure	The transmission and distribution of electricity are carried out by one vertically integrated company, Egyptian Electricity Holding Company (EEHC). Generation is open to private sector (IPP)	A single buyer model where the power generation and distribution are privatized sectors while transmission is held by the NEPCO, the single state owned transmission system operator and the only authorized energy off-taker.	The generation, distribution and supply of electricity are carried out by one vertically integrated company, Enemalta	A single buyer model where the power generation is privatized while transmission and distribution is held by the STEG, the single state owned transmission system operator and the only authorized energy off-taker.
	Electricity Mix	66%natural gas, 8%RE	55%Natural gas, 26% Oil and 19%RE	46%natural gas, 46% oil, 7%RE	97%natural gas, 3%RE
	Capacity installed	38,857 MW	5,236.4 MW	540MW	5,467MW
RE Market size	Capacity installed of RE	6000MW, 2832MW from hydro, 1375MW from wind, 1587 MW from PV, 140MW from CSP and 11.5 MW from biomass	600MW	112MW PV	360 MW including 60MW from hydro
	Objectives and strategy for RE	20%by 2022 and 42% by 2035	10%by 2020. 2,000 MW from wind and solar by 2020	10%by 2020	30%by 2030
	Available Technologies	Hydro, wind, PV, CSP	Wind, PV, CSP	PV, SWH, waste to energy	Hydro, wind, PV, SWH
Existing RE mechanisms	Auction	Yes	Yes	No	Yes
	FiT	Yes	No	Yes	No
	Net metering	Yes	Yes	Yes	Yes

Stakeholder Mapping	Agency in charge of RE	New and Renewable Energy Authority (NREA)	Energy and Minerals Regulatory Commission (EMRC)	Regulator for energy and water services Malta (REWS)	Agence Nationale pour la Maitrise de l'Energie (ANME)
Financing schemes	Multilateral Banks financing scheme	Egypt Sustainable Energy Financing Facility (EgyptSEFF) and Green Economy Financing Facility (GEFF) for Egypt promoted by EBRD	SUNREF by AFD GEFF-Jordan by EBRD	European Structural and Investment Fund for Energy Efficiency and Renewable Energy by EIB	SUNREF by AFD
	Government loan schemes	N/A	Jordan renewable energy and energy efficiency fund (JEEEF)	N/A	Tunisian Investment Fund (FTI)
Job creation and education system	Number of jobs created/ to be created	14,344 in 2018	N/A	N/A	10,000 by 2030

All 4 countries have strategies and RE objectives by 2020 and/or 2030 and beyond. This demonstrates the importance of RE in electricity mix and the vision that each country has about energy security and diversity.

However, in terms of realizations Jordan and Egypt are more advanced than Tunisia and Malta. This is due to the fact that they both have RE policies that attract foreign investors and developers and ensure project bankability. For Malta, land restrictions seem to be the main reason that is slowing down RE projects as for Tunisia, the lack of regulator makes the process less transparent.

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MENA Power Investment Outlook: 2019-2023

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