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EBSOMED
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INDUSTRY OUTLOOK

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EBSOMED Employers thematic committees

Education and R&D on Energy Technologies

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Analysis of New Energy Technologies and sector in Egypt,

Jordan, Malta and Tunisia

Contents

List of Figures

Acronyms

AFD	Agence Française de Développement
BOO	Build Operate Own
BOOT	Build Operate Own Transfer
BSO	Business Support Organizations
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 the first part 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.

After conducting a literature review of the energy market in all 4 countries, the second part of the study is more focused on the current education and R&D programmes available and/or planned in each country. This section is based on interviews conducted with country experts and stakeholders involved in the education and R&D identified by each member of the EBSOMED technical committee.

The last part of the report analyses the main findings and provides the technical committee with best practices and a set of recommendations of how measures can be adapted into other countries.

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.

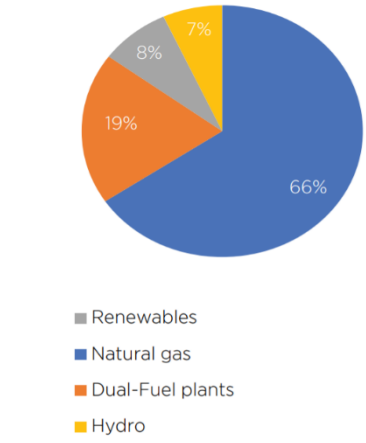


Figure 1: Electricity generation and sources in Egypt in 2015

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).

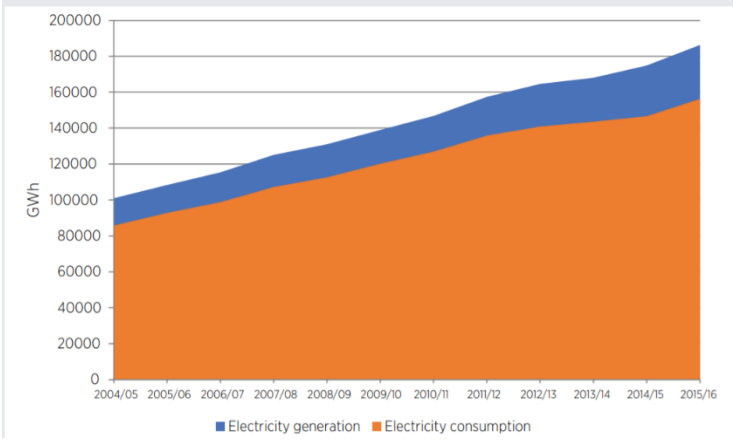


Figure 2: Evolution of Electricity generation and consumption in Egypt from 2004 to 2016

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.

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.

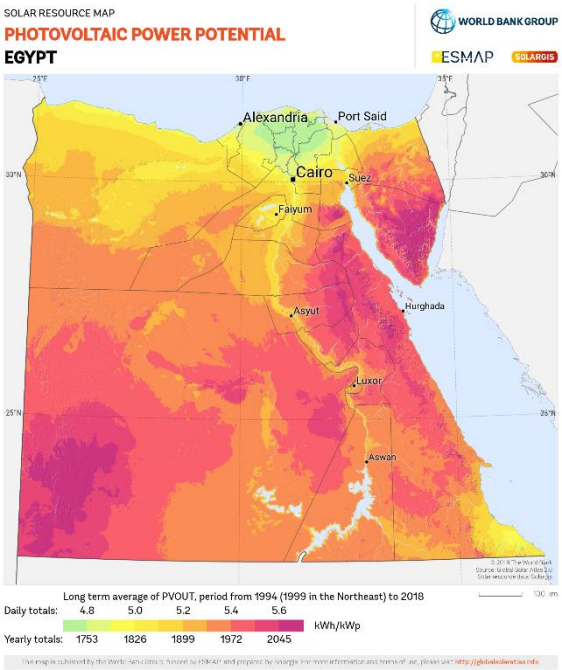
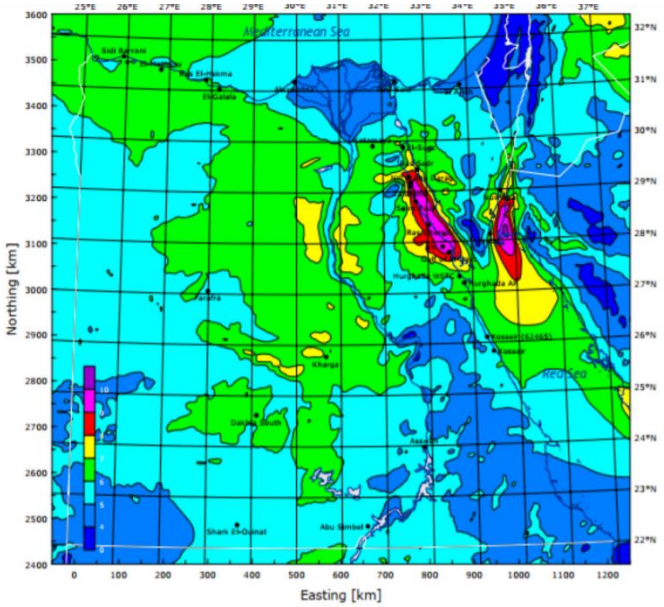


Figure 4: Egypt Solar Resource Map



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.

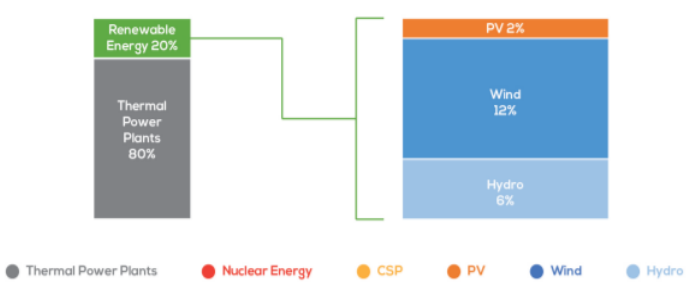


Figure 6: Electricity Production by 2022

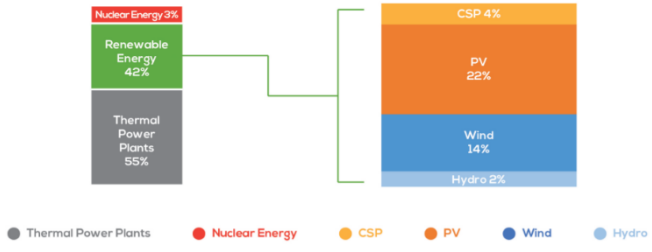


Figure 5: Electricity production by 2035

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:

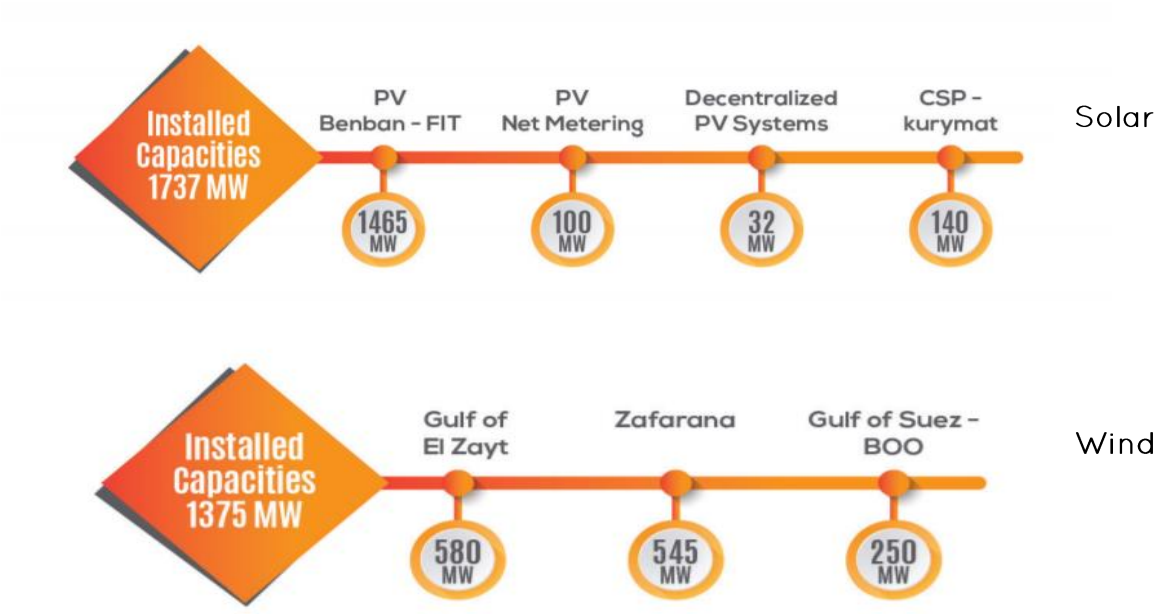


Figure 8: Installed RE capacity per mechanism

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%

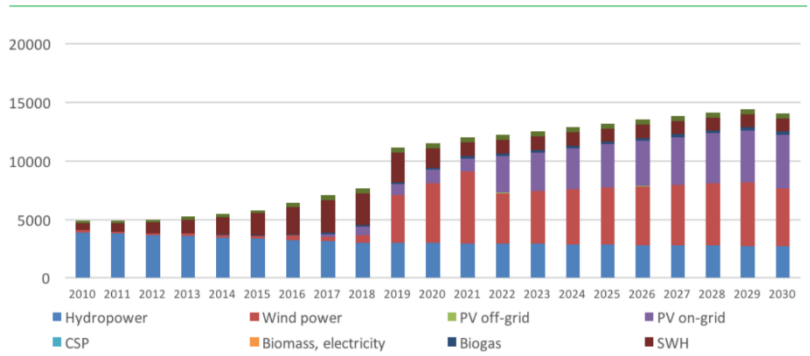


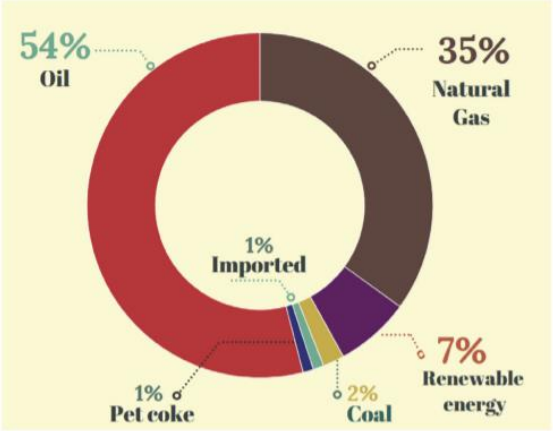
Figure 9: Direct jobs created by RE sector per technology in Egypt from 2010 to 2030 (RCREEE)

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.



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.

Figure 10: energy production per source

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.

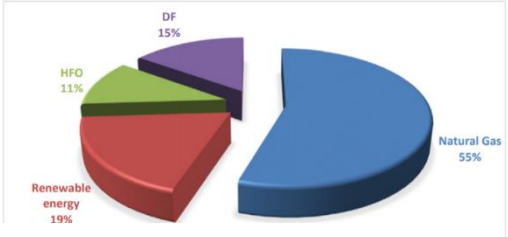


Figure 12: Electrical power generation by source in 2018

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.

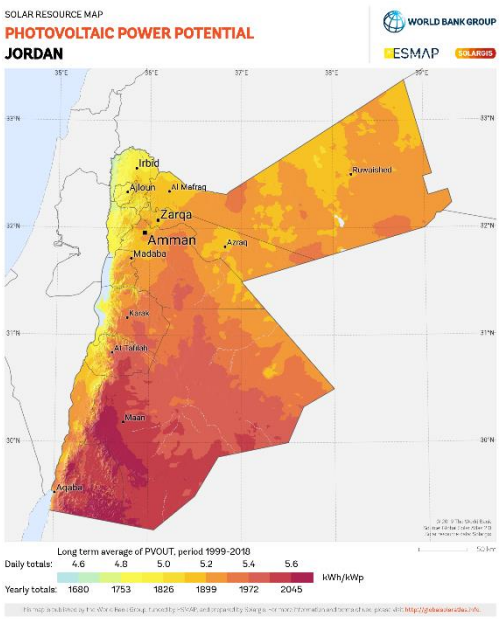


Figure 13 Jordan Solar Atlas

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.

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.

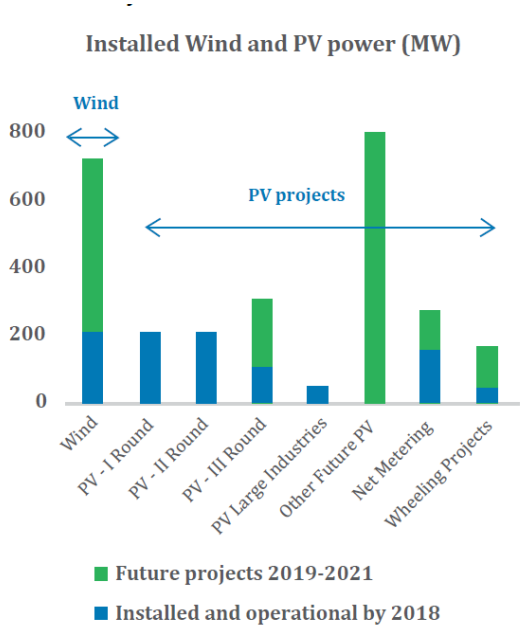
Roadmap and objectives

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.



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.

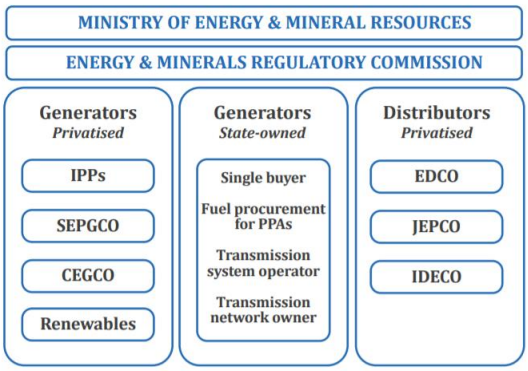
If all those projects will effectively come on- line, Jordan will be able to overcome its 2020 targets, installing over 1.5 GW of solar PV plants, 723 MW of wind power and 447 MW of distributed electricity generation under net Metering and Wheeling mechanisms.

Figure 14: Installed Wind and PV power (MW)

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.

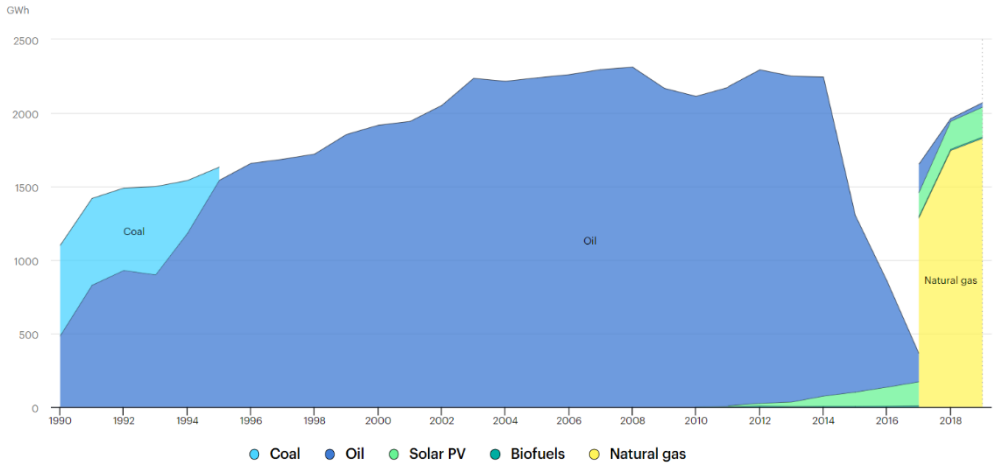


Figure 15: Electricity generation by soucre, Malta 2009-2019 (IEA)

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:

- 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

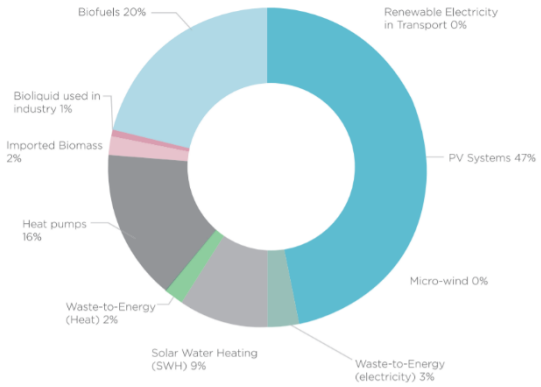


Figure 16: Contribution by technology as a percentage share of the overall target by 2020

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.

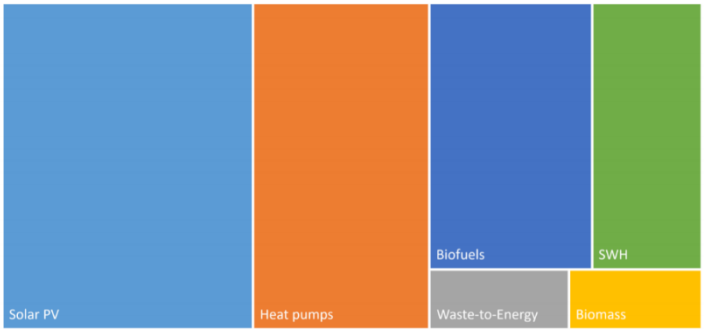


Figure 17:Share of RES technologies in consumption in 2017

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.***

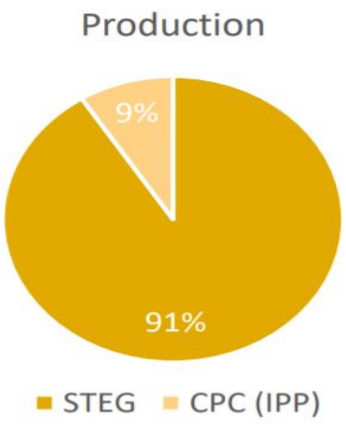
- Over the period 1990-2018, primary energy consumption more than doubled, from 4.4 Mtoe to 9.5 Mtoe.
- At the same time, primary energy production fell from 5.4 Mtoe in 1990 to 4.6 Mtoe in 2018.
- This deterioration in the energy balance has especially accelerated since 2010; the country's **energy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



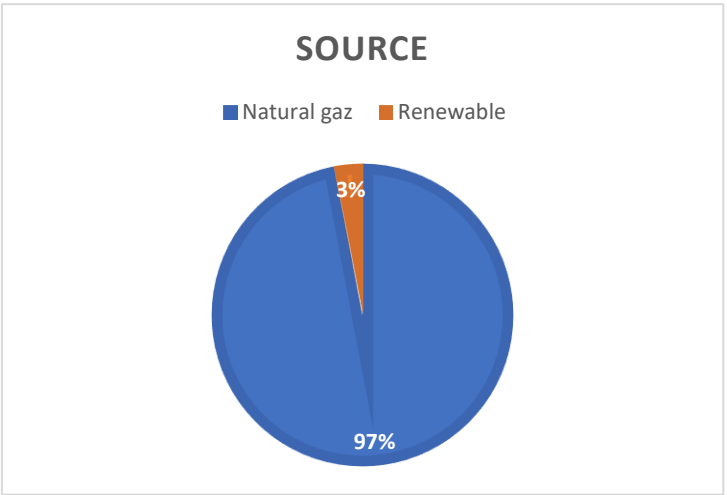


Figure 19: Electricity Production by producer

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.

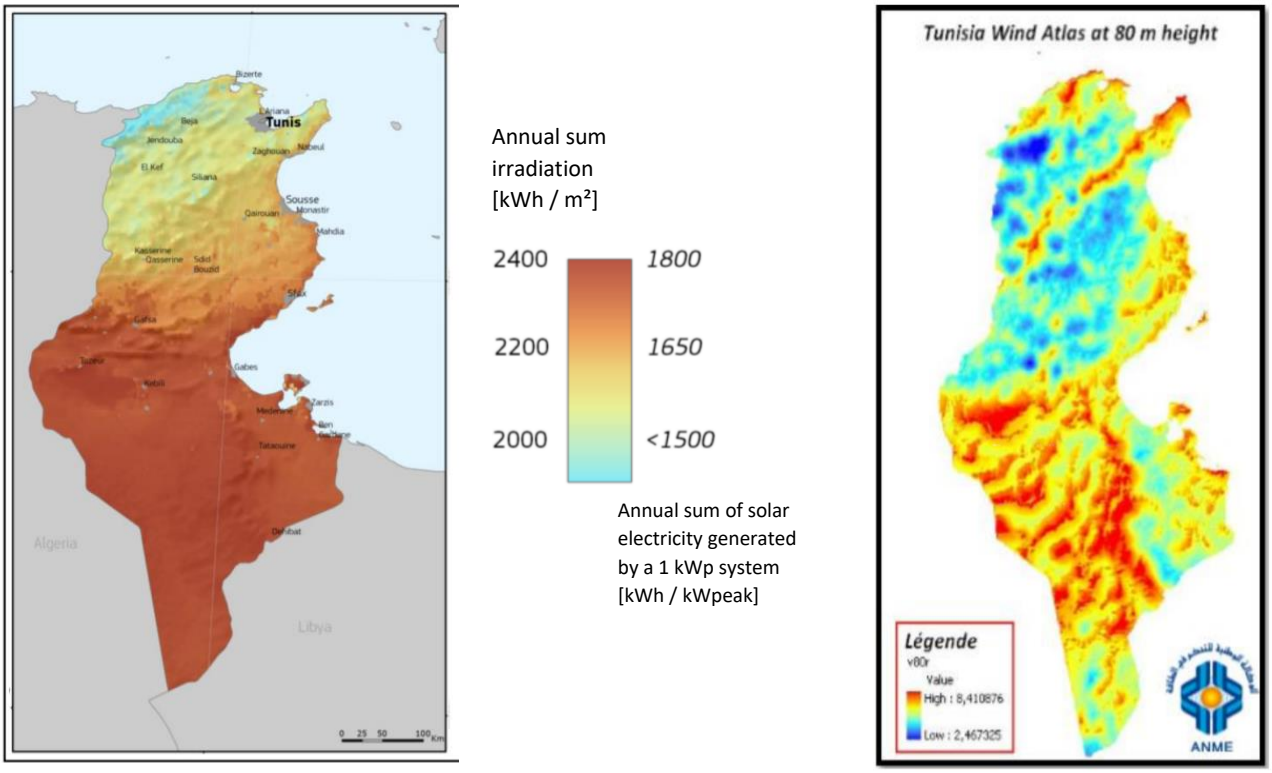


Figure 21: Global Irradiation and solar potential and Wind Atlas

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.

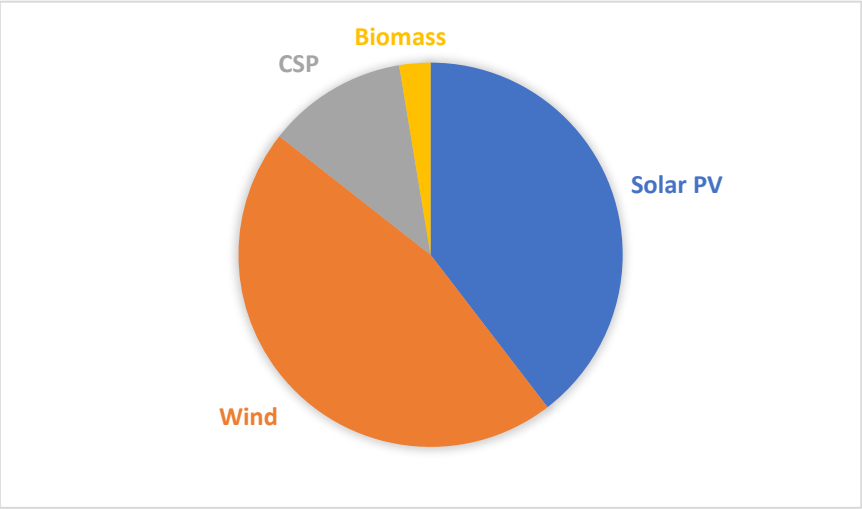


Figure 22: Tunisian Solar Plan by 2030

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

ENERGY EDUCATION AND R&D

After conducting a literature review of the energy market in all 4 countries, this part of the study is more focused on the current education and R&D programmes available and/or planned in each country. This section is based on interviews conducted with the following country experts and stakeholders involved in the education and R&D identified by each member of the EBSOMED technical committee:

COUNTRY EXPERTS INTERVIEWED	POSITION AND INSTITUTION
PROF. LUCIANO MULE STAGNO	DIRECTOR OF INSTITUTE FOR SUSTAINABLE ENERGY, UNIVERSITY OF MALTA
CAMILLERI GLORIANNE- BUGEJA GEORGE – DR. CINI MELCHIOR - GRECH JACQUELINE	R&I PROGRAMMES UNIT, MALTA COUNCIL FOR SCIENCE & TECHNOLOGY
ENG. WAFAA ISMAIL ABDALLAH	ENERGY SECTOR HEAD / ECO FEI
DR. MOHAMED MEGAHED	DEPUTY MINSTER OF EDUCATION FOR TECHNICAL EDUCATION
PROF. WISSEM DIMASSI	DIRECTOR OF THE NANOMATERIALS AND SYSTEMS FOR RENEWABLE ENERGY AT LE CENTRE DE RECHERCHES ET DES TECHNOLOGIES DE L'ENERGIE (CRTEN)
PROF. ABDELMAJID JEMNI	DIRECTOR OF LABORATOIRE D'ETUDES DES SYSTEMES THERMIQUES ET ENERGETIQUES AT ENIM
ENG. SAMER ZAWAYDEH	JORDANIAN ENERGY EXPERT
PROF. AHMED AL-SALAYMEH	PRESIDENT OF THE NATIONAL UNIVERSITY COLLEGE OF TECHNOLOGY IN JORDAN
ENG. FADI MARJI	PRESIDENT OF THE NATIONAL SECTOR SKILLS COUNCIL

Complementary information was further collected from internal reports and presentations shared by the interviewees. The interview addressed the following questions:

Education programmes

1. What programmes are being given by academic institutions in RE/EE in your country?
1. Is RE/EE education being given at
    - Secondary level
    - University level: undergraduate and/or postgraduate
    - Vocational Training
    - Industry level
2. Can you provide us with flagship RE/EE education programmes in your country?

Skill Gap analysis

3. In your opinion, what skill shortages are there in the energy sector?

4. Are industries involved and consulted by academia when developing the curricula of the courses?

R&D institutions

5. What are R&D institutions doing in expanding the utilisation of RE technologies in your country?
6. At what level is the industry involved in the research projects of R&D institutions?
7. Are there existent structures that allows for communication between R&D institutions and industry?
8. What is a prominent example of R&D-industry cooperation project or programme in energy?
9. What are challenges that hinders R&D-industry cooperation in the energy sector?
10. Are there governmental and international programmes dedicated to R&D-industry cooperation in the energy sector?

Education and R&D in Egypt

In Egypt, there are 30 public universities and around 30 private schools and most of them offer energy courses in the mechanical or electrical engineering in addition to dedicated green energy undergraduate/postgraduate programs. Below is a list of the main programs:

#	University	Program	Degree
1	Cairo/Kassel University	Renewable Energy and Energy Efficiency (REMENA)	Master's Degree
2	Cairo University	New and Renewable Energy	Graduate Diploma
3	Cairo University	Green Process Engineering	Master`s Degree
4	Aswan University	New and Renewable Energy	Bachelor's Degree
5	Aswan University	New and Renewable Energy	Graduate Diploma
6	Aswan University	New and Renewable Energy	Master's Degree
7	Zewail City of Sci.&Tec.	Renewable Energy Engineering	Bachelor's Degree
8	Banha University (Shoubra)	Power Engineering and Sustainable Energy	Bachelor's Degree
9	American University in Cairo	Sustainable Development	Graduate Diploma
10	American University in Cairo	Sustainable Development	Master's Degree
11	American University in Cairo	Sustainable Development	Dual Degree
12	Egypt-Japan Univ. of Sci.&Tec.	Energy Resources Engineering	Master's Degree
13	Alexandria University	Techniques and Materials of Renewable Energy	Master's Degree
14	Ain Shams University	Energy and Renewable Energy Engineering	Bachelor's Degree
15	Ain Shams University	New and Renewable Energy	Graduate Diploma
16	Helwan University	Energy Program Engineering	Bachelor's Degree
17	Mansoura University	Renewable Energy Systems	Graduate Diploma
18	Menofia University	Renewable and Sustainable Energy Engineering	Bachelor's Degree
19	Tanta University	New and Renewable Energy Systems (Mechanical)	Graduate Diploma
20	Tanta University	New and Renewable Energy (Electrical)	Graduate Diploma
21	South Valley University	Renewable Energy Physics	Graduate Diploma
22	Port Said University	New and Renewable Energy	Graduate Diploma
23	British University in Egypt	Renewable Energy Engineering	Master of Science
24	British University in Egypt	Renewable Energy Engineering	Master of Engineering
25	British University in Egypt	Sustainable Design Engineering	Master of Science
26	British University in Egypt	Sustainable Design Engineering	Master of Engineering
27	Badr University in Cairo	Environmental and Energy Engineering	Bachelor's Degree
28	Heliopolis University	Energy Engineering	Bachelor's Degree

In addition to renewable energy educational formal programs, there are numerous TVET (Technical and Vocational Education and Training) programs implemented in technical schools in Egypt with particular focus on the maintenance and installation of solar technology. TVET in RE and EE is supported by development agencies and programs such the EU TVET programme, or the GIZ as well as the USAID programmes in RE and EE. For example, the EU TVET programs helped technical schools acquire modern equipment for solar and wind technologies for illustration purposes. The USAID WISE (Workforce Improvement and Skills Enhancement) project helped design curriculum for energy programs based on competency-based approach, and was implemented in a number of schools such as in Aswan and Hurghada. The coordination of these projects was administered by the Ministry in charge of Education. Thanks to this support, 10 technical schools/advanced technical schools and those operating by dual system offer RE training mainly in solar energy and a few in wind energy, across 11 governorates.

The advantage of the technical education is that it provides hands on practical trainings unlike the formal education which is more theoretical, particularly when the schools are located nearby solar stations like in Aswan where the Benban solar complex is. In fact, many private developers in the Benban are very cooperative

and involved in training students and developing the curriculum. For example,[7], Alcazar Energy launched a summer training program for students of Benban Solar Technical School in collaboration with the USAID WISE project.

Technical education has an ambitious objective in cooperation with the German government, through KFW funding, to establish a number of centres of excellence in RE and EE across different parts of Egypt. In parallel, the university of Ain Shams[8] in partnership with the Massachusetts Institute of Technology is hosting USAID's Centre of Excellence for Energy. The Centre informs national energy policy formation, links education and research into renewable energy solutions with entrepreneurs, promotes energy efficiency, and develops innovative applied research solutions utilizing both conventional and alternative energy sources.

From the interviews with Egyptian stakeholders, it was identified that despite the wide range of engineering and postgraduate courses in RE and EE, some aspects are not fully covered and needs further trainings. It was highlighted that they cover all theoretical aspects but what is still missing is the technical skills, and field exposure. This is of course being offered to technical education programs, but higher education is lacking the hands-on learning and exposure to real projects, and integrate construction and/or maintenance skills to their curriculum.

There is no detailed nor public information about the funds received for energy R&D projects, however one main source of funding identified is the Science and Technological Development Fund. It is a public fund that has stimulated the Egyptian scientific society by funding distinguished research papers and establishing scientific partnerships with scientists from many advanced countries in order to keep track of quickly advancing technology, and be open to different societies, as well as, new economic unions, compete on the international arena, link scientific research to technological development and cooperate with civil society institutions to activate their role in the integrated scientific research system. One of the topics for call for grants is renewable energy.

To enhance the cooperation between the industry and researchers, The Egyptian Renewable Energy Cluster Initiative – ERECI – was launched as an initiative financed by the Egyptian Ministry of Scientific Research. ERECI project aims to set-up a stable cluster organization in the Renewable energy field in order to support the Egyptian industrial development and enhance the partnership among Institutions, researchers and enterprises. The principal purpose of the cluster initiative is to support job growth and new technology development in the strategic field of renewable energy. The Cluster include the following partners:

[7] https://alcazarenergy.com/alcazar-energy-launches-summer-training-program-for-students-of-benban-solar-technical-school-in-collaboration-with-the-workforce-improvement-and-skills-enhancement-wise-a-usaid-funded-project/

[8] https://www.usaid.gov/egypt/higher-education/center-excellence-energy

Project local partners

- Cairo University
- The American University in Cairo
- Federation of Egyptian Industries / environmental copliance office and sustainable development FEI/ECO SD
- Helwan University
- Industrial Modernisation Centre

Project international partners

- Innova Bic – Italy
- New Frontier Services – Belgium
- Oxford Research – Denmark
- Università di Messina – Italy

Education and R&D in Jordan

There are about 30 universities in Jordan, of which 11 state universities and the rest are private. Engineering education is available at all state universities, but only offered in some of the private universities as shown in the table below. In 2016, about fifteen universities are offering courses related to energy and/or RE in their study plans for various engineering disciplines as mandatory or elective courses. The renewable energy stream, in Jordan, is relatively new and such a new specialty in engineering became as a fashion in both of state and private universities. Moreover, currently, few universities are offering MSc courses in energy but under different titles like RE, energy efficiency and environment, energy management and alternative energy technologies.

Universities offering general or specialized courses related to energy education.

University	Status	Dept.	Course		
			Title	Compulsory	Elective
Jordan	State	Mechanical	Solar Energy		x
			Energy conversion		x
Mutah	State	Mechanical	Renewable Energy	x	
			Energy conservation & Power Generation	x	
Alelbit	State	Architecture	Energy Sources		x
		Civil	Energy Sources		x
		Sustainable & Renewable Energy	All special courses	x	
Yarmouk	State	Civil	Alternative Energy		x
		Electrical	Alternative Energy		x
		Mechanical	Energy Conversion & Renewable Energy	x	
			Solar Energy		x
JUST	State	Chemical	Renewable Energy		x
		Mechanical	Renewable Energy	x	
			Wind Energy		x
			Concentrated Solar Power		x
			Photovoltaic		x
Al-Balqa'	State	Mechanical/Husun	Energy Conversion	x	
			Solar Energy	x	
		Mechanical/FET	Energy Conversion & Alternative Energy	x	
Al-Hussain	State	Environment	Renewable Energy		x
		Civil	Renewable Energy		x
		Mechanical	Energy Conversion	x	
German-Jordan	State	Energy	All special courses	x	
Hashemite	State	Mechanical	Renewable Energy		x
			Energy Conservation		x
		Electrical	Principles of Renewable Energy Systems		x
		Architecture	Architecture & Building		x
			Green Building		x
Applied Science	Private	Mechanical	Solar Energy		x
Zarka	Private	Mechanical	Renewable Energy		x
		Energy	All special courses	x	
Azituna	Private	Civil	Energy Principles		x
		Architecture	Energy Principles		x
		Power & Control	Energy Principles		x
			Renewable Energy		x
		Mechanical	Solar Energy		x
Philadelphia	Private	Mechanical	Solar Energy		x
American	Private	Mechanical	Energy Conversion	x	
			Renewable Energy	x	
			Solar Energy		x
Middle East University	Private	Renewable Energy	All special courses	x	
Irbid Private University	Private	Electrical	Renewable energy systems	x	

One of the main flagship education programs is the Renewable Energy Master at the University of Jordan launched by the now-called Water, Energy and Environment Centre back in 2012. This master came to fill a skill gap of RE/EE engineers back in 2008-2010 and it was funded by the now-called ERASMUS program supported by the EU. Through the EU assistance and support of higher education institutions in Jordan, the University of Jordan developed an RE/EE curriculum and its accreditation in partnership with universities from UK, Sweden and Italy. The 2-year Master program was then implemented in 2 other Jordanian universities, one in the North of Jordan and one in the South. Part of the master is for students to spend two weeks in one of the European partnering countries. The

University of Jordan accepts 15 students yearly out of 100 applicants. The programme is financially sustainable but seeks funds to allow students to be exposed to other universities through the exchange programs.

In the first years of the master, where there was not a lot of dedicated RE programs, graduates would find jobs easily. However now, the market cannot absorb all the graduates. One of the recommendations is that Jordan should review and increase its RE targets by 2030 as there are a lot of unexploited potential and there is more room for new technologies such storage technologies, electric vehicles and also a better implementation of energy efficiency in buildings and at industry level. With this, new employment opportunities will be generated.

One other aspect of education in Jordan is that there is currently a development of TVET programmes and structures applied to renewable energy. The purpose is to train students on maintenance of RE power plants, particularly after the installation of many solar and wind projects across Jordan. For example, the National University College of Technology is providing specialized technical diplomas in the field of renewable energy maintenance and electric and hybrid vehicles. In addition, a new structure has been recently launched called National Skills Council for Water and Energy. In general, the National Skill Council mission is to provide strong employer leadership that is capable of delivering sustained improvements in public and private sectors' productivity and competitiveness through the better use and development of people's skills. It provides bridges between the labour market and the education and training systems to improve the match between demand and supply on the labour market in the energy and water sector. One way of reaching this goal is advocating for and contributing to improvements in the TVET sector.

Other identified skills that need to be further enhanced is the financial education of RE/EE projects that is lacking in the education programs and has been so far addressed by international programs such as RENAC Green Banking MENA addressed to professionals.

To better bridge the gap between the labour market and the education system, it is therefore recommended to focus more on technical education that provides trainings on maintenance of solar projects and include hands-on modules into existent curriculum as well as adding finance and profitability assessment courses to higher education programs.

In terms of the private sector involvement in the education program, companies are consulted by universities to provide their feedback on curriculum through sent questionnaires. However, this is not systemized but rather based on individual initiatives of the program directors or it is a requirement from European projects funding the education program. The private sector contribution is still considered little and should be further enhanced by creating a body similar to the National Skill Council on higher education that can supervise and harmonize the private sector participation. In addition, it has been noted that most universities require their students to spend 8 weeks within a company as part of their curriculum, but this is a very limited time for students to acquire on-job training. One of the best practices identified is a 6month internship in Germany organized by the Jordan Germany University.

R&D in RE and EE is quite limited in Jordan due to the lack of doctoral programs around this topic and to dedicated green technologies R&D organizations. It seems that it is individual initiatives that pursue bilateral programs such as an upcoming one with the Technical University of Hamburg for a PHD on green technologies.

Institutionally, there is the National Energy Research Center part of the Royal Scientific Society which has many testing labs : energy labelling, lighting testing, PV system testing, solar thermal testing. Recently, the National Energy Research Centre, in collaboration with ENI CBC MED and the Ministry of Education, started implementing the SOLE project which aims to create joint strategies to support cost-effective and innovative energy-saving interventions in the public building sector in order to enhance the capacity of public institutions in Mediterranean countries to plan and implement sustainable energy policies. A pilot project will be implemented in ISKAN AL FAIHA' school, Madaba. The project focuses on increasing the use of efficient and renewable energy-based heating and cooling systems. The project budget is 3.6MEUR mainly financed by the EU/ Under the ENI CBC MED Programme.

Another cited program that was successful in its beginnings but is now not very popular, is the FFF (faculty for factory)[9] program. FFF was created and launched in 2003 from the University of Jordan as a concept aimed to strengthen the role of applied scientific research carried out by academic institutions in cooperation with industry sector to serve the national economy, support the technological component in our pursuit of industrial development and enhance competitiveness. Through this program, a professor is available to work with a company/industry on a particular application or to optimize a process. This is co-financed by the industry and the university. Due to lack of funds, the program has not taken off as planned.

Finally, one of the recommendations was to establish a Centre of excellence for R&D in energy managed by the private sector that should be fully equipped with modern technologies and open to establish cooperation agreements with universities. A more systematic, cohesive and centralized approach was highly recommended as opposed to fragmented initiatives.

[9] http://sites.ju.edu.jo/ar/fff/ENHome.aspx

EDUCATION AND R&D IN MALTA

In Malta, undergraduate and postgraduate programs related to energy are offered by the University of Malta. The university offers a Bachelor of Engineering in Electrical and Electronic Engineering with modules in renewable energy and green systems. The main flagship programme with a focus on clean technologies is the one-year Master of Science in Sustainable Energy[10] offered by the Institute for Sustainable Energy. The Institute was founded in the 90s and was rebranded in 2009, since its creation 11 years ago the master has trained over 60 students. The master contributed in populating many officials in the government and public energy and research agencies and the private sector such as installers and major suppliers.

Initially, the master was very technical but it has integrated many non-technical modules such regulation, policy, economic impact of projects etc. considering that there was a lot of demand from candidates with various background.

The curriculum review is systematic and is based on a survey addressed to different stakeholders including the private sector and industries, it is expected that new modules like hydrogen and storages would be integrated for upcoming classes.

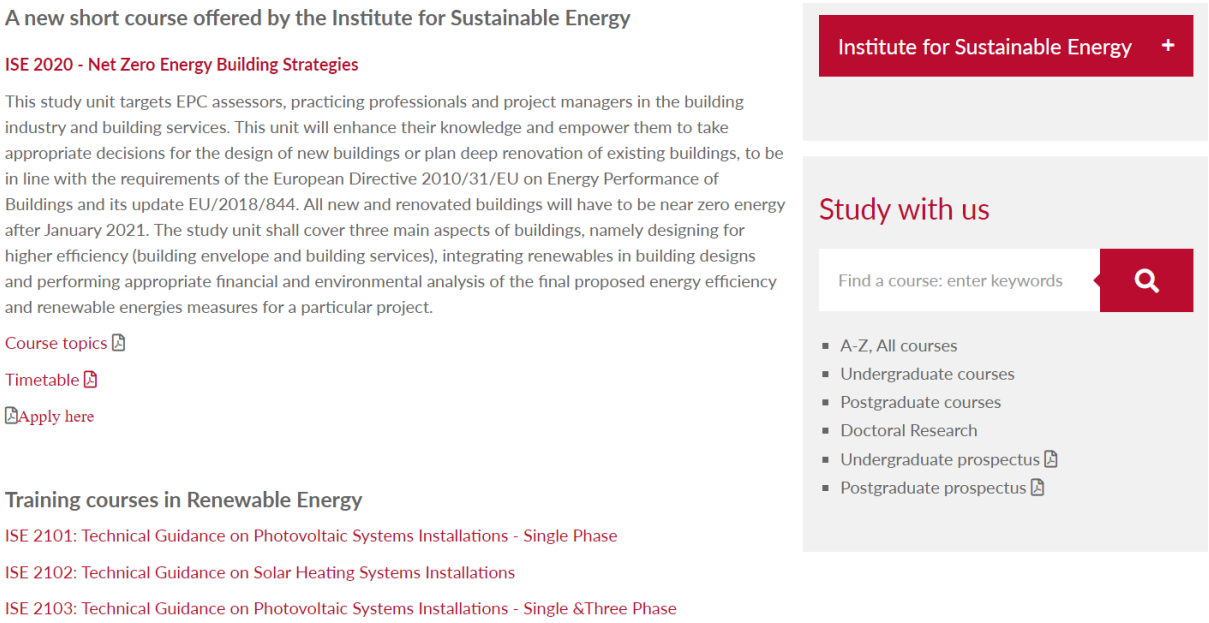
Although education in Malta is free, the tuition fees for the master degree at the University of Malta is 1,000EUR a semester, however the student can claim 75%of this cost from Malta Enterprise scholarship programme.

Malta Enterprise is the country's economic development agency, tasked with attracting new foreign direct investment as well as facilitating the growth of existing operations. it acts as an adviser to government on economic policy due to its close and constant interaction with the main economic players in the country. Malta Enterprise is also the national contact point for the Enterprise Europe Network through which companies based in Malta can develop links with counterparts in over 60 other countries.

In addition to the master programme, the University of Malta offers short technical courses to installers which provides important link to have qualified and eligible installers for PV and SWH. These courses are:

- Technical Guidance on Photovoltaic Systems Installations - Single Phase
- Technical Guidance on Solar Heating Systems Installations
- Technical Guidance on Photovoltaic Systems Installations - Single &Three Phase
- Net Zero Energy Building Strategies

[10] https://www.um.edu.mt/ise/students



A new short course offered by the Institute for Sustainable Energy

ISE 2020 - Net Zero Energy Building Strategies

This study unit targets EPC assessors, practicing professionals and project managers in the building industry and building services. This unit will enhance their knowledge and empower them to take appropriate decisions for the design of new buildings or plan deep renovation of existing buildings, to be in line with the requirements of the European Directive 2010/31/EU on Energy Performance of Buildings and its update EU/2018/844. All new and renovated buildings will have to be near zero energy after January 2021. The study unit shall cover three main aspects of buildings, namely designing for higher efficiency (building envelope and building services), integrating renewables in building designs and performing appropriate financial and environmental analysis of the final proposed energy efficiency and renewable energies measures for a particular project.

Course topics

Timetable

Apply here

Training courses in Renewable Energy

ISE 2101: Technical Guidance on Photovoltaic Systems Installations - Single Phase

ISE 2102: Technical Guidance on Solar Heating Systems Installations

ISE 2103: Technical Guidance on Photovoltaic Systems Installations - Single &Three Phase

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In fact, and 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.

It was identified from the interviews that more efforts should be spent on making the requirements to become installers more rigorous including their training programs. This would help better bridge the gap between the market requirement and the skills set, as well making sure that installations are well constructed and properly maintained. It was also highlighted that more financial education modules should be added to the current curriculum. Finally, topics such transport, waste management and storage technologies are to be considered in higher education programs.

In terms of research, the Institute for Sustainable Energy at the University of Malta was responsible for conducting several research projects funded by both the government and the EU. Some of the research projects identified are:

- The project SolAqua that aims towards installing cost-effective offshore PV installations. Early phases of Solaqua have seen different types of prototypes deployed at sea. These 'proofs of concept' were possible thanks to funding from MCST (Malta Council for Science and Technology) and Malta Marittima (via Maritime Seed Award), with the support of the University's Knowledge Transfer Office (KTO), Take Off and Centre for Entrepreneurship and Business Incubation (CEBI).
- Development of a different type of PV panel for Mediterranean roofs
- Cooling of panels to work efficiently,
- Part of the Horizon project, the institute is the RE partner in a project that aims to capture plastics from the ocean

- Wind storage, the institute has created a spin off company that develops a technology for pumped aired storage
- Promotion of Near Zero CO2 emission buildings due to energy use funded by European Regional Development Fund

In total, the Institute is involved in 10 projects where about 2-3 are EU funded.

Any MCST funding that the university of Malta has received; required as an eligibility condition the involvement of an industrial partner. In addition, for the EU Horizon project, the university of Malta is partnering with many industries from all over Europe. Moreover, the University is in continuous contact with Malta Entreprise and work closely with the organization. In fact, the size of the country makes networking, partnerships and access to industries easy. The biggest challenge for collaboration with the private sector is that the industry in Malta is not very interested in R&D as they do mainly installation and it is sometimes challenging for the University to find the right and appropriate partner to have access to MCST funding programs.

Funding for R&I in the Field of Low-Carbon Technologies

Malta is part of the EU and benefits from any European structural funds dedicated to Research and Innovation. Therefore, the approach is very different from the other MENA countries and avoids any fragmentation of procedures and processes and provides a more cohesive thinking and approach to all involved stakeholders in the sector. In fact, in order to have access to EU R&I funds, Malta needs to establish a Smart Specialization Strategy applicable to sectors that will bring a competitive advantage to the country. In the 2021-20127 Strategy, the use of sustainable use of resource and Maine and Maritime technologies include RE and EE projects. This strategy is conducted by MCST based on a bottom-up approach that involved all parties; CSO, industries, SMEs, researchers, universities, during 2,5 years. With this strategy, MCST applies for EU funding and once it is obtained, it is disbursed to the Ministry in charge of EU affairs which is then in charge of dispatching this amount across all interest stakeholders through calls for projects/applications.

The Malta Council for Science and Technology (MCST), acting for and on behalf of the Foundation for Science and Technology, is a public body established by the central government in 1988 with the mandate of advising government on science and technology policy.

The table below provides an overview of the main existing funds dedicated to R&I in general and to energy in particular:

Fusion Program	FUSION is the programme for the disbursement of public funding for R&I support, managed by the Malta Council for Science and Technology (MCST). The budget is set to approximately €2.2 million annually in the period 2018-2020. FUSION is composed of two programmes: 1. The Commercialisation Voucher Programme (CVP): this aims to improve the development and

	commercialisation potential of innovative research ideas. While the programme does not contribute directly to Malta's R&I expenditure target, it seeks to ensure that the commercialisation potential of proposed innovative solutions is taken into account in the preparatory stages of the project, including the protection of potential intellectual property. 2. The Technology Development Programme (TDP): this aims to support the actual development of innovative projects proposed by public and industrial entities. TDP provides state financing in the form of grants for research, development and innovation in science and technology. Annex 1 provides a list of CVP energy projects [11]
Horizon Europe	Horizon Europe is the EU's key funding programme for research and innovation with a budget of €95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth. The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies.
Horizon 2020 (EU Research and Innovation programme from 2014 to 2020)	Maltese entities are involved in a number of Horizon 2020 projects under the areas of secure, clean and efficient energy as well as climate action, environment, resource efficiency and raw materials. The total budget to Maltese beneficiaries towards secure, clean and efficient energy amounts to approximately €1.174 million since 2014.
Energy and Water Support scheme	The R&I Scheme seeks to support R&I projects whose objectives are in line with national policies and seek to contribute in a tangible manner to addressing one of the following: 1- A national policy priority or challenge in the energy and water sectors; or 2- Economic competitiveness and growth in a variety of national sectors, from an energy and water perspective. The selection and funding of proposals under this Scheme shall be on a competitive basis. The focus is on projects at oriented-basic research and applied research to experimental design stage, that is projects at Technology Readiness Level (TRL) 2-6, with a

[11] since Energy is not a smart specialisation area, the categorisation has been done by the fund administrator to be best of his/her abilities.

	duration ranging between eighteen and twenty-four (18-24) months.
ERDF	Operational Programme 1, which manages Malta's ERDF-CF funds for the 2014-2020 period, provides support for projects within its twelve priority axes; these include low-carbon economy, R&I and low carbon transport. A number of R&I projects relating to the field of low-carbon technologies have received funding through this programme, particularly which establish research infrastructures; these have received over €55 million. The Solar Research Laboratory of the Institute for Sustainable Energy (University of Malta), designed with the primary focus of undertaking research on materials used for solar cells, and the Sustainable Living Complex at the University of Malta, were supported by ERDF funds

An initial stock-taking exercise was carried out by the Energy and Water Agency in 2019 to assess the level of domestic R&I in energy and low-carbon technologies from 2010-2018. An overview of these projects is provided below. This illustrates that the majority of domestic R&I in this field has, so far, been dedicated to energy use in buildings and the development of new technologies.

	SET Plan Actions	No. of Projects	Total Grant Value
1	Performant renewable technologies integreated in the system	7	€1,439,416
2	Reduce costs of technologies	0	
3	New technologies & services for consumers	6	€4,936,855
4	Resilience & security of energy system	7	€1,112,544
5	New materials & technologies for buildings	3	€6,151,588
6	Energy efficiency for industry	1	€194,987
7	Competitive global battery sector (e-mobility)	0	
8	Renewable fuels	9	€6,823,693.57
9	CSS/U	0	
10	Nuclear Safety	0	

EDUCATION AND R&D IN TUNISIA

Almost all engineering schools in Tunisia such ENIT, ENIS, ENIG offer electrical engineering diploma with one or two teaching modules in renewable energy or energy efficiency but the only engineering school that has a dedicated energy engineering diploma is ENIM in Monastir. During the first two years of this diploma, the student is offered a versatile training that ensures a minimum level of competence to integrate all energy aspects across all sectors of the Tunisian industry. The third year, the student chooses a sub-specialization in one of the following 5 options including energy efficiency (EE) or renewable energy (RE) or energy and environment with EE and EnR being the most chosen speciality by ENIM students. These two specializations offer the following job opportunities:

ENIM Specialization	Job opportunities
Energy Efficiency	At the end of this training, the engineering student could occupy the position of consultant engineer in energy economy and optimization. The student can act as an advisor in renewable energies, energy audit or cogeneration or trigeneration installations.
Renewable Energy	At the end of this training, the engineering student could occupy the positions of: renewable energy development manager, renewable energy systems design engineer, renewable energy project manager. The specialization offers the opportunity to work on projects related to solar, wind, hydraulics, geothermal energy... The student is capable to carry out feasibility studies taking into account technical, environmental and regulatory constraints while meeting project profitability, safety and respect for the environment.

Energy master programmes are however more popular in engineering schools with a duration of 24 months, below is the list of masters offered to engineering students:

SCHOOL	Master Programme	Link
ENIT	« International Master Program on Renewable Energy Systems for Africa: Technology and Management »	http://www.enit.rnu.tn/pdf/mastere/PresentationMastereProlMPRESA-TEAM.pdf
ENIM	Master International de Recherche "REMENA " Renewable Energy and Energy Efficiency for the Middle East and North Africa (MENA)	http://www.enim.rnu.tn/fra/s1317/pages/388/REMENA
ENIG	Mastère de Recherche Systèmes Intelligents & Energies Renouvelables	http://www.enig.rnu.tn/index.php?p=contenu&dr=fr&tmp=14&ids=78

ENIS	Mastère de Recherche systèmes électriques & énergies renouvelables	http://www.enis.rnu.tn/fra/pages/420/Syst%C3%A8mes-Electriques-&-Energies-Renouvelables-(SEER)

The two master programmes of ENIM and ENIT are taught in English and are international programs in collaboration with other foreign universities. ENIT master program is in collaboration with Technical University of Munich (TUM), while ENIM REMENA program is in partnership with Kassel University in Germany and Cairo University in Egypt. Upon successful graduation the student will be granted a Master of Science (M.Sc.) double degree from the University of Kassel and the Cairo University or the University of Monastir. The only disadvantage of these programs is the high costs associated to the subscription and there are few scholarships available to finance the tuition fees.

In terms of the involvement of the industries and the private sector in the education programs and developing the curriculum, in Tunisia, any professional master, unlike research master, must include professionals from the private sector. This condition is required by the Ministry of Higher education when submitting a new master degree for approval by the public authority. In addition, most universities on a voluntary basis, consult the private sector and industries through a joint seminar or workshop to get their views and feedback on the modules and content to be taught to students.

It is also worth-noting that the engineering schools in Tunisia thrive to provide the best quality programs and to showcase this, ENIT and ENIM for example have obtained the EUR-ACE label for all their engineering diplomas. The EUR-ACE is a framework and accreditation system that provides a set of standards that identifies high-quality engineering degree programmes in Europe and abroad. It is a certificate awarded by an authorised agency to a HEI (Higher Education Institution) in respect of each engineering degree programme which it has accredited.

Characteristics of the EUR-ACE® label

- It encompasses all engineering disciplines and profiles, is internationally recognised and facilitates both academic and professional mobility.
- It gives international value and recognition to engineering qualifications and is awarded to programmes which fulfil the programme outcome standards as specified in the EUR-ACE® Framework Standards.
- It respects the great diversity of engineering education within the European Higher Education Area and,
- has created a quality system for accredited engineering degree programmes that share common objectives and outlooks.

Although there are diverse programs dedicated the renewable energy, what is still missing in curriculum is modules dedicated to entrepreneurship and business creation, and how to promote an entrepreneurship mindset among the students. In addition, engineering programs lack modules that addresses the policy and regulation aspects of RE and EE in Tunisia, it is very much focused on technical and theoretical information and does mot reflect the current situation neither the incentives to promote clean technologies. For Management schools, there are some efforts to include sustainability modules in their curriculum, but management

oriented universities do not have the right support or vis-à-vis to be able to make these changes and update their courses.

In terms of research and development, there is research and development structure in the Ministry of high education and scientific research dedicated to renewable energy called CRTEn (The Centre of research and technologies of energy). Its mission is to support the development of the national industry in the energy sector, responding to the various requests for expertise inherent in renewable energies, and making R&D a growth engine. Six laboratories are integrated in this centre: LPV (photovoltaic), LSNA (semi-conducteurs, nanostructures and advanced technologies), LaNSER (nanomaterials and renewable energy systems) these laboratories are oriented to research on the electric conversion of solar energy. LPT (thermal processes), LMEEVED (Control of wind energy and energetic recovery of waste) and LTSEE (technologies of solar energy and energy efficiency). In these laboratories we focus on thermal solar energy conversion.

In addition, all engineering schools have their own research laboratories and units, some of which are dedicated to green energy such as ENIT research unit in energy and environment or ENIM research laboratory in thermal and energy systems.[12] This laboratory brings together researchers on 5 topics: aerothermodynamics, materials for energy, heterogeneous environment, modelling and optimization of energy systems and combustion. Created in 1999, the lab produces about 37 scientific articles each year and its objectives are:

1. The development of means of study (means of measurement, digital codes) adapted to the various problems of fluid mechanics and energetics.

2. Contribution to the advancement of the state of knowledge of certain subjects related to fluid mechanics and the transfers of matter and energy.

3. The creation of a competence centre in the field of fluid mechanics and energy.

Some of the research projects applied to renewable energy and energy efficiency are:

- Wind turbine power system for grid stabilization with integrated energy storage
- Local materials and smart envelopes for high energy efficiency buildings
- Drying and treatment of wood with solar energy
- Realization of a parabolic solar concentrator prototype
- Study and optimization of a hybrid system for the treatment and recovery of textile waste

In additions the lab has 5 patents applied to renewable energy and energy efficiency.

[12] http://leste-enim.com/

These researches are financed by national programmes and international cooperation projects. Nationally, there are two types of programs PNRI (National research and innovation program) and PRF (Federated Research Projects) and both require a private sector partner in the project.

PRF have been set up and funded by the Ministry of Higher Education since 2002 following a Call for Proposals. Each PRF project is steered and managed by a Project Support Structure which is a public structure with a vocation to support research and technological development. The duration of a PRF project is 4 years. PRFs aim to mobilize the skills and creation of synergies between research structures (Laboratories and Units research) and socio-economic partners, public or private, whether are companies, specialized organizations, associations, or others, in with a view to providing concrete solutions to targeted problems in connection with the socio-economic development of the country. These projects serve as a basis for the establishment of thematic research networks.

PNRI[13] is a program managed by the Ministry of Industry with a purpose to finance projects of research, development, innovation and improvement of the quality of products of industrial companies for the development of their competition capacities and modernization of production mechanisms, through the consolidation of cooperation and partnership between industrial companies, research structures and technical centres.

There are many international frameworks that allows for research projects such CMCU (Comité Mixte pour la Coopération Universitaire) between Tunisia and France or Tun-Ger 2+2 between Tunisia and Germany or Horizon 2020, an EU Research and Innovation programme. However, the process to apply for these funds is not a national cohesive approach but rather fragmented and relies on individual efforts of the member staff of the research centres and labs.

[13] http://www.tunisie-innovation.tn/upload/1462894366.pdf

Analysis And Recommendations

After conducting a literature review of the energy market in all 4 countries, and interviewing country experts and stakeholders involved in the education and R&D, this section analyses the main findings and provides the technical committee with best practices and a set of recommendations of how measures can be adapted into other countries.

Matrix of Indicators between the 4 countries

The below matrix summarizes the main findings of the study relevant to the electricity market, RE market, financing schemes, education programmes and R&D landscape.

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 and the bureaucratic procedures decelerates the project implementation.

In terms of education, all countries have put in place high education degree programs for sustainable energy either at Bachelor or Master level. Egypt has been more active in promoting technical education in RE through numerous TVET programs. Whereas in the 3 MENA countries, various universities offer multiple education energy programs, Malta has a main leading university, the University of Malta, offering such programs.

Regarding R&D, Malta has a structured and a bottom-up approach in terms of attracting EU funds for energy R&D programs, unlike the 3 MENA countries which adopt a less systematic and less cohesive approach whereby many programs are dependent on the initiatives of universities and sometimes individual ones.

Country	Indicator	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 Government loan schemes	Egypt Sustainable Energy Financing Facility (EgyptSEFF) and Green Economy Financing Facility (GEFF) for Egypt promoted by EBRD N/A	SUNREF by AFD GEFF-Jordan by EBRD Jordan renewable energy and energy efficiency fund (JEEEF)	European Structural and Investment Fund for Energy Efficiency and Renewable Energy by EIB N/A	SUNREF by AFD Tunisian Investment Fund (FTI)
Education programmes	Flagship high education and technical education programmes	International Research Master " Renewable Energy and Energy Efficiency for the Middle East and North Africa "(MENA) in Cairo University Technical RE programs in Aswan and Hurghada	The Renewable Energy Master at the University of Jordan The National University College of Technology is providing specialized technical diplomas in RE	Master of Science in Sustainable Energy - by the University of Malta	Energy engineering diploma in ENIM International Research Master " Renewable Energy and Energy Efficiency for the Middle East and North Africa "(MENA) in ENIM
R&D institutions	Existent organizations in charge of RE R&D	Academy of Scientific Research and Technology (ASRT)	National Energy Research Center	The Malta Council for Science and Technology (MCST) The Institute for Sustainable Energy at the University of Malta	The Centre of research and technologies of energy (CRTEn) Research Labs within engineering schools
R&D funding	Existent funding dedicated to R&D and applied to RE	The Science and Technological Development Fund	N/A	Horizon 2020 Fusion Program Horizon Europe Energy and Water Support scheme	PNRI (National research and innovation program) and PRF (Federated Research Projects) Horizon 2020

Education programs and Skills Gap Analysis

Egypt

In Egypt, there are 30 public universities and around 30 private schools and most of them offer energy courses in the mechanical or electrical engineering in addition to dedicated green energy undergraduate/postgraduate programs. One flagship program is REMENA program in partnership with Kassel University in Germany and Cairo University in Egypt. Upon successful graduation the student will be granted a Master of Science (M.Sc.) double degree from the University of Kassel and the Cairo University.

In addition to renewable energy educational formal programs, there are numerous TVET programs implemented in technical schools in Egypt with particular focus on the maintenance and installation of solar technology. Ten technical schools/advanced technical schools and those operating by dual system offer RE training mainly in solar energy and a few in wind energy, across 11 governorates.

Despite the wide range of engineering and postgraduate courses in RE and EE, some aspects are not fully covered and needs further trainings. It was highlighted that they cover all theoretical aspects but what is still missing is the technical skills, and field exposure. This is of course being offered via technical education programs, but higher education is lacking the hands-on learning and exposure to real projects, and integrate construction and/or maintenance skills to their curriculum.

Jordan

About fifteen universities are offering courses related to energy and/or RE in their study plans for various engineering disciplines as mandatory or elective courses. Currently, few universities are offering MSc courses in energy but under different titles like RE, energy efficiency and environment, energy management and alternative energy technologies. One of the main flagship education programs is the Renewable Energy Master at the University of Jordan launched by the now-called Water, Energy and Environment Centre back in 2012.

In the first years of the master, where there was not a lot of dedicated RE programs, graduates would find jobs easily. However now, the market cannot absorb all the graduates. One of the recommendations is that Jordan should review and increase its RE targets by 2030 as there are a lot of unexploited potential and there is more room for new technologies such storage technologies, electric vehicles and also a better implementation of energy efficiency in buildings and at industry level.

To better bridge the gap between the labour market and the education system, it is therefore recommended to focus more on technical education that provides trainings on maintenance of solar projects and include hands-on modules into existent curriculum as well as adding finance and profitability assessment courses to higher education programs.

In terms of the private sector involvement in the education program, companies are consulted by universities to provide their feedback on curriculum through sent questionnaires. However, this is not systemized but rather based on individual initiatives of the program directors or it is a requirement from European projects funding the education program. The private sector contribution is still considered

little and should be further enhanced by creating a body that can supervise and harmonize the private sector participation.

Malta

In Malta, undergraduate and postgraduate programs related to energy are offered by the University of Malta. The university offers a Bachelor of Engineering in Electrical and Electronic Engineering with modules in renewable energy and green systems. The main flagship programme with a focus on clean technologies is the one-year Master of Science in Sustainable Energy offered by the Institute for Sustainable Energy.

Initially, the master was very technical but it has integrated many non-technical modules such regulation, policy, economic impact of projects etc. considering that there was a lot of demand from candidates with various background.

The curriculum review is systematic and is based on a survey addressed to different stakeholders including the private sector and industries, it is expected that new modules like hydrogen and storages would be integrated for upcoming classes.

In addition to the master programme, the University of Malta offers short technical courses to installers which provides important link to have qualified and eligible installers for PV and SWH.

More financial education modules should be added to the current curriculum. Finally, topics such transport, waste management and storage technologies are to be considered in higher education programs.

Tunisia

Almost all engineering schools in Tunisia offer electrical engineering diploma with one or two teaching modules in renewable energy or energy efficiency but the only engineering school that has a dedicated energy engineering diploma is ENIM in the city of Monastir. During the first two years of this diploma, the student is offered a versatile training that ensures a minimum level of competence to integrate all energy aspects across all sectors of the Tunisian industry. The third year, the student chooses a sub-specialization including in EE or RE.

The engineering schools of Tunis (ENIT) and Monastir (ENIM) offer international master programmes taught in English in collaboration with other foreign universities. ENIT master program is in collaboration with Technical University of Munich (TUM), while ENIM REMENA program is in partnership with Kassel University in Germany and Cairo University in Egypt.

In terms of private sector involvement in the education programs and in developing the curriculum, any professional master must include professionals from the private sector. This condition is required by the Ministry of Higher education. In addition, most universities on a voluntary basis, consult the private sector and industries through a joint seminar or workshop to get their views and feedback on the modules and content to be taught to students.

Although there are diverse programs dedicated the renewable energy, what is still missing in curriculum is modules dedicated to entrepreneurship and business creation, and how to promote an entrepreneurship mindset among the students. In addition, engineering programs lack modules that addresses the policy and

regulation aspects of RE and EE in Tunisia, it is very much focused on technical and theoretical information.

Examples of Industry and R&D collaboration projects

Two examples of collaboration between the industry/private sector and R&D institutions are presented below among many initiatives and projects across the 4 countries

Malta: Solaqua

Malta's limited surface area means that, beyond the existing photovoltaic (PV) panels installed on rooftops or disused quarries, any land left for larger PV installations is rare and expensive. The Institute for Sustainable Energy at the University of Malta believes the answer to this problem lies not on land, but at sea. SolAqua proposed that installing solar panels in open water, in offshore floating PV farms, could be as cost-effective and reliable as those on land. The project was built in three phases:

2012 to July 2016

The aim of Project SolAqua 1 was to study and develop viable, cost-effective solutions for floating Photovoltaic systems at sea. While several floating systems had been launched since 2007 in lakes, ponds and reservoirs, the first SolAqua prototype was the first ever floating photovoltaic platform in open sea.

Prototype 1

Prototype 1 was a raft with flexible PV modules on top attached by a patented mounting system (General Membrane). It was launched in **December 2014**.

Prototype 2

Prototype 2 was launched in **August 2015** and consisted of marine (water-proof) panels, additionally coated with transparent lacquer floating on polystyrene very close to the water.

Prototype 3

Prototype 3 was using a steel pipe structure and PVC tanks as floats. Traditional and glass-glass panels were mounted. This prototype was launched in **April 2016**.

July 2017 to July 2018

SolAqua 2 was to find the optimal design both of the structure and the PV system. Regarding the structure the focus was the lowest cost structure that would withstand the expected forces and the work on the PV system was to maximize the power output thus improving overall cost.

As a result, a raft was designed that is modular and can be scaled up virtually to any size. Its compound design using several materials lends itself well to making it low cost. Preliminary cost analysis indicated that such a raft could be built, in volume, at a cost that is competitive to land based systems.

March 2019 to May 2020

The ultimate aim of this research is to launch a large (hundreds of kWp to MWp) farm in Maltese territorial water. If such a project meets the cost and power output targets, it would be possible to implement similar systems worldwide.

The next step is to test the concept and to measure the maximum power output in different sea conditions.

Project Partners

The project partners include The Regulator for Energy and Water Services and The Malta Council for Science and Technology (MCST) but also partners from the private sector such as:

- Pandia Energy Limited, a company operating in Europe on solar photovoltaic installation both on roofs and ground-mounted.
- General Membrane Limited, a supplier of the photovoltaic modules. This company is experienced in flexible panel and simple attachment system.

Egypt: RE Energy Alliance-Made in Egypt

This project is funded by the Academy of Scientific Research and Technology (ASRT). The main goal of this project is to strengthen the cooperation between the important pillars in Egypt namely academic institutions, industry and SMEs, NGOs, and the public authorities for the purpose to advance and deepened the local manufacturing of some Renewable Energy (RE) components in PV, and thermal energy systems.

The development in this project is substantially supported by the contributions of 14 partners forming the consortium. The main objective is to deliver two local RE products based on the scientific approach, the teamwork know how, and the cooperation with industry.

The two final deliverable products are:

- An integrated PV system (Made in Egypt) of a capacity (5-10 kW) for typical PV-grid or off grid connected system that suits the residential sector in the country.
- A semi-commercial PTC mirror (180x160cm) with a new coating (Made in Egypt) for high reflectivity, and efficiency; tested and approved for life cycle operation.

The project is 24 months duration and started in Jan 2019. It is headed by Helwan University and supported by the project's partners (academy, industry, SMEs, etc.). The private sector is represented by the following companies and institutions:

- **Federation of Egyptian Industries:** It is one of the country's largest employers' associations, with 19 active industrial chambers as members, representing over 102,000 industrial enterprises out of which more than 90% belong to the private sector; accounting for more than 2 million workers and 18%of the national economy. Since its inception The FEI has been carrying out its responsibilities towards defending and supporting Egyptian industries.
- **Acropol Renewable energy solutions:** an Egyptian company established on 2006, Its main business is distributing different models of a high-quality solar energy solutions.
- **ALDAWLIA:** Founded in 1976, is a private manufacturing, trading and contracting firms in Egypt working in the field of electrical power engineering. ALDAWLIA employs 130 highly qualified permanent staff.
- **Industrial Modernization Center:** The Industrial Modernization center (IMC) objective is to be the prime development organization for industry modernization, contributing to Egypt's sustainable economic growth. IMC started delivering services since 2002 and built up its portfolio based on a demand driven basis to accommodate with the continuous needs and ongoing challenges of the industry.

Best Practices and Recommendations

Knowledge Transfer

- In terms of large-scale renewable energy installations, Egypt and Jordan are good examples of how well-streamed procedures and PPP schemes can accelerate project implementation and transform policies to real projects. Both countries have set up a good investment environment for both project developers and financial institutions that minimized perceived risks and helped achieved the countries RE targets. Knowledge transfer is highly recommended to showcase the best practices and the lessons learnt throughout the concession processes which can help a country like Tunisia achieve its 2030 RE goals.

- In terms of small-scale net metering installations, Malta and Tunisia are good examples of how SMEs can install their own RE systems to generate electricity for their own use. Knowledge transfer is highly recommended to showcase the best practices and the lessons learnt throughout the net metering processes.

- Each of the 4 countries has been successful in promoting particular RE schemes which could beneficial to the other countries. Therefore, it is important to have regional forums where best practices are shared and information is disseminated. The role of the BSOs is very critical as they are the bridge between the private and public sector. In addition, each of the BSO should play a role in informing their members of investment opportunities and regulations in the sustainable energy sector.

Education Programmes

- Systematic review of high education programmes is important in matching market needs with universities' curriculum. It is important that universities get in contact with the private sector and other stakeholders to get their feedback. Malta is a good example of how universities involve companies through organized workshops and structured questionnaire. The BSOs could be a partner in this review as they are the voice of the private sector and should promote this approach within their members and the universities.

- Professional masters in Tunisia must include companies' representatives to deliver some courses, this is also a good practice that could applied in other universities.

- Promote technical education programs applied to RE in the installation and maintenance of RE power plants, to ensure that the local market has the right skills and capabilities when power plants are operating. Egypt is a pioneer in launching diverse TVET RE programs in governorates where big RE projects are implemented and Jordan has kicked off this process as well.

- Promote regional education programs similar to the REMENA master program between Egypt, Tunisia and Germany. Funds however should be sought to enable international mobility of students and professors from the different countries.

Cooperation between private sector and research organizations

- Clusters can foster innovation by collectively cooperating and competing in a fruitful way, as they a setting where multiple stakeholders including researchers and industry can collaborate to produce local products or RE components. It is also a forum that helps dialogue between the different parties. Egypt has formed an RE cluster that involves universities, researchers and industry to produce PV components made locally.

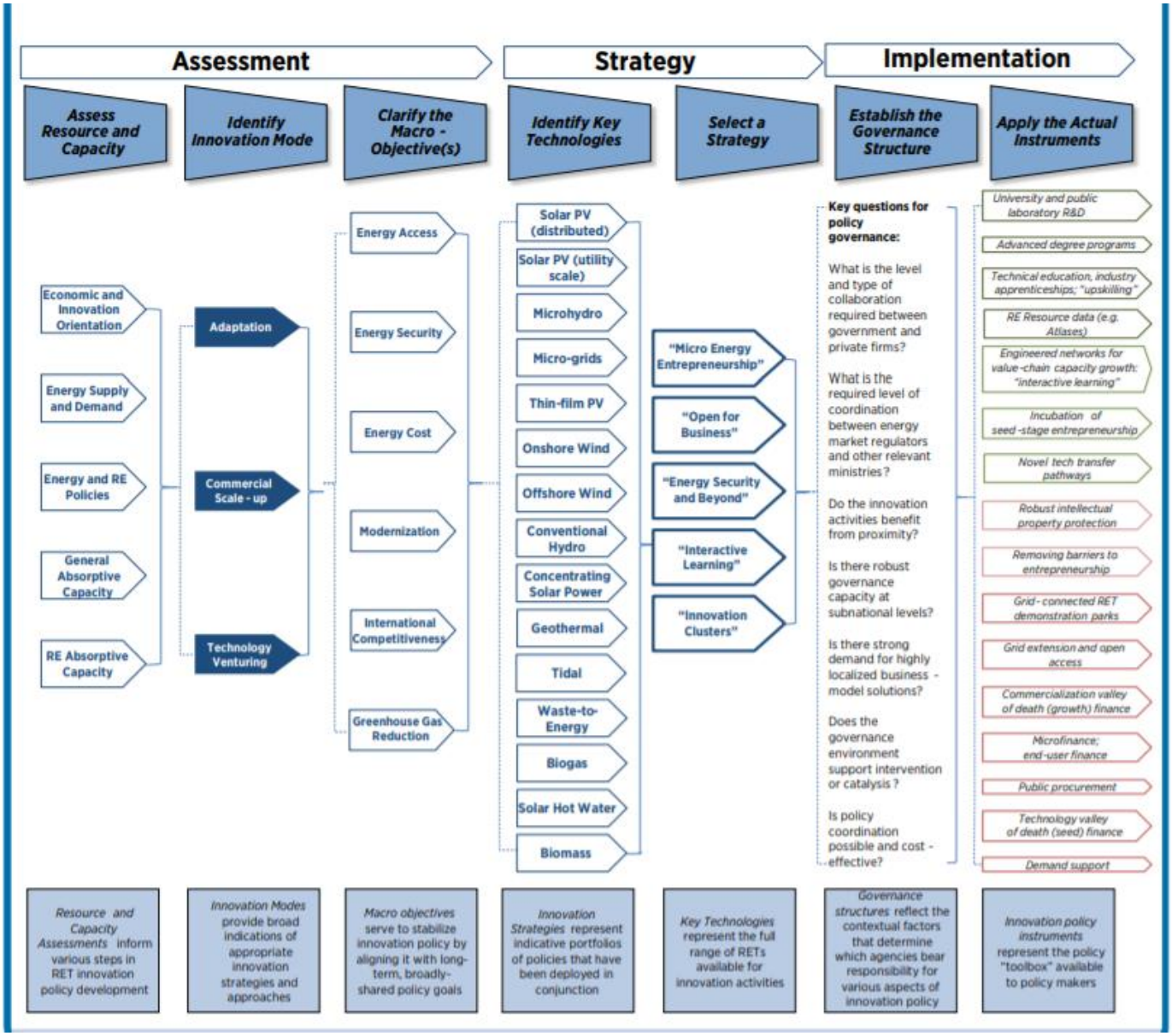
- Certain research public funds in Tunisia require to include a partner from the private sector to be eligible for funding. It is a good practice that BSOs can help promote within the relevant national authorities to ensure collaboration between private sector and research centres.

- International and inter-sectorial cooperation is a catalyst of innovation and a powerful tool to develop goal-oriented and streamlined R&D programmes in the complex landscape of innovation. It does this by bringing together stakeholders, enabling the exchange of experiences and facilitating access to competences, knowledge and funds. Many of the research projects and papers conducted in Malta or in Tunisia are in cooperation with international engineering schools.

Research and Development

- Governments particularly in the MENA region should put in place policies and instruments to promote technological innovation customised to bolster the unique capacity development needs in a country, and appropriate for the technologies of interest in the context in which they are applied. Below is a chart from a discussion paper by IRENA that provides broad guidelines for

designing renewable energy technology innovation policy (RETIP), The RETIP process articulates a three-stage process covering the entire innovation policy development cycle and consists of: the assessment of existing resources and capacities, the identification of technologies and strategy that are well suited to the particular context, and the selection of appropriate policy instruments and establishment of a governance structure.



- The relevance of having a governance structure to interconnect all innovation related fields and align technical expertise, innovation stakeholders and national plans is of a paramount importance. This would foster a more cohesive, structured and representative approach to raise funds to finance different innovation programs. As an example, Malta through MCST elaborate a Smart Specialization Strategy applicable to sectors that will bring a competitive advantage to the country, based on a bottom-up

approach that involved all parties; CSO, industries, SMEs, researchers, universities. With this strategy, MCST applies for EU funding and once it is obtained, it is disbursed to the Ministry in charge of EU affairs which is then in charge of dispatching this amount across all interest stakeholders through calls for projects/applications.

- Public-private partnerships for knowledge infrastructure are a widely used innovation policy instrument. Such programmes involve state funding of R&D projects led by industry, and collaborations between scientists from industry and government. Such partnerships have the potential of developing commercial products and innovation. For example, the European Union's Seventh Framework Programme and most recently Horizon 2020 have a strong and increasing focus on stimulating cooperation between public and private actors in research and innovation activities.

- The exchange of information among researchers, policy makers and main market actors in the region. The report calls for the dissemination of research activities among technology centres via, for example, newsletters, peer-reviewed journals which focus on R&D of RET in the Mediterranean region or international research summits with a clear focus on the Mediterranean context.

Final word about the role of BSOs

- The role of BSOs is crucial in bringing to the attention of policy makers and investors the needs for innovative technological solutions, for RET use and also economic proposer of SMEs. This report encourages partnerships with BSOs when formulating RE policies, innovation policies and programs.

ANNEX 1

FUSION CVP Funding - (Date from 2015 onwards. Since Energy is not a smart specialisation area, we have categorised these projects ourselves)

Project Reference	Beneficiary	Acronym & Title	Grant Amount CVP
R&I_2020_021	Dr Ing Reiko Raute	SLID - Sensorless Inverter Drive	20060
R&I_2020_008	Dr Ing Paul Refalo	Development and Analysis of an IndustRy 4.0 System to Autonomously ImproVE the Sustainability of Pneumatics	20060
R&I_2020_007	Dr Robert Camilleri	Recycling Lithium ion battery cells into a portable power cube (Power^3)	20060
R&I_2019_030	Dr Ing Reiko Raute	Hybrid Inverter Drive (HID)	20060
R&I_2019_029	Dr Ing Reiko Raute	Wireless Inductive Power Transfer (WIPT)	18644.4
R&I_2018_031	Mr Andre Micallef	_ICECAP - Thermoelectric Cooler for elECtronic Applications	20060
R&I_2018_040	Ing Matthew Spiteri	INNOTHERM Innovative thermal generation	8250
R&I_2018_030	Profs Tonio Sant	DEMO SolHEAT - Software package for design, energy management and optimization of solar systems	16402
R&I_2017_038	Profs Luciano Mule Stagno	Medsolar	18901.25
R&I_2016_002	Dr Robert Camilleri	A novel evaporative cooled battery pack NEVAC	20060
R&I-2019-010	Prof. Vincent Buhagiar	Double-C Block	18777.5
R&I-2016-033T	Dr Ing Jason Gauci	SATMET	20060
R&I-2015-047T	Albertax Limited	MicroCHP	18902
R&I-2015-044T	Profs Tonio Sant	FLASC	18880

References

Green Jobs in Tunisia (ILO, 2018) https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_631705.pdf

PROJETS D'ÉNERGIE RENOUVELABLE EN TUNISIE GUIDE DÉTAILLÉ (GIZ, 2019) http://www.tunisieindustrie.gov.tn/upload/ENR/Guide_detaille_ENR_tunisie_mai2019.pdf

Current status and future investment potential in renewable energy in Jordan: An overview (2020) https://www.sciencedirect.com/science/article/pii/S2405844020301912

Case Study on Policy Reforms to Promote Renewable Energy in Jordan (ESCWA, 2018) https://www.unescwa.org/publications/policy-reforms-promote-renewable-energy-jordan

SCALING-UP RENEWABLE ENERGY DEVELOPMENT IN JORDAN (RES4MED, 2019) https://www.res4africa.org/wp-content/uploads/2019/03/Scaling-Up-Renewable-Energy-Development-in-Jordan.pdf

Renewable Energy Outlook EGYPT (IRENA, 2018) https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Oct/IRENA_Outlook_Egypt_2018_En.pdf

A guide in Egypt and Jordan Current Situation and Future Potentials (2016) https://library.fes.de/pdf-files/bueros/amman/12534.pdf

NREA Annual Report 2019 http://nrea.gov.eg/Content/reports/English%20AnnualReport%202019.pdf

Egypt Sustainable Energy Financing Facility (EgyptSEFF) https://www.egyptseff.org/en/about-us

MAPPING EE AND RES MARKET POTENTIAL AREAS WITH HIGHER IMPACT ON LOCAL ECONOMY AND JOB CREATION Tunisia, Egypt and Lebanon (RCREEE, 2020)

https://www.rcreee.org/sites/default/files/v3_15_a32_impact-map-eco-and-job_final.pdf

EBRD Egypt https://www.ebrd.com/news/2019/ebrd-and-afd-deepen-green-finance-in-egypt.html

EBRD Egypt https://www.ebrd.com/news/2020/ebrd-and-qnb-alahli-boost-green-investments-and-small-firms-in-egypt.html

Market Survey ON ENERGY EFFICIENCY AND RENEWABLE ENERGY SOURCES PROFESSIONAL TRAINING (RCREEE, 2020)

https://www.rcreee.org/sites/default/files/a21_marketsurveytraining-final.pdf

Malta's 4th Biennial Report (UNFCCC, 2020)

https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/35164807_Malta-BR4-1-BR4_Malta_V4_final.pdf

Malta's 2030 National Energy and Climate Plan (EC, 2019)

https://ec.europa.eu/energy/sites/ener/files/documents/mt_final_necp_main_en.pdf

IEA Malta Energy Data https://www.iea.org/countries/malta

IEA Egypt Energy Data https://www.iea.org/countries/egypt

SOLARGIS Malta https://solargis.com/maps-and-gis-data/download/malta

The National Renewable Energy Action Plan - Office of the Prime Minister 2015 - 2020

MENA Power Investment Outlook: 2019-2023

This document is developed by

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FEDERATION OF EGYPTIAN INDUSTRIES

MEA
MALTA EMPLOYERS ASSOCIATION

غرفة صناعة الأردن
Jordan Chamber of Industry

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