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PERIODICAL SURVEY



ENERGY TECHNOLOGIES

EBSOMED Employers thematic committees

Education and R&D on Energy Technologies

Volume 2



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ASSOCIATION DES CHAMBRES DE COMMERCE ET D'INDUSTRIE DE LA MEDITERRANEE
ASSOCIATION OF THE MEDITERRANEAN CHAMBERS OF COMMERCE AND INDUSTRY
جمعية غرف التجارة والصناعة للحوض الأبيض المتوسط



Deutsch-Arabische Industrie- und Handelskammer
German-Arab Chamber of Industry and Commerce
الغرفة الألمانية العربية للصناعة والتجارة

Analysis of New Energy Technologies and sector in Egypt, Jordan, Malta and Tunisia

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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 MINISTER 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 as 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 Hurgada. 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,¹ 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 Shams² 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:

¹ <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/>

² <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 compliance 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	
Alebit	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	
JUST	State	Chemical	Solar Energy		x
		Mechanical	Renewable Energy		x
			Renewable Energy	x	
			Wind Energy		x
			Concentrated Solar Power		x
			Photovoltaic		x
Al-Balqa'	State	Mechanical/Husun	Energy Conversion	x	
			Solar Energy	x	
			Energy Conversion & Alternative Energy	x	
Al-Hussain	State	Mechanical/FET	Renewable Energy		x
		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)³ 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.

³ <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 Energy⁴ 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

⁴ <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](#)

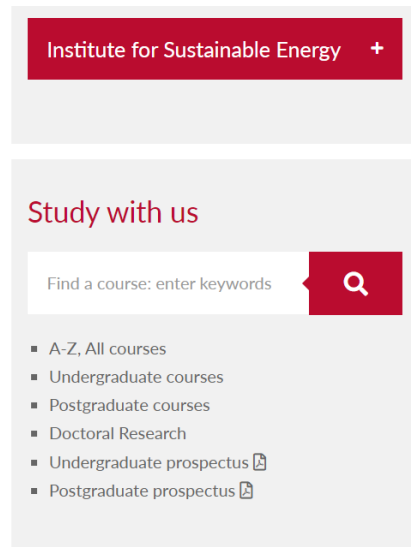
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Training courses in Renewable Energy

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 Enterprise 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 2021-2027 Strategy, the use of sustainable use of resource and Marine 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
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	<p>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.</p> <p>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.</p> <p>Annex 1 provides a list of CVP energy projects ⁵</p>
Horizon Europe	<p>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.</p>
Horizon 2020 (EU Research and Innovation programme from 2014 to 2020)	<p>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.</p>
Energy and Water Support scheme	<p>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:</p> <ol style="list-style-type: none"> 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. <p>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 duration ranging between eighteen and twenty-four (18-24) months.</p>

⁵ since Energy is not a smart specialisation area, the categorisation has been done by the fund administrator to be best of his/her abilities.

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
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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 integrated 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/master/PresentationMastereProMPRESA-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-Elctriques-&-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 not 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 CRTE n (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.⁶ 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.

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.

⁶ <http://leste-enim.com/>

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.

PNRI⁷ 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.

⁷ <http://www.tunisie-innovation.tn/upload/1462894366.pdf>

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

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