

The Role of Local Market in Establishing Solid Master Program in Renewable Energy and Sustainability

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Abstract—This contribution describes the work-in-progress joint master program JAMILA (Joint mAsTer of Mediterranean Initiatives on renewable and sustainable energy), which is cooperation within the Tempus Joint European Project and aims at establishing a new master courses on renewable and sustainable energy at the two Colleges of Engineering at Al-Quds University (AQU) in Jerusalem and the Palestine Polytechnic University (PPU) in Hebron in Palestine as well as the three European Universities Cadez, Newcastle and Sapienza. To achieve this, it was of great significance to carry out a survey with a distinguish goals to examine market conditions and determine the needs for renewable energy qualifications in the labor market, in touch with companies and institutional bodies operating in this field in Palestine. A multidisciplinary curriculum has been developed to cover and address the latest trends in the field of renewable energy.

Keywords—Renewable Energy, Energy Management, Analysis and Recommendations, Curriculum Design.

I. INTRODUCTION

Educational programs in renewable and clean energy are relatively new and rare, and are generally offered as engineering degrees [1], [2], [3]. Internationally, graduate certificate programs in renewable energy are becoming more available, as are concentrations in renewable energy within environmental and policy management graduate degrees. Degree programs typically take two years of full-time study to complete, and a thesis or project is usually required for graduation [4]. One of these successfully implemented master programs to address the renewable energy and energy efficiency demands for the Middle East and North Africa (MENA) Region, is REMENA, depleting fossil fuels, increasing energy costs and the growing energy demand call for a substantial change in the energy policy of the corresponding countries [5]. This program is aimed at educating German and international students in measures for a sustainable energy sector where the students are expected to have working experience in a corresponding area to be obtained in different disciplines, e.g. law, economic, social, engineering or natural sciences. Another example focusing on management issues is SEMAC (Sustainable Energy Management Advanced Certificate), a Canadian program

designed to support employment opportunities in the emerging field of sustainable energy management, with focus on the energy demands of commercial, institutional, industrial and community facilities [6].

Regionally, for example in Jordan, several studies and approached have been started in order to study the market analysis and needs for renewable energy and energy efficiency (REEE), serving as analysis and recommendations for curricula development [7]. This study was based on one-on-one interviews with staff working in REEE related areas and had the following objectives: to determine the concentration of business activities of companies working in REEE in Jordan within sales/installations, to find out the difficulties in finding qualified persons with skills related to technical aspects and to general knowledge of REEE, to locate companies with a clear need for qualified engineers with multidisciplinary skills covering finance, marketing, or economics.

In Palestine, An-Najah National University offers a master program in renewable energy entitled as “Clean Energy and Energy Conservation Engineering”, which provides basic and advanced education in the fields of clean energy and energy efficiency, in both areas: economic and environmental sustainability [8]. It is cooperation within the Tempus Joint European Project with the leading technical university Kungilia Tekniska Hogskolan (KTH) in Sweden, and the Berlin Technical University in Germany.

This contribution describes the work-in-progress joint master program JAMILA (Joint mAsTer of Mediterranean Initiatives on renewable and sustainable energy), which is cooperation within the Tempus Joint European Project and aims at establishing a new master courses on renewable and sustainable energy at the two Colleges of Engineering at the two universities, Al-Quds University (AQU) in Jerusalem and the Palestine Polytechnic University in Hebron, in Palestine as well as the three European Universities Cadez, Newcastle and Sapienza. This master program must satisfy the current and the future market needs from highly qualified engineers to lead the advancement in renewable energy in Palestine.

This Master program is distinguished from other national master program in several points: First, the location of the future Master program is in the middle and south region of

Palestine (Jerusalem, Ramallah, Bethlehem and Hebron), which will simplify the students' mobility and reduces the resulted costs to join the program. Second, it will contribute to solve the energy problems in this area in such a way that, on the one hand, students will be educated in current and future technologies of renewable energy systems for integrating energy-related technologies with the economics and financial considerations required to implement them, with the ability to expose students to a combination of local and European academic and corporate experience in energy-related systems. On the other, it will provide graduates with the necessary skills and knowledge of renewable energy management principles, approaches, techniques, and tools, for being able to function quickly and effectively in the position of energy manager or energy coordinator at their company, building or facility. Finally, graduates will be equipped with leadership and decision-making skills to implement energy systems in the private or public sectors of the local, regional as well as the global market.

II. ANALYSIS AND RECOMMENDATIONS OF THE PALESTINIAN CURRENT STATUS ON RENEWABLE ENERGY

The proposed Master program in Renewable Energy and Sustainability (MRES) has been designed to satisfy the current and the future market needs from highly qualified graduates to lead the advancement in renewable energy in Palestine. Figure 1 illustrates the applied procedure starting from detecting the market needs and underlining the long term strategies in energy utilization until proposing concrete master courses lead to 36 credit hours master program (MRES).

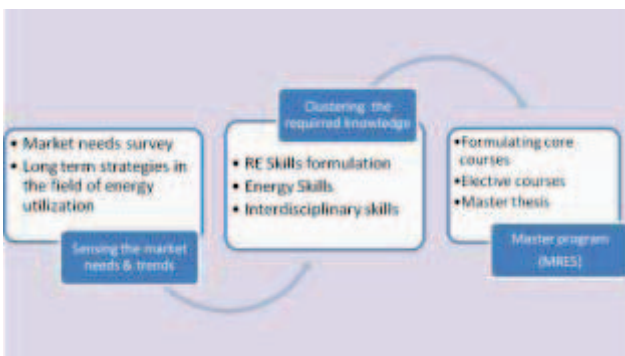


Figure 1: Proposed approach for establishing MRES

II.1 SURVEY DATA COLLECTION AND PROCESSING

As illustrated in the mentioned procedure the most important stage is to discover the local market needs by carrying out a field survey with a predetermined goals that are aimed at :

- knowing the current market of the renewable energy experts and M.Sc. graduates,
- knowing the working scope and type of companies/institutions and whether they being adopted to renewable energy,
- estimating the future need by determining the growth rate of their employment,

- sending distinguished engineers to join the M.Sc. program,
- taking part in the events of M.Sc. program as conference days, workshops, carrier days, etc.,
- proposing and co-supervising topics for the M.Sc. thesis,
- and support program sustainability throughout partially funding and working together for fundraising etc.

The stakeholders of the survey include companies of the renewable energies and vendors, companies that deal with energy production in its two forms: conventional and renewable energy, the authority of energy and natural resources, the electrical supply authority, the environmental authorities, research centers, universities and higher education institutions, trading & consulting companies, and renewable energies associations and NGOs.

In order to collect information about the Palestinian labor market, it was necessary to focus the survey on highly qualified graduates that can work as:

- Technical managers for companies of renewable energies.
- Sales managers for companies of renewable energies.
- System designers and analyzers.
- Developers and researchers for the renewable energies.
- Lecturers at universities.
- Researchers at universities or research centers.
- Establish his/her own renewable energy related business.
- Technical managers at renewable and related associations, government, authorities and NGOs.

A survey questionnaire with several questions and measure classifications was carried out. The survey questions was classified in groups in order to expose the characteristics of the interviewed company, the qualifications of its employees, its readiness for building the Master program capacity, and support and collaboration with the Master program. Figure 2 illustrates some of the collected data related to status of renewable energy in Palestine.

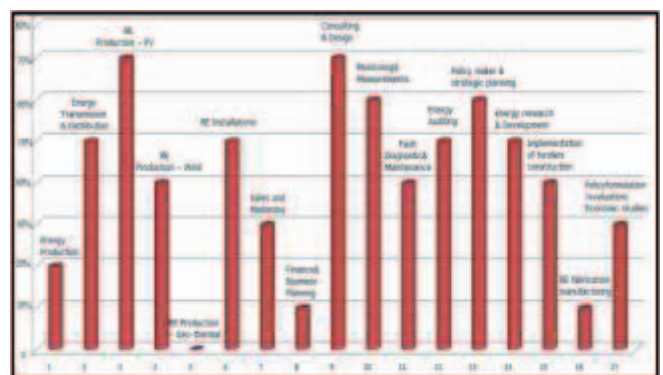


Fig.2: Frequency of company activities.

It is clearly shown that Palestinian local market has wide spectrum of skills diversity starting with solid research in

renewable energy to pure exploitation of generated energy. Therefore graduates have to be equipped with solid knowledge in order to cover the majority of required skills.

II.2 SKILLS CLUSTERING

After having analyzed the results of the survey, the following findings can be observed as depicted in fig.3, where the percentage of employability related to renewable energy market in Palestine for majority of skills have roughly identical weights, which means, the proposed master should allocate equal program content realizing each of these skills:

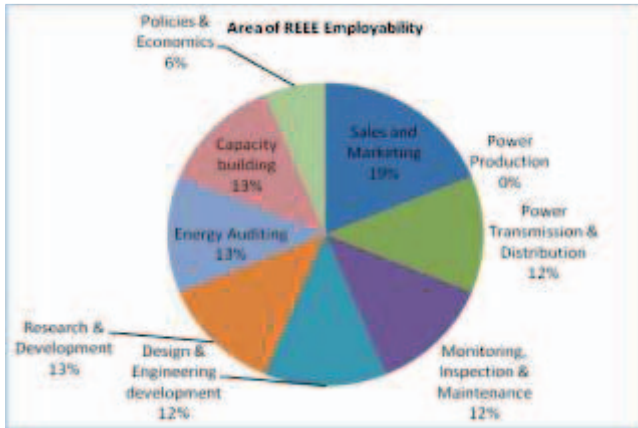


Fig.3: Percentage of employability with respect to skills type.

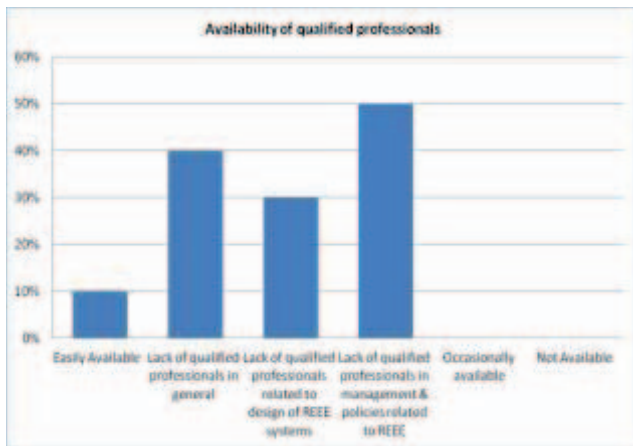


Fig.4: Availability of qualified professionals in RE.

Figure 4 shows the availability of qualified professionals in Palestine where significant shortages in qualified professionals in the field of renewable energy requires more efforts to be spent for modernization such field.

As a result of conducted surveys, the following key elements can be stated:

- Despite there is a huge diversity in renewable energy skills, these skills have to be developed and raised to the international level.
- It is obvious that the all areas of the Palestinian territories need more focus to be developed in the area of Renewable Energies.
- Most of the companies specialized in RE are small ones and their business and market are carried out locally or regionally.
- The willingness and readiness of the private sector in the field of RE is insubstantial for acquiring Master graduates in RE or supporting their Bachelor engineers to attend the Master program.

As such, collaboration with the RE private sector is of great significance to increase their awareness of the necessity of RE Master graduates as key contributors to the development of RE in Palestine. Figure5 illustrates the skills chart that forms the Master program character. Moreover, the skills and engineering knowledge acquired through the Master graduates must be concentrated on:



Fig.5: Master program character.

- It is obvious that the all areas of the Palestinian territories need more focus to be developed in the area of Renewable Energies.
- Most of the companies specialized in RE are small ones and their business and market are carried out locally or regionally.
- The willingness and readiness of the private sector in the field of RE is insubstantial for acquiring Master graduates in RE or supporting their Bachelor engineers to attend the Master program.
- Business, management and finance of renewable energies including sales and marketing, and energy auditing.
- Renewable power systems including power production and generation, power transmission.
- Process control of renewable energy systems including monitoring, control, fault diagnoses, as well as inspections and maintenance.

- More in-depth research and development of renewable systems
- It is necessary to tackle policies and economics of renewable energies

It is also important to have experts specialized in capacity building programs on renewable energy for providing vocational training for professionals and policy makers with deep and up-to-date knowledge on renewable system technologies including energy and climate change, thermo-solar energy, photovoltaic systems, biogas agro waste biogas, waste technologies, wind energy, energy efficiency in buildings, etc.

III. OBJECTIVES OF THE MSTER PROGRAM AND GRADUATES' SPECIFICATIONS

The Master program integrates the technology side of renewable energy (RE) systems development with the management and financial planning needed to implement them effectively. The goal of this master program is to create a high-level signature, interdisciplinary cross-faculty and cross-university graduate program for the engineer, who is pursuing an industrial or public planning based career.

The curriculum is flexibly designed with core and elective courses in renewable energies engineering knowledge, finance and management . It is possible that the electives can be taken from any department within the Colleges of Engineering at Palestine Polytechnic University (PPU) and the Al-Quds University (AQU). A joint research-based thesis will be offered to ensure the university-private sector component is involved. Through this curriculum and interaction with visiting practitioners and stakeholders, the students will be equipped with the advanced interdisciplinary skills required to design, optimize and evaluate the technical and economic viability of renewable energy schemes. Furthermore, they will be prepared to integrate renewable energy system development effectively over a broad spectrum of technologies with the management and financial requirements to implement them successfully and to compete in the local, regional and global energy market.

Following the huge business incentives, markets and a wide variety of employment opportunities throughout the world can be expected with the development of renewable energy resources as a substitute for fossil fuel technology. Thus, the purpose of the Master program is also to help meet this demand by cultivating qualified and skilled professionals with specialist knowledge into the relevant technology within the renewable energy sector. Graduates of the program will be involved in the decision-making or policy planning that will deliver sustainable, energy efficient systems to the global market. They will have the basic training necessary to lead efforts within companies to plan and implement new energy generation investments, realize energy efficiency improvements specifically at the system level, and participate in energy and environmental markets such as, power purchase agreements, energy management monitoring and cap-and-trade systems. In brief, the various program objectives include the following:

- Heightening the responsibility of the Master program graduates through the broad knowledge in renewable

energies, electric power systems, management/finance of energy systems, as well as computerized systems for renewable energy in industry and research.

- Providing the students with the necessary scientific, engineering, business and economic expertise and knowledge in renewable energies for being able to conceptualize, design and operate of existing technical/business systems as well as to invent new solutions and techniques.
- Supplying the industry, research institutions, colleges and universities, nationally and internationally, with engineers and experts with a high level of in-depth knowledge and expertise in a selected range of advanced topics in renewable energies.
- Equipping the students with the necessary knowledge and self-confidence coupled to an understanding of the process of technological and economical innovation and of the key factors in the strategic and operational management to establish a start-up enterprise.
- Encouraging hard working students with extraordinary professional qualities in pursuing further knowledge and experience in renewable energies at universities or research institutions.

IV.EMPLOYABILITY

The governments of many countries have made renewable energy a priority area in their energy policies, and graduates of this Master program are likely to go onto successful careers in management, particularly at the technical-business interface. Thus, the program graduates' employability opportunities locally, regionally and globally include: (1) Government and Local Authorities, (2) Energy related NGOs such as Energy Authority, Renewable Energy Federation Union, etc. (3) Establish a Renewable Energy business / firm, (4) Renewable Energy Researcher and Tutor, (5) Electrical and Energy Generated / Distributed Companies such as Jerusalem District Electricity Company, Northern Electricity Company and Southern Electricity Company, and (5) Related Industries;

The concept of the Master program aims at enabling students to promote themselves by acquiring knowledge and skills for being able to innovate in the field of renewable energy, in addition to their ability to implement the concept of renewable energy development for practical business purposes. This is strengthened by additional management qualifications oriented on technical knowledge as well as multidisciplinary abilities in terms of team development, presentation and project management. At the end, the graduates are experts with a context sensitive first-class training in the field of renewable energy engineering and management with the ability to plan and design projects.

During the Master program, the students will be equipped with several new graduate attributes such as knowledge, understanding, skills, abilities and attitudes (see below). Moreover, the curriculum of the master program possesses them with all-roundedness attributes including intellectual professional practical and transferable key skills. It is worth noting that this program is a multidisciplinary one and designed to be offered to students coming from different

engineering and non-engineering fields including Electrical, Electronics, Communications, Computer, Mechanical and Industrial Engineering, and applied sciences programs.

- A graduate-level understanding of basic disciplinary concepts as well as identifying the different aspects of renewable energies with regard to management and finance.
- Designing, developing and implementing renewable energy systems belonging to a diverse range of energy resources such as solar, thermal, electrical, wind, tidal, wave, hydroelectricity, geothermal, biomass and waste technology, hydrogen, bioprocessing and bio-based materials.
- Identifying, analyzing and solving technical problems of renewable energies related to computer engineering, for example, computational techniques and system modeling, knowledge-based systems and artificial intelligence, computer simulations for engineering design.
- Having a minimum computer programming knowledge, understanding and skills to solve practical engineering problems related to renewable energies.
- Applying mathematical techniques to model and solve engineering, business, and finance problems related to renewable energies.

Appreciating and identifying all kind of issues of renewable energies related to product design, management and finance, as well as generating and evaluating design management and finance solutions to solve a specific problem.

V. CURRICULUM

Figure 6 illustrates the proposed multidisciplinary curricula where huge variety of courses and teaching modules should cover large spectrum of required skills with 12 credit hours of core courses, 18 hours of elective courses from three groups and master thesis of 6 hours as follow:

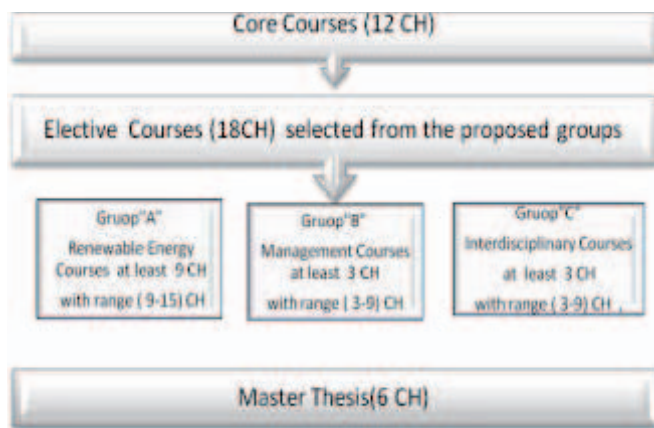


Fig.6: Master curricula.

A. Topics of the Master Program

The proposed Master program is multidisciplinary and covers the latest trends in the field of renewable energies including the following major components:

- Renewable Technologies technicalities that includes:
 - Renewable energies technologies, policy and markets: solar thermal and electricity systems, wind, hydrogen, tidal, wave, geothermal, hydroelectricity, biomass and waste technology, bioprocessing and bio-based materials.
 - Grid systems, renewable heating and cooling; energy storage, structural integrity of renewable energy systems;
 - Energy conversion technologies, thermodynamics machines and their application to energy conversion and management in buildings (refrigeration plant, energy conversion plant and energy management, etc.)
 - Energy system analysis and optimization: Energy use in buildings/ Zero emission buildings; Sustainable Heat Pumping Processes and Systems; Gas technology
- Technical Support Topics that includes:
 - Advanced Topics in power electronics and machines;
 - Control systems, optimization, decision-making, business models and operations; energy management and audit;
 - Risk and reliability engineering.
- Management and finance that includes:
 - Environment and sustainability that includes:
 - Management/Finance: Principles, regulation, economic procedures, Computational methods, emissions trading, and operation of energy systems;
 - Renewable Energies for built environment: Environmental legislation (Energy and Environmental Review and Audit, environmental regulations, hands-on environmental review and audit, environmental management systems, establishing a monitoring and targeting scheme;
- Energy Sustainability that includes energy consumptions, sustainable development applications and corporate environmental management.
 - Applied Computations that includes:
 - Computational techniques and system modeling;
 - Knowledge-based systems & artificial intelligence: Basics of Knowledge-based Systems, Representing design process as a space of states, Relating design artefact, designing intent & designing rationale and building ontology & applying an agent-based architecture as a solution of a problem.
 - Computer Simulations for Engineering Design.

VI. CONCLUSION

This contribution shows the approach to design the joint multidisciplinary Master program curriculum in the field of renewable energy & sustainability (MRES) at the two colleges of engineering at Al-Quds University (AQU) in Jerusalem and the Palestine Polytechnic University (PPU) in Hebron in Palestine. It covers and addresses the needs for renewable energy needs in the Palestinian labor market as well as solves the energy problems in this area. It was based on a survey with a distinguish goals to examine market conditions and the need

for renewable energy qualifications in the labor market. The program execution should be carried out in both universities in complementary manner , where the proposed courses can be taught by both university professors resulting in better use of human resources and infrastructure resulting in solid master program, and solid academic and research relationships between both universities.

In the future, several studies must be carried out in order to provide feedback about its strengths and weaknesses for improvement purposes.

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