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1. Introduction

This work was undertaken as part of DEV5.1 of Work Package 5 of the MUREE project. One of the main targets of the MUREE project is to develop a capacity building and staff development programme in the field of renewable energy (RE) in Jordan. In order to achieve this, training, technical assistance and consulting services will be provided by the participating EU Universities to the Jordanian faculty members, students, engineers and technicians in the project. The MUREE project foresees transfer of knowledge and skills to Jordanian partners through access to information and facilities, practical and academic training which will enable them to effectively redesign their RE courses to include state-of-the-art technologies. Under this Work Package, each participating EU University will make available to Jordanian partners its facilities, as well as technical assistance and specialized skills in a range of RE sub-fields among them solar energy, electric machines and drives, biomass, wind energy, etc. This exposure to varied practical training and experiments is essential for skill transfer to Jordan.

UCY, TUB, Sapienza and TUG have assisted the Jordanian partner universities to develop this plan during the 2-day roundtable workshop which was held in Graz on April 12-13, 2013. The workshop aimed at defining the long-term capacity building plan for the MUREE project. The proposed activities below provide the core for the Capacity Building Program.

2. Activities Description

This long-term capacity building plan and vision aims at developing human resources and upgrading skills and capacities of university professors, technical assistants, researchers and students in the field of Renewable Energy. The capacity building plan consists of four DEVs:

DEV5.2: Establishment of the RE Training Centre in Jordan (Due date: 15/10/2013)

The RE training centre will be established for all Jordanian universities with trained staff in administrative, pedagogical and technological aspects. The Centre will be based at the University of Jordan (UoJ). 2-key staff members involved in the Centre set up will make a 1-week study visits to UCY and Sapienza to be trained on experiments and state-of-the-art equipment setup, usage, operation and maintenance.

DEV5.3: Academic Visits to EU Partners (Due date: 15/2/2014)

20 teaching staff from all Jordanian partner universities will be selected according to pre-defined criteria. Each of these members of staff will be trained during a 1-week training visit to UCY, TUB, Sapienza, and TUG. Training materials traditional and online will be prepared and customized to Jordanian needs.

DEV5.4: Trainees Visits to EU Partners (Due date: 15/4/2014)

20 training visits will focus upon how the four EU partner universities organize their training starting from general programme and methodology to specific examples of training initiatives that are organized and have proven success. A significant component of training will be related to technical aspects of scientific measurement and characterization of solar energy systems.

DEV5.5: Training Workshops in RE in Jordan (Due date: 15/10/2014)

Jordanian staff trained in EU will hold regular multiple effect workshops at their own institutions and in the training centre. These workshops will be scheduled at the end of the project and will continue after the lifetime of the project.

The above tasks became more defined and time-bound in the Workshop 5.1 in Graz (see Results and Discussion) where the exact needs of the Jordanian universities and the capabilities of the EU universities were discussed thoroughly.

3. Results and Discussion

In this section of the report, we describe:

- The Jordanian needs
- The capabilities and facilities of EU Partner Universities
- The plan for Capacity Building

Jordanian Needs Analysis

For the development of the long-term capacity building program, it was essential for the Jordanian needs to be analysed and taken into account. For this purpose, a market needs analysis report was conducted by JUST in March 2013 (Report DEV1.2: Jordan current status on Renewable and Energy Efficiency-Analysis and Recommendations for Curricula Development). In the context of the MUREE project, a survey was conducted which aimed at examining market conditions and the need for renewable energy (RE) and energy efficiency (EE) qualifications in the labor market. The investigation focused on all academic programs being offered in Jordan in the field of RE, actual market demands, trends and needs as well as government policies and regulations. The results of this scoping and needs analysis helped determine the most appropriate nature of theoretical, practical and training content to embed in courses of bachelor degree programs. The report considered an overview of RE and EE market in Jordan, the Energy mix in Jordan, policy framework for the development of RE and EE, and a labor market survey. This report highlighted the fact that the main form of training required currently in Jordan is vocational training. It was evident that there are skill gaps in the local labour market with regards to specific competencies and

these included engineering competencies in various areas of RE, as well as economics, and installation and maintenance skills. The most needed human resource expertise for the local market was in solar energy and thermal applications as well as photovoltaic systems design and simulations.

At the workshop of DEV5.1 the specific needs of Jordanian Universities were discussed further. The outcome from the needs analysis, in a nutshell, was that the main elements needed by Jordanian Universities are:

- 1) State-of-the-art Equipment;
- 2) Courses on RE that are not duplicated by existing courses in the respective Jordanian universities;
- 3) A good RE Training centre;
- 4) Vocational training.

The consensus was that there is a need for a RE Training centre but that there is no dedicated expertise on how to build and design it. There is also a need for training materials for short courses, how to use equipment for training and for demonstration activities. It was suggested that the training centre should be oriented, during the starting phase, on the courses identified during the Workshop DEV2.1 in Graz (Workshop on Curricula Updating). Furthermore, it was highlighted that each Jordanian partner needs different equipment, but in order to narrow down the choices all have agreed to follow the market needs.

Capabilities and Facilities at EU Partner Universities

For the development of the capacity building program, the capabilities and facilities of the EU partner Universities were also discussed among the partners in the Workshop 5.1. The following training opportunities at EU research facilities emanated:

- **UCY:** Mainly academic, research and training opportunities in the photovoltaic field. Some training opportunities include: exposure to practical equipment training (operation, maintenance, etc), basic experiments in PV characterization, outdoor facilities for evaluation/monitoring of different PV technologies, indoor characterization of modules/cells, etc.
- **Sapienza:** A less technical training visit than in UCY which will include visits in Co-generator and Tri-Generator plan in Policlinico, in the Geothermal plant in Larderello and the PV plant in University campus. The training visit will be general in accordance with the courses in which Sapienza is involved (“Energy Conversion” and “Renewable energy systems”)
- **TUB:** The training will focus on the area of Sustainable Manufacturing. There exist opportunities to visit the RENA institute (collaboration with TUB), be introduced to the International Master Program in Berlin and to the research conducted on wind design, simulation, and solar thermal systems.
- **TUG:** The training will focus on Electric Machines and Drive Systems that form a core part of many renewable energy conversions systems, such as wind turbines and hydropower plants. The visits will benefit from the recent revision of the teaching and training methodology and material in a number of courses and laboratories in this area at the host institution. Possibilities to visit local renewable energy plants are investigated.

Plan for Capacity Building

1) The Selection Criteria for Training Staff from Jordan

Jordanian professors, who will provide the updated courses, will visit the EU Universities for training. Each Jordanian University will establish 4 persons who will attend the meeting in EU.

2) The Training Approaches

The goal will be to see new methods of teaching and also to participate to specialized and practical training. EU partners will give prepare the didactic materials and provide a feel on the relation between students and professors. Laboratories focusing on renewable energy areas will also be visited.

3) Establishing of Training Centre (DEV5.2)

Two aspects concerning the Centre were agreed upon at the Workshop DEV5.1:

- The Centre has to be useful for all Jordanian Partners and also other Jordanian universities
- It will provide different forms of training including vocational training, student and administrative staff training, etc.

The audience in the Training Centre can be engineers (students, professionals, faculty members) on the following topics: PV, solar thermal, wind, including electrical aspects of these. The Centre will provide lectures simulation packages and hands-on experiments. Possible resources include virtual labs, remote labs, training packages, physical labs at PSUT, UoJ own resources. In order to guarantee the sustainability of MUREE project also in the future, a certification could be associated to each courses. The training centre will use, in the starting phase, materials prepared for the selected courses to be updated and e-learning materials (based on the Workshop 2.1). Staff from UCY and Sapienza will visit Jordan for establishing the training centre. EU institutions will assist UoJ in choosing the hardware and software for the centre (e-learning course, experimental analysis). Fees for courses will not be requested in the training centre.

4) Proposed Activities for the Academic Visits to EU Partners (DEV5.3)

- 1) Overviewing the developed material
- 2) Exchanging experience in teaching methodology (possible class attendance and participation)
- 3) Visiting research laboratories on-site or external laboratories
- 4) Visiting pilot projects and commercial projects (small- and large-scale)
- 5) Attending dedicated seminars. For instance, a dedicated seminar on the undergraduate and postgraduate course on Photovoltaics at UCY can be developed for the trainees which will cover the program of study and syllabus.
- 6) Educational laboratory and experiments as part of academic courses; conducting practical experiments.
- 7) Exposure to various IEC standards for testing for instance photovoltaics.

5) Proposed Program for Trainees Visits to EU Partners (DEV5.4)

- a.Overviewing developed material
- b.Exchanging experience in teaching methodologies
- c.Practical exposure in research laboratories where state-of-the-art equipment can be used and scientific measurements conducted.
- d.Visiting Pilot projects and commercial projects.

More specifically, each university partner will provide training on the following topic:

- UCY- educational labs, PV characterization, PV system design, Data collection and Monitoring from PV systems, standard test condition testing, PV system installation (more for technical people), problem and maintenance;
- TUG- electric drives and control, theory, measurements, accuracy of measurements, documentation for measurements;
- Sapienza- general introduction on each RE system, bio-energy/bio-fuel/Hydrogen experiments, Analysis of different biomass, characterization of different systems for energy production, design of

PV plants, PV components (selection and sizing), Stirling engines technologies (CSP dish technologies), VAWT Wind Turbine-Darriues;

- TUB- Mobility concept of laboratory, progress on wind experiments, CSP, PV characterization and wind characterization.

6) Training Workshops in Jordan (DEV5.5)

The target audience for the training workshops has been defined to be professionals (professors, students, teachers, administrators). The trainers and speakers at the training workshops will be Jordanian people who participated the dedicated training sessions in the EU (DEVs 5.3, 5.4). The type of training to be provided will include seminars, hands-on training, other based on the audience and equipment of the training centre. The plan and agenda of the training workshops will be decided during the next steering committee meeting between the partners. The contribution of UCY to the training workshops will be the implementation of some short training courses or seminars in Jordan.

4. Conclusions

This report presents the plan of action which was discussed and agreed during Workshop 5.1 regarding the long-term capacity building program in MUREE. The focus will be on the appropriate training of Jordanian professionals in EU Universities in order to enable the transfer of knowledge and know-how in renewable energy and energy efficiency to the Jordanian Universities. The appropriate upgrading of skills and capacities will ensure that Universities in Jordan are placed in a position to offer quality education comparable to European standards which also meets the socio-economic needs of its emerging knowledge-based society.