



Project Title: Modernising Undergraduate Renewable Energy Education: EU Experience for Jordan

Acronym: MUREE

Project Number: 530332-TEMPUS-1-2012-1-JO-TEMPUS-JPCR

Funding Scheme: TEMPUS (Joint Projects, Curricular Reform)

Grant Agreement Number: 2012-3324/001-001

Duration 3 Years Starting on 15/10/2012

Coordinator: Princess Sumaya University for Technology (PSUT), Jordan

Project Manager: Professor Abdallah Al-Zoubi

Address: Khalil Saket Street 118, Amman 11941, Jordan

Tel: +9626 5359949 / +9627 77355299

Fax: +9626 5347295

Email: zoubi@psut.edu.jo

Project Website: <http://muree.psut.edu.jo/Home.aspx>

Deliverable Title	<i>Academic Visits to EU Partners</i>		
Author(s)	<i>Maria Hadjipanayi</i>		
Organisation Name(s)	<i>University of Cyprus</i>		
Deliverable No.	5.3		
Deliverable Type	Learning Resources		
WP Number	5		
WP Leader	<i>University of Cyprus</i>		
Due Date of Delivery	15/2/14	Project Month	17
Submission Date	3/11/14	Project Month	25
Dissemination Level	International Level		
Total Number of Pages	6		

1. Introduction

In 2014, four training visits of Jordanian participants to four different EU Universities took place. For these visits, 20 Teaching staff from all Jordanian partner universities will be selected, according to pre-defined criteria. Each of these members of staff was trained for a week on matters of RES at the University of Cyprus (UCY), the Graz University of Technology (Graz), the Sapienza University of Rome (Sapienza), and the Technische Universität Berlin (TUB). Detailed activities description is presented in this report. These visits successfully completed the deliverable task 5.3 of the MUREE project.

2. Activities Description

(a) University of Cyprus, PV Technology Laboratory

The training took place in the period 13-17 January 2014 at the PV Technology Laboratory of the University of Cyprus (UCY) situated at the main campus. The following six (6) academics from different Jordanian Universities participated:

- Dr. Ayman Al-Maaitah, Mutah University
- Dr. Ahmed Al-Salaymeh, University of Jordan
- Dr. Ayman Faza, PSUT
- Dr. Mahmoud Hassan, PSUT
- Dr. Qais Khasawneh, Jordan University of Science and Technology
- Dr. Mohammad Al-Abed, Hashemite University

The morning of the first day of the visit began with onsite tours in the PV technology Laboratory (indoors and outdoors). Initially, an outline of the agenda was presented and then a selection of some of the activities undertaken at the PV Technology group were presented in order to familiarize the Jordanian partners with current burning issues in the field of PV, which will thus help in the optimisation of the teaching course and its tailoring to meet the current and up and coming evolution of the technology. Members of the PV Technology laboratory presented the ongoing research work undertaken. Dr George Makrides provided a guided tour of the outdoor and indoor PV Technology UCY testing facility. Mr Alexander Phinikarides presented the outdoor PV system test infrastructure. Additionally, Mr Minas Patsalides presented the issues behind Power Quality and grid-integration and Mrs Nitsa Kindini presented the PID facility and a description of the research field with respect to degradation. Mrs Vaso Paraskeva presented the research undergone at the indoor laboratory. Mr Marios Toumazou presented his experimental desalination unit and finally, Mr Yiannis Koumparou presented his project regarding net-metering.

In the afternoon, there was a dedicated session on the needs of the Jordanian partners in terms of teaching RES courses and in particular designing a new PV course in their respective universities. The session involved a presentation/briefing session by Dr. Mahmoud Hassan, PSUT and by Mohammad Al-Abed, Hashemite University. In this session the syllabus of the proposed PV course was presented together with the existing situation with regards to the teaching of PV in Jordan at the University level. Every Jordanian partner presented their courses and outlined their needs for the new course.

The 2nd day of the training visit at UCY involved a thorough overview of the teaching activities of the PV Technology Laboratory. Members of the Laboratory presented and discussed important topics of the PV field namely performance assessment evaluation of different photovoltaic technologies, reliable assessment of degradation for different photovoltaic technologies, a power quality assessment, as well as assessment of new degradation mechanisms discovered in particular the potential induced degradation (PID) of photovoltaic modules. Moreover, this session included a presentation of characterisation techniques of cell technologies and an overview of energy policies for RES in particular on PV net-metering schemes.

Next, a presentation of the course Renewable Energy Sources: Photovoltaics (of the UCY) was made to the Jordanian partners by Dr George Georghiou and Dr George Makrides. The course outline, syllabus, curriculum and sample lectures were presented to the trainees. A new course at the UCY titled Advanced Solar Technologies was also introduced to the Jordanian partners. The day ended with general discussion on new concepts of PV technology as well as the potential PV technology course in Jordan.

The 3rd day of the visit involved detailed presentations by the academic teaching staff at UCY on the theoretical part of the Photovoltaic course at UCY. Lecture slides from chapters 2 to 7 of the actual PV course at UCY were presented in detail in order to give the main concept of the course and the structure.

On the 4th day of the training visit, the focus was the practical part of the PV course at UCY. Essentially, the laboratory part of the course was presented in order to provide ideas about the new PV course to be developed by the Jordanian partners. The presentations and briefing involved the following laboratory experiments:

Lab-1: Mr Michalis Papastavrou demonstrated in detail how to monitor a PV system and acquire data for performance analysis.

Lab-2: Mr Minas Patsalides demonstrated in detail how to design a grid-connected PV system using both PV-Syst and SMA Sunny Design simulation software.

Lab-3: Mr Minas Patsalides demonstrated in detail how to characterize indoors PV cells utilizing the laboratory apparatus.

Lab-4: Mr Marios Toumazou demonstrated in detail how to install a grid-connected PV system (PV and inverter topology).

Lab-5: Mr Alexander Phinikarides presented an indoor characterisation experiment for PV modules. The last day involved a detailed overview of the equipment necessary for the courses and research discussion and action plan on how to proceed with the implementation of the on PV technologies as well as a global review of PV courses by Dr. Makrides. The visit closed with a general photovoltaics course in the MUREE project. During this discussion, the action plan was decided and agreed upon. It was decided that based on the agreed syllabus the detailed material will be developed by the Jordanian partners with the help of UCY. Specifically, UCY will assist in the development of the course in the topics of solar cells, PV modules and arrays and PV systems.

A detailed agenda of the UCY visit is attached to this report.

(b) Graz University of Technology, Electric Drives and Machines Institute

The training took place in the period 3-5 February 2014 at the Electric Drives and Machines Institute of Graz University of Technology in Graz, Austria, from 3rd to 5th February 2014. Three (3) teaching staff from Jordanian partner universities (Dr. Hussein Majali, Mutah University, Dr. Osama Saadeh, Jordan University of Science and Technology, Dr. Mohammad Salah/Hashemite University) and one student (Mr. Bilal Atieh, Hashemite University) had been preselected and participated at the training. Each of these members of staff and student was trained during the course of the stay at Graz University of Technology. Teaching and learning materials were exchanged, and the further design of the Electric Drives and Machines Course discussed. The discussion considered the design of the syllabus, the context of the Jordanian needs, and the use of the course in the context of the new curriculum in renewable energy that is to be designed in the frame of the EU project.

The training started with a presentation of the host and its institution, i.e. Graz University of Technology, the Faculty of Electric Engineering and Information Technology, the research and teaching facilities of the Electric Drives and Machines Institute, the courses the institute is responsible for, and the context these courses are taught in.

The remainder of the first day was filled with presentation by the Jordanian partners, covering the topics of the proposed Electric Machines Drives course (Osama Saadeh), the research background, courses taught and methodology used (Hussein Al-Majali), the HU mechatronics engineering program and teaching methodology for the motor drive systems course (Mohammad Salah), and classical and modern ways of teaching (Osama Saadeh).

On the second day, various courses offered by the Electric Drives and Machines Institute that might be of interest to the Jordanian Partners, as well as the teaching methodologies used respectively, were presented. These included the courses "Introduction to Electric Machines", "Introduction to Electric Drives", and "Electric Machines for Electric Drives" (Annette Muetze, EAM), "Electric Machines for Power Engineering" and "Analytic and Numerical Design of Electric Machines" (Johann Bacher/EAM), "Power Electronics", "Electric Machines and Drives Laboratory", and "Electric Drives and Machines Laboratory" (Klaus Krischan, EAM), "Control of Electric Drives and Machines" and "Modelling and Simulation of Electric Drive Systems and Machines" (Roland Seebacher, EAM) and "Introduction to Electrical Engineering, Laboratory" (Heinrich Eickhoff, EAM).

On the third day, the discussion was continued to include selected exercises of the laboratories offered by the Electric Drives and Machines Institute: "Synchronous Machine" (Johann Bacher, EAM), "Switching Power Devices" (Werner Konrad/EAM), "Transformer" (Stephan Dunkl, EAM) and "Efficiency Determination of Induction Machines" (Klaus Krischan, EAM).

Overall, the visit to TUG resulted in a refinement of the course developed. In particular, both on the second and the third day, the course syllabus of the proposed new electric drives and machines course was discussed in-between the already reported timetabled activities. It was decided that the course design might comprise more lecture hours than required so that a subset of the proposed lectures could then be selected by each of the Jordanian partners, to meet the requirements of their student body, respectively. Selected teaching material was made available to the Jordanian Partner by the host. The Jordanian partner proposed to teach the new course in the upcoming spring semester. Thereby, experience with the planned content, methodology, and material should be gained. The material should then be discussed again among the partners at the end of this academic year, leading to a revised and finalized course that can then be taught in the upcoming academic year.

The detailed agenda and the proposed syllabus are attached to this report.

(c) Sapienza University of Rome

The Jordanian participants of the visit in Sapienza University in the period 3-7 February 2014 were:

- Dr Osama Ayyadi, Prof Ali Badran, University of Jordan
- Prof Handri Ammari, Mutah University
- Prof Bashar Hammad, Hashemite University
- Prof Ayman Qamoh, PSUT
- Mr. Mohamad Salameh, PSUT
- Mr. Yazan Shwaifet, PSUT
- Mr Ayman Abu Hamdi, PSUT

On the first day, the technical visit starts with the welcome of Prof Naso and Dr Katuscia Cipri. The first day is dedicated to the training activities and experiences on renewable systems and energy efficiency at Sapienza University, including also stage opportunities, thesis and international cooperation. Prof Naso illustrates the didactic system in Italy, based on Bologna Process and credits, his course on energy systems at Sapienza. The national energy balance and the external collaboration with companies and energy agencies, such as energy industries (e.g. Civitavecchia plant energy conversion) are discussed. Dr Emanuele Michelangeli shows, through a .ppt presentation, the long term international experiences of CIRPS. In more than 20 years, CIRPS has coordinated and participated in National and International cooperation projects in South America, Africa and Asia. One of the goals is to transfer capacity building mainly for developing countries' population.

Prof Domenico Borello describes the different approach he uses in his course on renewable systems, which includes a simulation part, mainly dedicated to understand the biomass energy production processes. Numerical approach seems to be profitable, training students toward a more scientific point of view.

On the 2nd day, the course on Energy Conversion is analysed with all participants and Prof Naso. Prof Ali Badran shows the syllabus he has prepared for. The programme includes renewable energies processes. Prof Naso suggests to pay attention to the scheme of energy conversion divided in primary sources, secondary sources, electric sources, final users, forcing students to understand how to reduce consumption and to increase energy efficiency. Prof Ammari suggests eliminating the part concerning renewable energy systems because included in other MUREE courses. The day carries on with the visit of Sapienza's laboratories: mechanical, aeronautical and measurement laboratories.

On the 3rd day (morning), visit to thermoelectric plant in Civitavecchia. The ENEL Torrevaldaliga North is a coal-fired power plant with a total installed capacity of 1980 MW. The coal-fired plant has replaced the old oil-fired plant composed by 4 groups with a total capacity of 2640 MW. With the introduction of the latest technologies, emissions have been significantly reduced, compared to

the previous oil-fired plant (Sulfur Dioxide: -82%, Nitrogen Oxides: -61%, Dust: -82%). [ENEL data]

http://www.enel.com/en-GB/innovation/project_technology/thermal_power_plants/clean_coal/

In the afternoon, a visit was conducted to Hydrogen Pole. CIRPS team shows the main researches carried out on solar collectors, hydrogen, electric vehicles, and biomass.

On the fourth day, Jordanian delegation meets Italian students. At Sapienza University, courses will start the last week of February and meeting with University students is not possible. Sapienza holds the IX edition of EFER (Energy Efficiency and renewable energy systems) second level Master. EFER is a 2 year master course, attended by students with different knowhow: engineering, architecture, physics, law and political science. Students show energy situation in Italy: energy balance, energy incentives and policies, energy efficiency initiatives and discuss with Jordanian delegation about the reason of their choice to attend a Master.

The last day of the training involved a visit to ENEA – Italian National Agency for New Technologies, Energy and Sustainable Development. ENEA is one of the more important research centre and includes several laboratories on energy (renewable energy, energy efficiency, nuclear), Climate and the Environment, Safety and Human Health, New Technologies, Electrical Systems. The visit includes: biomass laboratories, concentrated solar thermal energy (CSP with ENEA patent), Photovoltaic laboratory, “Energy House” with solar cooling and heating.

(d) Technische Universität Berlin

An academic seminar for MUREE representatives took place in Berlin in the period 16-20 June 2014 at the facilities of the Technische Universität Berlin. Eight (8) Participants from Jordanian universities took part in this seminar, namely:

- Dr. Imad Halaseh from the MUTAH University
- Prof. Suhil Kiwan from the Jordanian University of Science and Technology
- Dr. Emad Attar from the Hashemite University
- Dr. Qais Khasawneh from the Jordanian University of Science and Technology
- Mr. Mohammad Hamdan from the University of Jordan
- Mr. Ahmad Sakhrieh from the University of Jordan
- Dr. Majdi Al-Omari from the Hashemite University
- Prof. Ayman Maaith from the MUTAH University

The seminar provided the participants with an overview of didactical and pedagogical approaches utilized by their colleagues in Berlin while teaching renewable energies content in well-established graduate programs. This five days seminar established common collaboration platforms in terms of resources exchange (personnel and material) as well as future perspectives of the MUREE project. The activities of the seminar, listed in detail below, included high-level meetings, courses’ visit as well as interaction with German lecturers and students, networking activities, etc.

- Wind energy and mobile wind channel meeting
- Visit to Renewables Academy (RENAC)
- GPE Lecture Example – Wind Energy
- Get-together with wind experts
- Photovoltaic experiments and mobile laboratory
- Lecturing methods: Project oriented teaching
- Biogas facility and wind farms visit

A ‘Next Steps meeting’ was organized during the academic visit at TUB (18 June 2014) in which the following topics were discussed:

(a) A PV short course: to be provided for 1-2 days in a Jordanian University utilizing the Mobile PV laboratory of TUB.

(b) Wind course: TUB can organize an intensive block course “Wind Energy” for the German Jordanian University (GJU).

(c) Spin-off projects: The possibility for new education and research projects between TUB and Jordanian Universities was discussed.

An agenda of the visit as well as the minutes of the ‘Next Steps meeting’ are attached to this report.

3. Conclusions

The general impression and comments of the attendees in all four visits was that the meetings were very successful, and that a solid foundation for further exchange of experience was laid. The “test run” of the delivery of the course material will reveal aspects that may need further refinement. Moreover, the action plans were decided and agreed upon in order for the actual work on new RES course designing and course delivery to take place. The participants also found very useful the Next steps discussion in TUB which resulted in concrete suggestions for new activities within MUREE and beyond. All the hosts (EU Universities) are very happy to keep supporting the further development of the course material in Jordanian Universities.

Attachments

1. Agenda for the Visit to UCY
2. Agenda for the Visit to TUG
3. Agenda for the Visit to Sapienza University
4. Agenda for the Visit to TUB