

## DELIVERABLE 5.2

### Students Training

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## 1. INTRODUCTION

This document reports on the training activities conducted in the scope of the Erasmus+ Capacity Building Project 609971-EPP-1-2019-1-JO-EPPKA2-CBHE-JP “Introducing Recent Electrical Engineering Developments into Undergraduate Curriculum” (IREEDER).

In detail, the purpose of this document is to report on the following main aspects:

- the accreditation of the developed subjects at Jordanian universities;
- the implementation of said courses;
- the laboratories established at the Jordanian universities which support the establishment of the courses and of other training activities;
- further training activities conducted by IREEDER Jordanian partners, including workshops organized with the Jordan Engineering Association;
- future plans, including established Memoranda of Understanding between Jordanian and European partners.

This document is developed in the scope of the *WP 5 - Exploitation of results and sustainability plan (Dissemination & Exploitation)* of the Project in compliance with the Project description and all applicable rules & guidelines.

## 2. IREEDER COURSES AT JORDANIAN UNIVERSITIES

A long term objective of IREEDER the developed subjects becoming autonomous after the community funding phase and bringing on further multiplier effects on education, economic and social development environment. The first step towards achieving this goal is the accreditation of the developed courses within each of the Jordanian academic partners (detailed in section 2.1). A further step is the implementation, already during the lifetime of the project, of the accredited courses (depicted in section 2.2) with the support of the established laboratories indicated in Section 3.

### 2.1 2.1 Accreditation Process

All Jordanian partners have concluded the accreditation stage of a set of courses in the three core areas of IREEDER: Renewable Energy, Cybersecurity and Internet of Things. The complete list of courses can be found in the individual sub-sections.

#### 2.1.1 Al-Hussein Bin Talal University

Eight courses have been accredited at AHU: two on Renewable Energy, four on Internet of Things and two on Cybersecurity.

Of these two represent an update on existing courses, whereas a grand total of six have been added as new course in the study plan.

The courses are hosted by for different departments: Electrical Engineering, Mechanical Engineering, Computer Engineering and Communications Engineering and are included in five different courses: Electrical Engineering, Mechanical Engineering, Computer Engineering, Communications Engineering, and Network Security Engineering.

Table 1 lists the courses accredited at AHU.

Course	Department	Program	Action taken
Renewable energy	Electrical Engineering	Electrical Engineering	Updating existing course
Renewable energy	Mechanical Engineering	Mechanical Engineering	Updating existing course
Introduction to Internet of Things	Computer Engineering	Computer Engineering	Added as a new course in the study plan
Introduction to Internet of Things	Communications Engineering	Communications Engineering	Added as a new course in the study plan
Introduction to Internet of Things	Computer Engineering	Network Security Engineering	Added as a new course in the study plan
Introduction to Internet of Things	Electrical Engineering	Electrical Engineering	Added as a new course in the study plan
Introduction to Cyber Security	Communications Engineering	Communications Engineering	Added as a new course in the study plan
Introduction to Cyber Security	Computer Engineering	Computer Engineering	Added as a new course in the study plan

*Table 1: Subject accreditation at Al-Hussein Bin Talal University*



### 2.1.2 Isra University

Three courses have been accredited at IU: one on Renewable Energy, one on Internet of Things and one on Cybersecurity.

All three courses, covering the topic span of the IREEDER project, have been added as elective specialization courses to the Communications and Electronics Engineering program, hosted by the Department of Communication and Electronics Engineering.

Table 2 lists the courses accredited at IU.

Course	Department	Program	Action taken
Introduction to Renewable Energy	Department of Communications and Electronics Engineering	Communications and Electronics Engineering	Added as elective specialization course
Introduction to Internet of Things	Department of Communications and Electronics Engineering	Communications and Electronics Engineering	Added as elective specialization course
Introduction to Cyber Security	Department of Communications and Electronics Engineering	Communications and Electronics Engineering	Added as elective specialization course

*Table 2: Subject accreditation at Isra University*

### 2.1.3 Mutah University

Five courses have been accredited at MU: one on Renewable energy systems, three on Internet of Things and one on Cybersecurity.

The course on Renewable Energy systems constitutes an update to an existing course, while the remaining courses are added as new courses in the study plan. The study programs covered are: Power and Control Engineering (hosted by the department of Electrical Engineering); Communications Engineering (also taught at the department of Electrical Engineering) and Computer Engineering (taught in the namesake department).

Table 3 lists the courses accredited at MU.

Course	Department	Program	Action taken
Renewable Energy systems	Electrical Engineering	Power and Control Engineering	Updating existing course
Introduction to Internet of Things	Electrical Engineering	Power and Control Engineering	Added as a new course in the study plan
Introduction to Internet of Things	Electrical Engineering	Communications Engineering	Added as a new course in the study plan
Introduction to Internet of Things	Computer Engineering	Computer Engineering	Added as a new course in the study plan
Introduction to Cyber Security	Computer Engineering	Computer Engineering	Added as a new course in the study plan

*Table 3: Subject accreditation at Mutah University*

## 2.1.4 Tafila Technical University

TTU have accredited eight courses: two related to Internet of Things, namely two instances of Introduction to Internet of Things, one for the Computer Engineering course and one for the Smart Systems Engineering program, two related to Cybersecurity (Introduction to Cyber Security and Computer and Network Security), and for on Renewable Energy topics (two instances of a Renewable Energy and Energy storage; Photovoltaic Energy Systems, Introduction to Renewable Energy). Four of these courses have been added as elective specialization courses, three as compulsory specialization courses, and one course has been updated based on project outcomes.

Table 4 lists the courses accredited at TTU.

Course	Department	Program	Action taken
Introduction to Internet of Things	Department of Communications and Electronics and Computer Engineering	Computer Engineering	Added as elective specialization course
Introduction to Internet of Things	Department of Communications and Electronics and Computer Engineering	Smart Systems Engineering	Added as elective specialization course
Introduction to Cyber Security	Department of Communications and Electronics and Computer Engineering	Computer Engineering	Added as elective specialization course
Computer and Network Security	Department of Communications and Electronics and Computer Engineering	Computer Engineering	Course updated based on project outcomes
Renewable Energy and Energy storage	Department of Electrical Engineering	Integrated Renewable Energy Engineering	Added as compulsory specialization course
Photovoltaic Energy Systems	Department of Electrical Engineering	Mechatronics Engineering	Added as elective specialization course
Renewable Energy and Energy storage	Department of Electrical Engineering	Electrical Power Engineering	Added as compulsory specialization course
Introduction to Renewable Energy	Department of Mechanical Engineering	Mechanical Engineering	Added as compulsory specialization course

*Table 4: Subject accreditation at Tafila Technical University*

## 2.1.5 Philadelphia University

Four courses have been accredited at PU: one on renewable energy systems, two on Internet of Things and one on Cybersecurity.

The course on Renewable Energy systems constitutes an update to an existing course, while the remaining courses are added as new courses in the study plan. The study programs covered are: Power and Control Engineering (hosted by the department of Electrical Engineering); Communications Engineering (also taught at the department of Electrical Engineering) and Computer Engineering (taught in the namesake department).

Table 4 lists the courses accredited at PU.

Course	Department	Program	Action taken
Introduction to Renewable Energy	Electrical Engineering	Electrical Engineering	Updating existing course
Internet of Things	Electrical Engineering	Communications and Electronic Engineering	Added as a new course in the study plan
Cyber Security	Electrical Engineering	Communications and Electronic Engineering	Added as a new course in the study plan
Internet of Things	Mechatronics Engineering	Mechatronics Engineering	Added as a new course in the study plan

Table 5: Subject accreditation at Philadelphia University

## 2.2 2.2 Course implementation

Given the swift accreditation process conducted at all partner universities it was possible, during the academic year 2021/2022, the implementation of a grand total of 21 course instances of the accredited courses at the participating Jordanian institutions.

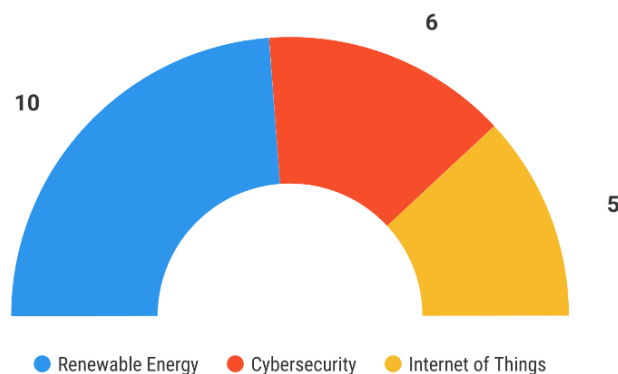


Figure 1: Course implementation by area

These courses were attended by a total of 367 students, of which 98 were females.

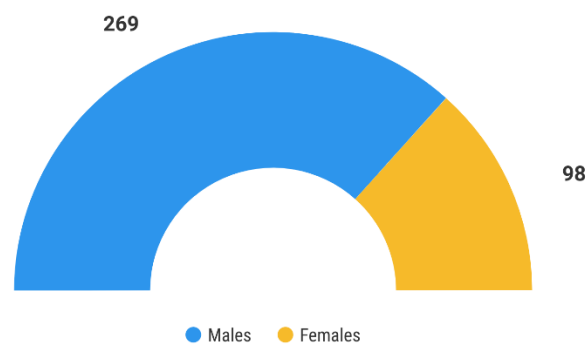


Figure 2: Course participants by gender

The full list of implemented courses can be found in Table 6 below.

Course	Partner	Academic Year	Semester	No. of students	No. of Female students
RE	PU	2021/2022	1st	9	0
RE	PU	2021/2022	2nd	12	1
IoT	PU	2021/2022	2nd	14	0
RE	PU	2021/2022	Summer	14	0
RE	IU	2021/2022	2nd	10	2
RE	MU	2021/2022	2nd	19	3
CS	MU	2021/2022	2nd	47	28
RE	AHU	2021/2022	Summer	33	3
IoT	AHU	2021/2022	Summer	16	9
CS	AHU	2021/2022	2nd	8	5
IoT	AHU	2021/2022	1st	5	0
IoT	AHU	2021/2022	2nd	17	9
CS	TTU	2021/2022	1st	15	5
RE	TTU	2021/2022	1st	36	17
RE	AHU	2021/2022	2nd	12	2
IoT	TTU	2021/2022	Summer	16	7
RE	AHU	2021/2022	1st	17	0
CS	IU	2021/2022	2nd	13	0
CS	IU	2021/2022	2nd	29	7
IoT	IU	2021/2022	2nd	13	0
RE	IU	2021/2022	Summer	12	0
			Total	<b>367</b>	<b>98</b>

*Table 6: Subject implementation at the IREEDER universities.*

### 3. ESTABLISHED LABORATORIES IN JORDANIAN PARTNERS

The IREEDER project has created teaching and training materials for undergraduate students in electrical engineering and other relevant fields on renewable energy (RE), the Internet of Things (IoT), and cyber security (CS). The practical component to courses and of any planned training action is planned to be supported by the establishment of advanced laboratories at Mutah University (MU), Tafila Technical University (TTU), and Al Hussein Bin Talal University (AHU), while other Jordanian partners will be able to access them via remote labs technology. Indeed, the remote laboratories established by the IREEDER project will allow for remote control and monitoring of laboratory equipment, allowing engineering students to conduct experiments in real time, at their own schedule, from anywhere, and whenever it is convenient for them. Aside from the experimental training provided by the internet laboratories, the system is also a great teaching tool since real-time demonstrations of the experiments may be done and concurrently watched by a group of students. This strategy is extremely useful for engineering schools, particularly in Jordan, because resources can be shared through the Internet even during the present challenging COVID 19 time.

The status of the IREEDER lab establishment is depicted in Table 7.

Laboratory	Location/ Partner	Status
Cyber Security	Tafila Technical University	Operating since Nov 2021 Inaugurated on 4th Jan 2022
Internet of Things	Al-Hussein Bin Talal University	Operating since Sept 2021 Inaugurated on 3rd Jan 2022
Renewable Energy	Mutah University	Operating since July 2021 Inaugurated on 6th July 2021
Remote Access equipment	Isra University	Operating since Dec 2021 Inaugurated on 13th Jan 2022
Remote Access equipment	Philadelphia University	Operating since Dec 2021
Remote Access equipment	Al-Hussein Bin Talal University	Operating since Nov 2021
Remote Access equipment	Mutah University	Operating since Nov 2021

*Table 7: Status of laboratory establishment*

Each of the academic institutions where the laboratories are located will be responsible for their maintenance and up-to-dateness, which includes both hardware and software, as well as required knowledge to maintain it by the laboratory staff.

#### 4. STUDENT TRAINING BY TOPIC AREA

A total of 13 student training instances have been conducted in the Jordanian universities: five on Renewable Energy (at TTU, AHU, MU and PU), four on Internet of Things (at AHU, MU, PU and IU) and four on Cyber Security (at TTU, MU, PU and IU).

The workshops took place between May and September 2022 and were attended by 250 student trainees, 50 of which were female.

The complete list of IREEDER student training workshops is depicted in Table 8.

Training workshop	Date	Location	No of Trainees	No. of Female trainees
Renewable Energy	23/05/2022	TTU	32	6
Renewable Energy	20/07/2022	AHU	34	0
Renewable Energy	17/08/2022	MU	12	4
Renewable Energy	02/08/2022	PU	15	0
Renewable Energy	17/09/2022	IU	9	3
Internet of Things	05/09/2022	AHU	21	8
Internet of Things	16/08/2022	MU	29	3
Internet of Things	01/08/2022	PU	32	0
Internet of Things	19/09/2022	IU	9	3
Cyber Security	06/06/2022	TTU	21	12
Cyber Security	15/08/2022	MU	15	8
Cyber Security	03/08/2022	PU	12	0
Cyber Security	20/09/2022	IU	9	3
		TOTAL	<b>250</b>	<b>50</b>

*Table 8: Student training workshops*

The following sections present each of the individual workshops conducted at each of the Jordanian partners, organized by topics, showcasing the agenda and selected event pictures.

## 4.1 Cybersecurity

### 4.1.1 CS Training Workshop at TTU – 6th June 2022

#### IREEDER CS Training Workshop Agenda

6 June 2022

Location: Tafila Technical University  
Coordinator: Dr. Ahmad Aljaafreh

Time	Topic	Presenter
9:30-9:45	General introduction to the workshop	Dr. Ahmad Aljaafreh
9:45-10:00	IREEDER project overview	Dr. Ahmad Aljaafreh
10:00-10:30	Introduction to Cyber Security	Dr. Ahmad Aljaafreh
10:30-10:45	Break	
10:45-11:30	Security and Risk Management	Eng. Omer Qwabeh
11:30-12:15	Security Engineering	Eng. Omer Qwabeh
12:15-13:00	Break	
13:00-13:45	Communications & Network Security: Securing network components	Eng. Omer Qwabeh
13:45 – 14:30	Communications & Network Security: Securing communication channels	Eng. Omer Qwabeh



Figure 3: Agenda and pictures – CS Training at TTU

## 4.1.2 CS Training Workshop at PU – 3rd August 2022

### Day Three: Cyber Security Workshop (Wednesday, 3rd Aug 2022)

Time	Topic	Material	Presenter (s)
08:00-08:30	General introduction to the workshop IREEDER project overview		Eng. Rasha Fraihat
08:30-9:30	Introduction to Cyber Basic concepts	Introduction to Cyber Security and Information Security, Malware Types	Eng. Walaa Araydah
9:30-10:30		Attacks Types and social Engineering principles	Eng. Samah Jaradat
10:30- 11:30		Threat Actor Type	Eng. Rasha Fraihat
11:30-12:30	Security Control	How to protect your data	Eng. Rasha Fraihat
12:30-13:00	Coffee Break		
13:00-15:30	Practical work	Overview of Cyber lab: Remote Lab Access	Eng. Walaa Araydah Eng. Samah Jaradat Eng. Rasha Fraihat
		Virtualization (Virtual Machines (VM) Lab Architecture)	
		Cloud	
		Password Cracking Security Engineering Models	
		Controls and Vulnerabilities	
13:30 – 16:00	Closing Session		



Figure 4: Agenda and pictures – CS Training at PU





### 4.1.3 CS Training Workshop at MU – 15th August 2022

#### IREEDER CS Training Workshop Agenda

15 Aug 2022

Location: Mutah University  
Coordinator: Dr. Ziyad Altarawneh

Time	Topic	Presenter
9:30-9:45	<b>General introduction to the workshop</b>	Dr. Ziyad Altarawneh
9:45-10:00	<b>IREEDER project overview</b>	Dr. Ziyad Altarawneh
10:00-10:30	<b>Introduction to Cyber Security</b>	Dr. Ziyad Altarawneh
10:30-10:45	Break	
10:45-11:30	<b>Security and Risk Management</b>	Eng. Yusra Saraireh
11:30-12:15	<b>Security Engineering</b>	Eng. Yusra Saraireh
12:15-13:00	Break	
13:00-13:45	<b>Communications &amp; Network Security:</b> Securing network components	Eng. Taghreed Tarawneh
13:45 – 14:30	<b>Communications &amp; Network Security:</b> Securing communication channels	Eng. Taghreed Tarawneh



Figure 5: Agenda and pictures – CS Training at MU

#### 4.1.4 CS Training Workshop at IU – 20th September 2022

### IREEDER CS Training Workshop Agenda

20 Sept 2022

Location: Isra University  
Coordinator: Dr. Ghaida Abu Rumman

Time	Topic	Presenter
11:30-11:45	General introduction to the workshop	Dr. Mohammad Siam
11:45-12:00	IREEDER project overview	Dr. Mohammad Siam
12:00-12:30	Introduction to Cyber Security	Dr. Nader Salameh
12:30-12:45	Break	
12:45-13:30	Security and Risk Management	Dr Hasan Kanaker
13:30-14:15	Security Engineering	Dr Hasan Kanaker
14:15-15:00	Break	
15:00-15:45	Communications & Network Security: Securing network components	Dr. Nader Salameh



Figure 6: Agenda and pictures – CS Training at IU

## 4.2 Internet of Things

### 4.2.1 IoT Training Workshop at PU – 1st August 2022

**Day One: IoT Workshop (Monday, 1<sup>st</sup> Aug 2022)**

Time	Topic	Material	Presenter (s)
08:00-08:30	General Introduction to IREEDER project		Eng. Samer Sartawi
08:30-09:30	Introduction to IoT	Definition of IoT	Eng. Huthaifah AlKhashashneh
		Enabling Technology of IoT	
		IoT Architecture	
		IoT challenges IoT Applications	
09:30-10:30	IoT Microcontrollers, Sensors for Data Acquisition and Actuators	Microcontrollers	Eng. Samer Sartawi
		Real time system	
		Embedded software	
10:30-11:30	Basic Programming and IoT IDE	Programming Fundamental	Eng. Samer Sartawi
		Integrated Development Environment (IDE)	
11:30-12:00	Coffee Break		
12:00-15:30	Practical work	IoT application Using Raspberry Pi	Eng. Samer Sartawi
		IoT application Using Arduino part 1	Eng. Huthaifah AlKhashashneh
		IoT application Using Arduino part 2	
15:30-16:00	Closing Session		

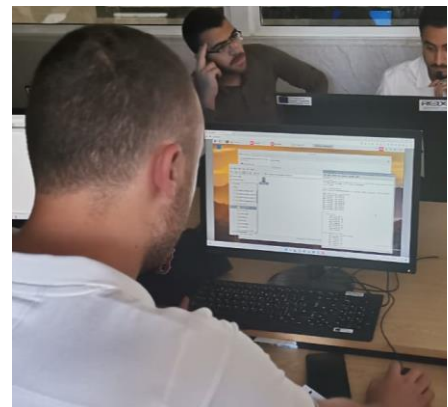


Figure 7: Agenda and pictures – IoT Training at PU

## 4.2.2 IoT Training Workshop at AHU – 5th September 2022

### IREEDER IoT Training Workshop Agenda

5 Sept 2022

Location: Al-Hussein Bin Talal University  
Coordinator: Dr. Abdullah Alhasanat

Time	Topic	Presenter (s)
09:00-9:30	General introduction to the workshop	Dr. Moath Alsafasfeh
9:30-10:00	IREEDER project overview	Dr. Moath Alsafasfeh
10:00-10:45	Introduction to IoT - Part I	Dr. Abdullah Alhasanat
10:45-11:00	Break	
11:00-11:45	Introduction to IoT - Part II	Dr. Abdullah Alhasanat
11:45-12:30	IoT Microcontrollers, Sensors for Data Acquisition and Actuators	Dr. Abdullah Alhasanat
12:30-13:15	Revision of Basic Programming and IoT IDE	Dr. Abdullah Alhasanat
13:15 – 13:30	Break	
13:15-14:00	Practical Implementation: Arduino Experiments	Eng. Samiha Alfalahat
14:00-14:45	Practical Implementation: Raspberry Pi Experiments	Eng. Samiha Alfalahat

*Figure 8:  
Agenda and  
pictures – IoT  
Training at  
AHU*



### 4.2.3 IoT Training Workshop at MU – 16th September 2022

#### IREEDER IoT Training Workshop Agenda

16 Aug 2022

Location: Mutah University  
Coordinator: Dr. Ziyad Altarawneh

Time	Topic	Presenter (s)
09:00-9:30	General introduction to the workshop	Dr. Ziyad Altarawneh
9:30-10:00	IREEDER project overview	Dr. Ziyad Altarawneh
10:00-10:45	Introduction to IoT - Part I	Dr. Ziyad Altarawneh
10:45-11:00	Break	
11:00-11:45	Introduction to IoT - Part II	Eng. Taghreed Tarawneh
11:45-12:30	IoT Microcontrollers, Sensors for Data Acquisition and Actuators	Eng. Yusra Saraireh
12:30-13:15	Revision of Basic Programming and IoT IDE	Eng. Yusra Sariereh
13:15 – 13:30	Break	
13:15-14:00	Practical Implementation: Arduino Experiments	Eng. Taghreed Tarawneh Nabeel Abu Amro
14:00-14:45	Practical Implementation: Raspberry Pi Experiments	Eng. Taghreed Tarawneh Nabeel Abu Amro

Figure 9:  
Agenda and  
pictures –  
IoT Training  
at MU



#### 4.2.4 IoT Training Workshop at IU – 19th September 2022

### IREEDER IoT Training Workshop Agenda 19 Sept 2022

Location: Isra University  
Coordinator: Dr. Ghaida Abu Rumman

Time	Topic	Presenter (s)
09:00-9:30	General introduction to the workshop	Dr. Mohammad Siam
9:30-10:00	IREEDER project overview	Dr. Mohammad Siam
10:00-10:45	Introduction to IoT - Part I	Dr. Mohammad Siam
10:45-11:00	Break	
11:00-11:45	Introduction to IoT - Part II	Dr. Mohammad Siam
11:45-12:30	IoT Microcontrollers, Sensors for Data Acquisition and Actuators	Dr. Osama Fares
12:30-13:15	Revision of Basic Programming and IoT IDE	Dr. Osama Fares
13:15 – 13:30	Break	
13:15-14:00	Practical Implementation: Arduino Experiments	Eng. Yaser Abdah
14:00-14:45	Practical Implementation: Raspberry Pi Experiments	Eng. Yaser Abdah



Figure 10: Agenda and pictures – IoT Training at IU

## 4.3 Renewable Energies

### 4.3.1 RE Training Workshop at TTU – 23rd May 2022

An RE Training workshop was organized at TTU on 23<sup>rd</sup> May 2022.

### 4.3.2 RE Training Workshop at AHU – 20th July 2022

#### IREEDER RE Training Workshop Agenda

Wednesday 20 July 2022

Trainer: Dr. Ahmad Salah and Dr. Mohammad Shalby – Al-Hussein Bin Talal University  
Location: Maan , Al-Hussein Bin Talal University

Time	Topic	Presenter (s)
09:00-9:30	General introduction to the workshop	Dr. Mohammad Shalby
9:30-10:00	IREEDER project overview	Dr. Saud Althunibat
10:00-11:00	Introduction to RE resources	Dr. Mohammad Shalby
11:00-11:30	Break	
11:30-12:30	Solar energy and photovoltaic systems	Dr. Ahmad Salah
12:30-13:30	Wind energy fundamentals and operation	Dr. Mohammad Shalby
13:30-14:00	Break	
14:30-15:30	Overview of RE industry in Jordan	Dr. Ahmad Salah
15:30-14:30	Introduction to PSIM software	Dr. Ahmad Salah



Figure 11:  
Agenda and  
pictures –  
RE Training  
at AHU



### 4.3.3 RE Training Workshop at PU – 2nd August 2022

**Day Two: RE Workshop (Tuesday, 2<sup>nd</sup> Aug 2022)**

Time	Topic	Material	Presenter (s)
08:00-08:30	General Introduction to IREEDER project		Eng. Lina Alkhateeb
8:30-10:00	Introduction to RE	Definition Of Solar Energy	Eng Nessreen Al-zboon
		Structure And Design Of A Solar Photovoltaic Power Plant	
		Introduction To Wind Energy	
		Structure And Characteristics Of Wind Turbines And Wind Power Plants	Eng Azad Otoum
		Structure And Characteristics Of Wind Generators Used In Wind Power Plants	
10:00-11:00	Hydrogen Fuel Cell	Structure And Design Of Hydrogen Fuel Cell	Eng. Lina Alkhateeb
11:00-11:30	Coffee Break		
11:30-15:30	Practical work	Overview Of RE Lab: Remote Lab Access	Eng Nessreen Al-zboon Eng Azad Otoum Eng. Lina Alkhateeb
		Study Of Photovoltaic Solar Panels	
		Operation Of The Solar Power Station In Battery Charging Mode	
		Autonomous Operation Of A Solar Power Plant Supplying A Load	
		Characteristics Of Electrical Loads Of Wind Power Plants	
		Characteristics Of Wind Power Plants In Battery Charging Mode	
		Characteristics Of Off-Grid Wind Power Plant Supplying The Load	
		Characteristics Of The Fuel Cell	
15:30-16:00	Closing Session		



Figure 12: Agenda and pictures – RE Training at PU

#### 4.3.4 RE Training Workshop at MU – 17th August 2022

##### IREEDER RE Training Workshop Agenda

17 Aug 2022

Coordinator: Dr Ziyad Altarawneh  
Location: Mutah University

Time	Topic	Presenter (s)
09:00-9:30	General introduction to the workshop	Dr Ziyad Altarawneh
9:30-10:00	IREEDER project overview	Dr Ziyad Altarawneh
10:00-11:00	Introduction to RE resources	Dr Ziyad Almajali
11:00-11:30	Break	
11:30-12:30	Solar energy and photovoltaic systems	Eng. Frasa Adayleh
12:30-13:30	Wind energy fundamentals and operation	Dr Ziyad Almajali
13:30-14:00	Break	
14:30-15:30	Practical Experiments :Solar system	Eng. Wala Sarairoh
15:30-16:30	Practical Experiments : Wind system	Eng. Wala Sarairoh



Figure 13: Agenda and pictures – RE Training at MU

### 4.3.5 RE Training Workshop at IU – 18th September 2022

#### IREEDER RE Training Workshop Agenda 18 Sept 2022

Coordinator: Dr Mohammad Siam  
Location: Isra University

Time	Topic	Presenter (s)
09:00-9:30	General introduction to the workshop	Dr Mohammad Siam
9:30-10:00	IREEDER project overview	Dr Mohammad Siam
10:00-11:00	Introduction to RE resources	Dr. Ghaida Abu Rumman
11:00-11:30	Break	
11:30-12:30	Solar energy and photovoltaic systems	Dr. Zakarya Omari
12:30-13:30	Wind energy fundamentals and operation	Dr. Ghaida Abu Rumman
13:30-14:00	Break	
14:30-15:30	Overview of RE industry in Jordan	Dr. Mohammad Siam
15:30-16:30	Introduction to PSIM software	Dr. Zakarya Omari



Figure 14: Agenda and pictures – RE Training at IU

## 5. FURTHER TRAINING ACTIVITIES CONDUCTED BY IREEDER PARTNERS

### 5.1 Memoranda of Understanding

#### 5.1.1 MoU between UCLAN and Isra University

A Memorandum of Understanding (MoU) between UCLan Cyprus and Isra University was signed on 1<sup>st</sup> of June 2022.

The scope of this MoU includes exchange of students and staff, reciprocal invitations to scholars for the purpose of talks, lectures and research, planning and implementation of collaborative research and organization of joint academic vents. The concept is the creation of condition for students from both universities to study in and graduate from the partner university in specialties represented in both universities and to carry out joint work of university teachers for the unification of educational programmes as well as the realisation of joint research on different spheres of science.

#### 5.1.2 MoU between UCLAN and Philadelphia University

A second Memorandum of Understanding (MoU) between UCLan Cyprus and a Jordanian partner (Philadelphia University) has been signed on the 2<sup>nd</sup> of June 2022.

The scope of this MoU is to develop collaborative activities in academic areas of mutual interest, exchange faculty and researchers, exchange students, conduct joint research projects, organize academic events and exchange academic information and material.

#### 5.1.3 MoU between UPAT and AHU

A Memorandum of Understanding (MoU) between UPAT and AHU was initially approved by both sides and being in the procedure to be finalized and signed. The MoU between the two partners aims at building on the successful cooperation in IREEDER project to further boost it to higher levels. Specifically, both universities intend to cooperate in other project-proposals in the field of renewable energy for open calls from international funders such as Erasmus-Plus program of the European Union. The MoU also aims at improving the cooperation in course development, research activities and staff and student exchange.

#### 5.1.4 MoU between IT and AHU

A further Memorandum of Understanding was signed between Instituto de Telecomunicações and Al-Hussein Bin-Talal University, with the objective to promote co-operation between the two institutions in education and in academic research, via, namely: the development of joint research activities; university/research staff exchanges or mutual visits to both institutions; doctoral student training and development; student exchange and/or visiting programmes; the exchange of

information, including the results of teaching and research collaboration; and any further other activities viewed to be mutually beneficial.

## 5.2 Jordan Engineering Association

Several training actions have been undertaken in collaboration with the Jordan Engineering Association, on the three IREEDER topics.

The following sections present each of the individual workshops conducted at each of the Jordanian partners, organized by topics, showcasing the agenda and selected event pictures.

Training workshop	Date	Location	No of Trainees	No. of Female trainees
Renewable Energy	07/12/2021	MVC-Maan	12	1
Renewable Energy	4/09/2022	JEA-Tafila	17	3
Renewable Energy	5/09/2022	JEA-MAAN	58	22
Renewable Energy	17/09/2022	JEA- Karak	81	18
Renewable Energy	15/10/2022	JEA-Amman	71	23
Renewable Energy	29/09/2022	JEA-Aqaba	43	28
Internet of Things	28/09/2022	JEA-Aqaba	38	21
Internet of Things	08/09/2022	JEA-Maan	41	21
Cyber Security	15/09/2022	JEA-Maan	45	8
Cyber Security	27/09/2022	JEA-Aqaba	42	23
		Total	<b>448</b>	<b>168</b>

*Table 9: JEA training workshops*

## 5.2.1 RE Training Workshop at Tafila – 4th September 2022

### IREEDER Renewable Energy Training Workshop Agenda

04-September 2022

Jordanian Engineers Association – Tafila Branch, Tafila

Coordinators: Prof. Ahmad Aljaafreh & Dr. Naeem Al Oudat  
(Tafila Technical University, Tafila, Jordan)

Time	Topic	Presenter (s)
09:00-9:30	<b>General introduction to the workshop</b>	Dr. Naeem Oudat
9:30-10:00	<b>IREEDER project overview</b>	Prof. Ahmad Aljaafreh
10:00-11:00	<b>Photovoltaic systems and components</b>	Dr. Eyad Almaita
11:00-11:30	Break	
11:30-12:30	<b>Renewable Energy Fundamentals</b>	Eng. Mohammad Alarni,
12:30-13:30	<b>Energy Storage Technologies</b>	Dr. Eyad Almaita
13:30-13:45	Break	
13:45-14:45	<b>Electricity Market Model in Transition Toward Renewable Energy</b>	Dr. Juman Alshwawreh
14:45-15:45	<b>Integrating of Renewable Energy into Electrical grid</b>	Dr. Eyad Almaita
15:45-16:45	<b>Optimal Control of Power Generation for Grid-Connected Renewable Energy Sources.</b>	Dr. Juman Alshwawreh
16:45-17:30	<b>Renewable Energy Practical Experiments: Solar system (1) Wind Systems (2)</b>	Eng. Mohammad Alarni D. Eyad Almaita





*Figure 15: Agenda and pictures – RE Training at Tafila [JEA]*

## 5.2.2 RE Training Workshop at Ma'an – 5th September 2022

### IREEDER RE Training Workshop Agenda

*Monday 5 September 2022*

Location: Jordanian Engineers Association – Ma'an Branch  
Coordinator: Dr. Moath Alsafasfeh (AHU)

Time	Topic	Presenter
9:30-9:45	<b>General introduction to the workshop</b>	Dr. Moath Alsafasfeh (AHU)
9:45-10:00	<b>IREEDER project overview</b>	Dr. Moath Alsafasfeh (AHU)
10:00-10:30	<b>Introduction to RE resources</b>	Dr. Ahmad Salah (AHU)
10:30-10:45	Break	
10:45-11:30	<b>Photovoltaic systems</b>	Dr. Ahmad Salah (AHU)
11:30-12:15	<b>Solar thermal systems</b>	Dr. Ahmad Salah (AHU)
12:15-13:00	Break	
13:00-13:45	<b>Wind energy fundamentals</b>	Dr. Mohammad Shalby (AHU)
13:45 – 14:30	<b>Wind Turbines operation and Control</b>	Dr. Mohammad Shalby (AHU)
14:30-14:45	Break	
14:45-15:30	<b>Integrating of RE into electrical grid</b>	Dr. Eyad Maitah (TTU)
15:30-16:15	<b>Energy storage technologies</b>	Dr. Eyad Maitah (TTU)





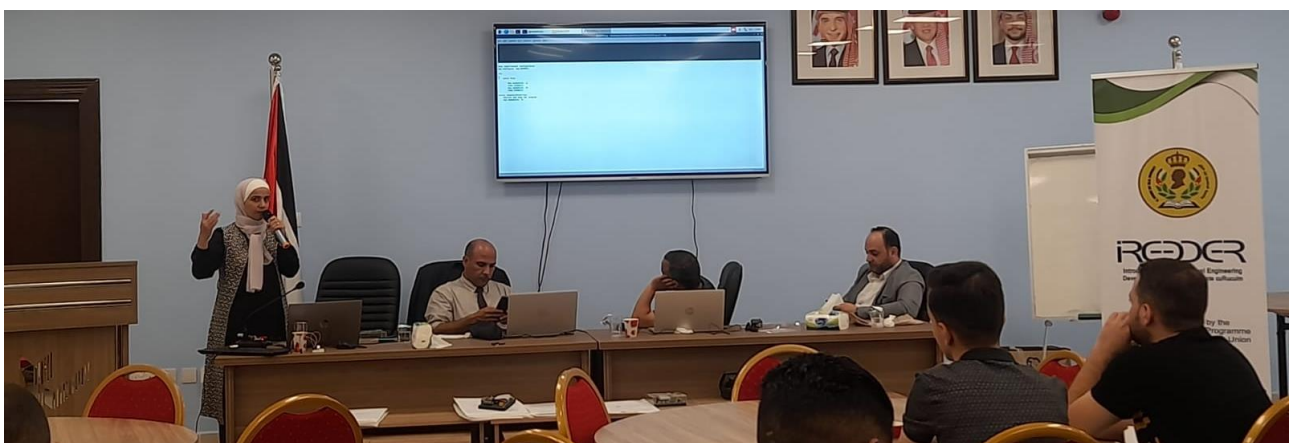
Figure 16: Agenda and pictures – RE Training at Ma'an

### 5.2.3 IoT Training Workshop at Ma'an – 8th September 2022

#### IREEDER IoT Training Workshop Agenda 8 Sept 2022

Location: Jordanian Engineers Association, Ma'an Branch  
Coordinator: Dr. Moath Alsafasfeh (AHU) & Dr Ahmad Salah (AHU)

Time	Topic	Presenter (s)
09:00-9:30	<b>General introduction to the workshop</b>	Dr. Moath Alsafasfeh (AHU)
9:30-10:00	<b>IREEDER project overview</b>	Dr. Moath Alsafasfeh (AHU)
10:00-10:45	<b>Introduction to IoT</b>	Prof. Ahmad Aljaafreh (TTU)
10:45-11:00	Coffee Break	
11:00-11:45	<b>IoT Microcontrollers, Sensors for Data Acquisition and Actuators</b>	Dr Moath Alsafasfeh (AHU)
11:45-12:30	<b>Revision of Basic Programming and IoT IDE</b>	Dr. Abdullah Alhasanat (AHU)
12:30-13:15	Break	
13:15-14:00	<b>Practical Implementation: Arduino Experiments</b>	Eng. Samiha Falahat(AHU)
14:00-14:45	<b>Practical Implementation: Raspberry Pi Experiments</b>	Eng. Samiha Falahat(AHU)
14:45-15:00	Break	
15:00-15:45	<b>IoT Connectivity Protocols and Technologies</b>	Dr. Abdullah Alhasanat (AHU)
15:45-16:30	<b>Data Storage and Cloud Systems in IoT</b>	Prof. Ahmad Aljaafreh (TTU)





*Figure 17: Agenda and pictures – IoT Training at Ma'an [JEA]*

## 5.2.4 CS Training Workshop at Ma'an – 15th September 2022

### IREEDER CS Training Workshop Agenda Thursday 15 September 2022

Location: Jordanian Engineers Association – Ma'an Branch  
Coordinator: Dr. Ahmad Salah (AHU)  
Dr. Moath Alsafasfeh (AHU)

Time	Topic	Presenter
9:30-9:45	<b>General introduction to the workshop</b>	Dr. Moath Alsafasfeh (AHU)
9:45-10:00	<b>IREEDER project overview</b>	Dr. Ahmad Salah (AHU)
10:00-10:30	<b>Introduction to Cyber Security</b>	Dr Bilal Alqudah (AHU)
10:30-10:45	Break	
10:45-11:30	<b>Security and Risk Management</b>	Dr. Eman Qtaimat (AHU)
11:30-12:15	<b>Security Engineering</b>	Dr. Eman Qtaimat (AHU)
12:15-13:00	Break	
13:00-13:45	<b>Communications &amp; Network Security:</b> Securing network components	Dr. Zeyad Al-Odat (TTU)
13:45 – 14:30	<b>Communications &amp; Network Security:</b> Securing communication channels	Dr. Zeyad Al-Odat (TTU)
14:30-14:45	Break	
14:45-15:30	<b>Security Operations:</b> Security Assessment and Testing	Dr. Bilal Alqudah (AHU)
15:30-16:15	<b>Security Operations:</b> Intrusion detection & Prevention, Recovery & Incident Response	Dr. Bilal Alqudah (AHU)

Figure 18: Agenda – CS Training at Ma'an [JEA]

## 5.2.5 RE Training Workshop at Karak – 17th September 2022

### IREEDER RE Training Workshop Agenda Saturday 17 September 2022

Location: Jordanian Engineers Association – Karak Branch  
Coordinators: Dr. Saud Althunibat & Dr. Ziyad Altarawneh

Time	Topic	Presenter
9:30-9:45	General introduction to the workshop	Dr. Ziyad Altarawneh (MU)
9:45-10:00	IREEDER project overview	Dr. Saud Althunibat (AHU)
10:00-10:30	Introduction to RE resources	Dr. Ziyad Almajali (MU)
10:30-10:45	Break	
10:45-11:30	Solar energy and photovoltaic systems	Dr. Ziyad Almajali (MU)
11:30-12:15	Wind energy fundamentals and operation	Dr. Ziyad Almajali (MU)
12:15-13:00	Break	
13:00-13:45	Integrating of RE into electrical grid	Dr. Eyad Maitah (TTU)
13:45 – 14:30	Energy storage technologies	Dr. Eyad Maitah (TTU)
14:30-14:45	Break	
14:45-15:30	Control of power generation of grid connected renewable energy resources	Dr. Jumana Alshawawreh (TTU)
15:30-16:15	Electricity market model in transition toward renewable energy	Dr. Jumana Alshawawreh (TTU)





Figure 19: Agenda and pictures – RE Training at Karak

## 5.2.6 CS Training Workshop at Aqaba – 27th September 2022

### IREEDER CS Training Workshop Agenda 27 September 2022

Location: Jordanian Engineers Association – Aqaba Branch  
Coordinator: Dr. Saud Althunibat (AHU)  
Dr. Moath Alsafasfeh (AHU)

Time	Topic	Presenter
9:30-9:45	<b>General introduction to the workshop</b>	Dr. Moath Alsafasfeh (AHU)
9:45-10:00	<b>IREEDER project overview</b>	Dr. Saud Althunibat (AHU)
10:00-10:30	<b>Introduction to Cyber Security</b>	Dr Bilal Alqudah (AHU)
10:30-10:45	Break	
10:45-11:30	<b>Security and Risk Management</b>	Dr. Eman Qtaimat (AHU)
11:30-12:15	<b>Security Engineering</b>	Dr. Eman Qtaimat (AHU)
12:15-13:00	Break	
13:00-13:45	<b>Communications &amp; Network Security:</b> Securing network components	Dr. Zeyad Al-Odat (TTU)
13:45 – 14:30	<b>Communications &amp; Network Security:</b> Securing communication channels	Dr. Zeyad Al-Odat (TTU)
14:30-14:45	Break	
14:45-15:30	<b>Security Operations: Security Assessment and Testing</b>	Dr. Bilal Alqudah (AHU)
15:30-16:15	<b>Security Operations: Intrusion detection &amp; Prevention, Recovery &amp; Incident Response</b>	Dr. Bilal Alqudah (AHU)





Figure 20: Agenda and pictures – CS Training at Aqaba



## 5.2.7 IoT Training Workshop at Aqaba – 28th September 2022

### IREEDER IoT Training Workshop Agenda 28 Sept 2022

Location: Jordanian Engineers Association, Aqaba Branch  
Coordinator: Dr. Moath Alsafasfeh (AHU) & Dr Saud Althunibat (AHU)

Time	Topic	Presenter (s)
09:00-9:30	<b>General introduction to the workshop</b>	Dr. Moath Alsafasfeh (AHU)
9:30-10:00	<b>IREEDER project overview</b>	Dr. Moath Alsafasfeh (AHU)
10:00-10:45	<b>Introduction to IoT</b>	Prof. Ahmad Aljaafreh (TTU)
10:45-11:00	Coffee Break	
11:00-11:45	<b>IoT Microcontrollers, Sensors for Data Acquisition and Actuators</b>	Dr Moath Alsafasfeh (AHU)
11:45-12:30	<b>Revision of Basic Programming and IoT IDE</b>	Dr. Abdullah Alhasanat (AHU)
12:30-13:15	Break	
13:15-14:00	<b>Practical Implementation: Arduino Experiments</b>	Eng. Samiha Falahat(AHU)
14:00-14:45	<b>Practical Implementation: Raspberry Pi Experiments</b>	Eng. Samiha Falahat(AHU)
14:45-15:00	Break	
15:00-15:45	<b>IoT Connectivity Protocols and Technologies</b>	Dr. Abdullah Alhasanat (AHU)
15:45-16:30	<b>Data Storage and Cloud Systems in IoT</b>	Prof. Ahmad Aljaafreh (TTU)





Figure 21: Agenda and pictures – IoT Training at Aqaba

## 5.2.8 RE Training Workshop at Aqaba – 29th September 2022

### IREEDER RE Training Workshop Agenda 29 September 2022

Location: Jordanian Engineers Association – Aqaba Branch  
Coordinator: Dr. Moath Alsafasfeh (AHU), Dr Saud Althunibat (AHU)

Time	Topic	Presenter
9:30-9:45	<b>General introduction to the workshop</b>	Dr. Moath Alsafasfeh (AHU)
9:45-10:00	<b>IREEDER project overview</b>	Dr. Saud Althunibat (AHU)
10:00-10:30	<b>Introduction to RE resources</b>	Dr. Ahmad Salah (AHU)
10:30-10:45	Break	
10:45-11:30	<b>Photovoltaic systems</b>	Dr. Ahmad Salah (AHU)
11:30-12:15	<b>Solar thermal systems</b>	Dr. Ahmad Salah (AHU)
12:15-13:00	Break	
13:00-13:45	<b>Wind energy fundamentals</b>	Dr. Mohammad Shalby (AHU)
13:45 – 14:30	<b>Wind Turbines operation and Control</b>	Dr. Mohammad Shalby (AHU)
14:30-14:45	Break	
14:45-15:30	<b>Integrating of RE into electrical grid</b>	Dr. Eyad Maitah (TTU)
15:30-16:15	<b>Energy storage technologies</b>	Dr. Eyad Maitah (TTU)





Figure 22: Agenda and pictures – RE Training at Aqaba

### 5.2.9 RE Training Workshop at JEA (Amman) – 15th October 2022



Figure 23: Pictures –Training at JEA (Amman)

### 5.2.10 Survey – JEA workshops’ participants

A survey was conducted with the participants of the workshops organized in conjunction with the Jordan Engineering Association, to gather information on their demographic data, and satisfaction with the events attended.

Participants were requested to provide demographic information and information about the events they chose to participate in, their motivation to attend and their satisfaction with the event.

In relation to their gender, 51.5% of the workshop participants were male while 48.5% were female.

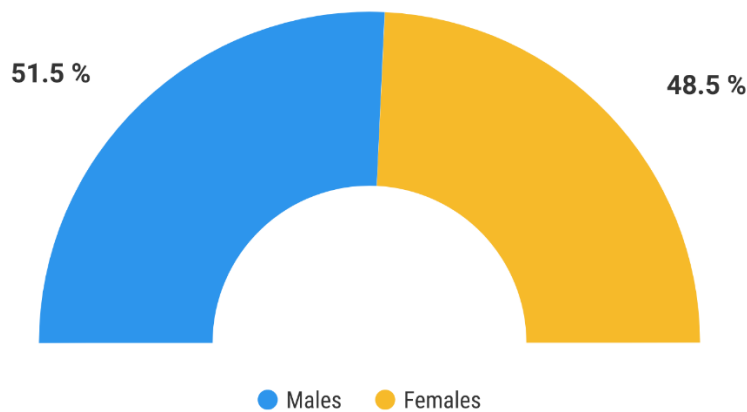


Figure 24: Gender distribution of the participants

In relation to their age, the majority of the participants were younger than 35, with the two most represented groups being the 26-35 year olds (43.9%) and those aged up to 25 (with 32.7%).

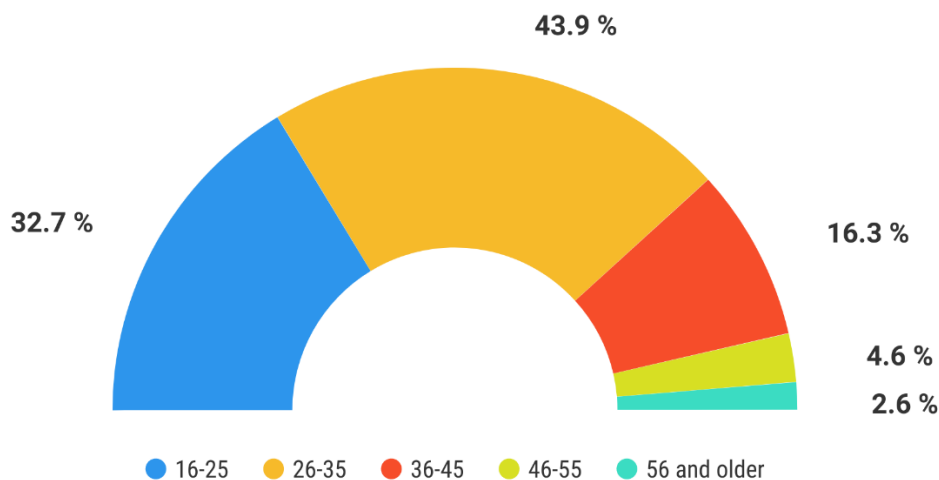


Figure 25: Age distribution of the participants

The majority of the respondents has attended the Cybersecurity workshops (66.4%), followed by the workshops on Internet of Things (21.4%), and Renewable Energy (12.2%).

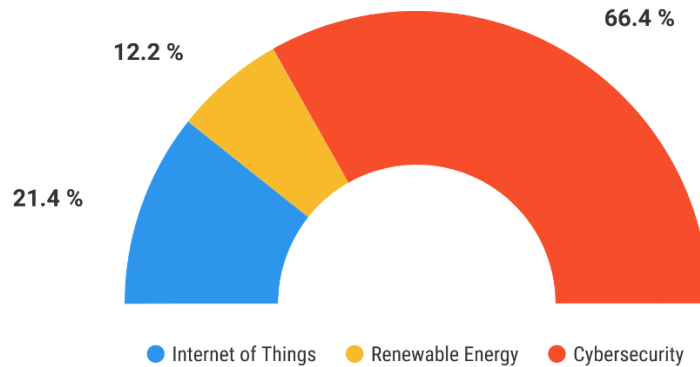


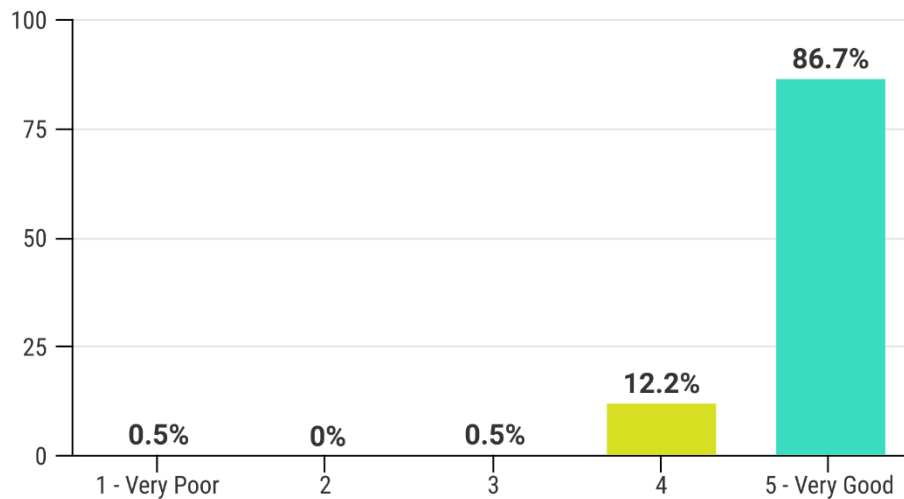
Figure 26: Workshops attended - Topics

The main reasons indicated by the participants to attend the workshop revolved around acquiring basic knowledge on the topic, refreshing the existing knowledge by gaining insight into the newest technologies, personal development, gaining experience and contacting with professors and other experts, and even looking for prospective jobs.



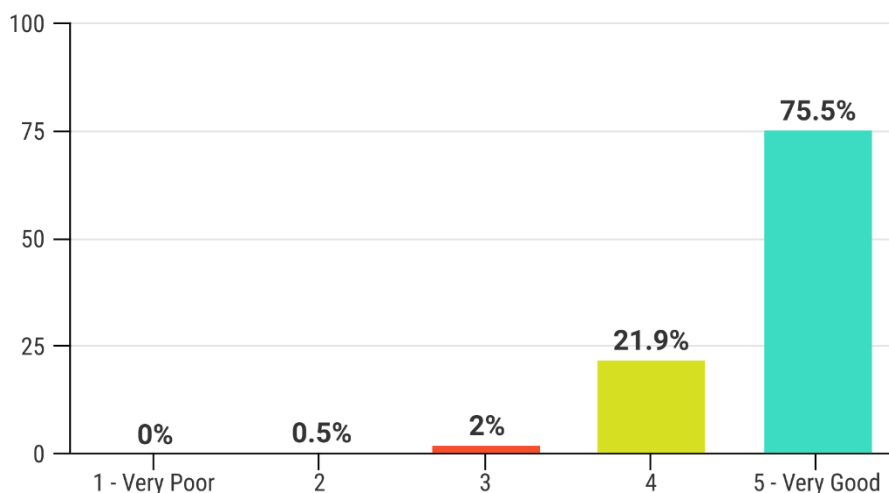
Figure 27: Motivation for attending workshops

When asked to assess the organization of the event, a substantial majority rated it as very good or good (more than 98.9%).



*Figure 28: Assessment: organization of the training on behalf of the organizing institution (e.g. registration platform, contact with the organizer, proper communication about training details)*

When asked to assess the functionalities of the conference tools and software used for the event (video, sound, other technical aspects), again a substantial majority rated it as very good or good (more than 97.4%).



*Figure 29: Assessment: functionality of conference tool and software used (video, sound, other technical aspects, ...).*



When queried about the possibilities provided in the workshop to interact with the tutors and network with other participants, 67.3% of the participants indicated these to be very good, 25.5% good, with only 7% of the participants considering them less desirable.

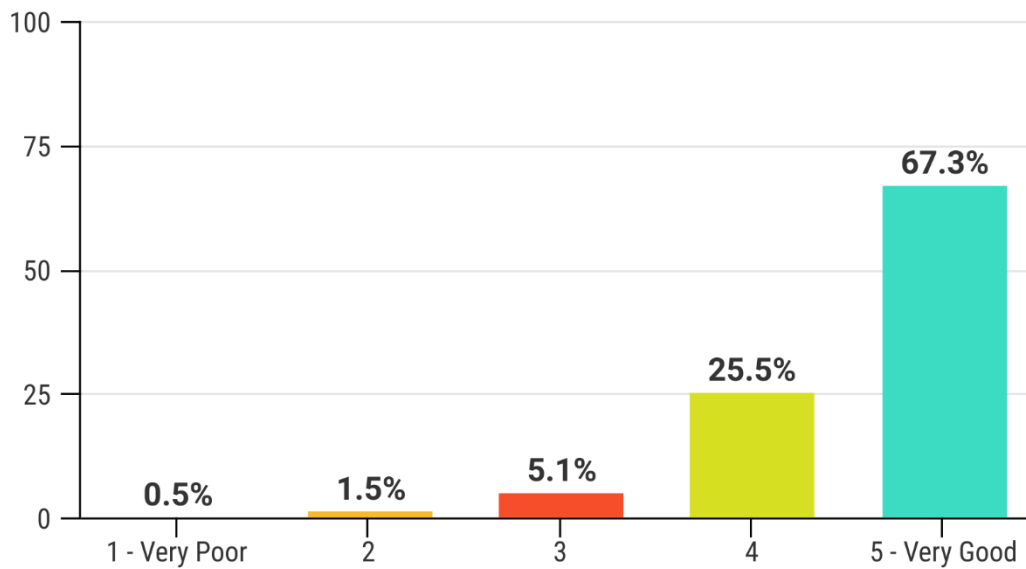


Figure 30: Assessment: Possibility to exchange and interact with tutor(s) and other participants (forums, sessions for discussion, Q&A, ...).

When asked to provide suggestions or recommendations for improvements on the organizational aspects, the majority of the participants didn't provide suggestions or recommendations, showing satisfaction with the organization of the events ("No, all the details was perfect", "All the event was perfect", with some showing their interest for a more extended event ("longer training (multiple days)", "It should be at least two days", "It must be longer"), a repetition of the event ("Do it again", "Do similar activities in JEA") or an extension to more advanced content in future events ("Make it more advanced")

The following questions assessed the participants' agreement with the following statements concerning the content of the training and audience.

In relation to the statement "**The training schedule and time frame were very good**", 67.9% of the participants indicate to strongly agree and 26% to agree with the statement.

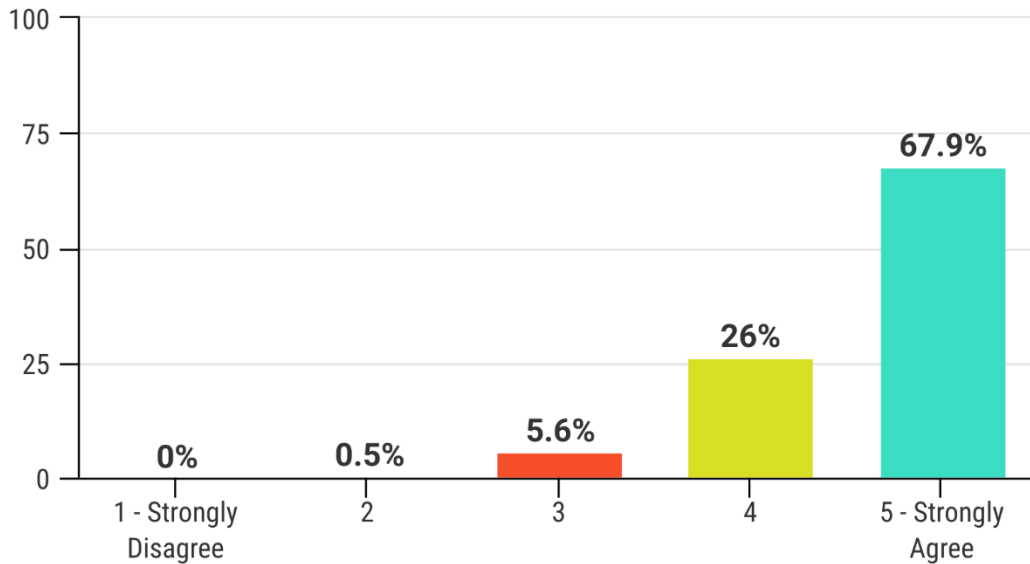


Figure 31: Assessment: “The training schedule and time framr were very good”

In relation to the statement “**The training was appropriate for my level of experience**”, 65.3% of the participants indicate to strongly agree and 27,6% to agree with the statement.

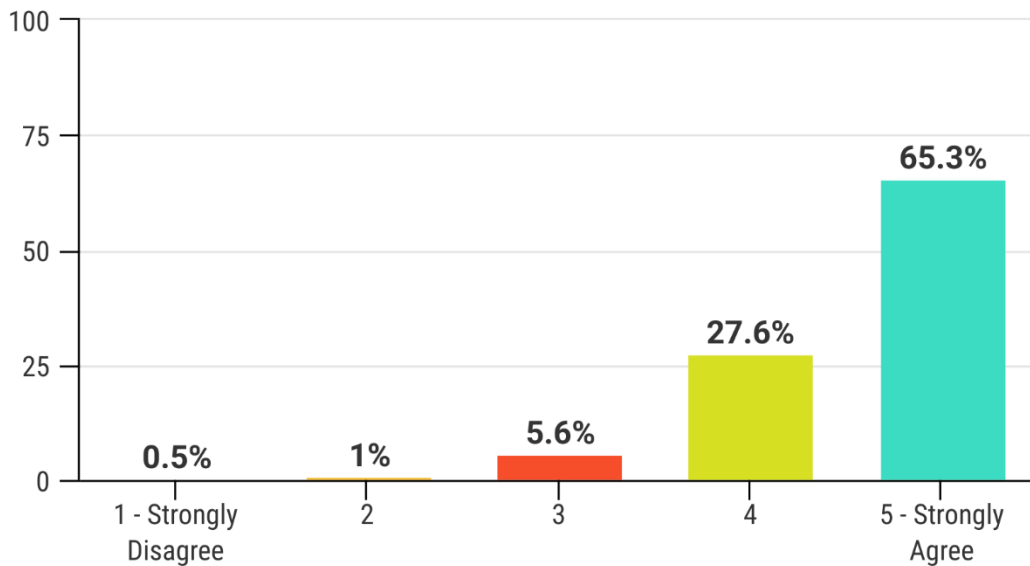


Figure 32: Assessment: “The training was appropriate for my level of expertise”

In relation to the statement “**The training met my expectations**”, 65.3% of the participants indicate to strongly agree and 26,5% to agree with the statement.

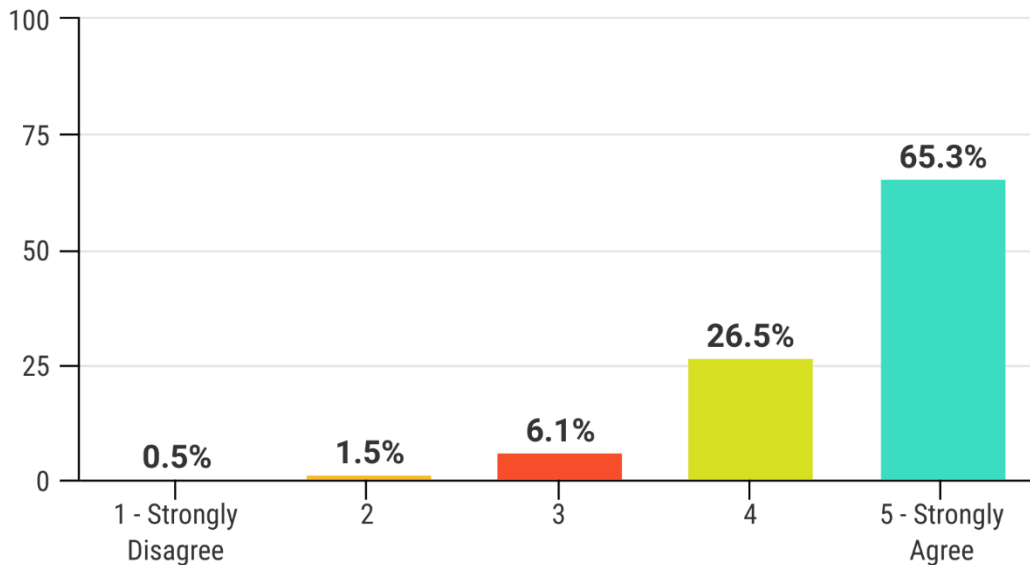


Figure 33: Assessment: “The training met my expectations”

In relation to the statement “**The raised my interest in the topic**”, 73% of the participants indicate to strongly agree and 21.9% to agree with the statement.

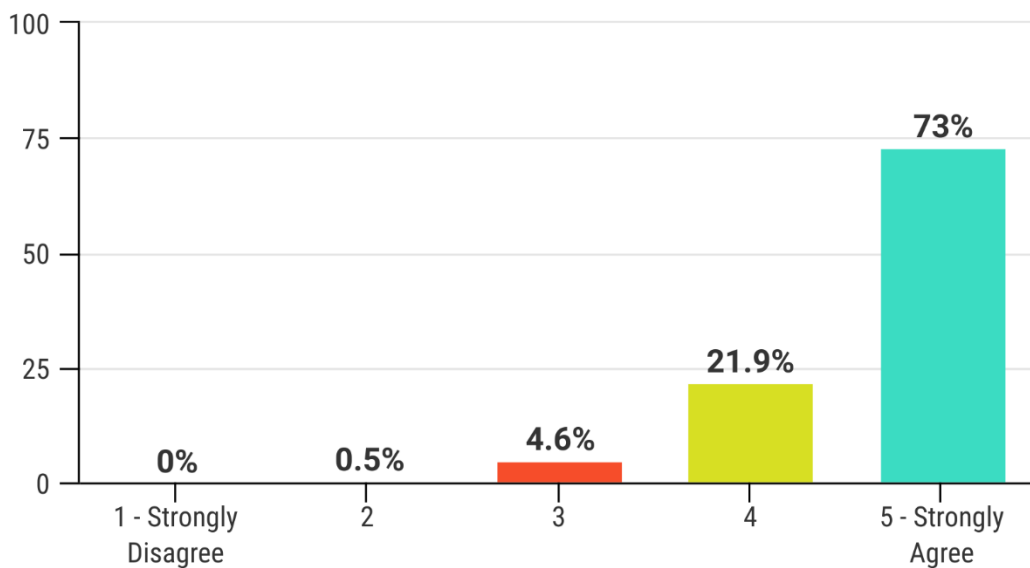


Figure 34: Assessment: “The training raised my interest in the topic”

In relation to the statement **“The knowledge and skills I received in this training are valuable to my work/future career”**, 69.9% of the participants indicate to strongly agree and 23.5% to agree with the statement.

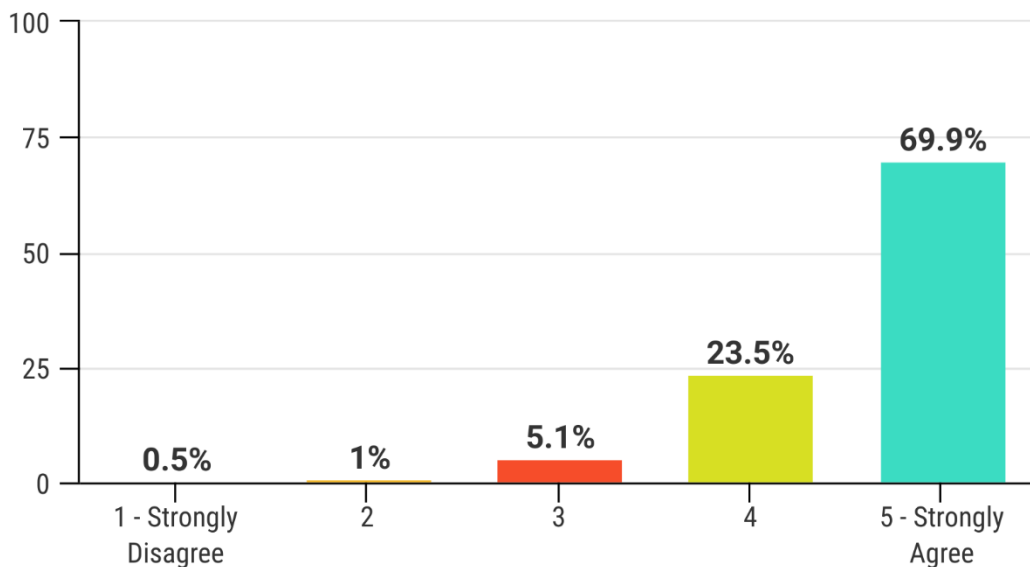


Figure 35: Assessment: *“The knowledge and skills I received in this training are valuable to my work/future career”*

As a global question **“How satisfied are you with the training workshop”**, 70.4% of the participants indicate to strongly agree and 26% to agree with the statement.

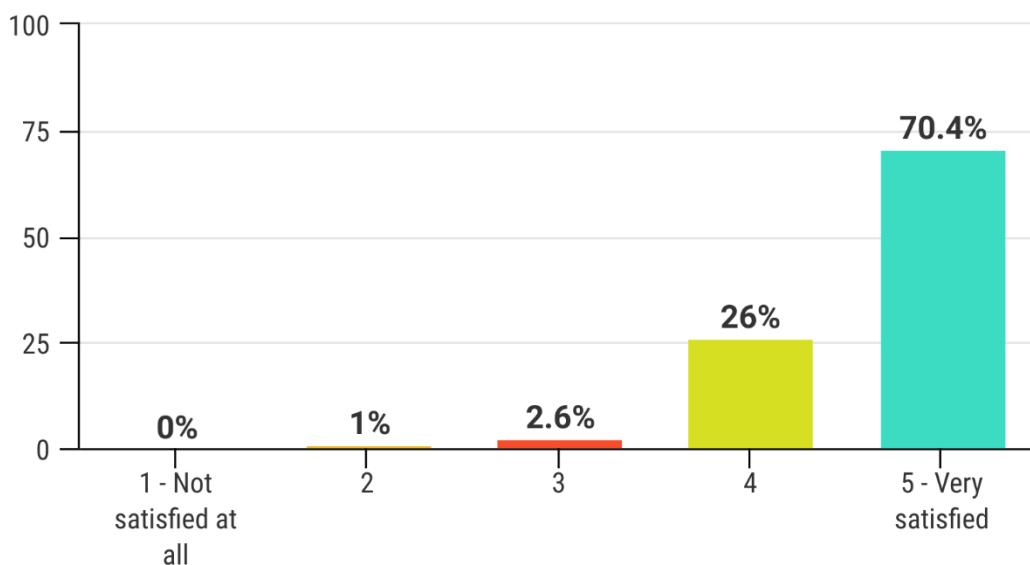


Figure 36: Assessment: *“How satisfied are you with the training workshop?”*

## 6. PLANNED ACTIONS BEYOND THE LIFETIME OF THE PROJECT

IREEDER partners are committed to maintain the developed training courses in force, as part of the project's sustainability plan (individual, at the partner level, and consortium-wide), either as a series of combined training actions or as individual events.

As such the following training actions are planned to take place in the second semester of the current academic year.

### *Renewable Energies*

TTU	Planned 04/2023
MU	Planned 04/2023
IU	Planned 04/2023
PU	Planned 04/2023
AHU	Planned 04/2023

### *IoT*

TTU	Planned 04/2023
MU	Planned 05/2023
IU	Planned 05/2023
PU	Planned 05/2023
AHU	Planned 05/2023

### *CS*

TTU	Planned 05/2023
MU	Planned 05/2023
IU	Planned 05/2023
PU	Planned 05/2023
AHU	Planned 05/2023

TTU indicates to plan to encourage and motivate students to perform their senior design project in the three fields, IoT, Cybersecurity, and Renewable Energy, beyond the lifetime of the project.