Business concept for the implementation of the Install+RES training course

WIP - Renewable Energies

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Table of Contents

1. Introduction to the Install+RES project ................................................................. 1
   1.1 Project objectives ............................................................................................. 2
   1.2 Project partners ............................................................................................... 2
2. Aim of this report ................................................................................................ 3
3. Market trend of renewable energy resources .................................................. 4
4. The expectations from the installers ................................................................. 7
5. Tools needed for the implementation of the training courses ....................... 8
   5.1 The certification of installers ........................................................................ 8
   5.2 Definition of the target group of the training courses ............................... 8
   5.3 The training course concept ........................................................................ 8
   5.4 The training course structure ...................................................................... 10
   5.5 The training material ................................................................................... 11
   5.6 The training equipment ................................................................................ 15
   5.7 The European Qualification Framework ................................................... 18
6. Costs related to the implementation of the training courses ....................... 19
7. Conclusions ...................................................................................................... 21
8. Install+RES National training providers ....................................................... 22

1. Introduction to the Install+RES project

The Install+RES project had the aim of establishing training courses for installers of small-scale renewable energy systems (biomass, solar, PV and heat pumps) in buildings. As such, the Install+RES project will invest in the sustainability of renewable energy system
installations all across Europe and will lead to a highly qualified and skilled workforce. The Install+RES training courses are based on a well-balanced relationship between theory and practice as the training courses mainly take place in demonstration facilities and laboratories, where practical work is performed. The courses are completed with an exam leading to a certification or qualification according to the requirements of the Directive 2009/28/EC on the promotion of the use of energy from renewable sources. The qualification as an installer will encompass developed practical skills and a profound understanding of the theoretical backgrounds, ecological and economical aspects and rational use of small-scale renewable energy systems in buildings.

1.1 Project objectives

In line with the priority requirements of the RES Directive 2009/28/EC and with the aim of confronting the booming demand for installers of small-scale renewable energy applications, the Install+RES project has committed itself to efficiently develop a training and certification or qualification scheme for installers of small-scale renewable energy systems in buildings. This was achieved with a carefully designed set of specific objectives:

- Translation and adaptation of the training material in line with the requirements stated in the new RES Directive and in line with the needs of each participating country (Bulgaria, Greece, Slovenia, Poland, and Italy).
- Implementation of “Train the trainers” courses: these courses are necessary due to the lack of trainer professional teachers who could perform high quality training courses for installers of small-scale RES in buildings applications in buildings. In most cases highly-qualified lectures with technical background are available but pedagogical knowledge is lacking.
- Establishing the training courses: 1 pilot course and 2 training courses will be established in each participating countries: Bulgaria, Greece, Italy, Poland and Slovenia.
- Certification or qualification of the installers: the installers trained during the Install+RES courses will be certified or qualified in line with the requirements of the new RES Directive 2009/28/EC.
- Formulation of specific actions to ensure the long term sustainability of the Install+RES training courses after the project lifetime.

1.2 Project partners

The list of the partners cooperating in this project is shown below. More information about them and the project is available under www.resinstaller.eu.
2. Aim of this report

The aim of this report is to provide a business model for training providers to implement training courses for installers of small-scale renewable energy systems in buildings. This business model is based on the experience acquired during the Install+RES project, which
had the aim to implement training courses for installers of small-scale renewable energy systems in buildings in several European countries: Poland, Italy, Slovenia, Bulgaria, Greece and Germany.

The Install+RES project lasted three years. It started in May 2010 and ended in April 2013. During the Install+RES project, 33 training courses for installers of small-scale renewable energy systems in buildings have been implemented and 516 installers have been certified or qualified according to the National legislation. During the project, remarkable feedback have been collected from the Install+RES project partners in order to ensure the long term sustainability of the training courses to be implemented after the end of the project.

This report is meant to be a guideline for the training providers interested in implementing training courses based on the Install+RES approach. It provides practical guidelines on how to implement training courses in line with the market trends of renewable energy sources and the expectations of the installers. The report provides remarkable information on the tools needed to match the market trends and installers’ expectations and on the costs related to the implementation of the training courses.

3. Market trend of renewable energy resources

The Install+RES project offered training courses for installers of PV, solar thermal, heat pumps and biomass systems. The Install+RES training providers have selected the technology or technologies to be implemented based on the National market trends.

An overview of market trends of renewable energy resources related to the technologies implemented within the Install+RES project: PV, solar thermal, heat pumps and biomass systems is shown in the following figures.

The graphs are based on the elaborations carried out by the Energy Research Centre of the Netherlands (ECN) in the report “Policy Studies 2011” based on the Renewable Energy Projections as published in the National Renewable Energy Action Plans of the European Member States¹.

Based on the National Renewable Energy Action Plans of the European Member States, electricity generated from PV in Europe will increase from 1470 GWh in 2005 to 83375 GWh in 2020 (Figure 1).

Based on the National Renewable Energy Action Plans of the European Member States, the number of solar thermal installations in EU countries will increase from 690 ktoe on 2005 to meet to 6348 ktoe (Figure 2).

The published National Renewable Energy Action Plans of the European Member States indicate that the thermal energy generated by the heat pumps will increase by 20 folds in the period for 2005 - 2020 (Figure 3).
Projections for thermal heat production in Europe from solid biomass are shown in Figure 4.

For the time being, the market of small-scale renewable energy systems is strongly related to the support schemes available at National level for such as technologies. The European renewable energy market is moving from policy driven industry to providing competitive energy solutions. In this transitional phase, small-scale renewable energy systems still need the support from the National government in order to reach a stage where they will become competitive with the traditional sources for energy production. The National support schemes are fundamental to attract customers of small-scale renewable energy systems and therefore a sustainable market development.
As a global figure for the heterogeneous European Union RES-supported electricity accounts on average for 8% of the 19 countries gross electricity generation and 9% of the countries final electricity consumption\(^2\).

The global financial crisis that is being especially severe in many countries of the European Union resulted in unexpected retrospective changes in European Renewable Energy legislation in many of these Member States. As a consequence, the European Renewable Energy sector and private investors have been deeply harmed.

The lack of harmonized support schemes in the European Union for the renewable energy sector is not something new and has been a central element in the European RES Policy debate.

Since year 2009, with the publication of the RES Directive, a common framework for the objectives and targets for RES in the Member States has been established, but the policies, and therefore the support schemes to the technologies is left to the Members States themselves. The last mentioned legislation changes make it more difficult for the whole EU to meet the 2020 renewable energy targets in the long term. In order to achieve these targets, national governments provide support schemes for a set of technologies and change and improve them by fine tuning these policies. This optimization process has still a wide scope for action and it is there where the mayor efforts of the policy makers and the industry are concentrated nowadays.

### 4. The expectations from the installers

During the Install+RES project, 33 training courses for installers of small-scale renewable energy systems have been implemented and 516 installers have been certified or qualified according to the National needs. At the end of each training courses the installers have been asked to fill in a questionnaire on their satisfaction about the course. The feedback from the installers provided the training providers with remarkable input to improve the training courses. The remarks for improvements obtained by the installers attending the training courses mainly focused on three aspects:

- a. the installers appreciated the practical part of the course, implemented in the laboratories where equipment was available to carried tests to get acquired with the small-scale renewable energy systems;
- b. the installers highlighted that a certification scheme for installers of small-scale renewable energy systems in buildings should be mandatory to ensure quality in the installations and attract participants to the training courses;
- c. the training courses should have a flexible structure. The training courses should be implemented during the weekend if the participants are employed installers, who cannot attend the courses during the working days.

Based on the feedback collected from the 516 installers certified or qualified during the Install+RES training courses, the Install+RES training course concept has been further improved by the Install+RES training providers. The next chapter provides an overview of the tools needed to implement training courses based on the Install+RES approach.

\(^2\) Council of European Energy Regulators (CEER), Status Review of Renewable and Energy Efficiency Support Schemes in Europe
5. Tools needed for the implementation of the training courses

5.1 The certification of installers

Article 14 of the 2009/28/EC Directive states that “Member States shall ensure that certification schemes or equivalent qualification schemes become or are available by 31 December 2012 for installer of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps”. The Install+RES courses provide the possibility to become a certified installer of RES, acknowledged by the National bodies. Upon successful completion of the Install+RES training course, the participants receive a certificate as installer of small-scale RES or installer of photovoltaic systems and/or solar thermal systems and/or heat pump systems and/or biomass systems, which complies with the criteria to be authorized by the National bodies of their country.

The accreditation and certification schemes provided by National Governments differ in the European Union amongst each country. The trainer provider shall undertake all the necessary administrative steps for the acknowledgment of the certificates by the responsible National body.

5.2 Definition of the target group of the training courses

In line with the requirements of the Directive 2009/28/EC (point 6.a, Annex IV) the target group of the Install+RES training course is installers with working experience, who have undergone, or are undergoing the following types of training:

a) in case of biomass boiler and stove installers: training as plumbers, pipe fitter, heating engineer or technical sanitary and heating or cooling equipment as prerequisite;

b) in case of heat pump installers: training as plumber or refrigeration engineer and have basic electrical and plumbing skills (cutting pipe, soldering pipe joints, gluing pipe joints, lagging, sealing fittings, testing for leaks and installations of heating or cooling systems) as prerequisite;

c) in case of solar photovoltaic or solar thermal installers: training as plumber, electrician, and have plumbing, electrical and roofing skills, including knowledge of soldering pipe joints, gluing pipe joints, sealing fittings, testing for plumbing leaks, ability to connect wiring, familiar with basic roof materials, flashing and sealing methods as prerequisite;

d) a vocational training scheme to provide an installer with adequate skills corresponding to a 3 years education in the skills referred to in point a), b) or c) including both classroom and workplace learning.

5.3 The training course concept

The Install+RES training course is based on a well-balanced relationship between theory and practice. The educational principle behind the training is “hands on learning”, which means that the Install+RES training course provides the trainees with practical lessons on how to install small-scale renewable energy systems into the electrical grid and as stand-alone. Moreover, during these practical lessons the participants learn how to connect at the same site different small-scale renewable energy systems. The training course mainly takes place in demonstration facilities and laboratories, where practical work is performed. In order to successfully implement the “hands on learning” concept, the practical lessons in the laboratories and at the demonstration facilities are carried out by two teachers working in tandem.
The course is completed with an exam leading to a certification. The examination includes a practical assessment of successfully installing biomass boilers or stoves, heat pumps, solar photovoltaic or solar thermal installations. After a successful passing of the exam, the participant is certified and qualified as installer of small-scale renewable energy systems in buildings.

The Install+RES course provides the trainees with practical and theoretical knowledge in order to:

- fully understand the client’s energy requirement;
- create an individually tailored plan;
- install the equipment and systems to meet the performance and reliability needs of the customers;
- incorporate the quality craftsmanship;
- comply with all the applicable codes & standards, including energy and eco-labelling.

The Install+RES course offers the opportunity to the participants to become a certified:

- Photovoltaic System Installer
- Solar Thermal Installer
- Heat Pump Installer
- Biomass System Installer

The participant can get qualified in one or more RES applications. The courses are designed to allow flexible participation. The successful completion of RES modules qualifies for the Certification of a Renewable Energy Systems Installer.

The Install+RES training courses are designed for a maximum of 16 participants.
5.4 The training course structure

The “Install+RES” training course structure is shown in the following figure.

**Figure 5 Install+RES course structure**

*Overview on Rational Use of Energy (RUE) and Renewable Energy Sources (RES):*

This module allows the trainees to obtain an exhaustive overview at European and national level on the energy standards in the buildings, the ecological labels and on the small-scale renewable energies systems, markets and potentials.

*Fundamentals of heating or electrical engineering:*

The attendance to this module is related to the technical background of the participants. This means that a participant with a technical background in electrical systems (for example an electrician), which would like to obtain a qualification as installer of solar thermal systems, has to attend the module on basic principles of heating engineering and a participant with a technical background in heating systems (for example a plumber), which would like to obtain a qualification as installer of photovoltaic systems, has to attend the module on basic principles of electrical engineering. A participant with a background in electrical engineering (for example an electrician), which would like to obtain the qualification to install photovoltaic systems, does not have to attend the module on basic principles of electrical engineering.

Both modules, fundamentals of heating and fundamentals of electrical engineering, will have to be adapted to the respective national standards and needs of the countries in which the training courses will be performed.
Qualification for solar thermal systems and / or photovoltaic systems and / or heat pumps and / or biomass systems:

These modules allow the participant to obtain the technical knowledge necessary to properly install a solar thermal system and / or a photovoltaic system and / or a heat pump and / or a biomass system. These modules are mainly carried out in demonstration facilities and laboratories, where practical work can be performed.

The modularization of the training course at the level of fundamentals as well at the qualification level makes it possible for the target group, i.e. installers with different kinds of working experiences, to receive the type of training which suits them best concerning the national standards in their country and / or their customer’s needs at local level in their region.

5.5 The training material

The training material of the Install+RES courses is in line with the requirements of RES Directive 2009/28/EC. Each module of the course is supplemented by a handbook which consists of three units:

- An information manual with the didactical material
- A workbook with exercises
- A book containing the solutions to the exercises

The handbook works as a study guide for the trainees and supports the practical part of the courses.

Some example of the Install+RES training material is provided in the following figures for the module on PV systems.

The Install+RES training material for PV, solar thermal, heat pump and biomass systems is available for free download in the Install+RES website http://www.resinstaller.eu/
1.2 Important technical terms used in photovoltaics

Open circuit voltage:

The open circuit voltage is the highest voltage of a voltage source. Amongst other things it is important for assessing the necessary personnel protection. The value of a module’s open circuit voltage provides information on the number of solar cells connected in series. PV strings of up to 800 volt are formed today.

Short circuit current:

The short circuit current is the strongest current in an electric circuit. The load resistance is thereby \( R_L = 0 \ \Omega \).

Normally in case of short circuiting the circuit protector is switched on, so that the voltage sources and the wires are protected. In photovoltaics short circuiting only raises the current marginally above the rated current. Modules and wires are not damaged. Experts talk of short circuit proof and intrinsic safety. Therefore in photovoltaics the short circuit current cannot be used to switch off the electric circuit.

The strength of a module’s short circuit current provides information on the solar cell surfaces, the radiation efficiency and the quality of the cells.

Loading the voltage source:

At household plug points or at large batteries with variable current the voltage remains mostly stable at the terminals. One speaks here of voltage sources with low internal resistance. In contrast if with various loads the current flow remains almost identical, one speaks of a ‘current source’. Solar modules have current source characteristics and therefore have strong internal resistance.

\[ U = \text{ } \\Omega \]

\[ I = \text{ } \\Omega \]
Part 1:
Basic Technical Knowledge for Using Photovoltaic Solar Energy

First measurement exercises in the solar energy laboratory

Building an autonomous PV system in the laboratory – experimental set up and measurement of the PV module

- Connect the solar module components to the voltmeter using the measurement cables.
- Use the red cables for the positive current and the blue cables for the negative.
- Irradiate the module using the 500 W halogen spotlight.

a) Measurement of open circuit voltage \( U_0 \):

\[ U_0 = \quad \]

b) Explain the term open circuit voltage.

c) Measurement of short circuit current \( I_s \):

\[ I_s = \quad \]

d) Explain the term short circuit current.

e) Although no power is delivered to the consumer through the neutral and the short circuit measuring them can provide useful information about the behaviour of the voltage sources.

What conclusions can be reached about the PV module based on the measurements made of \( U_0 \) and \( I_s \)?

Figure 7 Sample of training material - Worksheet for PV systems
Part 1:

Basic Technical Knowledge for Using Photovoltaic Solar Energy

First measurement exercises in the solar energy laboratory

Building an autonomous PV system in the laboratory – experimental set up and measurement of the PV module

- Connect the solar module components to the voltmeter using the measurement cables.
- Use the red cables for the positive current and the blue cables for the negative.
- Irradiate the module using the 500 W halogen spotlight.

a) Measurement of open circuit voltage ‘\( U_0 \)’:

\[
U_0 = 18 \text{ V}
\]

b) Explain the term open circuit voltage.

The open circuit voltage is the highest voltage without connected loads.

c) Measurement of short circuit current ‘\( I_s \)’:

\[
I_s = 320 \text{ mA}
\]

d) Explain the term short circuit current.

Short circuit current is the highest electrical flow possible for a module connected to a short circuit.

e) Although no power is delivered to the consumer through the neutral and the short circuit measuring them can provide useful information about the behaviour of the voltage sources.

What conclusions can be reached about the PV module based on the measurements made of \( U_0 \) and \( I_s \)?

\( U_0 \) provides information on the number of solar cells in a series. \( I_s \) is dependent on the strength of radiation, the colour spectrum of light and quality of cells and cell surfaces.

Figure 8 Sample of training material - Solutions for PV systems
5.6 The training equipment

The trainer provider must arrange for adequate technical facilities to guarantee practical training, including laboratory equipment or corresponding facilities. The possession of the appropriate equipment is fundamental in the practical training structure of the Install+RES course based on “Hands on learning”.

The classroom management must be designed in a way that action-oriented teaching is possible and appropriate laboratory and field facilities are as close as possible to the learning place. The main aspects of the laboratory technique must be designed according to the learning content of different involved trades from building services engineering (electrical trade) to systems mechanic (HVAC trade). The list of necessary equipment for the Install+RES laboratories is given in the following pages. This necessary equipment should be supplemented according to regional needs by using individual device models, demo models and illustrative examples (recommended equipment). There should be enough equipment for a course with a maximum of 16 participants.

At the training facility there should be at least 2 rooms, each with about 80 to 100 m², preferably in an existing adult educational institution. One of the two rooms should be made use of for the theoretical discourse, whereas the other room should be intended to serve for practical exercises on the laboratory facilities.

Apart from an office (administration) and school facilities, the laboratories should include the following:

- Storage cupboards, students and lab tables, blackboard, projection equipment, video projector and laptop, at least 8 multimedia PC workstations, water and power supply (AC 16 A), drainage, benches, lighting, etc.

- In addition, outdoor facilities with a photovoltaic and solar thermal energy system shall be connected to the laboratory room that the solar power and solar heat gain can be used in laboratory experiments like in reality.

- It’s also necessary that 1 to 2 training roofs with at least 6 m² are available for the practical work, regardless of the weather. Conventional regional roofing and professional installation material for the photovoltaic and solar thermal systems should be available.

- Parking spaces and storerooms with cabinets for tools, installation material for the module and the solar collector assembly and solar components.

A detailed reference list of the equipment needed for the laboratories is presented in the following pages for the implementation of the module on PV systems. The examples (including pictures) of the individual equipment components refer to the exemplary equipment of the Vocational School for Electricians and Electronics Installers of the City of Munich and are considered to be examples of best practice according to the long-term experience of this school. Similar teaching material can be designed according to the regional or local needs and built with own resources. In some cases, specialized companies also offer these (educational) teaching materials.

The full list of the Install+RES training equipment for PV, solar thermal, heat pump and biomass systems is available in the Install+RES report “Best practices for the implementation of training courses for training providers and installers of RES systems in Europe” which can be downloaded for free from the Install+RES website http://www.resinstaller.eu/
### Equipment for the implementation of the Photovoltaic module

**Mobile demo plant for PV in case form.**

Thus, simple grid systems can be built as stand-alone systems.

The components can also be used in an advanced laboratory work station concept.

**Exercise roof mounting with options for about 4 m² of photovoltaic modules with complete mounting material and various modules with cables, inverters and safety technology; also suitable for solar thermal plants!**

On the back with mounting options for the solar station or the PV technology.

**PV-laboratory system with all components for off-grid and grid connected systems.**

Application at the laboratory workplace on a grille frame; the components can be kept in a container under the laboratory bench.

**PV-house system if possible in an accessible position of the facade or the roof.** All cables lead into the laboratory, where the PV energy can be used for various experiments and can be fed into the house mains.

Such plants should be wired in at least three strings of each 500 - 1000 W and should be installed with different angles. Additional sensors for radiation and temperature should pass on their measurements into the laboratory.

**In the laboratory, a measurement and experimental array should make use of the solar energy for PV experiments or for feeding into the mains via multiple inverters.**

This experimental array contains further modules for surge protection, for backing up the power circuit to a battery pack and measuring instruments to produce a test protocol of the entire system.
| Demonstration device for displaying an electric arc from a PV plant, and eye protection; connecting the experimental array to the PV technology with safety connection. | ![Demonstration device](image1)

- Collection of solar cell samples in the usual display formats of amorphous and crystalline cells.
- Samples from the manufacturing process of solar silicon | ![Solar cell samples](image2)

- Collection of special types of solar cells and solar modules; special modules such as concentrator modules and bifacials and multilayer modules, triplex cells. | ![Solar cells](image3)

- Electrical components for PV systems, such as generator terminal box, surge protection, inverters, AC power box, accumulators, installation materials, etc. | ![Electrical components](image4)

- Set of installation materials for PV-carrying racks of various vendors. | ![Installation materials](image5)

- Set of measuring devices for PV: radiation meter, energy analyser, characteristics meter, universal meters, VDE testing equipment for PV systems. | ![Measuring devices](image6)
Electronic components such as inverters, charge controllers, MPP-trackers as real components to teach the functional structure, work processes and possible interferences.

Display technology for the visualization of the PV energy output with included data converter systems for PC and Internet connectivity (web server).

Set with solar cables and connector systems for connecting solar modules in a PV system; realization of exercises in order to produce connecting cables.

Simulation software for planning of photovoltaic systems is also recommended.

5.7 The European Qualification Framework

The Install+RES training courses are prepared following the European Qualification Framework (EQF) standards, which allow individuals and employers to better understand and compare the qualifications levels of different countries and different education and training systems. The EQF’s main components are a set of 8 reference levels described in terms of learning outcomes (a combination of knowledge, skills and/or competences). The eight levels cover the entire span of qualifications from those recognizing basic knowledge, skills and competences to those awarded at the highest level of academic and professional and vocational education and training. EQF is a translation device for qualification systems. The Install+RES training providers shall aim to meet the learning outcomes 5 and 6 of the European Qualification Framework.

Detailed information on how to implement training courses based on the European Qualification Framework (EQF) is available in the report “How to integrate the Install+RES training courses in the European Qualification Framework (EQF)” available for downloading for free from the Install+RES website http://www.resinstaller.eu/.

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3 Agreed upon by the European institutions in 2008, the EQF is being put in practice across Europe. It encourages countries to relate their national qualifications systems to the EQF so that all new qualifications issued from 2012 carry a reference to an appropriate EQF level. For further information on EQF please visit the website of the European Commission-Education and Training under http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm
6. Costs related to the implementation of the training courses

The costs related to the course organization and the course examination are categorized in the following tables.

Course organization:
- renting rooms
- costs of trainers
- printing materials
- laboratory equipment
- catering
- administration, supporting personal
- marketing and advertisement of the courses

Course examination:
- preparing, organizing and carrying out theoretical and practical exam
- printing examination papers
- payment for the services of members of the examination committee
- issuance of certificates

The trainer provider must also consider the cost incurred in the process of accreditation of the training courses.

The cost of the course varies considerably from one country to another. The cost can also vary significantly from one training centre to another within the same country depending on the number of hours of the courses, number of trainers involved, availability of equipment, etc.

The next table provides a reference on the costs of the courses for a number of sixteen participants and two trainers per individual course (or 8 trainers for the RES course including all the modules). The cost figures are calculated based on the costs of the courses implemented in the Install+RES target countries.
<table>
<thead>
<tr>
<th>Type of course</th>
<th>Cost of the course excl. VAT(^5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic System Installer</td>
<td>4 000 € to 8 800 € / each course</td>
</tr>
<tr>
<td>Solar Thermal Installer</td>
<td></td>
</tr>
<tr>
<td>Heat Pump Installer</td>
<td></td>
</tr>
<tr>
<td>Biomass System Installer</td>
<td></td>
</tr>
<tr>
<td>Renewable Energy Systems Installer</td>
<td>~ 16 000 €</td>
</tr>
</tbody>
</table>

As an example, the following table shows a breakdown of the costs incurred in the implementation of the Install+RES training course by the Cracow University of Technology in Poland.

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**Case example**
Install+RES training course at the Cracow University of Technology, Poland

**Type of courses offered**: Courses for installers of RES systems including PV, solar thermal, heat pump and biomass systems

**Number of participants**: 16

**Number of trainers**: 8 trainers

**Number of hours**: 220 hours (22 meetings on weekend, 10 hours each)

**Costs and expenses (excl.VAT)**:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renting rooms</td>
<td>1 446.15 Euro</td>
</tr>
<tr>
<td>Costs of trainers (8 trainers)</td>
<td>6 698.77 Euro</td>
</tr>
<tr>
<td>Printing materials</td>
<td>1 732.27 Euro</td>
</tr>
<tr>
<td>Cost of the examination</td>
<td>3 110.94 Euro</td>
</tr>
<tr>
<td>Laboratory equipment</td>
<td>Available at the facilities of the University</td>
</tr>
</tbody>
</table>

**Course fee**: During the lifetime of the Install+RES project the courses were subsidized by the Ministry of Science and Higher Education in Poland (Ministerstwo Nauki i Szkolnictwa Wyższego) and were offered free of charge for the participants.

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\(^4\) The costs do not include any profit foreseen for the training activities

\(^5\) These figures do not include the cost of the laboratory equipment. The cost of the laboratory equipment rises up to 20,000€ per module and should be added to these costs, if the equipment is not available in the training centre. The cost for replacement of damaged equipment or outdated equipment must also be considered by the course provider.
7. Conclusions

During the Install+RES project 33 training courses for installers of small-scale renewable energy systems in buildings have been implemented in several European countries: Germany, Poland, Italy, Slovenia, Bulgaria and Greece. The courses led to qualify or certify 516 installers of small-scale renewable energy systems in buildings. Based on the experience gained within the Install+RES project and on the 20-20-20 targets set by the European Union, it can be assumed that training courses for installers of small-scale renewable energy systems in buildings will still be needed in the future. The market of renewable energy systems will still increase in the future and as consequences also the demand of qualified installers able to properly install small-scale renewable energy systems in buildings. The demand of qualified installers will further increase in the Member States which have defined or will define that only certified installers have the permission to install small-scale renewable energy systems in buildings.

In line with the expectations of the installers, the Install+RES project provided flexible training courses structures, which were adapted to the needs of the installers and to the National legislation. The Install+RES courses were mainly implemented in laboratories, where practical work is performed. This “hands on learning” approach gave to the installers the possibility to get acquainted with the small-scale renewable energy systems.

Based on the experience gained within the Install+RES project, it can be assumed that the implementation of a training courses for small-scale renewable energy systems in buildings, including the modules on PV, solar thermal, heat pump and biomass systems, should cost, as average, 16 000 €. This corresponds to a range from 4 000 € to 8 800 € (depends on the country) per each module. These costs are VAT excluded and do not include any profit for the trainer providers and the cost for the laboratory equipment. The cost of the laboratory equipment rises up to 20 000€ per module and should be added to the cost per each module. The cost of the equipment has to be added only once, if the equipment is not available in the training center. The cost for replacement of damaged equipment or outdated equipment must also be considered by the course provider.
8. Install+RES National training providers

Further questions or more information about the Install+RES training courses implemented in Poland, Italy, Slovenia, Bulgaria and Greece can be provided by the Install+RES training providers mentioned below.

**Bulgaria**
Vocational High School of Electronics “John Atanasov” (VHSE)
Website: www.spge-bg.com
E-mail: i_ned2001@yahoo.co.uk
Telephone: +35 9028720047

**Greece**
Centre for Renewable Energy Sources and Saving (CRES)
Website: www.cres.gr
E-mail: stselep@cres.gr
Telephone: +30 2106603370

**Italy**
Italian National Association of Plant Builders (ASSISTAL)
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