Structure of the Install+RES Training Course

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1 Introduction

The Install+RES project has 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 will be 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.

In order to reach this aim, during the first part of the Install+RES project the training course material for installers of small-scale renewable energy systems in buildings was developed in English and German languages. The training material developed during the first part of the project was then translated into National languages to establish training courses for installers of small-scale renewable energy systems in several European countries, namely Poland, Italy, Slovenia, Bulgaria and Greece.

In this first period of the Install+RES project, the training course structure as well as the training material have been developed in line with the requirements of the Directive 2009/28/EC on the promotion of the use of energy from renewable sources taken also into account the possible cooperation with the most valuable EU projects on training courses for installers of small-scale renewable energy systems in buildings.

This document contains further information on the development of the Install+RES training course structure and the content of each of the modules: solar thermal systems, photovoltaic systems, heat pump systems, basic knowledge of electrical or heating engineering and the module on Overview on Rational Use of Energy/Renewable Energy Sources. Next to a detailed overview of the lessons, duration and hours of each module of the training course, this document also outlines the target groups to benefit from the courses in the future.

2 Development of the Install+RES Training Course Structure

The theoretical part of the training course has been developed by taking into account the requirements of the new RES Directive (Annex IV):

- the theoretical part of the biomass module has taken into account the requirements stated at the point 6.b of the Annex IV of the new RES Directive
- the theoretical part of the heat pump module has taken into account the requirements stated at the point 6.c of the Annex IV of the new RES Directive
- the theoretical part of the solar thermal and photovoltaic modules has taken into account the requirements stated at the point 6.d of the Annex IV of the new RES Directive

In line with the requirements of the new Directive 2009/28/EC (article 14, Annex IV), the 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 will provide 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 will learn how to connect at the same site different small-scale renewable energy systems. The training course will mainly take 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 should be carried out by two teachers working in tandem.

The course will provide 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 course modules will be completed with an exam leading to a certification. The examination will include 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 will be certified and qualified as installer of small-scale renewable energy systems in buildings. The names of the certified planners will be published on the Install+RES homepage.

2.1 Training Course for Installers of Small-Scale RE systems at the BZS

The content of the training course of the Install+RES project is based on the training course material of the course for installers of small-scale renewable energy systems, which has been developed and carried out at the Vocational School for Electricians and Electronics Installers, Training Centre for Solar Technology (Bildungszentrum für Solartechnik, BZS) of the City of Munich, Department of Education and Sports, Germany.

This course has been based on the following modules:
- ecological marketing
- basic knowledge of heating engineering
- basic knowledge of electrical engineering
- photovoltaic systems
- solar thermal systems
- heat pumps

The module “ecological marketing” comprises lectures on basic knowledge on energy and environmental topics, focusing on the energy demand, energy price development, centralized and decentralized energy supply, renewable energy sources. The module includes lectures on renewable energy laws and regulations on energy savings, lectures related to the individual use of energy based on the analysis of heating, warm water and electrical bills, personal energy balance, CO2 load calculation. The module also includes lectures on marketing concepts comprising the costs of PV, solar thermal, heat pumps systems and
marketing development of small and large enterprises.

The module “basic knowledge of heating engineering” comprises lectures on basic knowledge of thermal engineering (convention and irradiation, physical state of the matter, power, energy, heat), on centralized and decentralized warm water production, heating techniques and measurement and installation techniques (sensor installation, piping conditions in the collector circuit, pipe and pump resistance, pump station and the valves).

The module “basic knowledge of electrical engineering” comprises lectures on basic knowledge of electrical engineering (electricity, voltage, resistance, series and parallel connection, conductor resistance and internal resistance, types of electricity, AC / DC, peak value, frequency, induction and transformers). The module includes also an overview of safety regulations and installation technology and circuitry.

The “photovoltaic systems” module includes theoretical lectures on basic and detailed knowledge on photovoltaic systems (the solar cell, types of solar cells, from the solar cell to module, form the module to the PV system) and on the design of a PV facility. The module includes a practical part on the installation of a PV system, monitoring the PV system via Internet, start up and maintenance of a PV systems, as well as lectures on safety, data evaluation and simulation.

The "solar thermal systems" module includes theoretical lectures on basic and detailed knowledge on solar thermal systems (collectors, absorbers, storage, heat exchanger, piping system, armatures, circulating pump, liquid for heat transfer, regulation techniques) and on the design of solar thermal facilities. The module includes a practical part on the installation of flat collector and vacuum pipe system on a roof and regulating technique practice (setting a difference temperature regulator, connecting a circulating pump), as well as lectures on starting up a thermal solar system, monitoring, security regulations and maintenance.

The module on “heat pumps” comprises lectures on basic knowledge of heat pumps (liquefaction, evaporation, thermodynamic processes), on function of heat pumps (cooling cycle, pressure and temperature changes in the cooling cycle, performance), designing a heat pump facility, construction components and functional process and hydraulic connection of a heat pump. The module includes a practical part on heat pump installation, measurement techniques, recording heating and cooling cycles, electrical performance, as well as lectures on energy balance, cost accounting, heating cost comparison.

2.2 Target Group of the Install+RES Training Course

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.

2.3 Development of the Install+RES Training Material

The modules on “Overview on rational use of energy (RUE) and Renewable Energy Sources (RES), Fundamentals of heating or electrical engineering; Qualification for solar thermal systems and / or photovoltaic systems and / or heat pumps” have been developed by the BZS, with support of the Akademie für Lehrerfortbildung und Püersonalführung (ALP), according to the existing material and experience gained by BZS in carrying training courses for installers of PV systems, solar thermal systems and heat pumps at the Vocational School for Electricians and Electronics Installers, Training Centre for Solar Technology, Department of Education and Sports of the City of Munich.

The module on biomass systems has been developed by WIP-Renewable Energies according to existing material and the experience gained by WIP-Renewable Energies through the European projects EARTH and BIG-EAST.

The BZS and the WIP-Renewable Energies have developed the teaching material also taking into account the synergies related to the possible collaborations with other on-going EU projects.

3 The Install+RES Training Course Structure

![Diagram of the Install+RES Training Course Structure]

* Solar thermal systems and / or photovoltaic systems and / or heat pumps and / or biomass systems
The modularization of the training course at the level of fundamentals as well as 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.

3.1 Modules of the Install+RES Training Course

The “Install+RES” training course structure will be based on the following teaching units:

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 system, has to attend the module on basic principle 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.
### 3.2 Overview of the Install+RES Training Courses

<table>
<thead>
<tr>
<th>Module</th>
<th>Lessons</th>
<th>Duration of each module</th>
<th>Duration of the training course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Overview on RUE and RES</td>
<td>25</td>
<td>2.5 days</td>
<td>265 lessons appr. 27 days appr. 200 hours</td>
</tr>
<tr>
<td>2.1 Fundamentals of Heating Engineering</td>
<td>30</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>2.2 Fundamentals of Electrical Engineering</td>
<td>30</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>3.1 Qualification for Solar Thermal Systems</td>
<td>45</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>3.2 Qualification for Photovoltaics Systems</td>
<td>45</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>3.3 Qualification for Heat Pumps</td>
<td>45</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>3.4 Qualification for Biomass Systems</td>
<td>45</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

A lesson consists of 45 minutes and there should be held approximately 10 lessons per day, which makes 7.5 hours per day.

### 4 Equipment needed for the Install+RES Training Course

The equipment that is needed by each training provider (Vocational High School of Electronics "John Atanasov" - VHSE, Centre for Renewable Energy Sources and Saving - CRES, Solski Center Velenje - SCV, Cracow University of Technology- PK and the Italian National Association of Plant Builders- ASSISTAL) to perform the practical part of the training course has been defined by the BZS.

The training providers will provide either adequate technical facilities or corresponding facilities, including laboratory equipment, to guarantee resp. to provide practical training. As the Install+RES training course is based on the pedagogical approach of combining theoretical and practical parts, the definition of the appropriate equipment is fundamental in the practical training structure based on the “hands on learning” concept.

The participants of the Install+RES training course will be provided with practical knowledge on the functional properties of the small-scale renewable energy systems. For this aim, the training providers have to set their laboratories with the right equipment to teach the future installers the practical knowledge to properly install the small-scale renewable energy systems.

The right choice of the equipment represents a fundamental step for ensuring that the “Install+RES” training courses will be successfully implemented. Therefore the training
providers will carefully choose the right equipment to be installed in their training facilities, and the BZS will support them in selecting the right equipment to be installed.