

CERTIFICATION AND QUALIFICATION OF PV INSTALLERS IN EUROPE TRAINING AND CERTIFICATION METHODOLOGY

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ABSTRACT: The European Union's energy strategy sets specific targets for a sustainable growth during the coming decades, including reaching a 20% share of renewables in final energy consumption till 2020. To achieve that, a number of initiatives and measures have been in force. The favorable European policies as well as the Member States' supporting legislations have resulted to high market growth for photovoltaics (PVs). However, the PV technologies' application requires highly qualified technicians for PV installation, repair and maintenance. As national markets have been growing faster than the qualified PV installers force can satisfy, the appropriate training systems and certification schemes need to be developed in order to validate the competence of the installers and to ensure efficient and good functioning of installed PV systems. This is the scope of the European initiative PVTRIN, supported by the Intelligent Energy Europe programme of the European Commission, which focuses on the development of an appropriate training and certification scheme for technicians active in the installation and maintenance of small scale PV systems and sets the base for a mutual acknowledged certification scheme within Member States.

Keywords: Photovoltaic, Education and Training, RES Installer, Qualification, Certification

1 INTRODUCTION

PVs' fast growth has created a high demand for qualified installers. More than 21.500 MWp of capacity were added to the grid in 2011. 465.000 PV jobs will have been created in 2015 in EU, according to the industry's estimations reaching 900.000 in 2020 [1]; almost half of them in installation and maintenance of systems. [2].

The installation of a PV system is a complex task, not only from the technical point of view where installers must have knowledge about DC electricity and safety, in parallel with roofing skills and understanding of designing rules, but also from the financial and legal aspects as -in most countries- PV systems are favored by financial incentives and are subject to a number of administrative issues and barriers. PV is considered as an expensive energy technology, thus the highest possible performance of a PV system is the main concern of the investors. Installers must not only perform technical tasks correctly and precisely, but also must provide customers with appropriate information about incentives, investment costs, payback time and other regulations critical to the installation of their PV system.

In most countries, there is a lack of certified training courses appropriate for PV installers. PV installer may not be yet recognized in the classification of occupations. Training is usually provided by secondary technical schools to upgrade the installer skills or by equipment distributors to introduce and train them specifically on their equipment.

Obviously, the need for quality installations calls for skilled technicians and appropriate education. The shortage of competent workforce may result in a threat to the PV market. Certification schemes can provide reassurance that the installer has the capacity to complete a PV installation safely and effectively. Along these

lines, the RES Directive (2009/28/EC) is forcing Member States (MS) for mutual acknowledged certification schemes [3].

The PVTRIN Training and Certification Scheme addresses the market needs and sets the base for the adoption of a mutual acknowledged certification scheme within EU MS. It is, initially, implemented in six countries which represent a different level of market maturity and perspectives: Greece, Bulgaria, Croatia, Cyprus, Romania and Spain.

2 APPROACH

The PVTRIN scheme provides the key components for a common qualification framework, an appropriate training methodology and a transparent and clearly defined accreditation route, incorporating the criteria set by the 2009/28/EC Directive for qualification schemes and certified training courses in each Member State, as well as the national framework and legislation and the national markets' needs. The PVTRIN action plan is illustrated in figure 1.

At first, the national legislative and normative framework regarding professional training, qualifications and certification, in the 6 participating countries, was identified and compared. Also potential synergies and barriers were evaluated.

In order to incorporate the genuine market needs and to assure the broadest possible support, the key stakeholder groups are involved to transfer the market's experience and to provide consultation. 43 organisations, involving PV/RES industry associations, professional unions and installers associations, vocational training organizations, accreditation/certification bodies, chambers of commerce, investors associations, are contributing to the PVTRIN activities.

A fieldwork research was conducted in the participating countries, in order to record the attitudes, perceptions and considerations of the PV industry actors regarding the training and certification of PV installers. A second survey has measured the satisfaction level of PV investors as concerns the quality of the installation process of their system.

The interaction with the stakeholder groups has revealed significant issues to be taken into account for the scheme's development. Also the cross-national analysis of the field surveys results highlighted the different markets' needs, industry's considerations and investors' opinion and perceptions [4].

Moreover, relevant initiatives and existing certification schemes for PV/RES installers -in Europe and internationally- were reviewed in order to exploit existing knowledge and expertise and to create links and synergies with relevant initiatives.

Through the above methodology, the under development scheme integrates the national legislation, the market's needs and the PV industry's requirements.

The developed documentation provides guidance for the certification procedure, the design and installation requirements, the required competences and training needs of technical staff, the appropriate infrastructures and technical facilities, the auditing mechanisms.

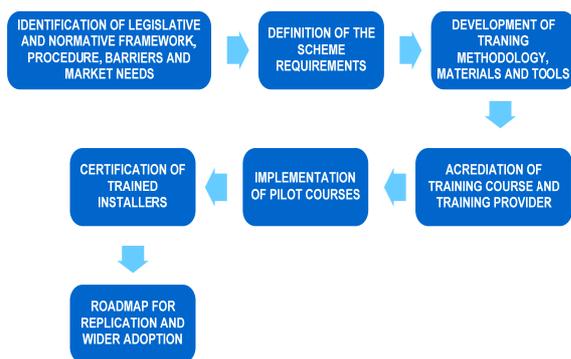


Figure 1. Development of the PVTRIN project [5]

3 PV INSTALLER'S TASK ANALYSIS

During the project's development, the qualification and skills expected from any qualified PV installer for efficient PV installation and maintenance of system were identified. The PV installers' tasks were analysed in order to develop the training curriculum, to identify the requirements for their assessment and to define the requirements for accrediting the training course. The following table (Table 1) presents the key tasks and skills of a small scale PV installer:

Table I. PV Installers' skills [6]

i. Working Safely with Photovoltaic Systems
- Maintain safe work habits
- Demonstrate safe and proper use of required tools and equipment
- Demonstrate safe practices for personnel protection
- Prove awareness of safety hazards and knowledge how to avoid them
- Understand and apply appropriate codes and standards

ii. Conduct a Site Assessment

- Identify tools and equipment required for conducting site surveys for PV installations
- Determine suitable location with proper orientation, sufficient area, adequate solar access
- Determine suitable locations for installing all PV system's components
- Illustrate possible layouts and locations for array and equipment
- Identify and assess any site-specific safety hazards associated with installation of system
- Obtain and interpret solar radiation and temperature

iii. Select and size a PV system

- Estimate and/or measure the peak load demand and average daily energy use for loads
- Determine the design currents and voltages for any part of a PV system electrical circuit
- Determine the capacity of system conductors, and select appropriate sizes
- Determine appropriate size, ratings, and locations for earthing and lightning protection
- Identify array layout, orientation and mounting method for ease of installation
- Select major PV system's components
- Estimate annual energy performance of proposed system

iv. Installation of the system in the field

- Install module array interconnect wiring; implement measures to disable array during installation
- Label, install, and terminate electrical wiring
- Use appropriate and correctly labeled D.C. junction boxes and isolation switches
- Verify continuity and measure impedance of earthing system
- Program, adjust, and/or configure inverters-controls for desired set points and operating modes
- Utilise drawings, schematics, instructions and recommended procedures in installing equipment
- Assemble modules, panels, and support structures as specified by design
- Inspect entire installation, identifying and resolving any deficiencies in materials or workmanship
- Activate system and verify overall system functionality and performance
- Explain safety issues associated with operation and maintenance of system

v. Maintaining and Troubleshooting

- Analyse the manuals of PV installations, determining actions required for the maintenance
- Design a typical periodical maintenance plan and select the appropriate tools
- Analyse the past production report and -potential-fault reports
- Identify typical installation mistakes/failures.
- Inspect entire installation, check mounting systems, ventilation, cable runs and connections
- Check system mechanical installation for structural integrity and weather sealing
- Check electrical installation for proper wiring practice, polarity, earthing etc.
- Compile and maintain records of system operation, performance, and maintenance

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- vi. Quality management and customer care
 - Understand all quality parameters as regards quality management, efficiency and functional controls
 - Recognize and understand EU standards associated to the system components and processes
 - Understand and apply all necessary customer care activities

4 THE PVTRIN TRAINING

For the development of the training course’s syllabus and training approach, the following inputs were taken into account:

- The criteria and requirements set by the 2009/28/EC Directive, as regards the qualifications and training of the small scale PV installers
- The existing national legislative framework
- The PV Installers task analysis
- The input and recommendations of the NCC’s members and other stakeholders, and the identified requirements of the certification scheme
- Successful examples and relevant expertise in EU level.

The course covers the design, installation and maintenance principles of small scale PV systems. Participants will develop their skills and understanding of basic solar theory, systems components, design, installation, commissioning and handover of a small scale PV system, including also maintenance and troubleshooting.

4.1 Training Materials

The training materials and tools have been developed to support the PVTRIN training providing the PV installers with applied knowledge, practical tips and best practice recommendations for efficient and quality installation and maintenance of PV systems.

The materials are developed based on the task analysis performed in the first steps of the project, aiming to be easily used by the trainees, as well as by their trainers, not only during the training course, but also during the installation process and fieldwork.

The training materials and tools developed under the PVTRIN project include handbook and troubleshooting guide for PV installers, list of resources, trainers’ manual, etc. [6].

The PVTRIN handbook contains the theoretical training of the PVTRIN course (Table 2), as well as comprehensive exercises and other useful resources i.e. further reading references (suggested books, online publications etc), useful links, glossary and references.

On top of the handbook and other guidebooks, an e-learning platform has been developed in order to facilitate the training procedure. The PVTRIN e-learning platform is a powerful self-study tool which enables trainees to review classroom lectures, to access additional information, to carry out activities and exercises, to communicate with the tutor, to self evaluate their advancement and to acquire further knowledge. At the same time, the PVTRIN e-learning platform enables trainers to monitor the progress of their trainees, to communicate with them in order to make suggestions about areas for improvement or new activities for better preparation for the final assessment.

Table 2. PVTRIN Handbook structure

Chapters of the PVTRIN handbook
1. Solar Basics
2. Design Principles
3. BAPV and BIPV
4. Installation – Sitework
5. Case Studies – Best Practices
6. Example Installation of a small scale PV on a Building
7. Maintenance and Troubleshooting
8. Quality Management and Customer Care
9. Glossary of Terms
10. Annexes
11. Further Reading

4.2 Pilot Courses

Eight pilot courses have been scheduled in the PVTRIN participating countries. The training course consists of two parts, the theoretical and practical training with balance of classroom lectures, presentation of case studies, practical exercises and actual hands-on work with PV system. The first part describes the underpinning knowledge that is required to understand the theory behind PV systems, related regulations, safety requirements and installation and testing. The second part concerns the application of practical skills in carrying out installation and testing. The dates for scheduled training courses are announced to the www.pvtrin.eu.

The structure of the PVTRIN course is presented in Table 3.

Table 3. Structure of the PVTRIN Training Course

Module	Class	Lab/site hours	Self Study
Basics	4		6
Design Principles	9	3	24
BAPV and BIPV	4		8
Installation - Sitework	10	2	30
Maintenance And Troubleshooting	3	2	8
Case Studies - Best Practices	3		14
Example installation of a small scale PV on building	4	7	12
Quality Management and Customer Care	3		6
Total	40	14	106

4.3 Applicants’ entry requirements

The PVTRIN training addresses to qualified electricians, who wish to activate in PV installation. The applicants are expected to be at least 20 years old, to have received training on DC systems, to hold license to practice in electrical installations of at least 10kW and to have gained relevant experience working for a PV

installation company, electrical installation company or a roofing company.

Detailed information about the entry requirements are provided by the PVTRIN National Contact Points [7].

5 THE PVTRIN CERTIFICATION SCHEME

The scope of PVTRIN Certification is to set the base for a mutual acknowledged certification scheme within EU. Thus, PVTRIN certification is based on the criteria set by the 2009/28/EC Directive (Annex IV):

- The certification process is transparent and clearly defined
- The solar photovoltaic installers will be certified through an accredited training programme or training provider
- The training leading to installers' certification includes both theoretical and practical parts
- The training course ends with an examination, which includes practical assessment, leading to a certificate
- The training is offered to installers with work experience, who have undergone training as electricians
- The PVTRIN certification is time restricted. A refresher seminar or event is necessary for continued certification.

Furthermore, the PVTRIN certification is compatible with the national legislative frameworks, and aims to maintain and enhance the reputation of the PV industry by underpinning the safety, quality and performance of PV installations and minimising technical failures and complaints.

The scheme requirements include, among other issues, applicable regulations and directives, installation and maintenance requirements, site specific issues, system performance, quality management, customer care.

5.1 Assessment of the trainees

To achieve certification, the PVTRIN trainee has to prove the required knowledge and skills by successfully completing the PVTRIN exams (written and practical part). Once the required areas of competencies are fulfilled and the assessment requirements are met, the installer is eligible for the PVTRIN Certification.

During the assessment the installer should demonstrate the following key competences:

- the ability to work safely using the required tools and equipment and implementing safety codes and standards and identify electrical and other hazards associated with solar installations;
- the ability to identify systems and their components specific to active and passive systems, including the mechanical design, and determine the components' location and system layout and configuration;
- the ability to determine the required installation area, orientation and tilt, taking account of shading, solar access, structural integrity, the appropriateness of the installation for the building or the climate and identify different installation methods suitable for roof types and the balance of system equipment required for the installation; and
- the ability to adapt the electrical design, including determining design currents, selecting appropriate conductor types and ratings for each electrical circuit, determining appropriate size, ratings and locations

for all associated equipment and subsystems and selecting an appropriate interconnection point.

5.2 The PVTRIN certification process

Fig. 2 describes the PVTRIN certification process.

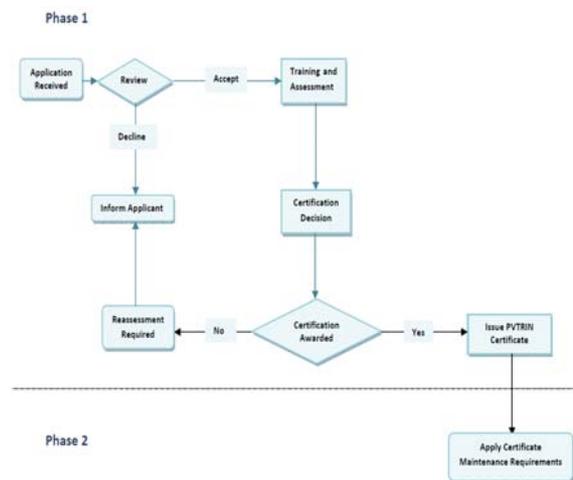


Figure 2: Schematic diagram outlining the PVTRIN certification process

The certified installer is awarded by the “Photovoltaics Certified Installer” certification mark which they can display publicly to demonstrate their proficiency. For the maintenance of the PVTRIN certificate an annual surveillance, refresher seminars and a re-certification process has been foreseen. The PVTRIN certification mark is illustrated at fig.3.



Figure 3. PVTRIN certification mark

5.3 Benefits of the PVTRIN scheme

The PVTRIN training and certification scheme benefits the installers, the training providers and the PV industry as shown at table 4:

Table 4. Benefits of the PVTRIN Scheme

i) for the technicians
<ul style="list-style-type: none"> ▪ appropriate training courses; ▪ flexible training opportunities through e-learning platform; ▪ advancement and updating of their knowledge and technical skills; ▪ employability; recognition and professional competitive advantage due to their certification according acknowledged quality standards; ▪ mobility; the certification provides the “passport” to the EU job market.
ii) for the training providers
<ul style="list-style-type: none"> ▪ a training methodology and accreditation scheme to be adopted in their training courses;

- a well-structured training course and state of the art training materials in their national language to utilize;
- tools to correspond to an active need of the market and the society;
- a specific, defined, policy and professional framework to develop their courses.

iii) for the PV industry

- availability of efficient workforce;
- increased credibility and confidence to the technology by the potential investors (better system performance and reduced risks);
- satisfied customers (efficient installations, less technical failures, lower operational costs).

6 CONCLUSIONS

The RES market development, followed by the rapid growth of PV installations, has created high demand for qualified installers. The establishment of common acknowledged quality standards to professional training and certification of PV installers can provide reassurance to customers that an installer has the knowledge, skills and competences to complete PV installations safely and effectively [8].

The European Initiative PVTRIN addresses the market needs by developing an appropriate training and certification scheme for technicians -who are active in the installation and maintenance of small scale PV systems- providing the key components for the development of a European acknowledged certification scheme. The implementation of the certification scheme provides benefits for the installers, the PV industry and the society. As a result of the PVTRIN's action plan, a pool of local technicians, competent at installing PV systems, according to multinational quality standards, will be established in the participating countries. This guarantees the safety and best performance of PV installations, lowering risks or technical failures during the system's installation and life cycle.

The PVTRIN certification scheme could be adapted to other small scale RES installations, and could be the base for implementation of certification schemes for solar thermal installers, small scale biomass stoves and boilers installers and heat pump installers, as requested in Directive 2009/28/EC. Thus, the PVTRIN certification will provide a supporting instrument, for EU Member States, to meet their obligations for acknowledged certifications for RES installers according to the RED Directive.

Long term, PVTRIN will contribute to the PV market growth, will facilitate job mobility of installers within Europe, and will enforce the EU MS to achieve the mandatory target of a 20% share of energy from RES in overall Community energy consumption by 2020.

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