

## THE CERTIFICATION OF SKILLS IN THE FIELD OF RENEWABLE ENERGY SOURCES (RES): THE CASE OF PHOTOVOLTAIC

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**ABSTRACT:** In recent years energy from RES is increasing considerably in many European countries as the result of incentive schemes. The risk is that a race for easy profits will annul the advantages of these technologies because of a dearth of appropriately qualified and experienced designers, installers, and inspectors who could assure the correct realization of RE projects.

To improve the overall quality of new PV installations, ENEA (the Italian Agency for New technologies, the Energy and the Environment) has defined, in accordance with interested parties, profiles for professionals to provide end users with the necessary assurances that their requirements will be fulfilled.

Keywords: Education and Training, Dissemination

### 1 INTRODUCTION

With the introduction of the Feed-in Programme, photovoltaic is becoming more and more important in Italy. During the year 2007 the total power of installed photovoltaic systems reached approximately 70 MWp. A similar growth is continuing also during 2008: from January to July another 80 MWp were installed bringing the total capacity to about 150 MW. Including power installed before the Feed-in Programme, the total capacity installed in Italy is 190 MW.

In this context, ENEA (the Agency for new Technology, the Energy and the Environment) has accumulated much experience in training on photovoltaic issues, as reported at the 21<sup>st</sup> European Conference held in Dresden in 2006 <sup>[1]</sup>. The course, financed by the Ministry of Environment, consisted in 26 sessions addressed to installers and designers, with a total of about 1120 participants.

In anticipation of an obligation for all Member States, arising from article 13.3 of the Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (COM(2008)19 final dated 23.01.2008), ENEA and Mesos (a spin-off company headed by ENEA researchers) have developed an action for the certification of designers, installers and inspectors of photovoltaic plants.

The RES Directive recognizes the importance of training the installers of small scale RE systems to assure the delivery of well-functioning and properly dimensioned photovoltaic systems. In particular, Annex IV.2 states: “Biomass, heat pump and solar photovoltaic and solar thermal installers shall be certified by an accredited training programme or training provider.”

Certification means that an installer has demonstrated necessary skills, knowledge and ability typically required of a practitioner to competently install, maintain and troubleshoot a small-scale RE system.

Certification is normally provided after training programmes for installers. In turn, these training programmes need to be qualified by the accredited certification body to make sure they apply sufficiently stringent and uniform training standards and are appropriate to achieve their goals.

The proposed RE Directive therefore states in Article 13. “Member States shall develop certification schemes for installers of small-scale biomass boilers and stoves,

solar photovoltaic and solar thermal systems and heat pumps. Those schemes shall be based on the criteria laid down in Annex IV. Each Member State shall recognize certification awarded by other Member States in accordance with these criteria.

### 2 EMPLOYMENT OUTLOOK

A report made by the Institute fuer Wirtschaftsforschung <sup>[2]</sup> states that in Germany 20,000 men are employed in distribution, installation and services in the photovoltaic field. In 2007, with respect to the increase of installed power of 1100 MW, 14850 installers were employed.

As to the above-mentioned study and according to private information from installers, on average, 8.5 man/days are required to install a small 3 kW system. Considering 210 working days/y, this corresponds to 13.5 skilled persons per MW installed. The 2008 target for 105 MW of cumulative installed PV power corresponds to a need of 473 skilled persons.

Year	New installed (MWp) + 50%/y	<u>Installers to be trained</u>	Installers employed
2007	70		945
2008	105	<b>473</b>	1418
2009	160	<b>743</b>	2160
2010	240	<b>1080</b>	3240

**Table 1:** Estimate of required installers

Taking into account the expected growth of the Italian PV market, Table 1 provides some values for the next two years representing the continuous increase in the demand of skilled persons.

### 3 ITALIAN CERTIFICATION PATH

#### 3.1 CEPAS

For the definition of the certification path of the operators involved in the design, installation and inspection of PV plants, ENEA has identified CEPAS (www.cepas.it) the national Certification Body for Person. CEPAS is a full member of IPC (International Personnel Certification Association (www.iatca.com) and

is accredited by SINCERT, which is the national accreditation body signatory of the mutual recognition system to the analogous accreditation national bodies over Europe (EA/MLA).

The certification scheme used by CEPAS follows the ISO/IEC 17024 standard (ex EN 45013) “General requirements for bodies operating certification of persons”. This standard requires that CEPAS doesn’t perform training by itself, but it is accredited to verify whether qualified training organisations are adopting the right procedure for the specific training.

The general criteria identified by ISO 17024 assume the participation of all stakeholders in the definition of the certification scheme: required competences; the competence of the instructors; the absence of conflict of interest between certification body and trainers; transparency, impartiality, confidentiality and security:

“The certification of a person establishes that a person, evaluated by a third party, according to precise rules, fulfils specified competence requirements, defined with the interested parties, to work with professionalism in a specific line of business”.

The certification scheme is identified by CEPAS as follows:



**Figure 1:** CEPAS certification scheme.

It means that before a person can be certified she/he has to show evidence of work experience in the specific area of competence, she/he has to pass a specific qualified course, has to show evidence of application of what she/he has learned and finally has to pass an exam before being registered as a person of a certified competence. The CEPAS professionals Register will ensure that the registered professional not only has the necessary technical expertise, but also respects the ethical code and follows continuous professional development.

### 3.2 The Technical Committee

CEPAS, with the support of ENEA, hosted a round table involving major public and private stakeholders in photovoltaics in Italy, the so called “Interested Parties”: GSE (Italian Electric Services Manager), Ministry of Environment, Ministry of the Economic Development, Ministry of Research and University, Regulatory Authority for Electricity and Gas, National Photovoltaic Industries Group, ISES ITALIA, JRC (Institute of Environment and Sustainability), National Association of Italian municipalities, ENEA, Energy Services Company in PV sector, Italian Banking Association, National Confederation of Handcrafts, SME, CESI Ricerca, Italian Associations dealing with PV sector

The Technical Committee defined the requirements and specifications referred to the key players for the

exploitation of photovoltaic energy: the designer, the installer and maintainer, the inspector and the relative qualified Training Course.

### 3.3 The Professional Profiles

In each of the three profiles the maintenance and the renewal of the CEPAS qualification requests the absence of customer claims, at least 8 hours/y of professional training and continuous improvement. The professional upgrading is very important for following the continuous innovation of the PV sector.

#### 3.3.1 The “Designer” profile

Among the requirements needed for the profile of “Designer”, the Technical Committee has deliberated :

- Profile: well-experienced person in the design of small photovoltaic plants ( $\leq 20$  kWp), in the planning and execution of work and in the acceptance test.
- Educational Level: at least secondary school.
- Specific knowledge: proof of the attendance of a course with duration of at least 24 hours dealing with specific topics.
- Field experience: at least 2 years experience in the design of the photovoltaic plant and realization of at least 1 PV plant out of 5 electrical installations.

#### 3.3.2 The “Installer” profile

- Profile: well-experienced person in the installation of small photovoltaic plants ( $\leq 20$  kWp) and in the relative maintenance.
- Educational Level: at least secondary school.
- Specific knowledge: proof of the attendance of a course with duration of at least 24 hours dealing with specific topics.
- Field experience: at least 1 years experience in the electric plant installations and realization of at least 1 PV plant .
- Knowledge about technical standards concerning the realization of PV power plants.
- Knowledge about existing procedures concerning grid connection and obtaining incentives.
- Knowledge about what the market is offering and to chooses the right products for a specific installation.

#### 3.3.3 The “Inspector” profile

- Profile: Person with a recognized professional experience in the field of verification of small PV plants ( $\leq 20$  kWp), technical conformity to existing norms and standards, legislations and to the completed and executive project.
- Good knowledge about technical norms dealing in general with electrical installations and more specific the photovoltaic ones.
- Knowledge about electrical measurements to verify the performance of the installation, both efficiency and expected production, and its correct execution.

## 4 IN DETAIL: THE COURSE FOR “DESIGNER”

In order to guarantee the quality of training, CEPAS, ENEA and Mesos have defined together the goals of the training course and the fundamental requirements necessary to achieve them.

Mesos – Innovation and Training Advice s.c.r.l. is a

private company created and committed by ENEA to better manage these new courses especially in design, logistics and dissemination aspects.

The course has been designed in order to allow the trainee to gain the competences needed for the professional requirements as foreseen in the scheme previously showed.

#### 4.1 Requirements

The work of the Technical Committee has included also the definition of the requirements sheet relative to the qualification for the course for professional profiles in the photovoltaic sector. The most important are referred to:

- Organizational requirements for the provider of the course:
  - Organization, human resources (teachers with 5 years of professional activities).
  - Infrastructure.
  - Promotion of the course (fully detailed brochure).
- Minimum requirements for the course: duration, objective, minimum requirements to access for participants.
- Structure.
  - General and specific topics.
  - Documentation: teacher's guide, participants' guide, final examination guide for teachers.
  - Evaluation.
- Conditions for the maintenance of the CEPAS qualification: duration, supervisory, control and prescription.

#### 4.2 Scope

The formation/training module has been organized in order to provide:

- Technical and normative elements which are fundamental for the design and the installation of photovoltaic plants.
- Procedures and formalities to connect to the grid and receive public incentives.
- The opportunity to meet PV operators in Italy.

#### 4.3 Programme

The programme of the qualified for "Designer" held in Rome 2007 - 2008 addressed the following topics and included a technical visit to the PV installation in the Research Centre of ENEA at Casaccia:

- The energy issue and renewable sources.
- Technology and devices.
- Technical and operational aspects.
- The photovoltaic plants.
- Design and electrical norms: choice and configuration.
- Installation: criteria and suggestions.
- Technical and functional checks: examples of PV power plant measurements.
- Optimization in the choice of components.
- Photovoltaic integration in architecture.
- Energy performance evaluation of different types of integrated plants.
- General design criteria.
- Examples of PV plants design.
- The incentives for RES and Feed-in Programme.
- Economy and taxation issues of PV.
- Use of photovoltaic plants in industry.

- The certification of the professionals.



**Figure 2:** Visit to the PV Plant at ENEA Casaccia

In order to make trainees participation interactive and stimulating, the course has been structured according to a mixed learning methodology, a combination of e-learning and face to face sessions.

The participants should attend the classroom seminars (32 hours) performed by the experts of ENEA to acquire technical and practical competences and should attend the e-learning course (50 hours) for Designers of Photovoltaics available on ENEA's web site (<http://odl.casaccia.enea.it/fotovoltaiico.htm>).

#### 4.4 Teachers

Educational contents and teachers are all strictly ENEA's researchers. As of July 2008, six professionals are qualified in the CEPAS Register and all ENEA's teachers are included.

#### 4.5 Feedback

The first course, qualified by CEPAS, started in November 2007 and was very successful. Full participation was achieved even if the promotion activities began late and were locally addressed. It has been replicated three times; the date for the fourth edition is scheduled for the 3rd of November 2008.

One of the characteristics of CEPAS qualified course is to optimize the complete learning process. Only twenty participants can attend the course and this maximum number was achieved in each editions.

The majority of the participants were engineers, the others were graduated. 46% of them were engineers or technical employees in private company, 34.50% of them self-employed persons, 11.50% owners of firm or design office.

In order to analyze the reasons for this success, participants were requested to give their personal reasons for choosing the course.

The user's feedback resulting from the questionnaires has shown that most of the attendees are interested in enhancing skills and in their certification.

The duration of the course was considered too long for the 40% of the participants who suggested reducing the course to only two days. Others would like to enhance the subjects with supplementary information.

Despite the above-mentioned comment, 69% of the participants stated that the complete duration of the course fully fulfilled their expectations

The lesson schedules have fully met the requirements of each one.

Of all attendees, 51% would like more exercises and simulation, about 20% considers important to emphasis on examples from projects and on activities in field.

By the evaluation analysis roughly 70% of the attendees considered the course beyond their expectation

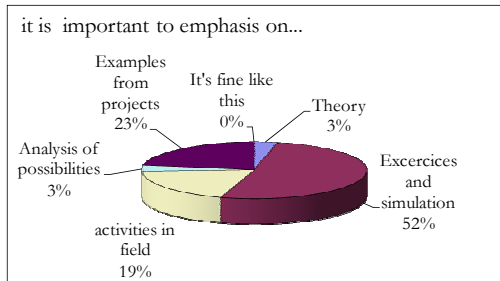


Figure 3: Is it important to emphasis more on...

All participants have expressed intention to recommend the course for “designer” organized by ENEA and Mesos.

Mesos was considered to play a very important role in transferring ENEA’s know-how towards Industry and Enterprises for the majority of the participants (33% very good and 53% good)

With reference to the question regarding an advanced follow-up of the course, 15% would surely participate, 69% guess to participate, 7,6% maybe would participate and 7,6% do not know. Nobody had expressed a negative intent.

At the end of the course, participants have to pass a final examination and a certificate of attendance will be issued and given to them. According to a CEPAS scheme, the course for “Designers of Photovoltaic plants” is a requisite to obtain CEPAS certification for “Designers of photovoltaic plants”.

All certified persons will undergo periodical audits in order to guarantee the stable practice in their profession and their continual professional improvement. This requirement is very important to keep professionals updated with the best available technology.

In order to provide participants with continuous professional development, ENEA and Mesos have programmed workshops held by photovoltaic experts of ENEA together with trained experts.

#### 4.6 E-Learning platform

ENEA supplies services and distance courses to help dissemination of scientific culture and promote technological transfer.



Figure 4: The DESIRE-net web page

The e-learning courses of 50 hours for Designers of Photovoltaics have been very successful and have been translated into English ([www.desire-net.enea.it](http://www.desire-net.enea.it) - DEvelopment and Sustainability with International Renewable Energies NETwork) through a collaboration with UNESCO, which wanted to promote renewable energies in developing countries of East Europe and Mediterranean countries.

The course has also been translated into French by the African Engineers Association who wants to promote renewable energies in French speaking African countries.

The training course covers most of the possible and necessary matters in the field of grid connected photovoltaic systems installed or integrated in buildings.



Figure 5: The interface of the e-learning course on PV energy

The aim of e-learning course is to provide the attendees, who usually are very heterogeneous, with the same background to improve the effectiveness of the face to face course. The attendees have to pass a test, by e-mail, at the end of the e-learning course in order to access to the certified course.

The course is advertised in the ENEA e-LEARN platform (<http://odl.casaccia.enea.it>).

There are more than 130 courses of which many in the field of energy and sustainable development.



Figure 6: The ENEA e-LEARN interface to enter the e-learning courses in different languages

All the courses are freely available; the user needs to register by providing a very short set of information used for statistical analysis of the registered users.

The combined learning option is very valid for a better exploitation of this technology everywhere, even in the developing countries as the UNESCO initiative has showed. UNIDO, (United Nation Industrial Developing Organization) is considering to use the ENEA e-learning platform to start up a capacity building program in developing countries in the field of renewable energies.

#### 4.7 Next Steps

Installer and Inspector of PV plants - In the near future, according to the requirements sheets disposed by CEPAS, ENEA's researchers and Mesos will set up two other combined courses for "Inspector" and "Installer" of PV plants. These courses will have a duration of 3 days (of 8 hours) divided into 16 hours of theory and 8 of practice.

It is worth mentioning that the GSE (the Italian Electric Services Manager that manages the Feed-in Programme) has expressly requested the course for PV plant inspector.

Moreover, courses for installers could be addressed to prepare technicians able to both construct plants and to guarantee all the maintenance activities required during system lifetime.

These courses foresee more practice than the course for designers and the attendees will have the opportunity to actually follow the installation by stages in the ENEA experimental plant. Both the inspector and the installer, in fact, have to know very well the practical problems related to the installation of the plant and the demonstration, more than the theory that they can access through the e-learning course, is important to them

New profile (EE) - ENEA and Mesos are now working on a combined course for energy qualification of building consultants. The training programme will comply with the CEPAS requirements sheet. Also in this case there is strong interest from many associations such as ICIC: the main Italian Association for building construction.

## 5 CONCLUSION

ENEA has anticipated the needs from the RES market by developing qualified combined courses for professionals overcoming the weakness of the actual education system in this sector.

Even Universities are far away for promoting simple courses to provide competences to professionals who have already left schools and Universities. There is the need, in fact, to promote short courses for professionals who want to be updated with innovative technologies for a fruitful long life learning education which will allow them to remain competitive in the globalize world.

The ENEA e-learning experience in promoting the knowledge transfer from research centres to the "outside world" has already received two international recognitions:

- The ENEA e-LEARN platform has been recognized, in fact, by CEN, in February 2007, as one of the best 10 international experience in e-learning (CWA 15660 "Providing good practice for E-Learning quality approaches").
- The DESIRE-net project [www.desire-net.enea.it](http://www.desire-net.enea.it) has been awarded during the SEE week last January as best cooperation project in Europe.

Mesos has set up the first qualified course with ENEA and, in particular, the course for "photovoltaic plants Designers" is the first in Italy and in Europe which is qualified by a third entity, CEPAS as the basis for the personnel certification. France and Austria have in operation schemes for accreditation and certification of installers of small-scale RES, too.

ENEA is open to collaboration with JRC to promote this experience in any other European country and is going to sign an MoU in the next weeks.

The Certification, is a characteristic that the European Joint Research Centre in Ispra (Italy) found important. The Renewable Energies Unit JRC-IE has pushed ENEA to start with the set-up of a certification procedure just after the introduction of the Italian feed-in tariff in 2005 and that, hopefully, will be introduced at European level.

ENEA, is open to collaboration to share all the knowledge built up in European research centres which are worthwhile to be shared among the broader international community to construct a sustainable future for all the countries in the world.

## 6 ACKNOWLEDGMENTS

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