

TRAINING EXPERIENCE IN ITALY

Salvatore Castello, Anna De Lillo, Saverio Li Causi,
ENEA C.R. Casaccia, Via Anguillarese 301 - 00060 - Rome, Italy

ABSTRACT: The ENEA courses have constituted one of the most effective interventions aimed at training professional figures, not sufficiently present in Italy yet, in order to qualify operators to be involved in the design and the installation of photovoltaic plants. The formative module have been organised in order to provide technical and normative elements fundamental for the design and the installation of plants, information concerning the purpose and the formality to access at public incentives and the opportunity to meet some important photovoltaic operator.

Training activities have covered most of the possible and necessary matters in the field of grid connected photovoltaic systems, installed or integrated in buildings, in response to the expected growth of this application.

ENEA courses have attracted a high number of installers, engineers and architects: basic knowledge on electricity and norms for the design and realization of civil electrical plants was required. These courses have been carried out on the basis of two different formative modules, with the involvement of the Italian Regions and Trade Associations and of Professional Ranks respectively. In particular the formative modules have been articulated in courses including theoretical and practical lessons which organization and teaching was entrusted by ENEA technical experts.

Keywords: Education and Training, Dissemination, National Programme

1 INTRODUCTION

Italy has always considered photovoltaics as a very important strategic choice for our country as confirmed in 2001 with the launch of the Roof-top Programme [1], and more recently with the Feed-in Programme This last initiative, developed by MSE (the Ministry for the Economic Development, formerly the Ministry of Productive activities) with a decree issued on August 2005, has defined the criteria for the promotion of photovoltaic systems connected to the grid through a feed-in tariff that provide a fair remuneration of the investment and operating costs [2].

In this contest country attitude concerning educational programmes and training courses on PV is proven by the fact that both Programmes are accompanied by diffusion and training activities. In the case of the Roof-top Programme these activities have been carried out by ENEA (the Italian Agency for New technologies, the Energy and the Environment) in the framework of an agreement with MATT (the Ministry of Environment and Land protection). As far as the Feed-in Programme these activities although foreseen in the Law n. 387 of 29/12/2003 (that implemented the European Directive 2001/77/CE of 29/10/2001) have been conducted in some cases by ENEA on his own and in other by ENEA in cooperation with Local Authorities as in the case of "Sicenea" project.

The two main topics of interest during the last years are represented by educational activities for teachers and students and training courses for both designer and installers. On this purpose, following the Roof-top Programme launching, have been started projects for the school such as "the sun at school " and "at school with energy" and have been activated numerous training courses for designer and installers.

As far as the link between these activities, the program of actions tuned by the Ministry of Environment and Land Protection proposed an articulated set of interventions aimed at answer to the requests coming from the professional training field from which descend the ones coming from the world of school ad of the

citizens. Qualifying points of this program are aimed at contributing to:

- promote continuous professional training through the most up to dated formation technology;
- revise teachers with respect to the functions of the scholastic system;
- improve the standards of the productive system;
- join together the research and enterprise world with the one of the school in order to bring into the school the culture of the compatible development and the organizational culture of the enterprise;
- promote the technological transfer through the sensitization of the enterprises towards the innovation and through the technical formation in the photovoltaic productive sector.

In this contest ENEA, with its research and technological experimentation infrastructure, represent one of the few subjects in Italy able to reach the specific aims of the program.

2 EDUCATIONAL ACTIVITIES

The projects for the school have been aimed at promoting a greater awareness on the use of the renewable energies and in particular of photovoltaics. The sensitization of citizens, since school time, is an essential preliminary remarks in order to attain the commitment of Italy at national and international level. In particular "the sun at school" project is aimed at:

- sensitize the teachers on renewable sources;
- provide technical information to the teachers;
- experiment module formation and consequently produce guidelines containing methodological indications and the possible thematic path to utilize in the framework of didactic activities;
- realize a network of schools in order to facilitate the diffusion and the exchange of information and experiences among teachers and students all over Italy.

The "sun at school" initiative has been promoted by the Ministry of Environment and Land Protection and by

the Ministry of Education, University and Research with the technical support of ENEA. The significant presence of photovoltaic plants installed on schools, in the framework of the Roof-top Programme, suggested in fact the starting of activities that would increase the involvement of teachers and students. The initiative has been organised in workshops addressed to teachers of 60 schools that have complied with the Roof-top Programme. The workshops, held by photovoltaic experts of ENEA together with formation experts, have been organised in order to make teacher participation interactive and stimulating. The formation experts have indeed stimulated teachers to translate technical information acquired into more complex didactic path to be inserted in the annual didactic programming.

3 TRAINING COURSES

Concerning training courses for designers and installers, the main aim has been to increase the competitiveness of the productive system at national level, with the joined consequences on the employment impact, through the creation of strong stimulus to the innovation, qualification and valorisation of the available human resources. The human resources patrimony is in fact characterized by a good degree of education but scarcely qualified owing to a generic specialisation and few oriented to the needs of the productive world.

Training activities fits with a strategy of strengthening the use of photovoltaics and have addressed two objectives: firstly to increase the number of installers and designers and secondly to strength the awareness about the necessity of photovoltaics. The courses have in fact constituted one of the most effective interventions aimed at training specialized professional figures, not present in Italy yet, in order to qualify operators to be involved in the design and the installation of photovoltaic plants. The formative module have been organised in order to provide:

- technical and normative elements fundamental for the design and the installation of plants;
- information concerning the purpose and the formality to access at public incentives foreseen by the Roof-top Programme;
- the opportunity to meet some of the most important photovoltaic operator in Italy.

The training courses, promoted by the Ministry of Environment and Land Protection, have been routinely organised and accomplished by ENEA in different Italian cities in order to allow a broad territorial coverage.

Both educational and training activities have been entirely funded by the Ministry of Environment and Land Protection in the framework of the collateral activities foreseen by the Roof-top Programme.

4 DIDACTIC MATERIAL

4.1 Objectives

Educational tools for designers and installers are aimed at specializing technicians, engineers and architects in the sector of the photovoltaic energy, able to work in one or more segments of the photovoltaic plants for civil use and able to satisfy the skilled job request

existing in this sector since the starting of the Italian Roof-top Programme. In particular this educational tools Introduce the concepts for renewable energies in general and photovoltaics in particular and allows to:

- discover the solar radiation and its potential;
- develop and acquire competences, and methodologies in order to size systems;
- integrate the basic competences on electricity and mechanics with the electrical and structural features of the photovoltaic plants;
- acquire awareness about photovoltaic technology pros and cons;
- understand architectural possibilities;
- know photovoltaic market as well as modules and system prices;
- analyse and compare plant performance;
- design photovoltaic systems according to standards and codes;
- become familiar with the practical aspects of the installation and acceptance tests.

4.2 Training programme

The training programme covers most of the possible and necessary matters in the field of grid connected photovoltaic systems installed or integrated in buildings, in response to the growth of this application, expected in the framework of the Italian Roof-top Programme.

The programme has attracted a high number of installers, engineers and architects and has been articulated in two or three days training courses conducted in different Italian cities.

The courses have been carried out on the basis of 2 different formative modules: one addressed to the installers with the involvement of the Italian Regions and Trade Associations, while the second one addressed to designers in cooperation with Professional Ranks. In particular the formative modules have been articulated in courses including theoretical and practical lessons which organization and teaching was entrusted by ENEA technical experts. Have been carried out 32 editions of the course: 26 addressed to installers and 6 specifically devoted to designers, with a total of about 1120 participants.

The total cost of the educational programme sums to about 300,000 € and has been entirely financed by the Ministry of Environment and Land Protection. In this figure are included the expenses for the preparation of the didactic material as well as photovoltaic components for didactic experiences.

4.3 Target groups

As far as training courses for installers, the target group has been essentially constituted by technicians having good knowledge of electricity and norms for the design and realization of civil and industrial electrical plants. Such requirements, also foreseen by the Italian law 46/90 for installers, can be summarized as:

- diploma of technical secondary school (5 years) with one year experience in the electrical sectors;
- state certificate of vocational school (3 years) with two year experience in the electrical sectors;
- three year experience in the electrical sectors;

The total number of installers that have participated to the 26 courses sums to about 850 units. Regarding the training courses for designers, the

target group has been essentially constituted by electronic, electrical, mechanical or civil engineers and by architects. The total number of engineers and architects that have participated to the 6 courses reach 270 units.

Both target groups have been decided in order to have:

- a good ratio between installers and designers;
- a broad and uniform territorial coverage all over Italy. Courses for installers have been carried out in 16 out of the 20 Italian regions. With the same criteria have been planned the courses for designers. Two have been carried out in north Italy, 2 in the mid and the last 2 in south Italy. Moreover the cities selected have not hosted the courses for installers.

4.4 Courses contents

During the courses have been carried out didactic activities aimed to provide detailed information on theoretical and practical aspects that can be summarised into 10 topics.

- 1 Energy, environment and renewable sources: basic concepts, features, potential, applications in Italy
- 2 The photovoltaic technology: photovoltaic effect, cell and modules manufacturing technology, commercial product features, thin films, industrial production, market expectation.
- 3 The plants: stand alone and grid connected system features, the diffused generation, environmental impact, fuel saving, applications in Italy, plant performances and IEA-task 2 database, installed power.
- 4 Plant sizing: solar radiation, components, data available and calculation tools. Array configuration, temperature and shading effects, the choice of the tilt angle, energy produced and load energy demand, plant configuration and main components.
- 5 Economic aspects: prices of systems and components, energy cost, pay-back time, prices evolution, added value.
- 6 Building integration: potential, realizations, innovative components.
- 7 Case studies: analysis of some typical realizations (integrated roof, façade and flat roof), plant design and component choice.
- 8 Standards: national and international norms, safety rules, grid interfacing, protection devices, plant operation aspects.
- 9 Practice aspects: mounting demonstration of a small system, testing procedures, fault detection, maintenance aspects.
- 10 Initiatives: the Italian Roof-top Programme, aims, incentives, barriers, collateral activities, ENEA role and experimental support.

Where possible, as in the case of the courses that have taken place in ENEA centres (Casaccia, Portici and Delphos), but also in the case of proximity with a photovoltaic installation, a technical visit to the plant has been included.

Moreover the cooperation with GIF, the Italian PV firms Group, has ensure the participation of important photovoltaic firms that in the framework of the courses have shown their own products. This section of the

courses, devoted to get in touch with photovoltaic agents, has allowed to provide information (very much appreciated) concerning the production, distribution and prices of the products on the Italian market. Besides turned out to be also very much appreciated the participation of authorities in charge of the local Roof-top Programme that have represented a real contact between public management and labour world.

4.5 Learning means

The didactic material provided to each participant has been prepared by ENEA. For each topic of the course has been prepared a report. Teachers have edited the reports that have been distributed to each participant on papyry format. The same teachers have prepared a multimedia presentations in ppt format that have been used during the lessons. At the end of the course a participation certificate to each participant has been given. In order to allow the practical demonstration, a demonstrative photovoltaic plant has been utilised to perform real mounting and acceptance tests. In this way the participants have been able to verify in practice the theoretical indications provided during the lessons.

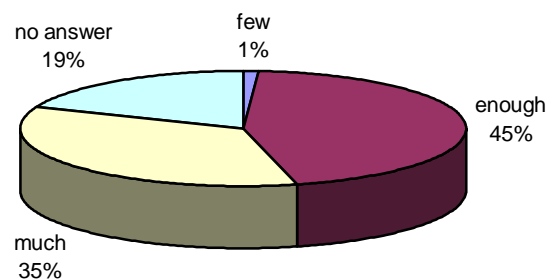
Besides have been realised off-line informative supports such as CD-roms and VHS Videos concerning plant installation and testing.

In cooperation with the ENEA Project (Knowledge Management Methodology) has been moreover tuned a on-line course (FOTOVinst) that through Internet make available some content of the course for installers. The resources utilised by FOTOVinst can be summarised:

- 1.5 person /year for the realisation;
- 73 Mb utilised;
- 25 lessons;
- more than 100 pictures;
- 8 exercise pills.

The course is available (www.enea.it - lavoro e studio - formazione a distanza).

Figure 1 - Course for installers: interest distribution



4.6 Evaluation systems

In an evaluation phase the quality of the course has been checked through a simple questionnaire that has been distributed to each participant. In this questionnaire has been requested:

- to what extent the course has satisfied your requirements;
- what has been the most interesting topic;
- and the less interesting;
- what has been the topic that you would deepen;

- other suggestions.

In figure 1 and table I are illustrated some results of the questionnaires analysis.

Table 1 - Course for installers: topic interest in participants

| <i>Topic</i> | <i>greater</i> | <i>smaller</i> |
|-------------------------|----------------|----------------|
| photovoltaic technology | 409 | 14 |
| pants and sizing | 446 | 30 |
| economic aspects | 209 | 113 |
| case studies | 224 | 56 |
| standards | 236 | 61 |
| practice aspects | 269 | 38 |
| products presentation | 198 | 75 |
| incentives | 218 | 81 |

4 CONCLUSIONS

In order to optimise the course content have been requested suggestions and comments to the participants. From the answers come out that:

- the request to update, through similar courses and the proposal of new educational projects;
- the need to extend the course, enlarging at least of one day, taking into account the density of the treated topics and the caused interest;
- the need to deepen specific topics, such as the plant sizing;
- the cost problems and the incentive limitation

Following a Professional Rank (Engineers and Architects) poll regarding courses content, turned out to be a strong interest for the topics proposed and a great adhesion, with over 70 requests from Professional Ranks displaced all over Italy. The limited time, due to the ENEA-Ministry of Environment agreement imminent expiring, has allowed to carry out only 6 of the requested courses.

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All requests regarding the preparation of the paper should be addressed to:

S. Castello
 ENEA C.R. Casaccia, via Anguillarese 301
 00060 - Rome, Italy
 Tel. +39 06 3048 4339
 Fax. +39 06 3048 6486
 e-mail: castello@casaccia.enea.it