PV PUBLISH - Architectural & technical advice for PV integrated systems in public buildings and schools: projects preparation

ARCHITECTURAL & TECHNICAL ADVICE FOR PV INTEGRATED SYSTEMS IN PUBLIC BUILDINGS AND SCHOOLS: PROJECTS PREPARATION - PRESENTATION AND THEIR IMPLEMENTATION

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ABSTRACT: The aim is to transfer the European technical experience into the Italian photovoltaic solar energy market, involving Public Administrations and schools Managements to promote pilot actions in the Tuscany, as well as improve practical application and visible prospects. Public Administrations will be provided with Architectural & Technical advice for a better PV systems integration in public buildings and schools. This action fits perfectly each partners' activities (research and development) in PV fields, in order to allow a qualitative increase.
An advanced technology will be joined by an architectural expertise, carrying out some application cases in order to involve the best practices of the partners as following:

- ✓ the experience in low energy retrofitting research and sustainable building design of ABITA – useful for the architectural advice allowing a better PV systems integration project;
- ✓ the technical expertise and capacity in Building Integrated Photovoltaic systems of IT Power and WIP;
- ✓ the support by Public Administrations through the Provincial Energy Agencies of Tuscany;
- ✓ Italian PV Industry Association's support for materials and PV technology equipment;
- ✓ support and collaboration with ETA during promotion & dissemination activity.

1 APPROACH

The aim of the project is to optimize PV in integrated scenarios building (roofing, cladding, roof mounted, as windows, solar shading, etc.) and to present practical applications and visible prospects where PV grid connected becomes a reasonable electricity source in urban areas.

The overall objectives (scientific and technical) of the project are:

- to contribute to the introduction of PV systems as an energy-significant option in urban areas in Italy
- improving technical performance of BIPV or other structures in the built environment
- to improve and demonstrate the attractive architectural medium (aesthetics value offered by PV)
- to inspire the future generation to become involved in renewable
- carry out project plans, feasible studies and analysis according to the National & European programs

The work phase includes:
- Bioclimatic properties and choice of projects
- General strategy of architectural actions
- Architectural integration:

Structural PV-Roofs, Photovoltaic Façades, Shadings systems, Installations on flat roofs

2 SCIENTIFIC INNOVATION AND RELEVANCE

The Scientific innovation and relevance of the work consist in the experimentation and the diffusion of PV technology through public administrations, especially PV integrated systems.

PV installation integrated in building roofs and facades allow the possibility of combining energy production with other functions of the building envelope, such as shading, weather shielding and heat production.

Cost savings through these combined functions can be substantial, e.g. in expensive façade systems where cladding costs may equal the costs of the PV modules. Additionally, no high – value land is required and no separate support structure is necessary. Electricity is generated at the point of use. This avoids transmission and distribution losses and reduces the utility company's capital and maintenance costs. 'Multiple integration' is perhaps the appropriate expression. Building integration does not just mean the mounting of PV modules on roofs or facades. Real integration can involve much more, it includes all the steps incorporated in the process of new construction or in retrofitting building, starting from planning the production of the construction materials through to operation and recycling. Multiple integration does not produce multiple costs. However, if it is done in the right way, it results in multiple savings. Savings of landscape, cladding materials, engineering effort and so on have often been mentioned in the literature. The further steps of integration have not yet been studied in detail, but it is obvious that integration into the existing manufacturing process of cladding materials should lead to further cost reductions. Integration starts at the beginning of the planning process of a building construction or renovation and continues until the building is finished.

However, the integration of PV into the architectural design offers more than cost benefits. It also allows designer to create environmentally design and energy efficient buildings without sacrificing comfort, aesthetics or economy.

3 CHOSEN BUILDING CHARACTERISTICS

Integration is an important step towards better aesthetic architectural improvement of PV modules into the building envelope.

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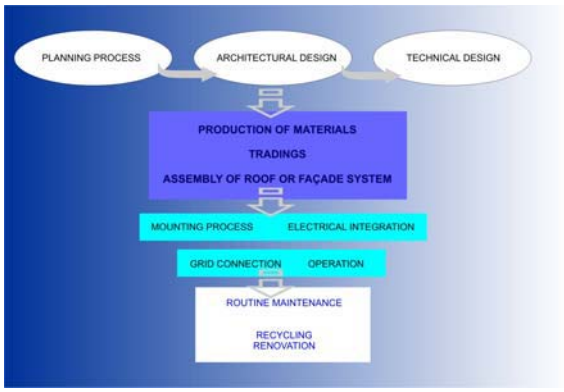

4 ISSUES

Issues relating to the incorporation of PV arise throughout the course of a project.

- Location
- Type of location
- Development sector
- New/retrofit
- PV Type
- Building location
- Peak output (kWp)
- Surplus power
- Implementation
- Funding assistance

Those solutions involved in developing the building industry in this country lag behind others in certain areas. While there is now good design assistance material in the form of design guidelines and computer – based optimization tools, and at other end of the project, commissioning, testing and monitoring guidance, the procurement stage is not well served.

There is also a need for the standards covering performance for modules and related systems to be incorporated into Italian standards documentation and, where standards do not exist, such as in manufacturing defects and appearance, they need to be formulated.

The proposed integrated systems will increasingly influence the skin of buildings

- Converters, integrated into module, can make cabling safer and easier, as a result of less module mismatch, there even improved systems performance is possible
- new types of solar cells allow the production of improved hybrid collector systems. In buildings with demand for domestic hot water the simultaneous use of heat electricity can improve the economics. Such systems benefit from an additional level of integration. Mounting and installation can be done in one as well, since the combination of inverter with the control device of the thermal system is feasible.
- the inverter can be combined with existing inverters in a building. In an office – school building, this could be the inverter for the uninterruptible power supply.

5 PROJECTS

The following table shows a wide variety of projects meeting the needs of a number of building sectors. Most of them set out to be “ideal” solutions. This reflects the state of Tuscany region in Italy at the present. Of the 12 projects, 9 will be realized with the financial support of the Minister of the Environment.

5.1 Finding for funding

Some chosen projects have been approved for the grant-funding assistance coming from the Italian Ministry of the Environment and EU funding.

Buildings	Funding
Technical Institute “Campedelli”, Lucca	ME
Technical Institute “E. Fermi”, Lucca	ME
Technical Institute “C. Marchesi ”, Pisa	ME
Gym “Gherardesca”, Livorno	ME
Gym Liceo “Enriques”, Livorno	ME
Naval Institute “Cappellini”, Livorno	ME
Scientific Pole, University of Florence, Sesto Fiorentino, (Firenze).	ME, EU
Primary school, Pontenuovo, Pistoia	ME, EU
PV Greenhouse for MEYER Hospital, Firenze.	ME

Ministry of the Environment: ME
EU funding: EU

5.2 Planning legislation

Local authorities generally support projects directed toward environmental safety strategies and PV Publish projects are all integrated in public buildings to be realized with funding coming from public administration.

Goals for sustainability are increasing into local Plans and reflecting the new trend of the Government’s commitment to environmental measures through Agenda 21.

5.3 Grid Connection and surplus power

Buildings analyzed in the present brochure are all well dimensioned: they don’t produce energy surplus to be exported, as happening in many European countries.

All PV Publish projects are grid-connected, PV installations won’t supply power or in insufficient quantity.

At the moment it is not possible to fed surplus electricity in the National grid, maybe the Italian Government will accord to the European Countries for the ENEL (National Energy producer) privatization in the 2004 so that PV buildings will satisfy not only individual needs, but also they will make a useful contribution to the electrical country’s requirements.

5.4 Optimizing PV systems

The basic rule to maximize the power output of an installation is simple: relative orientation and tilt angle of the array.

Besides to increase the PV system efficiency it is also necessary to keep the modules cool and clean with a good maintenance of electrical connection.

5.5 Standards

Designers need simple standards and codes of practice to build components and their installation.

Actual Italian standards relates to:

- the appearance of modules, including bubbles in the resin in glass/glass modules, alignment of cells, acceptability of torn cells and alignment and positioning of conducting tape;
- Non-electrical safety issues including handling, durability and hazards arising from fire;
- PV carrying system assemblies such as PV-integrated curtain walls, roof lights etc.

5.6 Maintenance

Maintenance of the systems is recognised to be low. However, providing safe access for maintenance to a PV array and its technical and cost implications have frequently been overlooked too late in the design process, because Safe access for maintenance and possible replacements is the most important need for a PV installation.

5.7 Costs

In the following table are explained approximate costs for PV systems.

System	Installed cost €/m^2
PV curtain walling, glass/glass crystalline modules	1.200
PV curtain walling, glass/glass thin-film amorphous modules	450
PV rainscreen cladding	900
PV roofing tiles	800
PV modules on a pitched roof	1100

6 CONCLUSIONS

The Tuscany PV Publish projects constitute an excellent example of PV application and moreover for PV integration in retrofitting cases.

The Energy Agencies have chosen all retrofitting projects, for the urgent need to cover the energy supply of those buildings realised during ’70s without an accurate attention to bioclimatic and solar active technologies, exploiting the favourable moment of Government incentives.

In Italy there are no political-economical procedures that at a national and local level have given a decisive contribution to the photovoltaic market. There is a necessity of economical and technical instruments to guarantee a real opportunity for the utilization of photovoltaic systems in public buildings and schools.

The main idea is to stimulate the Public Administration to be an example of an environmental political action. The action comes as a consequence of previous partners experiences in their own countries, and a consequence of the evaluations about PV researches carried out in schools and public buildings for the previous ALTENER programme. (Pilot action for the promotion of PV in schools and public buildings: evaluation of lessons –learnt and transfer to other areas of the EU)

Public actions result therefore necessary to stimulate such systems adoption, to encourage the firms to find new process and technical solutions, knowing that interesting borders amelioration exist, whether to costs level or to devices efficiency increase. A great activity of new products development - more suitable for the architectural applications - is to remark as effect of the support's mechanisms until now adopted by several countries.

In Italy the PV market is not yet adequately benefited, it is constituted above all by applications not covered by other systems. For the big fittings demand is obviously institutional piloted therefore by political will and by opinions movements, rather than by real demands and needs to satisfy.

The most recent typology of Photovoltaic technology applications is the one using buildings integrated systems: PV systems can be used as integrative source, a contribution - according to the dimension of the plant - to the building global electric budget. These applications introduce different advantages:

- energy produced near user has a greater value than energy furnished by the traditional electric power station;
- electric energy production during insulation times allows to reduce the demand to the net during the day, just when there is the greatest request. Hypothesising a high development of building integration of PV systems, it is possible to foresee a levelling of the daily peak request, usually corresponding to the more expensive kWh electrical cost. It is a more and more interesting alternative, particularly for the increasing use of the conditioning systems in the residential, commercial and public buildings;
- the PV installation cost could also be an avoided cost decreasing the global building cost, because the PV modules can be constructive elements replacing tiles or façades glasses;
- the adoption of these systems allows the diffusion, directly among the consumers, of a great “energetic conscience”, with positive increase of the use of electric energy produced and exchanged with the net.

It is necessary to highlight the PV systems esthetical value: the silicon cell has a pleasant aspect and a particular effect, making it an interesting material for the contemporary architecture. It is possible to use different colour cells, adapting them to the several contexts.

7 REFERENCES

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