HIPHIP – FOSTERING MARKET PENETRATION OF PV SYSTEMS INTEGRATED IN BUILDINGS IN EUROPE

Isabelle Michel, Denis Rambaud-Méasson

Innovation Energie Développement (IED), 2 Chemin de la Chauderaie
69340 Francheville, France - Tel : +33 (0)4 72 59 13 20 - Fax : +33 (0)4 72 59 13 39 – ied@ied-sa.fr

ABSTRACT

The general objective of the Hip-Hip project, partly funded by the EC, is to foster market penetration of GC-PV systems integrated in buildings in Europe by removing technical and non technical barriers as well as developing new PV products for the building industry, through the two PV manufacturers, Photowatt and Shell Solar. The objective, is to reduce PV systems costs through innovative design and better system optimisation. This project is designed to provide platforms for the development of the photovoltaic technology in the countries where the market is still underdeveloped.

The six European countries involved in this project are Austria, Germany, the Netherlands, France, Italy, and Spain, with the three latter markets being still in their 'infancy'. The project is divided in three Lots with decreasing turnkey cost objectives from 7,00 EUR/W_p to 5,45 EUR/W_p, and a total capacity installed of 2,7MW_p.

This presentation provides up to date data on the outcomes of the project and the various exchange of experience on the following themes : grid integration and impacts on the grid, financial and regulatory aspects, non-technical barriers, certification of building integrated PV systems.

All the publishable results can be found on the project website : www.hip-hip.net

KEYWORDS

Grid connected PV systems, cost reduction, barrier removal, PV market development.

PROJECT STATISTICS

Each project is recorded on the Hip-Hip project database, describing as many parameters as possible, including the following : customer details, system characteristics, cost breakdown, subsidies, monitoring and performance.

Currently, around 2 MW_p of GC-PV systems have been ordered by customers out of the 2,7 MW_p target. Lot 1 is described in this paper as it is the sole completed Lot, Lot 2 will be added by the time of the EPIC 2002 conference. In total, the Lot 1 projects represent 500 kW_p of grid connected PV systems distributed onto 120 projects, at an average target cost of 7 EUR/W_p. The projects within this first batch are recorded as follows :

Building Application

The Hip-Hip projects within Lot 1 are mainly installed in the domestic sector, with more than 270kW$_p$ of GC-PV systems, corresponding to 87 projects. This sector is also benefiting from the highest subsidies, which can explain this tendency together with strong 'green' motivations. The average PV system size in the household sector is around 3 kW$_p$ and closer to 10 kW$_p$ in the other sectors. This specificity explains as well that more than three quarter of the power peak is installed in the private sector.

The majority of the installations are in new buildings (81%) where strong disparities exist between countries : Germany, Italy and the Netherlands installed 100% of the PV systems on new buildings, in France, on the contrary, more than 70% of the power capacity is on rehabilitated buildings.

Integration Type And Size

Most PV systems are integrated onto sloped roof (64%). In Italy and France, around 90% of the power peak installed is on sloped roof types. Façade projects take place mainly in Germany and Austria.

65% of the power peak installed within Lot 1 are above 5 kW$_p$. A large number of systems are in the range 5 kW$_p$ – 10 kW$_p$, due mainly to the Spanish projects being all in this range as shown on Figure 1. Germany and Italy have almost no installations below 2 kW$_p$. The French and the Dutch installations represent most of the PV systems under 2 kW$_p$.

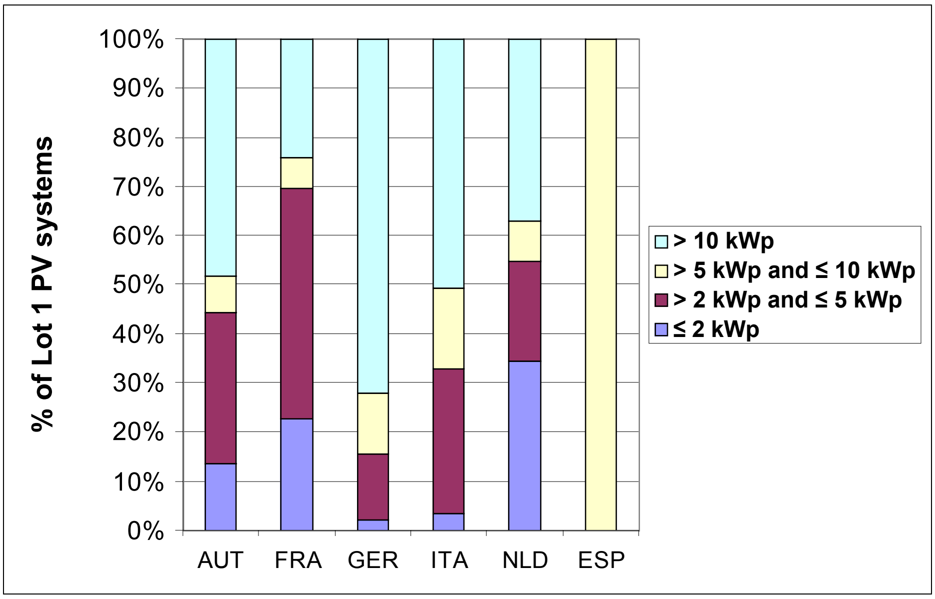

Figure 1: PV system size characteristics per country

PV System Cost and performance

Currently, cost objectives are met for each Lot, despite a cost increase of the PV modules and cells on the international market.

The large scale NUON project within the Dutch consortium met successfully its cost target by installing a large number of PV systems a same property site. This project has benefited from the dialogue existing between the architect, the housing developer and the PV system installers at a very early stage of the project. This collaboration resulted in the cheapest support structure cost of all the consortiums, representing around 4% of the system cost as well as the cheapest mounting cost in the same proportion.

The inverter cost in France and Spain is low compared to the average. This can be due to the bulk purchase the PV system installers benefit as solely PV integrators, such as APEX BP Solar, and Total Energie in France or AESOL in Spain.

Glass façades and canopy

As expected, a façade and atrium integration cost more than a roof integration . Façade systems could be split in three types of installations, curtain walling, rainscreen cladding and rainscreen overcladding, in a cost decreasing order.

Figure 2 : Photos of Hip-Hip realizations – From left to right and top to bottom :
Bank Caja Navarra Campanas, Spain - Vroonermer housing development, The Netherlands - IMT Marketing und Trendanalyse Institute, Austria – New office building for ST Micro electronics, France.

Saint Gobain Glass Solar has tentatively isolated the cost of the PV component inside its BIPV installations as shown on table 1. It can be considered that the additional cost for a glass façade PV integration is between 6 and 14 Euros/W_p. This range is close to the one obtained for less luxury PV products.

	BIPV 80 W/m_	
	EUR/W_p	EUR/m_
Modules	5 - 13	400 – 1,040
Electrical devices + mounting	1,5 – 2,5	120 - 200
Metallic construction + mounting	4 – 6,5	320 - 500
Prices for PV + installations	10,5 - 21	840 – 1,740
Reduction Glass surface	0,5 - 5	40 – 400
Reduction construction and mounting	4 – 6,5	320 – 500
Prices for Glass façades / glass units	4,5 – 7	360 – 900
Additional costs for BIPV	**6 - 14**	**480 - 840**

Table 1 : Glass façades / canopy BIPV costs (source: Saint Gobain Glass Solar)

Roof integration

PV systems integrated on flat roofs seem cheaper than on inclined roofs. They are around 10% under the average cost of a PV system. They are also usually less complex to install, simply mounted using steel or aluminium frames, separate from and above the finished conventional roof. This framework can be fixed or adjustable to enable the angle of the array to be altered relative to the pitch of the roof and thus optimise the amount of sunlight received.

The Austrian consortium, through SED, manufacture and install solar tiles, shown on Figure 3. These prove to be expensive to market if the manufacturer is not a known tile manufacturer. Marketing campaign are necessary together with mass production in order to obtain competitive cost compared to traditional PV systems.

Figure 3 : Photos of Hip-Hip PV systems – *Left*: Sophisticated system design for the ISE building, Freiburg, Germany – *Right*: Solar tile application in Fussach, Austria

Electrical installation

The yield obtained from a well thought electrical wiring of a PV array can be improved compared with conventional wiring. Within the HIPHIP framework, for example, the yield has been increased of 8% for the saw-toothed roof over the atrium of the ISE institute (Institut Solare Energiesysteme) shown on the photo on the left hand side of Figure 3. The roof modules are subdivided into three electrically isolated submodules, which are then connected horizontally. This configuration has allowed for minimised mismatch losses as only submodules with the same irradiation conditions are connected in series.

CONCLUSIONS

At this stage of the project, innovative products and approaches have proved successful for cost reduction, despite the cost increase incurred on PV cells due to the expanding market. It can as well be observed, as expected, that the larger the PV installation, the lowest the cost per W_p, and that more than half of the GC-PV systems are installed in the domestic sector. The results to date are summarised below by IED, the European coordinator of the project :

- The Austrian consortium is using two types of PV products, modules and integrated PV cells on tiles. The 'solar tiles', developed by the SME SED, is a good example of integration. However they apply only to small scale domestic projects with quantities not allowing yet for mass production.
- The German consortium, led by Saint Gobain Glass Solar, encounters difficulties to reach its to reach its capacity targets given the high cost of the glass canopy PV system costs, despite its competitiveness with other types of PV systems when the cost of the building component replaced is subtracted from the PV system cost.
- The Dutch consortium, led by Ecofys, managed the lowest PV system costs through the major distributed GC-PV electricity generation scheme from the electric utility NUON. The Dutch national context influences greatly the implementation of such programmes, with municipalities for example imposing the integration of PV systems on housing developments.
- In France, the French consortium being led by ADEME, the HIPHIP project is allowing to almost double the power capacity of GC-PV systems in buildings. Currently, the French Government is elaborating an ambitious national programme built upon lessons learnt. Most systems are installed in the domestic sector. Some commercial applications should nevertheless appear, with high visibility. Grid connection remains an important issue.
- The delayed Italian '10,000 Roofs programme' has contributed to the late start of the HIPHIP project in Italy, demonstrating the need still of high subsidies in the PV industry. The Italian consortium's activities, coordinated by ANIT, started with an equal share of household and industrial buildings in Lot1, with a tendency in Lot2 to concentrate on the domestic sector. There is a high percentage of system size above $10kW_p$.
- The Spanish consortium, led by AESOL, found initially high barriers to the development of their activities, due mainly to a lack of regulatory framework. The installations were initially implemented essentially in the domestic and industrial sectors, tending now to concentrate in the domestic sector and in the range 5kWp to $10kW_p$.

Cost reduction has been achieved via large scale projects, standardisation, integration, and financial approaches. Two main barriers are clearly noticeable (not taking into account grid connection issues in France and Spain) : cost and certification issues. Although real integration tends to be cheaper per Watt peak and in a mass production context (not achieved via the HIP-HIP project alone), certification of building integrated products is found to be very complex and expensive. The project consortium is dealing with these issues in an attempt to ease the certification process through some kind of uniformisation across borders, the Netherlands being the most advanced in this field within the HIPHIP project.

Nomenclature

HIPHIP :	House Integrated Photovoltaics Hightech In Public
BIPV :	Building Integrated Photovoltaic
GC-PV :	Grid connected PV
W_p :	Watt peak
AUT :	Austria
FRA :	France
ESP :	Spain
DEU :	Germany
NLD :	The Netherlands
ITA :	Italy