

A MARKET FOR PV IN EUROPE: THE INDUSTRY VIEW

AN INTERVIEW WITH EMMANUEL FABRE

During a career spanning some 25 years, Emmanuel Fabre has emerged as one of the leading figures in the European PV industry. Mr. Fabre served 10 years with Philips RTC, followed by 8 years with Photowatt, before assuming his present position as Managing Director of NAPS France 7 years ago. He is also serving his second term of office as President of EPIA (the European Photovoltaic Industry Association).

Firstly, could you describe why and how EPIA came to be formed.

During the early '80s many European PV industrialists recognised that if our comparatively small voices were going to be heard we would need to present a united front to the outside world. This gave rise to the idea of an association which would act as a focus and mouthpiece for PV industrialists, and so EPIA was formed in 1985.

We now have some 35 members, and can count amongst our number all of the major European PV companies – a fact which has helped us to gain substantial credibility with the European Union.

This 25 kWp amorphous silicon facade at the Joint Research Centre in Ispra, Italy, illustrates Europe's commitment to PV. [COURTESY TAYLOR & EIFFERT]



Emmanuel Fabre, as EPIA's newly elected President, addresses the Association's AGM Gala Dinner in Vienna in March 1995.



Is the European PV industry in good health at present?

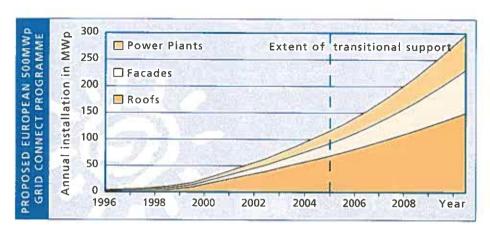
In terms of world shipments, the industry, both in Europe and abroad, has been steadily growing throughout the past decade. Towards the end of the '80s, market growth rates were in the region of 15 to 20 %. The world recession affected market expansion somewhat, but growth continued at around 6 to 8 % during 1992 and '93. According to our best industry sources, last year was very encouraging, with shipments up 14 % on the previous year.

We have been particularly pleased to see that penetration by European companies on the world market has risen dramatically in recent years – increasing by over 28 % in 1994 compared to '93. Europe's three year average growth rate exceeds that of both Japan and the USA, and our annual production is now only exceeded by the USA. I am confident that we can continue to expand in the near future. However, we should not overlook the fact that in terms of the ultimate potential for PV, the cumulative production to date has been little more than a drop in the ocean.

What are the reasons for this relatively slow market development?

In industrialised countries, where consumers are already grid-connected, high system costs are a major stumbling block. Insufficient support from utilities and governments and a failure to consider PV above, or even alongside, conventional power sources are also substantial barriers to the uptake of grid-connected systems, whilst a general uncertainty or caution on the part of planners, designers and users is another area for improvement. In developing countries, where PV has already been proven to be reliable and cost-effective, there are different obstacles. Many potential users have difficulty in financing purchases. There can also be a lack of awareness of the potential for PV applications, a scarcity of technical skills, and a general lack of infrastructure

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which makes project planning, implementation and support difficult.

How do you plan to overcome these problems?

The solutions to the respective obstacles are clear and the PV industry itself is now confronting those areas where it can have an impact - reducing production costs, and improving performance and reliability of systems. For instance, while crystalline silicon (c-Si) cells are still the main basis of PV modules, thin-film modules are now in commercial production, following promising pilot runs. These lend themselves well to large volume, low cost production and could therefore be a cheaper alternative to c-Si in the future, although stable efficiencies of thin film modules will have to improve significantly before they offer a serious challenge to c-Si.

There remain, however, a large number of issues which are directed by government policy, and by the utility and funding agency decision makers. These we do not have direct control over and as such will require considerable effort to influence.

So how do you foresee the market developing up to 2010?

That depends a great deal on the level of stimulation both from within the industry itself, and from governments, utilities, and other agencies. If we do nothing to encourage the market, beyond that which we are

already doing, then growth should continue at approximately the present rate - i.e. around 15 % per year. However, our main objective now is to promote a significant increase in the contribution of electricity generated from PV. We are confident that if we manage this then the European PV industry will be able to maintain its competitive position in the international market. In the extreme case, that we manage to fulfil all of our objectives, we could achieve an annual expansion of the PV market by as much as 35 %. This would involve convincing political and utility decision makers of the urgency of implementing arrangements which would allow PV to compete with conventional power sources, cultivating greater awareness of our products and achieving the technology breakthroughs and cost reductions that we are presently chasing.

You obviously have great ambitions for expanding the PV market, but what are your achievable goals?

Realistically, we are concentrating on securing political support for a programme with a target to install 2000 MWp in Europe coupled with the supply of 20 million Solar Home Systems to the developing world by 2010. This corresponds to a manufacturing capacity of 1000 MWp per year by that time. Such a scenario would be pleasing to PV industrialists, but it would also be beneficial to Europe as a whole, not least in terms of the direct employment creation

which could exceed 60000, and the abatement of 2 million tonnes per year of CO₂ which would otherwise be emitted as power generation by-products from EU countries. Increased diversity and improved strategic stability of energy supply, as Europe's own oil and gas reserves are reduced, also weigh in favour of PV.

And the next step?

The process is no doubt going to be a gradual one, but EPIA has devised a comprehensive Action Plan based on achievable targets of production and installation which we believe will enable us to fulfil our ambitions. However, the next occasion for assessing our progress will be the 13th European PV Conference in Nice in October. Please join us there!

PROPOSED PROGRAMMES OF THE EPIA ACTION PLAN FOR A COMMERCIALLY STABLE PV MARKET

European 500 MWp Grid Connect Programme: A major programme of public support incorporating a 100000 PV roof (300 MWp) project, a 2000 PV building facades (100 MWp) project, a large scale power plant (100 MWp) project

European 100000 Isolated Building Programme: The target electrification with PV of 100000 isolated buildings, mainly in Southern Europe

Developing World Programme: A European enabled installation of 20 million solar lanterns or solar home systems (1000 MWp)

Low Cost Manufacturing Partnership Investment Programme: A partnership for new large scale manufacturing plant involving the PV industry, European Commission, electricity utilities and European investment funds

PROGRESS ON GRID-CONNECTION GUIDELINES

Internationally recognised standards for the grid-connection of PV systems are one area that would help the promotion of photovoltaics. Task V of the IEA PVPS Programme is operating in this field and has recently completed a survey of national practices that will assist in the development of such guidelines.



Experiences gained from grid-connected PV installations such as this example at the ECN Renewable Energy Centre in Petten, The Netherlands, will help to establish guidelines for future applications.

In order to ensure that new grid-connected PV systems are correctly and safely installed and at the same time are fully compliant with relevant national regulations, the IEA, through Task V of the PV Power Systems Programme, is investigating and collating experience from member states around the world.

The resulting data is being used in the development of international guidelines which should provide future developers with a ready reference to local legislation, common connection practices and recommended safeguards to avoid endangering operators or damaging equipment.

A report, reviewing experiences gained from existing grid-connected PV installations (Subtask 10 of PVPS Task V), has now been completed, drawing on information supplied by eight participating countries. It is anticipated that more data will become available as other countries encounter practical examples of dispersed grid-connected PV systems. The report will be updated at

NATIONAL PRACTICES REPORT

The Report covers:

- Type of generation covered in guidelines
- Classification of interconnection voltage
- Limitation of generation capacity per consumer
- Correspondence to reverse power flow
- Requirements for independent facilities producing electricity (power factor, harmonics, electromagnetic interference, protection devices, etc.)
- Safety and wiring of DC side
- Metering of energy produced
- Authorisation procedure
- Standard configuration and electrical layout

regular intervals to accommodate such additional information, and any amendments of existing national guidelines.

IEA

JAPANESE PV PROGRAMME GOES THROUGH THE ROOF

Japan's New Sunshine Programme is an ambitious attempt by the nation's government to introduce alternatives to fossil-fuel energy sources. The incorporation of PV into the country's energy mix – to help reduce consumption of imported petroleum and combat the problem of global warming – is seen as a priority.

As part of the promotion to introduce new energy resources, the Japanese cabinet has

already sanctioned substantial financial backing for a pilot programme of rooftop PV installation. A government subsidy of 50 % of costs is available to householders to help implement PV system installations. In the 1994 financial year over 2000 million yen (\$20 million) was allocated for some 600 systems each of 3-4 kWp. Double this amount has been earmarked for 1200 projects in 1995.

The Council of Ministers for the Promotion of Comprehensive Energy Measures, which



Testing of Sanyo pv roof tiles at Rokko Island.

JAPANESE PV PROGRAMME GOES THROUGH THE ROOF



PV is an important component in Japan's total energy system approach to housing development, so much so that many major residential builders are joining forces with the PV industry. [COURTESY MISAWA HOMES CO. LTD.]

has prepared a national directive on New Energy Introduction, is urging potential developers to promote PV alongside other renewable energy resources as part of a total energy system approach to building design. Potentially, 70000 homes could be involved in the rooftop PV project so it is perhaps not surprising that a number of leading PV

manufacturers have formed alliances with prominent housing developers. Evidently The Council is also aware of the need for central and local government backing of PV systems and has called not only for wideranging information dissemination activities, but also for the introduction of PV generation plant at government-related facilities. These would serve both as practical demonstrations and as a valuable endorsement of the advantages of PV power generation systems.

The Programme is still very much in its infancy, but if all goes well some 400 MWp of PV could be installed in Japan by the year 2000, and an estimated

4,6 GWp by 2010.

IEA

US UTILITIES COOPERATE IN DSM PV PROGRAMME

In 1991, the US Environmental
Protection Agency (EPA) initiated a
nationwide programme to
investigate the environmental and
demand-side management (DSM)
benefits of distributed, gridconnected PV systems. The cosponsorship programme has so far
gained support from 21 electric
power companies.

During 1993-94, 11 power companies joined Phase I of the EPA programme with the ambition of evaluating how grid-connected PV systems might contribute to their DSM programmes and assist their pollution reduction strategies. The \$1,1 million project which saw 101 kW_{ac} of PV installed on residential and light commercial buildings in 17 cities across the USA is cost-shared,

with 50 % being met by the EPA and the remainder by the participating utilities.

Indications show that the systems are contributing to reduced peak demands, particularly on warm, sunny afternoons during midsummer when air conditioning loads are high. There is also considerable potential for replication. Environmentally, the project indicates that during summer months, each kW of PV installed could prevent the emission of 70-180 kg per month of CO₂.

Phase II demonstrations with a total installed capacity of 216 kW_{ac}, a wider geographical coverage, and a more pronounced focus on commercial, institutional and industrial buildings have now commenced. The 12 utilities involved are expected to meet over 65 % of the \$2,5 million project costs. In addition to continued monitoring of the pollution reduction po-

tential for DSM PV systems, these projects are now helping to refine designs so that systems can be more easily and safely installed in future and will be compliant with relevant electrical codes.



Idaho Power Company has installed 18 kWp of PV at Its Headquarters in Boise, USA, under Phase II of the EPA PV demonstration programme. [COURTESY ASCEN-SION TECHNOLOGY INC.]

PHOTOVOLTAICS IN FINLAND

In a sparsely populated country like Finland, even though annual solar radiation may be only half that of the sunniest parts of the world, PV is an excellent means of providing environment-friendly, reliable and cost-effective electricity in remote areas.

Because photovoltaic systems are reliable, easy to use, and have a long operational life, they have proved to be practical in small-scale off-grid applications, even for the extreme northern climate.

A good example, and the most important professional application for PV in Finland, is for powering navigation aids in sea and lake areas. The National Board of Navigation has some 1400 such devices and the number is increasing. This application is ideal for PV: power consumption is small (5-10 W per light), electricity from the grid is not available, and high reliability is essential. These systems typically consist of 1-3 PV modules (50-150 Wp) and nickel-cadmium batteries. Small-scale off-grid systems are also utilised at 14 coastal locations for the Coast Guard's control stations.

These have a total capacity of 4 kWp supplemented by diesel backup systems.



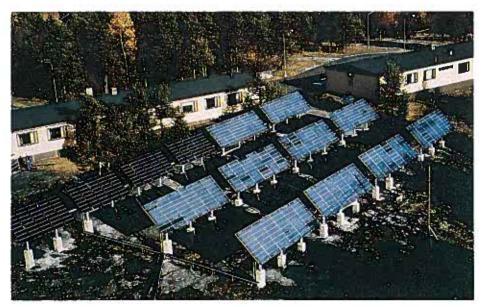
Significant numbers of recreational homes in Finland, similar to this summer cottage, use PV to meet lighting and entertainment needs.

About half of Finland's 400000 recreational homes are situated off-grid, and of these some 15-20000 are powered by PV. Generally a photovoltaic system consists of a 50 Wp module and a battery, which is enough to meet lighting, television and radio power demands from spring to autumn. The system is easily expanded because of the modular nature of PV.

An example of a larger recreational off-grid application is the self-sufficient summer house: 2,2 kW PV modules are connected through an inverter to run household appliances.

In addition to recreational homes, boats and caravans are natural points of use for PV. Walkers in the vast uninhabited areas in Finnish Lapland also benefit from photovoltaics: emergency telephones in several huts on the walking routes are powered by PV. Successful grid-connected applications include Imatran Voima Ltd's 30 kWp PV power plant in southern Finland – one of the most northerly grid-connected solar power stations in the world. It has functioned since 1989 and its annual energy output is approximately 20 MWh.

Building-integrated PV is also arousing interest and is potentially a more cost effective form of grid-connection. At present there are four grid-connected, building-integrated photovoltaic systems in Finland: The first 3 kWp system was installed in 1990 by Helsinki University of Technology. The three other systems are each rated at 1 kWp: PV is integrated in an office building, in an experimental plastic house, and in a single-family house.



High latitudes do not necessarily prohibit the use of PV as this 30 kWp PV power plant which feeds the local utility in southern Finland demonstrates.

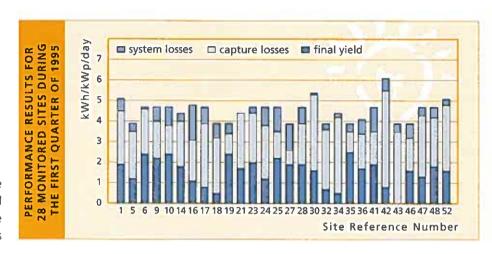


PV FOR LEAST COST ELECTRIFICATION IN RURAL SPAIN

La Garrotxa is a mountainous district in Catalunya, characterised by a large number of masies (country dwellings) scattered among its valleys and mountains. 65 rural houses have been electrified with 51 kWp of PV, at a cost lower than extending the grid.

With the beginning of industrial activity, the arrival of basic services in larger towns and villages caused many people to migrate from their isolated dwellings and hamlets to the more developed valleys.

Nevertheless, there still remained a relatively large population living in masies, without services such as electricity or tele-



The stand-alone PV system installed at Masia La Pineda in Oix, La Garrotxa, consists of a 900 Wp array, a 3 kW inverter and a 19 kWh battery. [courtesy trama technoambiental]

As yet, performance data is only available for 28 of the 65 systems. The chart above presents final yields, capture losses and system losses for these 28 systems in the first quarter of 1995.



phones. This prompted the district authority, the Consell Comarcal of La Garrotxa, to launch a number of programmes aimed at providing the inhabitants of these residences with basic services.

A 1991 survey found some 220 masies without electricity, and assessed the cost of electrifying them by the two available alternatives: stand-alone PV or extension of the public grid. It was concluded that in over 90 % of cases, PV was the cheapest option. The following year, an electrification project was initiated.

In 1993 work began, and most of the installations were commissioned in 1994. A total of 65 sites have now been electrified, with a total PV capacity of 51 kWp. A typical installation includes: 800 Wp of PV modules; batteries (400 Ah at 48 V); and a power conditioner.

The equipment includes a maximum power point tracking regulator, a sinusoidal inverter of 1 to 4 kW at 230 V, 50 Hz, and a data logger to monitor the main energy parameters.

The average cost of each installation was \$18000 (2,5 million pesetas) of which 25 % was paid directly by the user in the form of a deposit which can be recovered if the equipment is transferred to another site,

due, for example, to the arrival of the grid, or if the user moves from the masia. The balance was financed through grants from the European Union, regional and national governments.

The programme is managed by a Users' Association SEBA, which carries out preventive maintenance and repair work, as well as training users. SEBA has also been instrumental in selecting low-consumption appliances and equipment.

Monitoring is on-going, and actual operating experience from this project is still limited, but preliminary data suggests that systems are performing well.

User satisfaction rating is high and the investment is considered a long-term alternative solution to grid extension. The PV systems installed to date have displaced 160 km of grid-extensions.

It is difficult to quantify the benefits in terms of prevention of damage to the fragile mountain environment, but quantifiable cost savings resulting from not extending the grid amount to approximately \$2,7 million.

The experience gained through this project is being used by the PVPS Task III on standalone PV systems.

GERMAN UTILITIES SUPPORT PHOTOVOLTAICS



Many of the electric utilities in Germany have programmes of support for Photovoltaics. This is certainly true in Bavaria where two utilities have launched new projects which will not only increase awareness of solar energy and PV but will also help to protect the special alpine environment.

Bayernwerk's Sun at School programme aims to supply up to 500 schools with 1 kWp grid-connected PV systems. The PV generators will be installed and operated by the schools themselves. The 1 kWp kit, which includes a digital inverter, has been specially developed in association with Siemens Solar.



Bayernwerk offers a substantial subsidy on the kits, enabling them to be supplied for approximately \$2000 (3000 DM) each.

In the Bavarian Alps, increasing tourism has inevitably led to higher energy demand and increased pollution. Many Alpine cabins have been modernised and now incorporate diesel generating-sets but with associated drawbacks including increased noise and exhaust emissions.

Isar-Amperwerke utility has made a com-

This 1 kWp PV array installed on the roof of a School in Bavaria has generated considerable interest among pupils. [COURTESY BAYERNWERKE AG]

mitment to improve the energy supply and environment of these alpine cabins by replacing the diesel generators with PV and other renewable energy sources. To accommodate this, the utility will provide a subsidy of up to 50 % of the total price of the installation, with a minimum of 25 % of the price being met by the cabin owner, and the remainder by local or national funds.

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