NATIONAL PROGRAMMES FOR THE SUPPORT OF PHOTOVOLTAICS IN GREECE

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Abstract – Europe has the potential to become a world leader in the PV sector. To achieve this task, individual national activities for PV RTD and market development schemes need to be co-ordinated at an international level and coherence should be sought. PV-EC-NET is a thematic network supported by the 5th Framework Programme that studies the PV RTD activities in Europe. By distributing a series of questionnaires, information related to PV RTD activities was collected and analysed, in order to suggest ways of improving the efficiency and coherence of these activities. The results of the information collection exercise for Greece are presented in this paper. Previous and running PV RTD activities are discussed, as well as the context in which they operate, i.e. the market support mechanisms. Strengths and weaknesses are pointed out and suggestions for improvements are made. PV specific RTD support in Greece is limited and is provided mainly through other, more generic programmes. Furthermore, market support mechanisms are weak and only some motivation for applications in rural areas has been offered. A feed-in tariff similar to the ones implemented in many European countries and a PV dedicated RTD programme would substantially strengthen the position of Greece in this sector. Finally, the emerging PV industry in Greece will support as well as increase the local RTD needs and activities.

1. INTRODUCTION

Photovoltaics (PV) are an emerging market with enormous potential worldwide. However, their cost and performance currently present a serious impediment in allowing PV to become a self-sustained market with wide commercial applications. Therefore, extended research in combination with market support and financing schemes are required for their promotion.

RTD is undertaken in European countries individually as well as under the umbrella of the European Commission. International collaborations are also encouraged through national initiatives. Nevertheless, in order to compete with research activities and subsequently the Japanese and US markets or other strong players in the PV community like Australia, a more coherent approach to optimise the efficiency and effectiveness of these actions should be taken.

The European Commission, within the 5th Framework Programme is co-funding a project involving organisations from 15 European countries. The aim of the project (PV-EC-NET, contract number: ENK6-CT2001-80578) is to maximise the coherence and hence the efficiency and effectiveness of the PV RTD Programmes of the EU as well as the independent EU member- and associated states. PV-EC-NET has therefore collected, analysed and disseminated the information concerning EU and national PV RTD programmes of the relevant countries. Subsequently, this information will be processed, in order to form a commonly shared European PV Road Map and a set of recommendations for he future strategy of PV RTD in Europe.

The process of the formulation of a European PV Road Map involved the benchmarking of current RTD activities in Europe and a SWOT analysis, in comparison with the activities of other major PV players worldwide.

This paper presents the results of the information collection and analysis for Greece. Further information, also on other countries, is available through other dissemination tools of PV-EC-NET, such as the project website, www.pv-ec.net and the project newsletter, which is also published on the website.

2. ORGANISATION OF RTD IN GREECE

2.1 General Information

The General Secretariat for Research and Technology (GSRT) of the Ministry for Development is the authority responsible for drafting the Research and Development policy in Greece. Implementation is achieved mainly through the participation of universities, research institutes and private enterprises, under the supervision of the GSRT and other instruments. The main financial tools for the implementation of the RTD policy are:

a. The annual "ordinary" state budget and
b. The Operational Programme for Competitiveness - OPC - under the European Community Support Framework (2000-2006).

Both tools concern a wide range of sectors where technology applications are used. The OPC covers a broad spectrum of activities for trade, industry, tourism, energy as well as research and technology. The total budget of OPC for the six-year period from the year 2000 to 2006 is 6,392M€ of which 640M€ is devoted to RTD activities. There is no budget dedicated to PV research, however the GSRT drafted at the end of 2002 a specific "focused" programme devoted to Renewable Energies and Energy Saving. The total budget of the programme is 16M€, of which approximately 9M€ represent public

funding. PV RTD is one of the thematic priorities covered by the programme.

In addition to the above programme, devoted to Renewable Energy Sources and Energy Saving, RTD actions in the field of PV are funded under other research programmes covering a broad spectrum of research priorities. The most relevant of these are:

- The programme for the promotion of industrial research (PAVE), funding research carried out by industry.
- The programme for improving Human Research Potential (PENED) funding doctoral (PhD) research carried out in research centres and higher education organizations, with the collaboration of industry.
- The Programme for Demonstration projects (PEPER) promoting the development of industrial prototypes.

Participation and funding through all of the above programmes is carried out on a competitive basis following open calls for proposals and peer review evaluation.

2.2 Targeted Programme in the fields of Renewable Energy Sources and Energy Saving (2002-2006)

The main objective of the programme is to bring research organisations closer to the industry through the formation of consortia in order to improve collaboration for the development of innovative products and services in the renewable energy sources and energy saving sectors. For the renewable energy sources sector the programme aims at the reduction of cost and the improvement of efficiency of relevant technologies, while in the field of PV emphasis is given to the following RTD areas:

- Grid inverters
- Prototype PV modules and small stand-alone PV systems
- Development of PV modules for building components and applications of building integrated photovoltaics
- Thermal photovoltaic (T-PV) systems

Funding is public and private. The public contribution is considered national but it is based on the Community Support Programme and covers 50% of the total project budget. For demonstration projects the public funding is reduced to 35%. The target group of the programme is private enterprises as well as R&D institutes and covers all actions from basic and applied research to development and demonstration.

After the first round of proposals, a total of 15 projects concerning all renewable energy sources technologies were awarded, with a total budget of 8.7M€. Three (3) of the projects concern PV RTD and their total budget (public and private funds) is 2M€, of which 50% is public.

The OPC also encourages international collaborations, especially with the Balkan and other non-European countries although no project related to PV was funded.

2.3 PAVET: Programme for the promotion of Industrial Research

This programme aims at encouraging the participation of private enterprises in RTD activities in order to increase their competitiveness. There is also another "version" of PAVET, namely PAVET-NE, which has similar objectives but it is targeted to newly established enterprises. The programme may cover a broad spectrum of RTD thematic priorities, including PV. However, there is currently no information for any PV related ongoing projects.

The public funding is again 50% and the rest of the budget is contributed by the participating private enterprises. R&D institutes and organisations are also allowed to participate but not as principal contractors, instead only as subcontractors to the participating private enterprises. In this case, the participating R&D institutes are funded by 100%.

The proposal evaluation procedure involves committees of experts from both academia and industry. The allowed duration of the projects is 18 to 24 months and the progress of the projects is assessed annually on the basis of progress reports, by the staff of GSRT as well as external experts. Upon completion, the project results and cost statements are also assessed by independent technical committees.

2.4 PENED: Programme for the improvement of human research potential.

The objective of this activity is to support and accelerate the evolution of the Greek economy, from the traditional sectors to a new, knowledge based economy by promoting related activities through education and training.

The activity covers all research areas, including PV technology and mainly supports scholarships leading to PhD degrees. The research is mainly undertaken at an academic department, which awards the PhD degree. However, the activity also requires the participation of a private enterprise, thus encouraging and strengthening the links between academia and industry. The activity is implemented by partnerships of PhD students, research organizations and private enterprises. Public funds represent 90% of the total budget of the programme, while the remaining 10% has to be provided by the private sector. No PV related projects have been proposed since June 2002, when the programme started.

2.5 PEPER: Programme for Technology Demonstration

This programme aims at promoting research activities within the industrial sector and at encouraging

partnerships between research organizations and private enterprises.

The activity covers all sectors of RTD. The projects funded by this programme should eventually lead to one of the following:

a. Design and production of industrial prototype or new/improved products and services.
b. Use of new and innovative methods leading to new products or services.
c. Development of quality control processes.
d. New management or operation processes.
e. New processes for the promotion of products and services.

The activity is implemented through partnerships, primarily consisting of private enterprises. Research organizations are also allowed to participate as contractors.

Public funds cover 35% - 50% of the total budget of each project. The remaining budget is provided by the private partners.

The activity implementation was initiated towards the end of 2001. Among the 82 approved projects there was one project related to PV: "Demonstration of the use of amorphous silicon PV in buildings". The project is still ongoing.

2.6 Financial data

From the description of the national RTD programmes in Greece, it is clear that there is no specific national PV RTD funding Programme in Greece. However, PV RTD is supported through more generic funding mechanisms, either targeted specifically to renewable energy sources research activities or even technology development in general. The exact total budget available for research on PV technology cannot be determined explicitly but an annual average spent (averaged over the last 3 years) can be estimated. This budget information is summarised in Table I below and is broken down into specific PV technology fields.

Research on crystalline-Si in Greece is negligible. Crystalline-Si has reached a level of commercialisation and further research is undertaken mostly by highly specialised groups. Most effort in Greece is put on thin film technology. This should be strengthened further in the following few years with the operation of the first amorphous silicon PV production line in Greece (Zachariou and Protogeropoulos, 2001), which is expected to begin production in early 2004. Some primary research is also undertaken by some university groups on organic cells and other materials.

Some work is also done by the building and aluminium industries, which develop building integrated PV components but due to the lack of a substantial market support programme the applications are still very limited. Finally, most of the research and development of the PV sector in Greece concerns the system components. Apart from the research and development of power electronics components, which is undertaken both by research organizations and universities as well as by the production units that exist in Greece, there is also substantial activity in applications and demonstration of these products.

Table I: Indicative annual budget by field of PV sector

PV RTD Field	Indicative annual spent (€)			
	Research	Development	Demonstration	Total
Cells & modules				
crystalline-Si				
Thin film-Si	100000	100000		200000
Other thin film				
organic cells	50000			50000
Other materials	50000			50000
Sub-total	200000	100000		300000
Buildings				
BIPV		50000		50000
Sub-total		50000		50000
Systems				
Inverters / BoS /networks	250000	150000	500000	900000
Stand-alone	150000	100000	700000	950000
Sub-total	400000	250000	1200000	1850000
TOTAL	**600000**	**400000**	**1200000**	**2200000**

This is the most significant national activity in the field of PV RTD and it is clearly driven by the existing industry. The emerging amorphous silicon production industry and any other industrial activity of the PV sector in Greece is expected to have a similar, positive effect on the national PV RTD activities.

3. MARKET AND GENERAL CONTEXT

PV is a sector with strong potential for application driven research and development worldwide and particularly in Mediterranean countries like Greece, where solar energy is abundant throughout long periods within the calendar year. Furthermore, the large number of islands and the needs for autonomous electrification of many remote locations impose the application of solutions such as stand-alone PV or hybrid systems for the fulfilment of the various energy requirements. These applications drive the industry, which tries to cover the market needs, which in turn also motivates the research and development activities. However, for this chain to operate in a most efficient way, good communication between the different stakeholders is required and of course, a clear National Policy and commitment for financial support should be provided, both for the further development of the market as well as for the development of new and improved products that will cover the market needs efficiently and cost effectively.

There are multiple factors that affect the successful development of RTD activities. The five most important ones are mentioned below:

a. Utilities have a very strong influence on the methods used for energy production and in Greece, the Public Power Corporation (PPC) has installed and is the owner of many PV systems. These are mostly stand-alone systems on islands not connected to the grid, that were required to cover local electricity needs. These systems and the potential for further applications have driven the development of the industry and hence research, especially in the balance of system and power electronics components sector. Although the prospects are encouraging and the potential for further applications is strong, due to the high kWh cost on most remote islands and locations, the installation of new PV stations has not been set as a first priority by the PPC.
b. With even this small electricity market penetration, the industry has shown interest in other sectors of PV technology such as module and cell production. The first production unit for amorphous silicon modules and building integrated components is underway, while other investors have expressed interest for creating crystalline-Si module assembly facilities. These initiatives trigger research activities within the industry or beyond.
c. The availability of research budgets and national support is fairly satisfactory, in terms of continuity. However, funding of research institutes and universities is based, to a great extent, on competitive RTD projects supported by the EC. On the other hand, although there is no PV dedicated budget, money is available through more generic programmes for PV research and continuation is expected.
d. The quality of researchers at universities and research organisations is high and there are also well equipped laboratories with strong capabilities but there is a lot of room for further facility and infrastructure improvement.
e. Finally, the positive attitude of the public towards solar energy in general, arising from the wide spread of solar thermal systems in Greece is a strong advantage that can aid the development of the PV market and consequently the industry and RTD activities.

On the other hand, there are also issues that should be changed or reconsidered in order to promote the efficiency and effectiveness of PV RTD. The most crucial ones are identified here:

a. In many cases the organizational structure of the Programmes could be simplified in order to make it easier for the interested parties to participate in a programme but also for the assessing body to follow its progress.
b. The lack of a strong market support mechanism also hinders further PV related activities. Although there are many cases, especially concerning remote applications, where PV is an economically viable solution compared to other conventional options, a PV support policy for large-scale market penetration is still necessary. PVs still need to enter the grid-connected household sector in Greece, like the solar thermal systems did a few decades ago.
c. Of course, PV RTD requires a PV dedicated programme, which will steadily support research activities over a long period of time, with clear aims and objectives. This will allow efficient project assessment and setting of subsequent targets for new projects.
d. The public awareness for PV has to be changed. Although people are fairly informed about the existence of PV technology and what it can do, the impression of the high cost is strong and it impedes market penetration. Of course this is partly true but a well designed subsidy scheme or support mechanism could invert this climate to the benefit of the PV market, industry and research as well as the general public.
e. Finally, the international influence on the national PV policy is weak. European or other international directives could be used to promote PV RTD and

markets locally or at an international level and successful paradigms of other countries could also be implemented in Greece.

4. CONCLUSIONS

Clearly the potential for PV development in Greece, both in terms of research as well as the market is great. Both sectors are mutually dependant and they are linked by the industry. If this link is strong, development in one sector will influence the other and new products can be fed into the market to cover the increasing needs. In this way innovation is implemented through actual applications (figure 1). Industrial development can also put pressure on the government for adopting a more favourable policy for PVs with realistic targets and specific programmes.

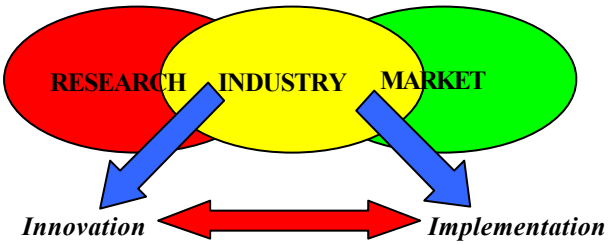

Figure 1: Schematic representation of relationship between RTD, industry and market.

Some effort has been made and is currently ongoing but a stronger focus is required. PV has to compete with all other technology thematic priorities in order to acquire research grants. Even the recent, targeted Programme is referred to all renewable energy technologies and is insufficient to create a critical mass of research activities related to PV in Greece. Therefore, a research programme dedicated to PV technology is necessary and this would exploit the existing infrastructure and research potential in the most effective way, promoting at the same time the other PV sectors such as the industry and the market.

On the other hand, a mechanism that would support the market in Greece is of paramount importance both for the market development but also for the promotion of research and technology development in the field. Currently, the only funding scheme for PV in Greece is a 40-50% subsidy of the initial investment cost, depending on the geographical location of the installation. This, of course is inadequate, especially because it is only targeted at legal entities and not individual investors and households. A mechanism that would encourage individuals to invest on PV technology and provide them with a reasonable rate of return would give a strong boost to the local market. A feed-in tariff has proven a very successful method in other countries and one of its main advantages is that it obliges the investor to complete the installation and maintain the system until it starts paying back. This would also work perfectly with old and deserted PV systems in Greece that were built with an initial subsidy but have been maintained poorly afterwards. The collaboration of the PPC and the Regulatory Authority of Energy (RAE) with the government could lead to a policy that would encourage PV investments by implementing a feed-in tariff that reflects the actual electricity cost, especially at remote and isolated locations.

Finally, links to European and other international collaborations should be made stronger and sharing of complementary expertise in various research areas should be encouraged. Duplication of research efforts within the EC should be avoided. This would enhance the effectiveness of research in Europe as a whole and achieve a more competitive position in the PV sector globally.

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