

EUROPEAN PHOTOVOLTAIC ACTIONS AND PROGRAMMES-2009

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ABSTRACT: The 7th Framework Programme for research and the second IEE Programme both have significantly increased budgets compared to the previous programmes, and will run for seven years, from 2007 to 2013, with calls planned annually. Under these programmes the EU has continued to provide support for photovoltaic research, technological development and demonstration together with market development and transformation. Technological development and innovation remain fundamental to delivering the more competitive PV systems, which are needed in the rapidly expanding renewable energy markets. At the same time, European legislation has proven to be an important driver of renewable energy development, including PV. The new recently adopted renewable energy directive is expected to play an increasing role and to stimulate to a large extent also the PV sector. The strong political commitment to renewable energy targets backed by sound support schemes and research and market transformation programmes are essential elements of the framework conditions which are necessary to assure the future growth of the PV sector in Europe.

Keywords: Photovoltaic R&D and Demonstration Programmes; Dissemination, Strategy; Market transformation.

1 INTRODUCTION

The last semester of the year 2008 and the first half of 2009 has been an extremely difficult period for the entire financial and economic system, and it had its impact also for the photovoltaic sector. In these critical times government programmes in Europe, USA and Asia can be extremely helpful to the sector, provided they are soundly devised and sustainable in the medium term, to ensure continuous PV deployment. Stable framework conditions already proved to be beneficial, which is reflected in the volume of new renewable investments in the EU which held up comparatively well in comparison to other regions. When analysing also other economical segments, the conclusion is that the strong political commitment to renewable energy targets backed by sound support schemes and measures made this sector less vulnerable than others to the difficulties.

The financial and economic difficulties could however not stop ambitious European policy commitments concerning climate and energy for the next decade. The challenges of climate change, security of energy supply and competitiveness remain there and the current financial and economic environment only stress the need to rethink and redesign our long term vision about our energy production and consumption patterns and their sustainability. This is why the European 2020 targets are confirmed and, with the adoption of the new renewable energy directive, the European legal framework has been established [1]. These developments give a new impetus to the PV sector, which is expected to be a significant contributor to reach our RES target because the new renewable energy directive provides a favourable legal framework and demonstrates strong political commitment. This is expected to attract more PV activities in EU markets, also in those Member States which have not yet started to use this technology.

According to the estimates reported in a recent publication, supported by the IEE programme, the cumulated installed photovoltaic capacity in Europe, by the end of the year 2008, is more than 9500 MW (it was

about 4900 MW at the end of 2007) [2]. In the year 2008, 80% of the world's new photovoltaic power was installed in the European Union, mostly in Spain and Germany. However, EU growth prospects are now facing the challenges of both the global financial crisis and the expected slow down in the Spanish market.

The European market remains very heterogeneous. Germany is by far the leading European manufacturer along the whole photovoltaic value chain, from feedstock production, to cells, modules inverters and components. In 2008, the German PV industry had a turnover of about EUR 7 billion and employed 48000 people (46% in the industry and components supply, 47% in the installation and 7% in sales) [2]. Overall, however, Europe remains a net importer of PV-cells and the trend will likely continue as the recent rapid growth of PV production capacity in Asia brings new challenges to EU players. Quality and longevity of PV-cells and modules, and profitable life-cycle features of whole PV-systems may become ever more important in such a highly competitive world market situation.

2 LEGAL INSTRUMENTS

European legislation has proven to be an important driver of renewable energy development (including PV), particularly in certain Member States. The new renewable energy directive is expected to play an increasing role and to stimulate to a large extent also the PV sector.

2.1 The Renewable Electricity Directive 2001/77/EC and current state of play

Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market has had a direct relevance to the PV sector over the past years. The directive set indicative national targets and encouraged favorable national conditions for the development of the sector, such as the revision of administrative procedures, or favorable grid

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connection and access conditions.

The directive left it up to Member States to select the technologies to be promoted and to design the support schemes. Some Member States have used this opportunity to support PV with effectively designed measures. However development of the RES-E in general and of the PV sector in particular has been uneven across the EU. Concerning PV deployment, the impressive growth of the total installed capacity over the last years in Europe was driven mainly by Spain and Germany.

Concerning the support given to PV, the Commission has stated that it is too low in most Member States even if the generation costs have dropped by 10-20% across the EU in the last couple of years [3]. Those countries that have average support levels closest to the minimum generation costs operate with feed-in tariffs or premiums. Other types of support, such as quota obligations and tax measures, give little incentive for investments in PV since these schemes generally promote the cheapest available technologies.

2.2 The new renewable energy directive and National Renewable Energy Action Plans

The new renewable energy directive sets for the first time legally binding European and national targets for the share of renewable energy sources in final energy consumption. It is ambitious in its objectives and, even if it is technology neutral, it will require the use of a wide range of technologies, with a growing role of technologies that are technically available but are not yet in or are at the beginning of the mass market deployment phase, such as photovoltaics.

Although the Directive sets a well defined EU framework, it leaves the details of implementation up to each Member State. More specifically, sectoral targets, as well as enhancing measures, such as streamlining administrative procedures, minimum requirements in buildings, improvement of the information to the public, training of installers of equipments, and electricity grid connection and operation conditions will be defined in each country's National Renewable Energy Action Plan, which are due by June 2010. The directive together with these National Action Plans will ensure a stable framework for investment decisions. Member States may also continue to decide on their support scheme. In this respect, technology specific schemes, such as differentiated feed in tariffs, have proven to be particularly important for PV development so far. The Commission also monitors continuously the success of the different support schemes in relation to the achievement of national RES-E targets. The Commission has recently stated that harmonization of support schemes remains a long term goal, however in the short term it has recommended a co-ordinated approach to RES support schemes based on cooperation between countries and optimisation of national schemes.

3 SUPPORTING PV DEPLOYMENT

Some of the signals coming from the PV sector, and which are complex to decipher, appear peculiar to each specific industrial segment. From one side, the weakened demand, determined by the tight access to project financing in an environment where supply has continued

to grow has resulted in a reduction of the average selling prices. In some PV market segments, sales may have also grown up in volumes but their margins have been down. It has been reported that some photovoltaic manufacturers are investing directly their own resources to circumvent the credit difficulties and get large projects off the ground. At the same time other companies, in the highest efficiency segment, maintain an optimistic feeling, on the assumption that customers are continuing to pay a premium for higher quality products.

In these critical times government programmes can be extremely relevant to the sector, provided, as mentioned before, that they are soundly devised and sustainable in the medium term, to ensure continuous PV deployment.

Notably, the feed-in tariff is gaining popularity also in USA, where a number of States have already implemented feed in tariff schemes as a policy option for encouraging renewable energy development. It has been recently reported that feed-in tariffs could be used effectively to meet USA state policy goals, including job creation, economic development, and meeting renewables targets [4]. However, it may take some time before the combined impacts of the financial crisis and of government interventions to address it become clear.

In the mean time it appears necessary to pay due attention to the downstream side of the sector, as it is a vital part of the photovoltaic value chain. This means the necessary infrastructures, also financial, to implement large decentralized solar plants. However it includes also the entire installers' segment. Lower PV costs together with favourable support schemes may sustain the further deployment of PV systems, but bring risks of poor quality systems being installed, which could lead to system failures and might damage consumer confidence. This implies the need for careful attention to installer training, and to the certification of installers as well as to the certification of components and systems.

4. EUROPEAN ENERGY PLAN FOR RECOVERY

The European Energy Programme for Recovery (EEPR) Regulation does not concern directly photovoltaics. Nevertheless, we shortly address it here because it is a major milestone in energy policy as, for the first time, a significant Community financial contribution (almost EUR 4 billion) is allocated to specific energy projects by means of a dedicated financing instrument. The aims of the EEPR are: to secure and speed up investments in the energy sector – with a direct impact on the EU economy and employment; to improve the security of supply of the most vulnerable Member States and link energy islands to the rest of the EU energy market; to speed up the implementation of the EU 2020 targets, by supporting the deployment of innovative energy technologies. The total budget of EUR 3 980 million has been divided between three sub-programmes: 60% of the budget is earmarked to gas and electricity interconnectors; 26% to carbon capture and storage; and 14% to offshore wind energy. The closing date for submission of proposals was 15 July 2009. Evaluation is to be completed by early September 2009. The European Commission will report on the implementation of the EEPR Regulation during the Energy Council in December 2009 and will present a

report to the European Parliament and Council in March 2010.

5. PV RTD AND DEMONSTRATION PROGRAMME

Through a series of RTD framework programmes, the Commission has maintained long-term support for research, development and demonstration in the PV sector, providing a framework within which researchers and industrialists can work together to develop PV technology and applications.

During the **6th Framework Programme**, FP6 (2003-2006), the European Commission committed EUR 105,6 million for supporting research and demonstration on PV, thus continuing a 30-year tradition of co-financing the development of solar electricity in Europe. All the PV projects funded under FP6 are collected in a synopsis recently published by the European Commission [5].

The European programme supports the accomplishment of champion cell efficiencies, like FULLSPECTRUM project, coordinated by Universidad Politécnica de Madrid, which helped Fraunhofer ISE to develop their 41,1% world record efficiency CPV solar cell and like LARCIS project, coordinated by Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW), which achieved 19,6% efficiency for chalcogenides based thin film solar cell, produced under pilot production conditions. The European programme supports, at the same time, the technological development of solar energy to make PV competitive with the conventional energy sources. The CRYSTAL CLEAR project, coordinated by ECN Solar Energy, successfully showed that combining technology development and economy of scale the direct manufacturing cost of wafer-based silicon solar modules can be lowered in range of EUR 0,9 – 1.3 per watt [6], which would enable 'grid parity' in most of Central and South European countries.

The **7th Framework Programme**, FP7 (2007-2013) has a significantly increased budget compared to the previous programme, and will run for seven years. Calls for proposals based on topics identified in the *work programme* are being launched on an annual basis. Concerning photovoltaics, FP7 has begun with less emphasis on the development of traditional wafer-based silicon, which is the focus of increasing R&D investment by companies and national programmes. Material development for longer-term applications, concentration PV and manufacturing process development have attracted most European funding. Furthermore, significant funding is expected to be made available for thin-film technology.

Four calls for proposals have been already launched for the years 2007, 2008, 2009 and 2010. The photovoltaic projects granted under the FP7 2007 calls have been described previously [7].

The projects which received grants under FP7 2008 call have already begun their work. Among these projects, *NACIR* deals with concentration PV (CPV) and is focused on EU cooperation with Mediterranean Partner Countries. The project is coordinated by Universidad Politécnica de Madrid and aims at accelerating the path for CPV to reach competitiveness with the flat panel PV system. Development and verification of cost-efficient manufacturing techniques and dissemination of

knowledge is the goal of the *ASPIS* project, coordinated by Fraunhofer IPA. The project activities include the verification of a novel Parallactic Tracking technology concept supporting flat, fixed solar panels with internal concentration and dynamic sun tracking and as well the prototyping of this technology. *MetaPV*, coordinated by 3E, is the first project in Europe aiming at the demonstration of the electrical benefits from photovoltaics on a large scale. Additional benefits for active grid support from PV will be demonstrated at two sites: a residential/urban area of 128 households with 4 kW each, and an industrial zone of 31 PV systems with 200 kW each. The enhanced control capacities will be implemented into PV inverters and as well the active voltage control, autonomous grid operation, and interaction of distribution system control with PV systems will be demonstrated in this project. The technical and economic assessment of the additional services from PV is a relevant part of the project to allow successful replication in other European sites.

Notably, a further call addressing jointly the Energy and Nano-materials Themes of FP7 has received several proposals exploring a number of extremely innovative concepts, such as self-organized nano-structured injection solar cells, nano-rod based thin-film solar cells on glass, plasmon-generating nano-composite materials, and innovative materials for excitonic solar cells. The projects selection finished and the project started at the beginning of this year. A novel concept for thin film solar cells based on silicon nano-rods, bearing the potential for solar cell efficiency exceeding 15%, will be explored in the *ROD-SOL* project, coordinated by The Institute of Photonic Technology. The objective of the *SOLAMON* project, coordinated by Commissariat à l'Énergie Atomique – CEA LITEN, is to develop plasmon generating nano-composite materials, which will pave the way to high efficiency and low cost third generation solar cells. The main objective of the *EPHOCELL* project is the study of energy down shifting and up conversion processes with the aim to modify the wavelength of solar photons by using a tuneable molecular system based on organic compounds and metal complexes. The project is coordinated by Leitat Technological Center.

The total cost of projects selected under FP7 2008 calls is estimated at EUR 30,0 million, with an EC contribution of EUR 19,6 million.

The third FP7 2009 call for proposals focused on thin-film technologies, including material development, production equipment and process development. The evaluation of the proposals is completed and seven projects are, currently, under negotiations.

The work programme for the **FP7 2010** calls has been published on 30 July 2009. The general call includes further development of very thin wafer based silicon solar cells and has a deadline on 15 October 2009. Other topic of the interest to the photovoltaic community is Topic ENERGY.2010.7.1-1: Large-scale demonstration of smart electricity distribution networks with distributed generation and active customer participation (for which PV generator are explicitly foreseen). Additionally, a joint call with India on photovoltaics and CSP has been published. This call addresses: development of novel materials, device structures and fabrication methods suitable for thin film solar cells and TCOs including organic photovoltaics;

development of new concentrator modules and field performance evaluation of Concentrated PV systems and development of a prototype of a small scale steam engine powered by a Linear Fresnel Reflector system. The submission deadline for this call is the 31st November 2009.

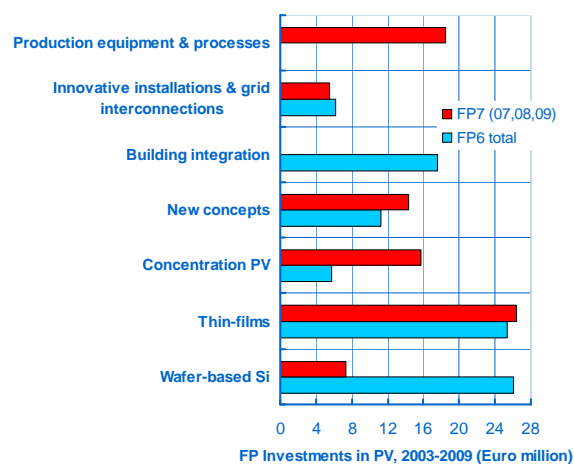


Fig 1: Investments in Photovoltaics under FP6 and the first three calls of FP7.

5. INTELLIGENT ENERGY – EUROPE

The Intelligent Energy – Europe (IEE) programme helps to achieve the EU's 2020 targets by supporting collaborative actions in which organisations from at least three different EU Member States work together to reduce non-technological barriers to growth in sustainable energy markets. IEE projects contribute to the development and implementation of EU policies and legal frameworks, and help to establish renewable technologies, including PV, within mainstream market structures and supply chains.

The first IEE programme ran for four years (2003-2006). Four calls for proposals were launched, with a total budget of EUR 250 million, leading to more than 400 projects and more than 60 local/regional energy agencies being funded. The four PV projects, which were supported in this period were: **PV Policy Group** (improving political-legal conditions and incentive mechanisms), **deSOLaSOL**, www.desolasol.org (promoting innovative joint investment schemes for grid-connected PV plants), **PV-UP-SCALE**, www.pvupscale.org (introducing PV into the urban-planning process), and **PURE**, www.pure-eie.com (raising awareness of PV electricity in the urban environment among professionals, urban planners and decision-makers). These projects have been described previously [7].

The second IEE programme (2007-2013) has a budget of EUR 730 million, which is on average double the annual budget of the first programme. Three annual calls for proposals have been already launched.

From the first two calls, two new PV projects have been funded. **PVs in BLOOM** (www.pvsinbloom.eu), which started in Oct 2008, is coordinated by Union of Veneto Chambers of Commerce. It is promoting the installation of small and medium sized PV plants (50 kW

up to 3 MW) on marginal or degraded land in Italy, Greece, Spain, Poland, Austria, and Slovakia. The project is adopting a bottom-up approach and has already engaged more than 40 municipalities. It plans to trigger the installation of about 20 MW of PV plants and has already unblocked the development of 1 MW in its target regions. **PV-NMS-NET** (www.pv-nms.net), which started in October 2008, is coordinated by Warsaw University of Technology. The project supports a network of twelve organizations working to promote PV markets in new EU Member States by contributing to the development of National Renewable Energy Action Plans and by helping to implement EU energy policies. It has recently produced a status report on PV markets in the new EU Member States.

The third IEE Call led to the support of two more projects, which address PV market issues. **PV LEGAL**, which started in July 2009 and is coordinated by the German Solar Industry Association, is producing a database on market barriers for large, medium and small PV systems across the EU, using experience from the RES LEGAL database. The project aims to achieve significant improvements in the legal and administrative frameworks of the 12 participating EU countries, resulting in reduced lead times for the development and construction of PV installations; less burdensome and more streamlined authorization procedures for smaller PV projects; and reduced workloads for PV authorisation bodies at national and regional levels. **QUALICERT** (www.erec.org/projects/ongoing-projects/qualicert.html), which started in July 2009 and is coordinated by ADEME and EREC will help with implementing the RES Directive's requirements concerning certification schemes for installers of small-scale RES systems, including PV systems in both new and existing buildings.

The next IEE call will be published in early 2010. For further information on the IEE programme, on-going IEE projects and future calls for proposals, see http://ec.europa.eu/energy/intelligent/index_en.html.

6 EUROPEAN SOLAR INDUSTRIAL INITIATIVE OF THE SET PLAN

The EU has endorsed the European Strategic Energy Technology Plan (SET-Plan) to accelerate the development and large scale deployment of low carbon technologies. The SET-Plan proposes a collective approach to research, development and demonstration planning and joint implementation of focused large scale programmes [8]. The SET-Plan has started being implemented and is currently working towards the establishment of large scale programmes such as the European Industrial Initiatives (EII) that bring together the industry, the research community, the Member States and the Commission in risk-sharing public-private partnerships aiming at the rapid development of key energy technologies at the European level. Six technology priorities have already been identified as the focal points of the first EIIs: wind, solar, electricity grids, bio-energy, carbon capture and storage and nuclear fission. The Solar European Industrial Initiative (SEII) addresses photovoltaics and concentrating solar power. The objective of the PV component of the Initiative is to improve the competitiveness of the technology and to

facilitate its large scale penetration, as well as its integration into the electricity grid, in order to establish PV as a competitive and sustainable technology contributing up to 12% of European electricity demand by 2020. Achieving this objective for photovoltaic energy requires the substantial reduction of PV costs, the improvement of device efficiencies, and at the same time, the demonstration of innovative technological solutions for the integration of large-scale PV-generated electricity into the European grid. The SEII proposes a R&D programme focused on increasing performance and extending life time of PV systems and components, and on key technologies for the connection to the power grid, such as inverter and storage devices; up to 5 pilot plants of advanced automated high throughput manufacturing processes for mass production; and a portfolio of demonstration projects of PV power production in decentralized applications in urban communities, e.g. for building integrated concepts and as centralised power plants of 50-100 MW. This will be underpinned by a long term R&D programme on advanced PV concepts and systems. The total cost of the SEII programme over the next ten years has been estimated at about EUR 16,1 billion, of which EUR 9 billion for the PV part.

7. CONCLUSIONS AND FUTURE PERSPECTIVES

During this difficult period of financial crisis, the three major European Institutions (European Commission, European Parliament and European Council) have made revolutionary policy, legislative and financial commitments to support the future development of sustainable energy technologies and to accelerate their penetration into European and global markets.

The new renewable energy directive, which contains mandatory national targets for the deployment of RES and which requires each Member State to submit a National Renewable Energy Action Plan by June 2010, has established a fundamentally new legal framework for the renewable energy sector. This framework does not contain targets for each renewable energy technology, but its implementation across the EU over the next few years will offer unique opportunities for the European PV industry to grow and to achieve its own ambitious targets.

In terms of financing, the European Recovery Plan has provided about EUR 4 billion for investments in major new energy infrastructures and each of the existing EU financing instruments has been adapted to respond to the new challenges of climate change and securing EU energy supplies. For example, the Community's structural and regional funds now include specific commitments to supporting sustainable energy initiatives, and the European Investment Bank has introduced major new instruments, such as ELENA, to meet the growing need for sustainable energy investments.

At the same time, the EU has continued to provide support for research and technological development (reducing costs, increasing efficiencies and enhancing long term reliability) through its FP7 programme, together with support for renewable energy market development (increasing deployment, changing behaviour and enhancing long term commitment) through its Intelligent Energy Europe programme.

Technological development and innovation remain fundamental to delivering the more competitive PV systems, which will be needed in the rapidly expanding renewable energy markets of the future.

Europe's ambitious combination of a new Directive, targeted financing and well focused EU programmes is designed to deliver simplified legal frameworks, more attractive financial support schemes, and more competitive PV systems. This combination will transform the EU's energy markets, and will make it possible for PV to become a major contributor to the EU's future mainstream energy supplies. By permitting the full potential of Europe's PV industry to be realised, thousands of new high skilled jobs will be created in the EU [9].

References

- [1] Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing directives 2001/77/EC and 2003/30/EC. OJ L 140/16 5.6.2009.
- [2] *Photovoltaic Energy Barometer*, Euroobserver-Systèmes Solaires, Le Journal du photovoltaïque, n.1 (2009).
- [3] Commission Staff Working Document: The support of electricity from renewable energy sources SEC(2008)57 23.1.2008.
- [4] T Couture, K Cory, State Clean Energy Policies Analysis (SCEPA) Project: An Analysis of Renewable Energy Feed-in Tariffs in the United States, Technical Report NREL/TP-6A2-45551 May 2009.
- [5] European Commission, Photovoltaic Solar Energy – Development and current research (2009) ISBN 978-92-79-10644, posted at http://ec.europa.eu/energy/publications/index_en.htm.
- [6] C. del Canizo, G. del Coso and W.C. Sinke, Prog. Photovolt: Res. Appl. 2009; 17:199-209.
- [7] P Menna, R Gambi, A Hercsuth, W Gillett, G Tondi, Proceedings of 23rd EUPVSEC, Valencia (2008) pp 3706-12.
- [8] A European strategic energy technology plan (SET Plan) - Towards a low carbon future [COM\(2007\) 723](#) final.
- [9] PV Employment: The role of the European PV industry for the Europe's job and education today and tomorrow. The project has been funded by the EU under FP6. The final results of the project are available at www.pvemployment.org.