

## REVIEW ON PHOTOVOLTAIC ACTIVITIES IN GREECE – ANALYSIS OF MARKET PROSPECTS AND THE INDUSTRY DEVELOPMENT

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**ABSTRACT:** A review of the recent market development and the industrial activities in Greece in the PV energy sector is done in this paper. A summary of the authorities involved in the approval process is mentioned and the most recent information on applications submitted, the evaluation and licensing results and the prospects of the market development on the short to medium term is reported. The first MW-scale photovoltaic station was installed and grid-connected in north Greece in July 2008 and reference to this milestone for the development of solar applications in the country is given. Finally, the development of the market has brought a considerable industrial activity in the PV sector and the main company activities are reported.

**Keywords:** PV Market– 1; National Programme – 2; Large Grid-connected PV systems – 3

### 1 GOVERNMENTAL AUTHORITIES

Three ministries are involved in the process of developing a PV project. The main roles and activities are summarised in the following:

#### Ministry of Development (MoD)

- Energy planning and policy in the country.
- Issues the main legislative and regulatory measures for the deferent energy resources.
- Planning research and development programmes and funds.
- Development of the new OPCE (Operational Programme for Competitiveness and Enterprise): to be announced within 2008, with subsidies for RES including the PV building sector.

#### Ministry of Environment , Land planning and Public Works

- A common ministerial decision is expected for the zoning and conditions of land positioning of RES. The concentration of large PV plants in specific areas is considered and it is negative for PV applications in the urban environment. An

improvement of the zoning plan in the next period is expected to contribute the development of the market and will resolve a number of problems related to the appropriateness of installing renewable power supply systems in certain areas.

#### Ministry of Economy and Economics (MoEE)

- Subsidisation through the Development Law 3299/2004. The whole process is on a competitive basis and subject to budgets available. The minimum budget for a project to be considered as an investment is 100k Euro. If approved, the subsidy in a PV project is 40%.

Comment: Subsidy to an investment could be a strong barrier in the creation of a sustainable PV market in the country due to “stop and go” process and the bureaucracy. This is another negative aspect of the framework because a significant budget of public money is needed for the implementation of the target, which is not always available.

- 4<sup>th</sup> Community Support Framework: now called NSRF – National Strategic Reference Framework, currently under way.

A number of authorities are also involved in the approval of a solar project:

RAE – Regulatory Authority for Energy: evaluation of proposals and consultation to MoD for issuing Energy Production Licences (EPL); fine tuning of the development of the PV Programme in the short/medium-term horizon.

PPC – Public Power Corporation: defines the grid-connection issues.

DESMIE – Hellenic Transmission System Operator (HTSO): contract issues for conditions of feeding energy to the grid and tariffs.

Town/Urban Planning Authorities: approval of a building license; communication with these authorities is done on a local level.

CRES – Centre for Renewable Energy Sources: final technical approval and commissioning of installed systems.

Other Authorities: Direction of Environment & Land Planning (DELP), 3 Archaeology Departments, 6 other authorities, Prefecture Council etc.

Further details on the role of each authority as defined in Law 3468/2006 have been reported in [1].

## 2 INCOME DRIVERS

The feed-in tariff that was introduced in Law 3468/2006 is the main support mechanism for the development of solar PV applications in Greece. Tariffs depend on system size and the place of application and they are summarised in Table 1 below. In parenthesis are indicated the tariffs valid for 2007, increased every year by a percentage on the average national inflation index or electricity prices.

Table 1: Feed-in Tariffs for PV systems

PV System Capacity, [kWp]	Feed-in Tariff, [Euro cent/kWh]	
	Interconnected System	Non-interconnected Islands
<100	45 (45.282)	50 (50.282)
≥100	40 (40.282)	45 (45.282)

According to the existing legislation, the validity of contracts for electricity sale is 10 years, plus another 10 years with option to the investor.

Another financial resource for PV investments can be the so-called Development Law 3299, which provides subsidises up to a percentage of 40% for photovoltaic projects. Applications are treated by MoEE and are on a competitive basis.

## 3 LICENCING PROCESS AND SYSTEM CATEGORISATION

An overview of the licensing process for large PV projects of capacity greater than 150kWp is summarised below:

- Step 1: application to RAE for Energy Production Licence (EPL). The environmental assessment study is included and is forwarded to the involved authorities by RAE.
- Step 2: application to the MoEE for project subsidisation.
- Step 3: installation license; mostly local authorities involved.
- Step 4: contract with utility and operation license.

Duration of actions mentioned above is risky to estimate although Law 3468 defines specific time limits for each activity.

The different system categories with respect to size are:

### Small systems of capacity ≤20kWp

These systems are exempted from an EPL process. Application for grid connection is done directly to the local utility office. Subsidisation is possible for systems close to the 20kWp threshold. Main barrier for the market development of small roof-top systems is the requirement for establishment of a company.

### Medium size systems 20kWp<P<150kWp

Applications for exemptions from an EPL are submitted to RAE. In September 2007, RAE discontinued the process due to the large amount of applications received.

### Large systems >150kWp

In the last summers' regional planning for the development of PV applications, RAE introduced 2 sub-groups in this category: 150kWp<P≤2MWp and P>2MWp. In March 2008, RAE discontinued the process due to the large amount of applications received.

## 4 PV MARKET RESPONSE

The latest data on the status of applications for EPL or exemptions are summarised in Tables 2 and 3 below for medium size and large PV systems respectively. The information in Table 2 was provided by [2].

Table 2: PV systems of P>150kWp

Status of Applications (after 2006)	PV Power, [MWp]	%
RAE Positive Decision	193.6	6.4
Negative Decision (missing data)	383.6	12.7
Negative Decision (failed evaluation)	211.3	7.0
Under Evaluation	2,230.5	73.9
<b>Total:</b>	<b>3,019.0</b>	<b>100.0</b>

Table 3: PV systems of 20kWp&lt;P≤150kWp

Status of Applications (after 2006)	PV Power, [MWp]	%
RAE Positive Decision	114.2	15.6
Negative Decision (missing data)	9.5	1.3
Negative Decision (failed evaluation)	10.1	1.4
Under Evaluation	599.3	81.7
<b>Total:</b>	<b>733.1</b>	<b>100.0</b>

The overall picture of applications submitted to RAE for approval in August 2008 is as follows:

- Total 8,227 applications submitted for an EPL or exemption, of equivalent PV capacity 3,752.1MW.
- Evaluation: 307.8MW approved, 614.5MW withdrawn, 2,829.8MW under evaluation.

It is reminded that small systems below 20kWp are not included in the numbers above.

## 5 ACT REGULATION UNDER WAY

Recently, the Ministry of Development (MoD) indicated the will of the government to introduce a legislative amendment to Law 3468/2006, see [3]. Main scope is to introduce an efficient procedure to evaluate the large amount of applications received for PV system integration.

In parallel, some new measures of interest to the investors will be introduced to accelerate the PV market development in the country:

1. The FiT will slightly decrease according to a monthly de-escalation mechanism (takes into account the expected downscaling of PV systems costs in the following years).
2. The tariff on the date of the system connection to the grid will be guaranteed for a period of 20 years (no more confusion with the 10+10 years issue).
3. A new Programme for the development of PV systems on buildings, roof-tops and facades will be in effect, with specific rules and simpler procedures aiming to the integration of PV technology in private and public buildings.

Although the legislative regulation to Law 3468 has not yet been finalised by the MoD, some information have been provided by affiliated associations [4], concerning specific issues of interest:

- The start year of the new measures will be 2010.
- The monthly FiT de-escalation is estimated to be around 1.0% in the 4-year period 2010 to 2013 and around 0.5% in year 2014.
- Starting FiT prices will be the ones existing today.
- The PV systems that will be grid-connected within 2008 and 2009 will have 20-years contacts with the present tariffs.

- A control mechanism for the annual growth rate of the PV market will be introduced.
- Subsidisation of the PV systems will not be discontinued, yet on a competitive basis (up to 40% on capital costs).
- The annual FiT adaptation to the percentage on average national inflation index or electricity prices will continue.

## 6 PROSPECTS FOR PV MARKET DEVELOPMENT IN GREECE

The potential of PV applications in Greece is high and now on a cost competitive basis for island power systems. In the mainland system, with high demands during the summer season, the contribution of PV systems to meet the day peak demand due air conditioning loads is of high value. Therefore, good prospects for the PV market should be mentioned with a new simplified framework and program structure for PV applications.

Already 2 years after the introduction of Law 3468/2006, the PV market develops in low annual rates of around 2 to 3 MWp per year, i.e. 2007 and 2008.

Implementing solar PV plants in Greece the main objectives should focus to:

- Create sustainable long-term PV market.
- Contribute to the electricity grids and high demands.
- Maximize the economic and social benefits.
- Support PV industrial development.

A summary of existing barriers in PV applications and some proposals to remove them are mentioned below:

- Strong simplification of the procedures for exemptions, licenses etc.
- A well-designed FiT is the best tool to support the PV applications in the priority and other areas without subsidies, eliminating the stop and go effect.
- The connection to the grid is a time consuming bureaucratic procedure with high cost. Simplification with easy access, technical guidelines, time limits and reasonable cost is suggested.
- Simple measures to open the PV market in the domestic sector for PV applications.
- Specific supporting mechanisms for BIPV and roof top PV installations.
- Programme for PV applications with priority to PV penetration in the urban environment and the islands systems.

From the latest legislative arrangements mentioned in section 5 above, it seems that year 2009 will become a special case in terms of PV market evolution in Greece due to the benefit of getting grid-connected at the highest possible FiT price. For 2009, a PV market of around 30MW could be considered as feasible. This includes

large and medium size systems, but not the building sector.

Starting in 2010, an average annual market growth rate of around 50% could be expected for 4 years i.e. 2010–2013. Thereafter, an average annual growth of 35% could be estimated. This would result in a total of around 900MW by 2015. In this calculation, the two large PV projects of PPC of total 50MW have not been calculated. Additionally, another 500MW could be a target for the PV market capacity in the building sector in Greece.

## 7 THE FIRST MW-size PV PLANT IN GREECE

The installation and grid-connection of the first MW-size PV plant in Greece constitutes a milestone in the development of solar power systems in the country. In Table 4 a summary of the general and technical characteristics of this PV installation is provided.

Table 4: Characteristics of the Pontoiraklia PV system

General Information	
Place of installation:	Pontoiraklia, Kilkis, North Greece
PV system owner:	Sunergy SA, Thessaloniki, Greece
Design & construction:	Phoenix Solar AG, Germany
Construction duration:	12 weeks (31.03 – 23.06 2008)
Grid-connection:	23 July 2008
Inauguration:	September 2008
Technical Data	
PV modules type:	PHX 160, c-Si 162Wp each
No of modules:	5824
Total nominal capacity:	943.5kWp
Inverters:	2 Xantrex, type GT500

Figures 1 and 2 that follow indicate the technical design and an overview of the actual installation respectively.

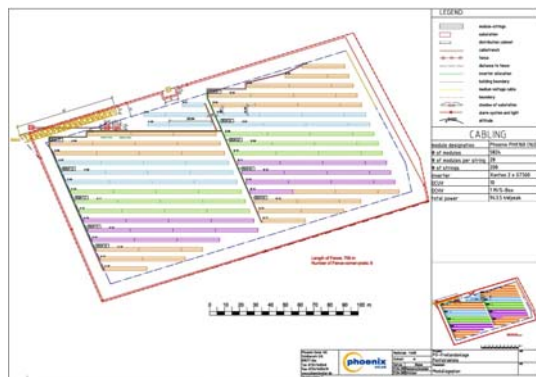


Fig. 1 General layout of the 1MWp PV plant at Pontoiraklia



Fig. 2 General view at the construction phase

Since the Pontoiraklia PV plant was only recently connected to the grid, few data on the performance of the station are available. Information on the operational characteristics of the plant will be reported after a reasonable time period.

## 8 DEVELOPMENT OF THE PV INDUSTRY

Politically supported growth of the market allows the local PV business such as, wafers, cells & module production, to get established and operative. A number of industrial activities in the PV sector are witnessed in Greece over the last few years and the main companies involved are listed below:

- Energy Solutions: manufacturing of c-Si modules; 10MW annual capacity; Greek company based in Bulgaria; running since 2003.
- Solar Cells Hellas Group: wafers and cells; annual capacity 60MW; start of production next month. Also, consideration for m-Si thin-film module production.
- Silsio /Piritium: development of manufacturing facilities for c-Si wafers and cells; annual capacity 60MW; estimated start of production in 2009.
- Next Solar: development of manufacturing facilities for m-Si thin-film modules; initial annual capacity 30MW; start of production in 2009.

A number of consultancy, marketing and construction companies in Greece, together with the support of certain financial institutions and banks have initiated activities, indicating that a sustainable environment for PV applications will be maintained in the country.

## 9 CONCLUSIONS

Since June 2006, the market reaction to the favourable conditions of Law 3468/2006 was outstanding and applications of around 4GW of equivalent PV capacity have been submitted. However, in terms of PV system realisation, the market in Greece is still in an embryonic phase. To resolve this issue, the government intends to introduce new legislative regulations, aiming to reactivate the market and accelerate PV systems integration into the grid. In this respect, the barriers for the development of BIPV systems are expected to be removed; this market should then develop in parallel to

the large ground-based systems. The subsidisation process could be reconsidered and even discontinued due to its stop-go inherent nature, in view of a sustainable PV market development.

The first in the country MW-size PV system was recently installed and grid-connected in North Greece. This constitutes a milestone in the development of solar energy in the country and many other of similar size PV systems are expected to be developed soon. Finally, a considerable industrial activity is under way, with good prospects for internationalisation.

## NOMENCLATURE

CRES:	Centre for Renewable Energy Sources
DESMIE:	Hellenic Transmission System Operator (TSO)
EIS:	Environmental Impact Study
EPL:	Energy Production License
ETA:	Environmental Terms Approval
FiT:	Feed-in Tariff
HTSO:	Hellenic Transmission System Operator
LV:	Low Voltage
MoEE:	Ministry of Economy and Economics
MoD:	Ministry of Development
NSRF:	National Strategic Reference Framework (in Greek ESPA)
OPCE:	Operational Programme for Competitiveness and Enterprise (in Greek EPAE)
PEAE:	Preliminary Environmental Assessment and Evaluation
PEI:	Preliminary Environmental Impact study
PPC:	Public Power Corporation (utility in Greece)
PPC-R:	Public Power Corporation Renewables
RAE:	Regulatory Authority for Energy

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