THE HELLENIC OPERATIONAL ENERGY PROGRAMME WITH EMPHASIS ON PHOTOVOLTAIC APPLICATIONS

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ABSTRACT: This paper reviews the scopes and the results of the National Programme in Greece in the general Energy Sector. Special emphasis is given to the targets, the technical and financial measures envisaged, the results achieved and the lessons learnt in the sensitive area of photovoltaic technology and applications. A qualitative analysis is attempted in order to specify crucial decisional parameters that would push forward future actions for the market development of PVs in Greece.
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1 INTRODUCTION

The so-called Operational Energy Programme (OEP) was first initiated in Greece in 1997 under the Community Support Framework (CSF) II. The Programme was announced by the Ministry of Development and was financially supported by both National and EU funds. The target audience of OEP was mainly investors from the professional sector. In 2001, the Operational Programme for Competitiveness (OPC) became effective, with virtually similar to OEP strategic scopes and actions. There have been five calls for proposals so far,

- OEP Phase I, March 1997, under CSF II
- OEP Phase II, October 1997, under CSF II
- OEP Phase II, December 1999 special announcement for PVs in Crete, under CSF II
- OPC Phase I, July 2001, under CSF III
- OPC Phase II, open call from October 2002 to December 2003, under CSF III

A review of the nation-wide PV applications is made. Experiences, problems encountered and lessons learned are presented. Reference to barriers for PV market development is given. The prospects created by the deregulation of energy production and distribution are discussed. The qualitative analysis of OEP and OPC refers to the development of domestic PV systems, feed-in tariff policy for PVs, the role of the Regulatory Authority for Energy (RAE) and certificates required for the connection of small PV systems to the grid.

2 OEP – OPERATIONAL ENERGY PROGRAMME

As a result of the approval of the Community Support Framework (CSF) II, the Operational Energy Programme was initiated in 1997 in Greece. In the initial stages of OEP, [1], the programme focused on the development of professional projects for electricity production from the Public Power Corporation (PPC), Energy Saving (ES) and Rational Use of Energy (RUE) as well as, Renewable Energy Sources (RES). The duration of OEP I and II was 5 years and the total budget for the targeted actions was €865.7M. Out of this budget, an average of 37% was EU support, 30% was National support and approximately 33% was the own contribution of the private sector.
The minimum budget for each project was 293.5kEuro for co-generation, wind power, small-hydro and biomass systems and 58.7kEuro for energy saving, geothermal, natural gas, central, passive and PV solar technologies. Concerning renewable energy sources, the percentage of the EU and National co-funding for each category is presented in Table 1.

Table 1. Project Subsidy for RES under OEP I (1997)

Project Category	Public Funding, [%]
Wind Power	
Electricity Production	40
Water Desalination	45
Geothermal	45
Small-hydro	45
Central Solar Systems	35–50
Biomass	45
Photovoltaics	
≤ 500kWp	55
> 500kWp	50
Passive Systems	40
Hybrid Systems Control	55

2.1 OEP – Phase I

Within the first phase of OEP, the programme budget was €117.4M for projects concerning Energy Saving (including co-generation and natural gas applications) and RES. The available budget for RES was €58.7M. The evaluation of 117 proposals submitted resulted in the approval of 57 projects with total budget €117.1M. A 45% of this was co-funded by EU and National resources. The approved budget was split between €50.5M and €66.6M for Energy Saving and RES projects respectively, i.e. 43.1% for ES and 56.9% for RES. As it is seen from the distribution of the budget, the success of Phase I of OEP was mainly due to the interest of the professionals in the energy sector for costly investments in renewable energy systems.
Concerning the project distribution into the different categories, 20 projects were approved for energy saving, 5 for co-generation, 6 for natural gas, 5 for wind parks, 6 for small-hydro, 6 for central solar systems, 5 for biomass, 3 for PV and 1 project for passive solar systems.
Two projects were eventually realised in 1998. The first involved the installation of a 10kWp grid-connected PV system in a small tourist resort on the island of Paros. The total system cost was €95.4k and is owned by Harmi SA. The second system is owned by ELPRA SA, a power electronics' company located in Thessaloniki. The system consists of a 6.5kWp PV array and it is configured

according to the R&D needs of the company in testing power electronic devices, or for feed–in energy. The budget of this project was €88.0k.

2.2 OEP – Phase II

Within the second phase of OEP which was initiated in October 1997, the total budget was increased to €214.2M which was split to €146.7M for Energy Saving projects and €67.5M for RES. The same general principles as in Phase I, concerning EU and National % subsidy on the capital costs per technology category were applied, see Table 1.

The interest for PVs in this 2nd Phase was not increased compared to the first call for proposals, mainly due to the practical exclusion of the vast domestic sector from the PV applications. The minimum required total system cost of 58.7kEuro, corresponding to a 7kWp PV system of ~€8.4/Wp, proved to be prohibitive for individuals to take the initiative to install PVs as independent or self-producers. Three systems were commissioned in this phase of OEP namely, Megistis Lavras Monastery 15kWp in Mountain Athos, Esperia SA tourist enterprises 50kWp in Rhodes and a public real estate services company 15kWp in Athens. The first system is stand-alone, while the other two are connected to the grid.

2.2 OEP – PVs in Crete

In December 1999 a special announcement for photovoltaics systems on the island of Crete was announced. The public support was 70% on the capital costs and the available budget €13.8M. This call was enough to double the PV capacity installed in Greece in 2000 compared to the previous year.

There were 25 projects of total PV power 2066kWp approved for financial support by the Ministry of Development. In these projects, cost varied between €5.88/Wp and €8.94/Wp with an average of €7.49/Wp. The production was estimated 1495kWh/kWp. Up to date, only 10 of these projects have obtained the energy production licence from RAE or have been finalised.

3 OPC – OPERATIONAL PROGRAMME FOR COMPETITIVENESS

The name of the programme changed to Operational Programme for Competitiveness (OPC), for the period 2000 to 2006. The total approved budget of OPC is €6392M. EU and national support is 31% and 19.4% respectively. The remaining 49.6% will be the contribution of the private sector. There are 8 in total Priority Actions of which, Action 2 refers to the support and encouragement of business activities of enterprises. As part of Action 2, Measure 2.1 refers to security of energy supply and reduction of imports of primary energy resources. The total budget of Measure 2.1 in the period 2000–2006 is €1072M, of which the public support is €382.2M.

3.1 OPC – Phase I

In July 2001, the 1st call for proposals of OPC was announced with total budget €293.5M. The subsidy for PVs was 50% on the capital cost. Again, no special measures were taken for small size domestic PV systems and the minimum required budget was prohibitive for small, household investors.

Three PV projects of total power 610kWp were approved for funding within this call in the PV sector. Most systems are to be installed in North Greece. The first of 400kWp power was granted to Heliodomi SA, to be integrated on the rooftop of a building, which will host the company's PV module production line. The second project refers to a 200kWp grid-connected PV system and finally, a small grid-connected system will be installed in Athens.

3.2 OPC – Phase II

In September 2001, OPC Phase II of the Energy Programme became effective. The call for proposals is open until 31 December 2003 and concerns private investments in the fields of rational use of energy, co-generation and renewables. The total budget available in this phase is approximately €117.4M. According to the programme, the budget thresholds are €44k low and €44M high per project. For PVs, the maximum limit of the eligible costs is €8.8/Wp. The maximum financial support from public funds in the renewable energy sector is summarised in Table 2.

Table 2. Project Subsidy for RES under OPC II (2002)

Project Category	Public Funding, [%]
Wind Power	30
Geothermal	40
Small-hydro	40
Solar Systems	30–40
Biomass	40
Photovoltaics	
Thrace district	50
Central Macedonia and Attika	40
Rest of the country	45
Passive Systems	40

As it is noticed in Table 2, in this phase of OPC, subsidy for PVs depends on the geographical site of the application and varies between 50% in Thrace, 45% in developing regions (e.g. islands) and 40% in the rest of the country. So far, these calls concern only legal entities and therefore the penetration in the household sector is negligible. Moreover, the minimum project budget of 44kEuro is prohibitive for domestic applications, i.e. in the range of 1kWp to 3kWp PV systems.

4 ANALYSIS OF THE ENERGY PROGRAMME FOR PVS

A qualitative analysis of the national Energy Programmes is attempted. The analysis is based on data gathered by experiences encountered due to the market development in Greece in the field of PVs, see also [3], requirements by the utility for grid-connection and numerous discussions and information provided by professionals, acting as PV system installers in Greece.

4.1 Development of domestic PV systems

Both OEP and OPC do not include dedicated measures and incentives for the realisation of PVs in private households. In fact, the market in Greece could be easily initiated, in a similar manner as it was for solar thermal collectors some 25 years ago. At that time the direct public support on the capital costs with minimum bureaucratic procedures created a huge market in Greece

for solar water heating systems and an industry, which is still one of the largest in its field in Europe. The existing domestic PV installations in Greece are few stand-alone systems and almost no grid-connected.

4.2 Energy prices and policy

Following directive 96/92 of the EU, law 2773 established the deregulation of the electricity market in Greece in 1999. This also launched RAE. Among other responsibilities and activities, RAE indicates kWh prices for independent energy producers. So far, no favourable feed-in tariff policy has been established in the PV sector.

4.3 Procedures for grid-connection of small PV systems

In order to place an application to PPC for the connection of an up to 20kWp PV system to the utility grid, the following documentation is required, [4]:

- Complete technical characteristics and description of the PV system, including modules, inverter and other sub-components.
- Electrical drawing of the grid connection of the PV system.
- Certificate of the town-planning authority, stating that the PV system can be connected to the grid.

After approval of the application and on delivery of a grid-connected PV system, the technical service of PPC, [5], requires an extra protection device attached to the automatic switch connector. This protection system will be operated by PPC and must include the following hardware:

- Voltage threshold relay, ±5% of the nominal 230V.
- Frequency threshold relay, 49.5Hz low, 50.5Hz high
- Voltage skew distribution relay.
- High amperage relay.

Additionally, a report by the responsible installation engineer is needed, including a complete electrical drawing of the electrical connections and stating that in the case of power shortage, the PV system will automatically disconnect from the grid. Finally, it is required that a reverse current cut-out devise is installed in an accessible to the PPC technical personnel position.

It is evident that these requirements by the utility are barriers which, practically, put off candidate PV technology end users, on top of the lapse of other incentives. For PV systems larger than 20kWp installed power, the situation is even more complicated, with further requests for licenses, impeding the development of the large PV systems market in Greece.

5 CURRENT STATUS OF RES INSTALLATIONS

Current RES applications are indicated on the map of Greece, Figure 1.

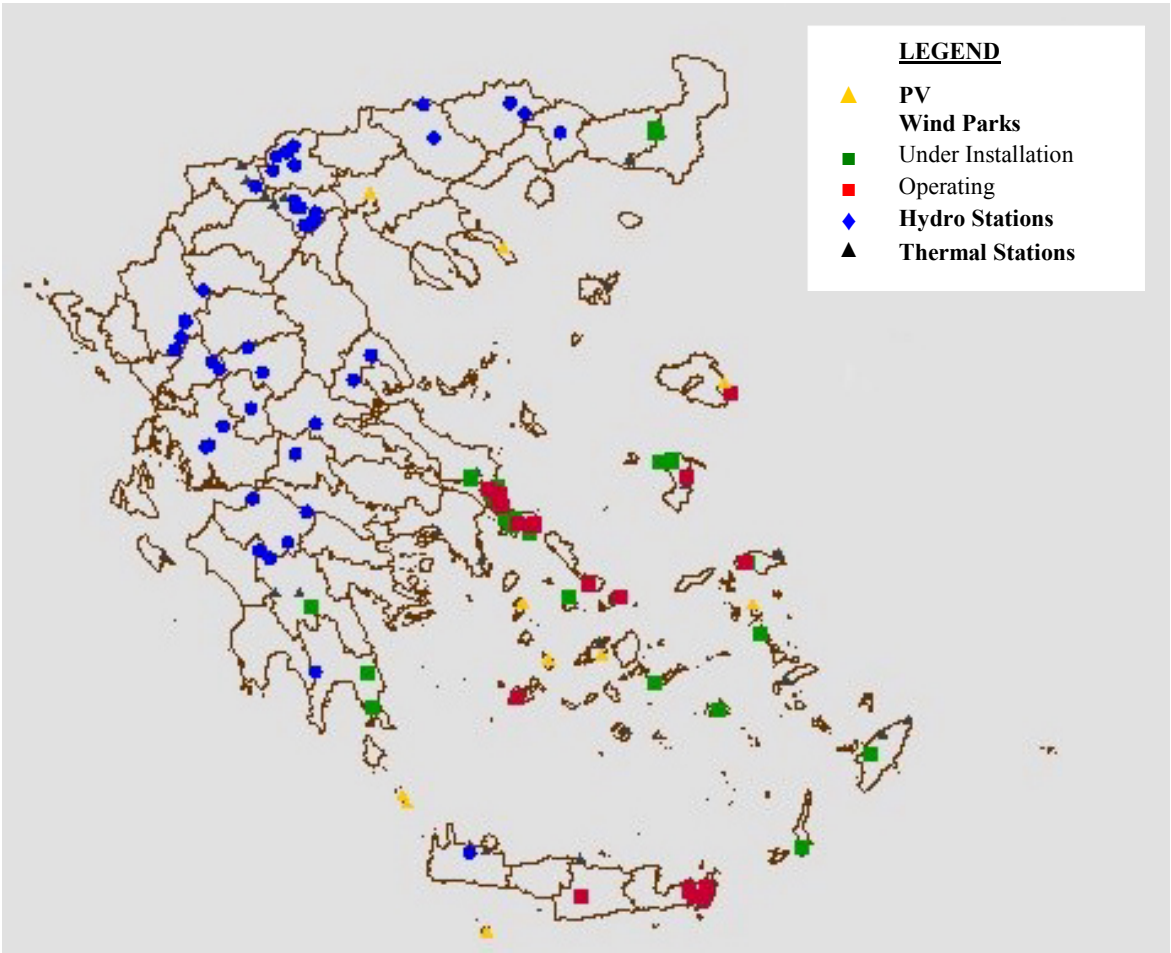

Figure 1. Installations of RES in Greece

The total PV capacity installed in Greece in 2001 was estimated at 1.5MWp. An indicative list of the main stand-alone and grid-connected photovoltaic applications in Greece is presented in Table 3.

Table 3. Main Existing Photovoltaic Applications in Greece

Position	Ownership	Installed PV Power, [kWp]	Year of Installation	Remarks
Kythnos	PPC – Public Power Corporation	PV: 100.0 Wind: 550.0	1983, 1990 1999	island, local grid-connected, hybrid
Antikythira	PPC	27.6	1987	stand-alone, island
Gavdos	PPC	20.8	1987	stand-alone, island
Arki	PPC	27.5	1988	stand-alone, island
Lesvos	PPC	8.0	1998	local grid-connected
Sifnos	PPC	60.0	1999	local grid-connected, THERMIE Programme
Aegean Sea Islands	PPC	total 61.6	1988–1990	80 stand-alone small systems
Antikythira	Hellenic Telecom	25.0	1987	stand-alone, telecommunication
Antikythira	Hellenic Telecom	8.4	1993	12 stand-alone PV systems
Mountain Athos	COSMOTE	6.8	1999	stand-alone, mobile phone antenna
Mountain Athos	Hellenic Telecom	47.5	1994–2000	24 stand-alone telecommunication systems
Evia	Hellenic Telecom	2.4	1997	stand-alone, telecommunication
Kalavrita	Hellenic Telecom	2.5	1997	stand-alone, telecommunication
Aegean Sea	Hellenic Navy	total 63.5	1979–2000	appr. 900 stand-alone solar powered lighthouses
Mountain Athos	Simonos Petra Monastery	45.0	1992	hybrid PV/small hydro system
Pikermi, Athens	CRES	6.0	1993	sun-tracking, N-S axis, horizontal
Pikermi, Athens	CRES	5.1	1999	grid-connected, car parking integration
Kythnos	CRES, ISET, SMA	14.6	2001	stand-alone, mini grid
Elounda, Crete	Elounda Island Villas	6.4	1996	electrification of a tourist resort
Donousa, Cyclades	University of Agriculture	18.0	1997	R&D in JOULE programme
Athens	National Technical University of Athens	48.7	2001	grid-connected, building integration, THERMIE
Vari, Attika	BP petrol station	5.5	1997	grid-connected
Glyfada, Athens	BP petrol station	5.5	2001	grid-connected
Nikaia, Athens	5th Lyceum	4.5	1997	grid-connected
Tavros, Athens	Block of flats	12.0	2002	grid-connected, building integration, THERMIE
Argos	RESPECT Ltd.	5.0	1998	stand-alone
Subtotal Installed PV Power:		**637.9**		

6 CONCLUSIONS

In conclusion, the Energy Programmes in the PV sector in Greece provided satisfactory motivation to a number of investors, particularly in rural areas. However, a new innovative scheme is needed to initiate a large number of investments for grid-connected systems. This can be done in future OPC call for proposals, after a new energy policy scheme is adapted for photovoltaics and supported by the Ministry of Development, PPC and RAE.

7 REFERENCES

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