

## THE PV MARKET DEVELOPMENTS IN GREECE

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**Abstract:** This paper presents in short the state of the PV market in Greece, the achievements so far and the suggestions of the PV market for next years. The developments in the project HELIOS are presented in short. The PV market environment in terms of new feed-in tariffs and measures for feed-in tariff reductions, a special imposition of tax on the revenues on PV electricity generation plants in Greece, aiming to reduce the burgeoning RES Fund deficit, which is forecast to almost triple by the end of 2014 due partly to the late photovoltaic growth.

**Keywords:** Greece, PV Market, PV System Statistics.

### 1. INTRODUCTION

Overview of the Greek PV market

The installed PV systems in Greece up to 2006 were mainly privately owned autonomous systems in remote locations where there is no grid. The grid connected market, besides a few demonstration projects, was relatively small until 2006. Although there was a legal framework for the RES market since 1994 the lack of a significant support scheme running over a long time, the involvement of many public services in order to receive a large number of licenses and the lack of concrete regulations for the market players have hampered the larger introduction of PV systems. The annual installed capacity of Photovoltaic systems in Greece before the new law, excluding demonstration programs and research projects, did not exceed 200 to 300 kWp. Figure 1 presents the installed capacity of PV systems in Greece until 2012 according to CRES. In the year 2007, the installed PV system capacity was raised by 2,3 MWp, half of it coming from grid-connected PV systems due to the law 3468//2006. For the years 2008 and 2009 an additional installed and connected capacity of 12 and 36.5 MWp was introduced, mostly in grid-connected PV systems, respectively. In the years 2010 and 2011 as the law and incentives have been active for 5 years now, the first serious penetration of grid-connected PV systems is taking place even though the country is going through a deep economic depression and lending funds are not easy to receive, while the lending rate is higher than other European countries. The grid connected new capacity for 2010 was 150 MWp and for the year 2011 it was 400 MWp. In the year 2012, due to the gradual maturity of many PV projects, the attractive feed-in tariffs and despite the economic situation, the annual PV installation capacity has reached its peak, of 912 MWp, while for the running year 2013 the momentum and the attractive feed-in tariff contracts that certain developers are still holding are expected to surpass 1000 MWp.

As it is reported by HELAPCO, the Hellenic Association of Photovoltaic companies [1], Greece ranks 5th in the world with regards to per capita installed PV capacity, reaching at 144 W/habitant at the end of 2012. While 4.5 billion € were invested in PV systems in Greece during the last 5 years. This is 35% higher than the cumulative amount invested in all other RES technologies during the last 20 years. In 2012, PV covered 3% of electricity

demand in Greece, while in 2013 the solar PV share is expected to reach 6%.

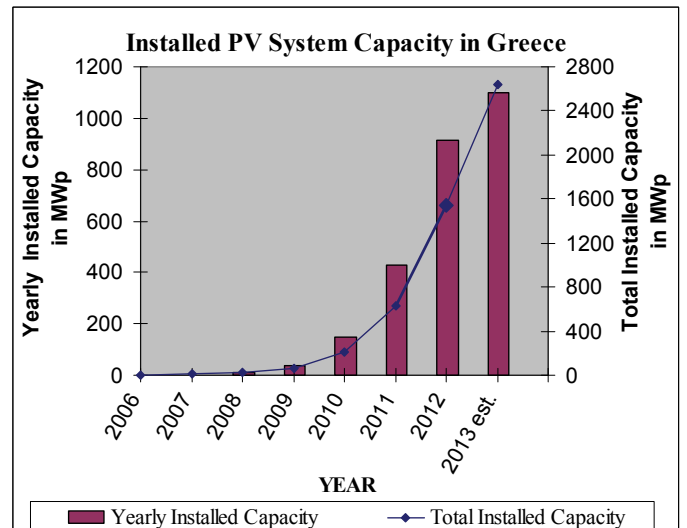


Figure 1: Historic PV market data, yearly and cumulative introduction of PV systems in Greece (CRES estimate for 2013).

The attractive feed in tariffs and the dramatic decreases of PV systems costs since 2011 have led to a boom that the Electricity Market cannot sustain anymore. The Electricity Market Operator cannot raise the necessary funds for compensating the 2.5 GWp of PV installed so far (hence there are delays in payments of the feed-in-tariffs).

As a result of cash flow problems of the Market Operator, the Greek authorities have taken drastic measures against existing and future PV installations, since August 2012 and until recently in May 2013:

- A temporary tax (until July 2015), ranging between 25% and 42%, has been imposed to all operating PV plants (residential systems excluded).
- Licensing process for new PV projects has been put on halt (residential systems excluded).
- Feed-in-tariffs (FiTs) for new PV plants have been reduced in 2013 to 125 €/MWh for residential systems (<10 kWp) (see Table 1), 120 €/MWh for small commercial systems (<100 kWp) and 95 €/MWh for large systems (>100 kWp) (see Table 2), with a further drastic digression planned for the years to come.

The latest feed in tariff levels for new “Feed in tariff contracts” are as follows:

Table 2: Feed in tariffs for the special program of PV systems on Buildings under 10 kWp.

Month/Year	Feed-in Tariff in Euro/MWh
February 2013	125,00
August 2013	125,00
February 2014	120,00
August 2014	120,00
February 2015	115,00
August 2015	115,00
February 2016	110,00
August 2016	110,00
February 2017	105,00
August 2017	100,00
February 2018	95,00
August 2018	90,00
February 2019	85,00
August 2019	80,00

Table 2: Feed in tariffs for PV systems **other** than the special program for PV systems on Buildings.

	Interconnected System		Non-Interconnected System (islands)
	A	B	C (independent of power)
	>100kW	<100kW	
February 2013	95,00	120,00	100,00
August 2013	95,00	120,00	100,00
February 2014	90,00	115,00	95,00
August 2014	90,00	115,00	95,00
For every year n from 2015 and on	1,1 x SMP <sub>n-1</sub>	1,2 x SMP <sub>n-1</sub>	1,1 x SMP <sub>n-1</sub>

SMP<sub>n-1</sub>= System Marginal Price of previous year

The average wholesale cost of electricity in Greece is about 75 €/MWh, with the cost of gas plants exceeding 110 €/MWh. Obviously, a solar kWh compensated with the new FiTs costs less than a kWh generated by a gas-fuelled power plant, reducing, simultaneously, country’s CO2 emissions.

It is noted that the total power capacity of photovoltaic plants for which feed-in electricity contracts has been signed exceeds the limit of planned PV power capacity introduction for the year 2014 and even surpasses the goal for 2020 as they have been set by the government, ie the limits of 1.500 MW and 2.200 MW respectively according to the National Renewable Energy Action Plan (NREAP) [2]. Currently (data of July 2013), the total PV installed capacity for connected PV plants has reached 2515 MWp.

The government has to update its targets and take appropriate measures so that the PV market sector, where several thousand companies are active and more than 25.000 people are employed, remains engaged in its activities. Furthermore, it has to take into consideration also all benefits and charges of all forms of energy and the initiative to transform the electricity market into a simple, transparent and fair operating scheme for all players and the consumers.

The halt on the licensing process for PV systems (except residential systems) however does not allow for the time-

consuming development of new free-field large projects and medium-size rooftop projects, which could become viable mid-term through economies of scale and/or reduced Capex (Capital expenditure) and Opex (Operation expenditure). Therefore, restart of the market cannot be envisaged soon.

HELAPCO proposes:

- Immediate restart of the licensing process for new PV projects, as projects compensated with the new low FiTs, not only have negligible effect on the RES account (which compensates electricity producers), but also contribute to the reduction of the total cost of electricity as PV systems contribute during the day when the System Marginal Price is higher than the FiT.
- Replacement of the annual digression of tariffs (now in place regardless of the market size) by a “corridor” mechanism following the German example.
- Additional incentives for PV projects similar to the rest of RES (e.g. wind projects qualify for 10-year tax-free operation).
- Introduction of net-metering and self-consumption as a second option and parallel to the FiT mechanism, for residential and small commercial rooftop systems.
- Revival of the Helios project, for the reduction of the country debt through income generated by large scale PV projects developed on public land.
- Redefinition of the country’s 2020 target (HELAPCO proposes 12 GW of solar and wind by 2020).

## 2. PROJECT HELIOS

The Project Helios aims at installing in public land up to 10 GWp of PV system capacity and exporting the solar energy generated electricity to EU member states. The Hellenic Republic will provide an “all-inclusive” platform to encourage and facilitate investments in the solar sector. Helios is an integral part of the Greek growth strategy and EU support mechanism. Greece commits future cash flows from project Helios or other privatization revenue in excess of those already included in the adjustment program to further reduce indebtedness of the Hellenic Republic by up to 15 billion Euro. Regarding the implementation of the project Helios, the Ministry of Finance after launching two tenders in 2011, it signed two contracts one with a consortium regarding financial and regulatory issues and a second one for technical support, where CRES was involved and contributed in the realization of the following:

- Land survey and technical suitability for the installation of photovoltaic parks
- Estimation of solar irradiation at the selected sites
- Generic PV system modelling and estimation of annual Photovoltaic energy yield, and financial evaluation of investments
- Rating of sites according to the Levelized Cost of Electricity (LCOE).
- The identification and evaluation of potential energy transmission mechanisms and routes, the validation of the optimal transmission route, the review of infrastructure requirements and networks technical specifications and the assessment of the investment
- Preliminary assessment through modelling and simulation of static security and cost estimate for the connection to the Hellenic Electrical System.

At the moment the deliverables has been handed by the two contracted advisory groups to the government for consideration.

### 3. ESTIMATION OF THE LEVELIZED COST OF ELECTRICITY (LCOE)

The recently reduced feed in tariffs for Photovoltaic project invite the question what is the levelized cost of electricity production for 20 years, with current costs of equipment, operation and maintenance in Greece. The calculation for the LCOE is the net present value of total life cycle costs of the project divided by the quantity of energy produced over the system life. The assumptions are concerning a large ground mounted PV system larger than 10 MWp installed capacity. The following assumptions were used to calculate the LCOE:

Assumptions for LCOE Calculation	
Initial PV system cost with installation, in Euro/KWp excluding VAT	1000
PV system Grid connection cost in Euro/kWp	100
Operation and Maintenance in % of initial investment	0.1
Annual Insurance in % of initial investment	0.15
Loan/Own capital in %	75%/25%
Annual Return asked for Own capital of investors in %	10
Loan interest in % annually (20 year loan)	7
Annual Income Tax Rate in %	25
Annual electricity production of PV station in kWh/kWp	1650
Annual electricity production reduction in %	0.5
PV system depreciation period in years	20

It also assumed that the residual value of the PV system is negligible and no income is considered from the CO<sub>2</sub> emission rights.

For a 10 MWp PV system the LCOE calculated considering all the above assumptions is 0.0756 €/kWh, or 75.6 €/MWh.

It is concluded that for such PV systems as considered above the LCOE is lower than the FiT offered (90-95 €/MWh) and it proves that the investment is still attractive until the year 2015. From there on, as Table 2 suggests, the System Marginal Price of the previous year has to be taken into account and all the other parameters of cost at that time in order to decide on the profitability of the investment.

Furthermore, regarding the residential PV systems (<10 kWp) the Feed-in-tariffs (FiTs) for new PV plants have been reduced in 2013 to 125 €/MWh. This FiT is not attractive as an investment. The proposal of HELAPCO and the other stakeholders for the introduction of a viable net-metering option for this segment of PV systems is very crucial in order to avoid the collapse of this PV market segment. A payback time of the installed PV system with all associated costs of about 10 years should be aimed, as this payback time has been a successful German practice for the promotion of PV systems that have an environmental impact and they are supporting job maintenance of the PV sector in Greece.

### 4. CONCLUSIONS

Given that PV system installations have surpassed the target of installations for 2020 it is proposed to review the national renewable energy sources mix for 2020, as the relevant Ministerial Decision no longer reflects the reality of the market. As the new FiTs for new PV system

installations no longer impose any financial burden to the special account for RES of LAGIE (The energy market operator in Greece) it is recommended to lift the blocking for the application process for new photovoltaic projects and remove economic, administrative and institutional barriers that slow down projects and discourage investment in green development.

Finally, attention and a special FiT should be given to the developing sector of Building Integrated PV systems (BIPV). The integration gives added value to the PV system and promotes the involvement of architects, thus introducing BIPV in the mainstream of building design. In any case, action should be taken to modify the building code in Greece in order to allow PV integration on buildings.

### REFERENCES

- [1]. HELAPCO, [www.helapco.gr](http://www.helapco.gr)
- [2]. NATIONAL RENEWABLE ENERGY ACTION PLAN, in the scope of Directive 2009/28/EC, July 2010, Ministry of Environment, Energy and Climatic Change.