Integration of electricity from renewables to the electricity grid and to the electricity market – RES-INTEGRATION

National report: Greece

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Interviewed Experts

We would like to thank all interviewed experts for their very valuable input and their support for this study. We highly appreciate their expert knowledge and their availability in the framework of the RES Integration Project on behalf of the European Commission.

For this country study, the following experts were interviewed:

Kampouris, Ioannis, Greek TSO- DESMIE

Seimanidis, Savvas, Association of RES-E Producers- ESIAPE

Anonymous, Public Power Corporation Greece-DEI

Loumakis, Stelios, Greek Association of Photovoltaic Producers- SPEF

Executive Summary

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow/Deep
	Relevant grid level	Transmission/Distribution grid
	Main barriers to integration	Inefficient administrative procedures Insufficient special planning

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	Common for non-interconnected islands
	Main barriers to integration	RES-Plants are sometimes cut off when new plants are connected to the grid

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Investors excluded from decision making process RES-Producer Rights are not clearly defined

Market design		
	Functioning markets	Compulsory participation in Day-ahead market
	Intraday market and gate closure	No intraday-market; 12:30 pm - gate closure for day-ahead market
	Main issue	high concentration in generation and supply

Support scheme		
	Support scheme	Priority dispatch; feed-in-tariff
	Market integration and/or risk sharing elements	No
	Balancing responsibility for RES producers	No

Table 1: Overview on grid and market integration Greece

There is a single grid connection procedure for transmission and distribution grid, due to the fact that PPC remains the owner of both systems. The novelties introduced by the law 3851/2010 have made the grid connection procedure less complicated but nevertheless created a “congestion” of applications, thus making the holding of the deadlines unrealistic. This is the main drawback RES-E

plants are facing for their further deployment along with other issues not directly related to the grid connection procedure. The enforcement of a RES-E Producer's rights in relation to license issues is possible but there is no right for compensation in any case. With respect to the costs of grid connection, for the transmission grid, there is a shallow costs approach, whereas for the distribution grid a deep cost approach.

The operation of the grid provides favourable conditions for the RES-E deployment. There is a purchase obligation for RES-E and a regime of priority dispatch. Apart from that, although RES-E plants are obliged to work in line with network requirements, the provision of ancillary services is not obligatory. In relation to the grid curtailment issue, there are general provisions included in the GGMOC so as to ensure the stability of the grid and a compensation mechanism is also foreseen. In the context of curtailment, under special circumstances not further outlined, the TSO is entitled to shut down a plant, without any previous notice.

The law defines a clear procedure for a regular drafting of grid development plans. The main responsibility lies at the DSO (which also is the dominant generator) and at the TSO. The legislator does not explicitly include the integration of RES-E into the goals to be considered, which are still limited to reliability of operation and economic feasibility. However, the grid operators claim to fully consider this issue, which is explicitly covered in a chapter of the transmission grid plan, for which a formal public consultation procedure is in place. Representatives of independent power producers and of RES-E associations argue that their interests are not seriously considered in grid planning, also due to the conflict of interest due to the fact that PPC acts both as dominant generator and as DSO.

Obligations of grid operators towards RES-E producers are binding only after the conclusion of a connection agreement contract. However, this can be signed only if the necessary grid infrastructure has been built, leading to a chicken and egg situation that does not enable RES-E producers to effectively pursue their rights.

The electricity market in Greece is still very concentrated. There is one company that controls 95 % of the generation and 100 % of the supply market. The market consists of a Day-ahead market, real-time dispatch (intra-day dispatch scheduling) and an Imbalance settlement (RAE 2009 RAE 2010) and a Capacity Adequacy Mechanism for the partial recovery of capital costs. For all market actors it is compulsory to participate in the Day-ahead market.

Support mechanisms for RES-E are: priority dispatch, a feed-in-tariff, a special feed-in-tariff for small photovoltaic plants and an investment support up to 35-50 %.

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Renewable electricity deployment

Greece started from a low share of RES-E, which was only 5 % in 1990 (Eurostat 2011). Strong growth in the last few years led to achieving 8.3% in 2008 (Eurostat 2011) and even higher figures are presented in the country's NREAP.

Current generation mix and net generating capacity

A graphical overview of Greece's electricity generation mix in 2010 is shown in Chart 1.

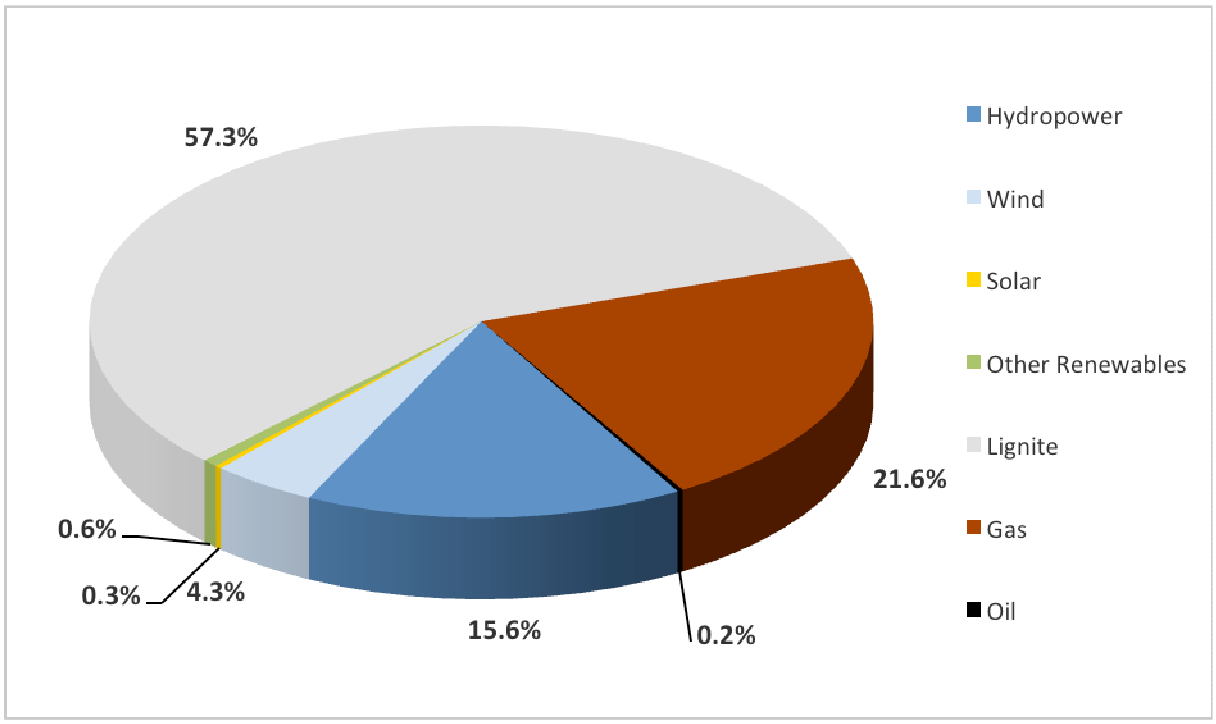

Chart 1: Generation Mix - 2010 (%), Source: own elaboration of Entso-e online database of Detailed Monthly Production. Sources not explicitly mentioned are included either in other renewable or other fossil fuels.

Power generation in Greece is dominated by lignite (57.3%), with important contributions of gas (21.6%), hydro (15.6%) and recently from wind, which reached 4.3% in 2010.

The significant cumulative capacities of gas and hydro could provide for significant balancing capacities for the expected further growth of variable renewable generation. However, a significant part of the wind resources is on the islands and in other areas with weak grid. Moreover, hydro capacities rely on precipitations that may vary significantly from year to year. In the medium and long term, the continuation of the current high reliance on coal will not be compatible with very high shares of variable generation.

The net generating capacity is provided in Chart 2.

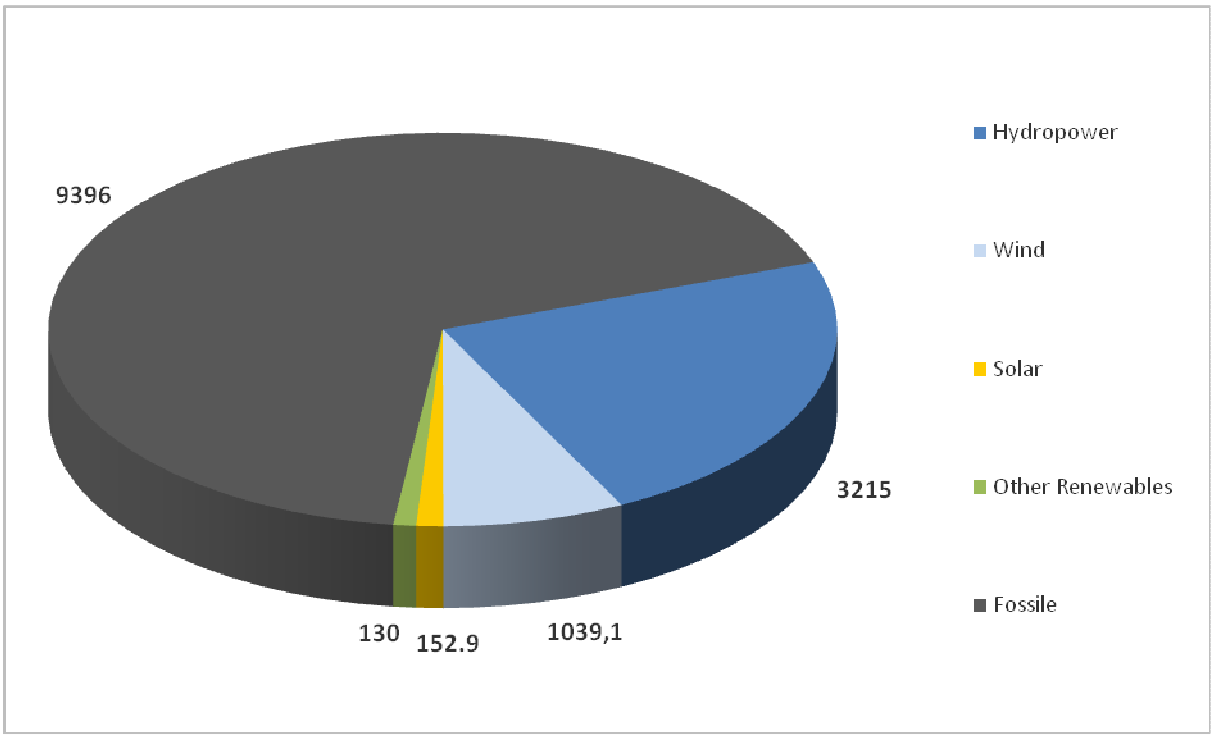

Chart 2: Net generating capacity - 2010 (MW), Source: own elaboration of Entso-e online database of Net Generating Capacity.

Electricity consumption

In 2010, Greece consumed 53,551 GWh (ENTSO-E 2011) of electricity, i.e. 4.7 MWh per inhabitant. This is significantly lower than the EU average of 6.2 MWh per inhabitant (ENTSO-E 2011, Eurostat 2011). Only six EU Member States have a lower consumption per capita, all of them are former socialist economies. The very low level of space heating demand and the high share of solar hot water heating contribute to the low electricity demand.

In terms of electricity intensity of the economy, in 2010 Greece consumed 239.6 MWh/ million EUR GDP, i.e. slightly less than the European average of 257.7.

Considering the development of electricity consumption in time (EEA 2010), Greece's consumption grew by more than 4% per year from 1990 to 2007. This is more than double the EU average.

Power demand grew in particular during the summer months. Greece is one of the three ENTSO-E countries with summer peak demand.

RES-E share

Chart 3 provides an indication of Greece's total electricity consumption and RES electricity production up to 2020, according to the submitted action plan (NREAP). In other words, this is not a forecast, but the plan according to the government.

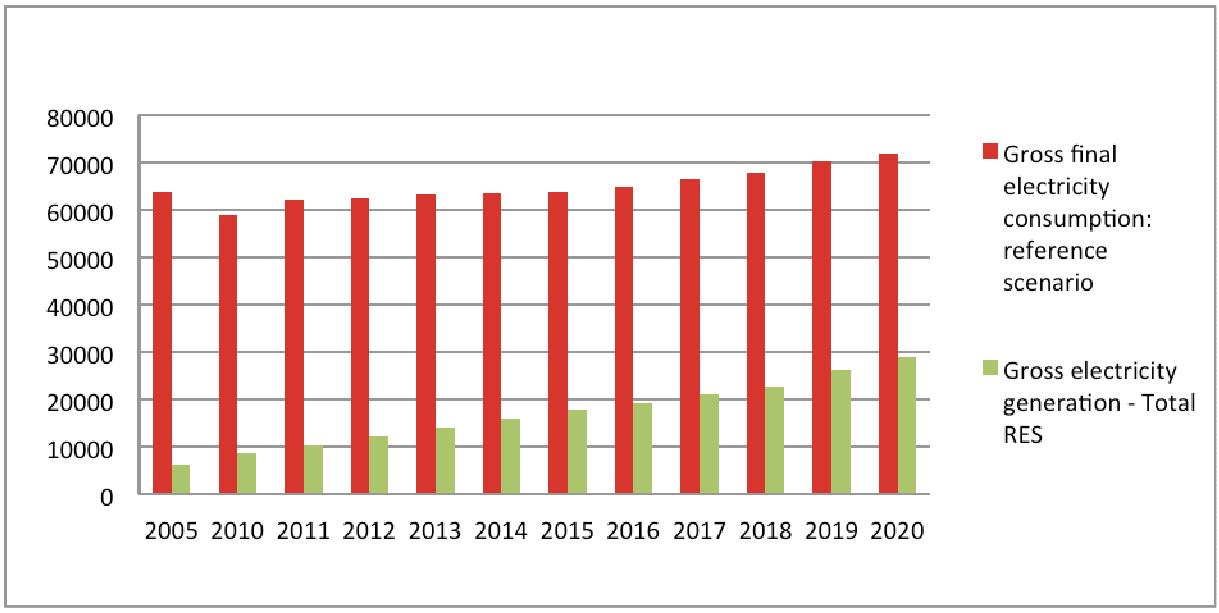

Chart 3: Electricity consumption and RES-E generation (GWh). Source: own elaboration of Greece's NREAP

According to the reference scenario of the Greek NREAP, gross final electricity consumption is expected grow from 58.9 TWh in 2010 to 71.8 TWh in 2020 (22.1%). This implies a reduction of the growth rate of consumption compared with the last decade, but still a growth rate of consumption over the European average.The share of RES-E is planned to increase from 14.6% in 2010 to 40.3% in 2020. In absolute terms, the NREAP assumes a growth from 8.6 TWh in 2010 to 29 TWh in 2020, i.e. a growth of 236% between 2010 and 2020. This compares with a growth of only 5% in the period 2003-2008, and to a decrease of -14% in the period 1998-2008 (Eurostat 2011). The assumed growth is huge and would require massive investments. The expected evolution of renewable electricity generation is further broken down in Chart 4.

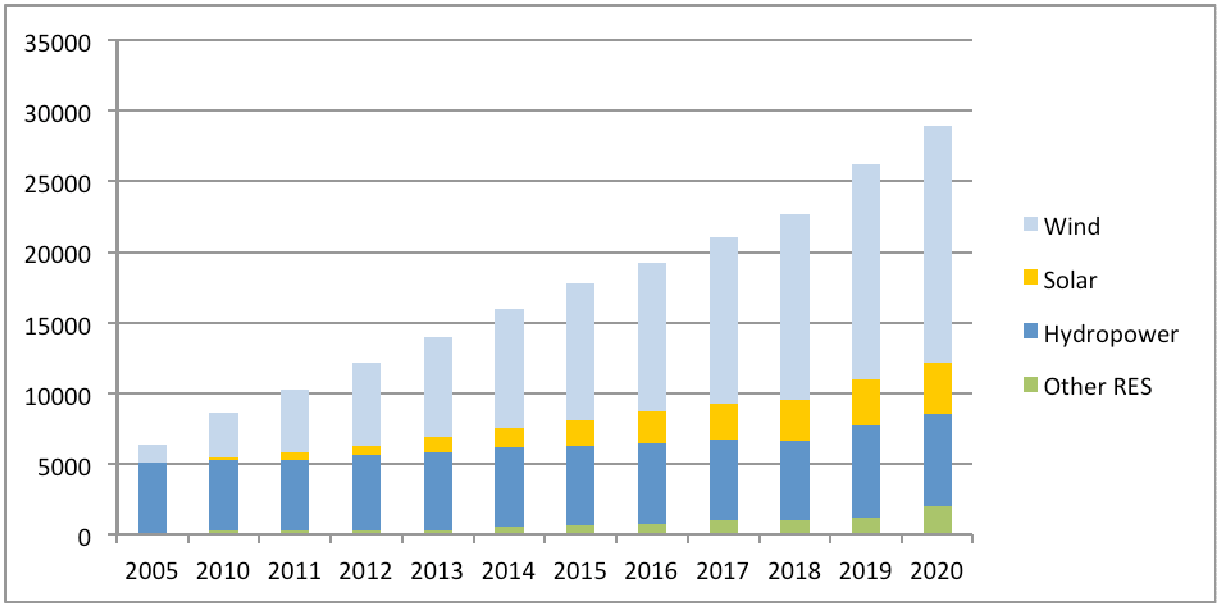

Chart 4: RES-E generation (GWh). Source: own elaboration of Greece's NREAP

Hydro generation is planned to grow by 30% from 5 to 6.6 TWh. The largest increase is planned for wind, which should grow from 3.1 to 16.8 GWh (ca + 550%), while solar energy is planned to grow from 0.24 to 3.6 TWh.

The largest part of the planned growth is expected from variable sources. While solar correlates well with peak demand in Greece, wind energy does not do so. Such large shares of wind generation would require a substantial development of the grid and probably of storage and balancing capacities, most likely requiring a significant reduction of the current high coal generation capacities.

Natural resources and geographical structure

As shown in Figure 1, the best on-shore wind resources in Greece are on the islands and in the coastal regions. In many cases, substantial grid expansion will be needed to exploit them, including submarine cables. Figure 2 shows that there are very good solar resources all over Greece, not only for PV but in some areas also for CSP.

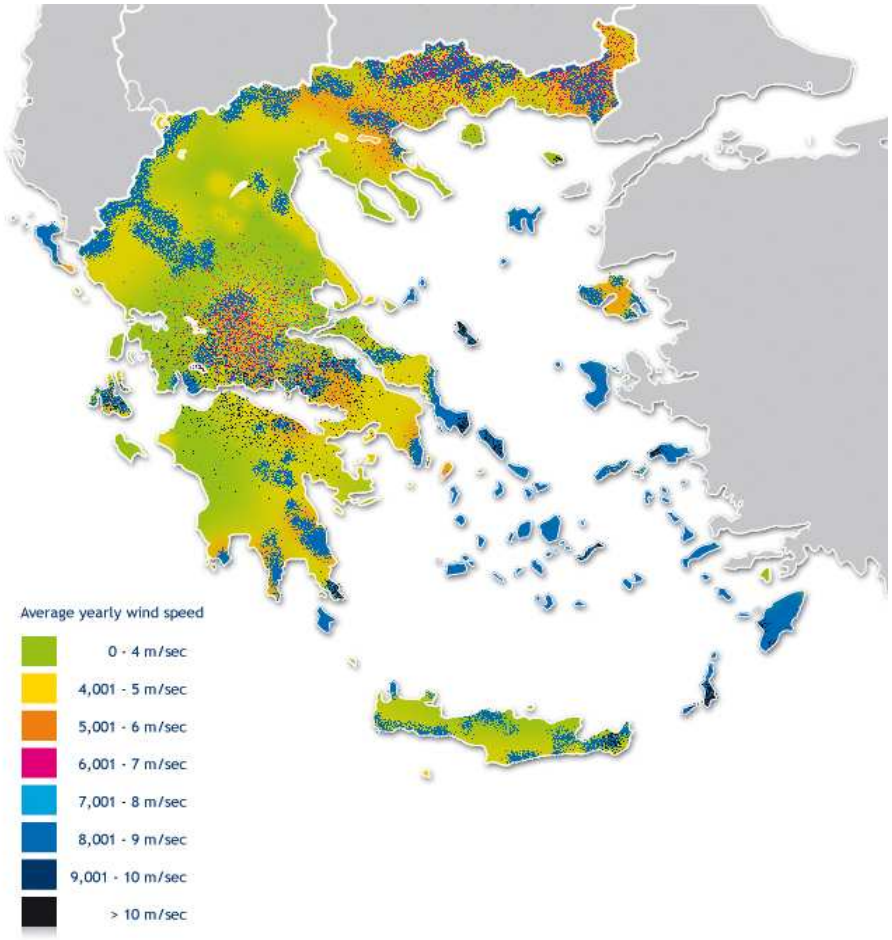

Figure 1: Average yearly wind speed in Greece. Source CRES

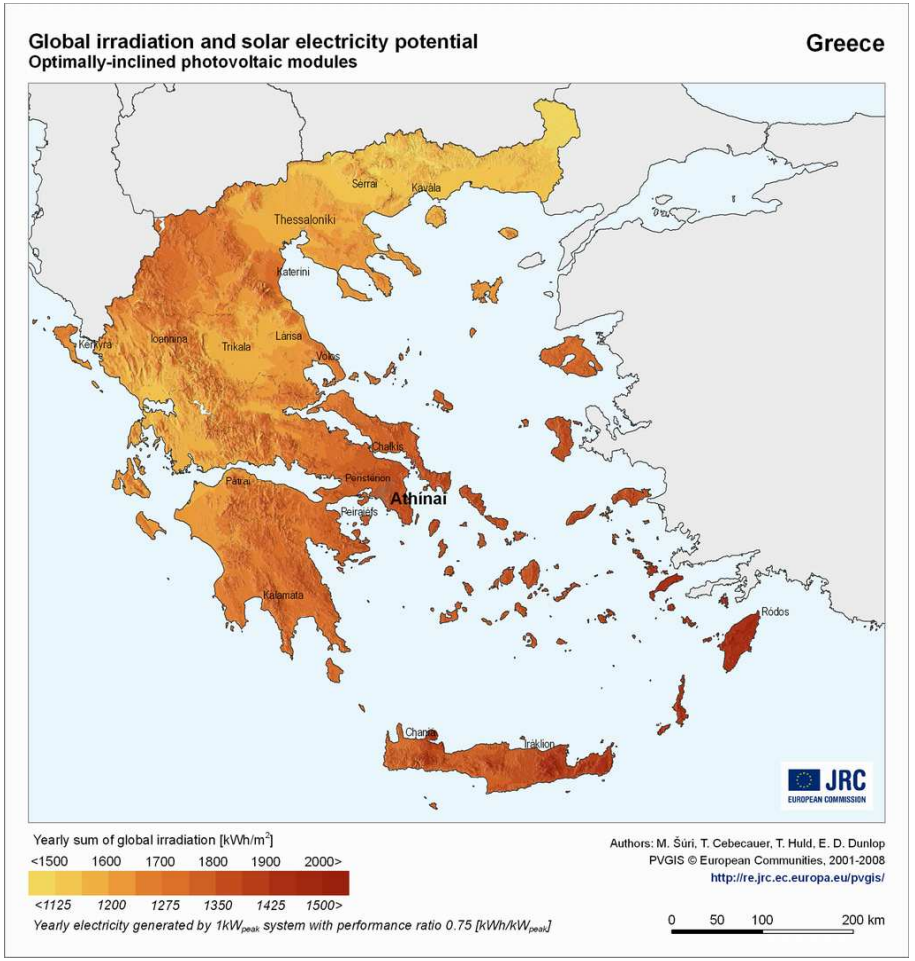

Figure 2: Yearly sum of global irradiation on horizontal and optimally inclined surface, 10-years average of the period 2001-2008 [kWh/m2]. (Source: EC JRC 2007)

Grid operators & dominant generators

Dominant generators

Power generation in Greece is dominated by the public power company PCC, which has a market share of 77% of the total energy demand during the first semester of 2010. In 2009 the respective percent amounted 84.5% (Kelemenis Soultati 2010).

In the last two years there have been considerable improvements in relation to the liberalization to electricity markets. New companies entered the electricity market, which is mainly due to the fact that competition is now open in the sectors of electricity generation and supply in the mainland grid and as of 1 July 2007 this covers all consumers including households. Nevertheless, the market a competitive market is not in place and competitors of PPC are continuously criticizing the dominant, purely monopolistic role of PPC.

The Greek market is split into two different systems: the mainland grid/ interconnected system and the non-interconnected islands, which include the islands of the Aegean Sea, Crete and Rhodes and have their own autonomous networks.

Transmission System Operators

Greek TSO known as DESMIE was established in 2000 as a first step of the liberalization process in Greece. DESMIE is currently a public limited company which belongs to the Greek public sector and PPC. Apart from that PPC remained the owner of the transmission grid.

Distribution System Operators

Currently, there is no unbundled DSO and DSO duties are undertaken by an organisational unit integrated in the PPC. PPC was criticized that the unbundling of DSO prevented the effective separation of distribution network activities and its activities as a business (RAE 2010). Nevertheless, the new draft on the liberalization of energy market in Greece, which integrates the so-called “third liberalization packet”, foresees the establishment of an independent DSO. Just like the transmission grid PPC has also the ownership of the distribution grid.

Interconnections, import/export

In absolute terms, Greece is the fourth largest net importer of electricity in the EU, after Italy, Lithuania and Finland.

GWh (2010)	BG	IT	MK	AL	TR	Total	% of consumption
Export	1	2299	8	493	0	2801	5,23%
Import	3453	72	3857	405	736	8523	15,92%
Net	**-3452**	**2227**	**-3849**	**88**	**-736**	**-5722**	**-10,69%**
Total flows	**3454**	**2371**	**3865**	**898**	**736**	**11324**	**21,15%**

Table 2: Physical exchanges in interconnected operation in 2010 (Source: ENTSO-E 2011)

Literature and other sources

EC JRC (2007): Šúri M., Huld T.A., Dunlop E.D. Ossenbrink H.A., 2007. *Potential of solar electricity generation in the European Union member states and candidate countries*. Solar Energy, 81, 1295–1305. Available at: <http://re.jrc.ec.europa.eu/pvgis/> (last accessed on 08.05.2011).

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Grid Connection

Summary

There is a single grid connection procedure for transmission and distribution grid, due to the fact that PPC remains the owner of both systems. The novelties introduced by the law 3851/2010 have made the grid connection procedure less complicated but nevertheless created a "congestion" of applications, thus making the holding of the deadlines unrealistic. This is the main drawback RES-E plants are facing for their further deployment along with other issues not directly related to the grid connection procedure. The enforcement of a RES-E Producer's rights in relation to license issues is possible but there is no right for compensation in any case. With respect to the costs of grid connection, for the transmission grid, there is a shallow costs approach, whereas for the distribution grid a deep cost approach.

Relevant legal sources

Law 3468/2006 and law 3851/2010[1] define mainly the grid connection procedure. Furthermore, FEK 1079 regulates the Special Program "PV on Rooftops". In addition, the Greek Grid and Market Operation Code (GGMOC[2]) regulates technical details with respect to grid connection

Connection procedures, deadlines, and information management

In Greece there is a main grid connection procedure for both the transmission and distribution grid. This is due to the fact that PPC, the Greek Public Power Corporation, remains the owner of both systems and will remain the DSO until the new energy draft law comes into force. The main differentiation with respect to the grid connection procedure, although not large, is between the interconnected system, namely continental Greece, and the non-interconnected islands. Apart from that, a less complicated grid connection procedure is foreseen as far as small RES-E Plants are concerned and as regards some special cases such as offshore wind farms, installation of PV by professional farmers and very small PV on rooftops.

[1] Law 3851/2010- Accelerating the development of Renewable Energy Sources to deal with climate change and other regulations addressing issues under the authority of the Ministry of Environment, Energy and Climate Change http://www.ypeka.gr/LinkClick.aspx?fileticket=qtiW90JJLYs%3d&tabid=37

[2] Greek Grid and Market Operation Code-Κώδικας Διαχείρισης του Συστήματος και Συναλλαγών Ηλεκτρικής Ενέργειας http://www.rae.gr/old/cases/C15/Codification_10-10.pdf

RES Plants connected to the interconnected system

Law 3468/2006 and law 3851/2010[3] define clearly the grid connection procedure. The diagram below provides an indication of the connection procedure for RES-E plants connected to the interconnected system.

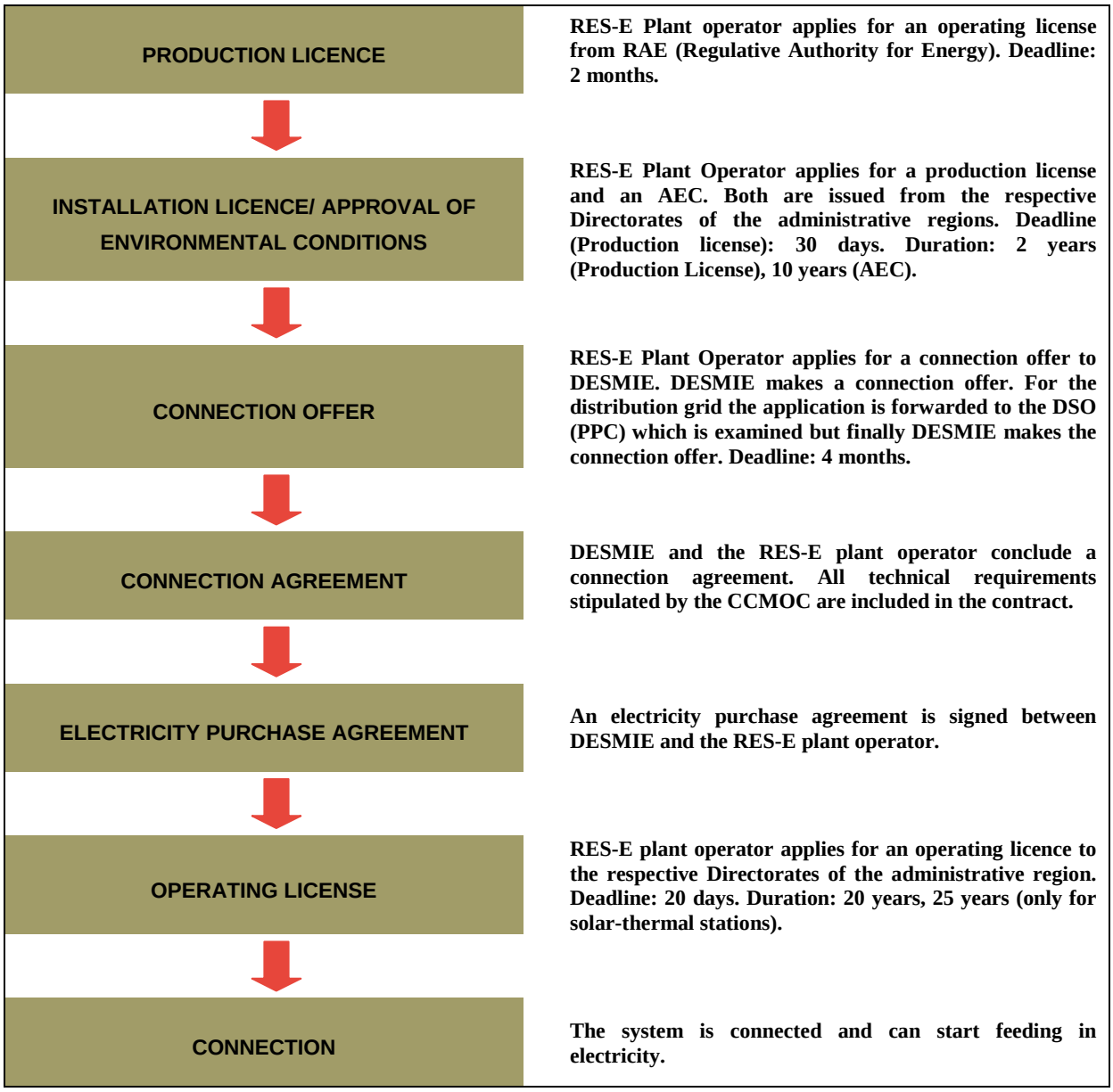

Diagram 1: Grid Connection Procedure for RES-E Plants Connected to the Interconnected System

[3] Law 3851/2010- Accelerating the development of Renewable Energy Sources to deal with climate change and other regulations addressing issues under the authority of the Ministry of Environment, Energy and Climate Change http://www.ypeka.gr/LinkClick.aspx?fileticket=qtiW90JJLYs%3d&tabid=37

Small RES-E Plants connected to the interconnected system

The procedure for connection of this kind of plants is very similar to the one indicated in Diagram 1, however with the following important differences:

- Small RES-E Plants enjoy a privileged treatment based on law 3851/2010. More specifically PV installations / solar-thermal plants with a capacity until 1MWp and wind parks until 100kW are freed from the obligation of issuing a production and an installation licence (Art 2 Par. 12 3851/2010).
- Wind farms until 20kW, PV plants until 0,5MW and PV plants installed on commercial buildings are freed from the obligation of conducting an EIA (Art.8 Par. 13 3468/2006).

The grid connection procedure for small RES-E Plants connected to the interconnected system is presented schematically below:

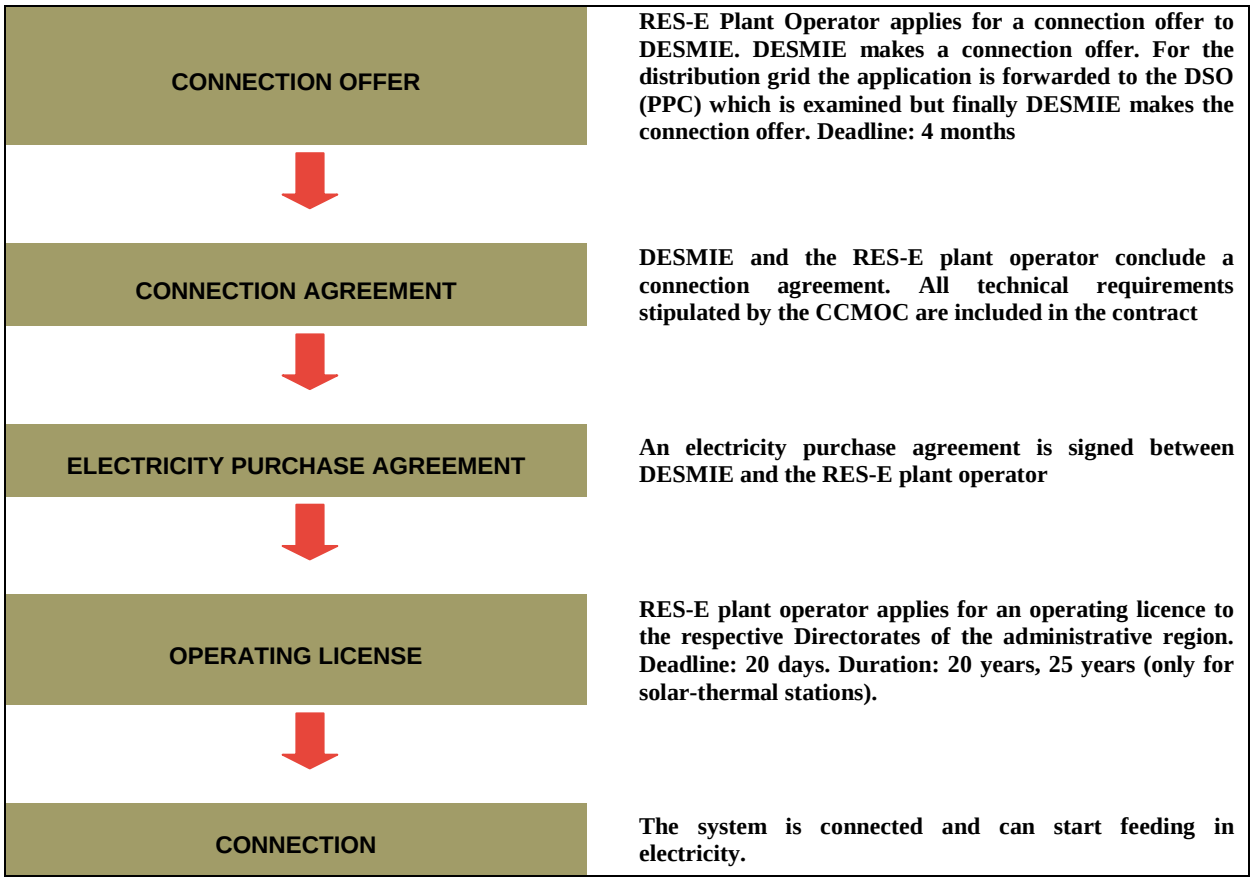

Diagram 2: Grid Connection Procedure for Small RES-E Plants Connected to the Interconnected System

From the diagram above one can understand that the grid connection procedure for small RES-plants in Greece is clearly less complicated as they are not obliged to issue a production license, an installation license and to apply for an AEC. The new grid connection procedure for small RES-E plants, defined by 3851/2010, was designed so as to boost the RES-E deployment and ease the unnecessary bureaucratic burden, with which small RES-E plants were entangled. Nevertheless, the

changes introduced by that law have also created other problems. For further details, please refer to page 24.

(Small) RES-E Plants connected to non- interconnected islands

There is hardly any difference as far as the grid connection procedure for RES-E Plants in non-interconnected islands. The substantial difference is that the authority responsible for the conclusion of an agreement with the plant operator is PPC, as the operator of non-interconnected islands (Art.10 3468/2006).

Offshore Wind Farms

There is a special regulation about the installation of offshore wind farms in Greece. Before any necessary step is made, law 3851/2010 stipulates that any decision relating with the installation of offshore wind farms will be made based on special spatial plans (Art. 6A 3851/2010). Apart from that, the decision for the definition of an area destined for an offshore wind farm is going to be made jointly by various ministries (Ministry of Defence, Ministry of Economy and Economics and YPEKA). Afterwards, a license is published with a decision by YPEKA, as it was mentioned earlier. The next step is the announcement of an open public tendering procedure "for the execution with financing or self-financing of the construction works of the offshore wind farm and its connection to the network, in return for the partial or entire concession of its exploitation by the contractor for a limited time period" (Art. 6A Par.5 3851/2010). A common ministerial decision, defining the details regarding the tendering procedure, is issued. Subsequently an operating licence is issued.

Nevertheless, it should be noted that, except for the apparent interest from the side of the investors, such a procedure concerning an offshore wind farm has not been realised. More specifically, the spokesperson of PPC and the DESMIE considered the development of offshore wind farms in Greece as unlikely to happen in following years (PPC 2011, DESMIE 2011).

Installation of Photovoltaic Plants by professional farmers on High Yield Farms

Apart from the general grid connection procedure, special attention was given on installing PV installations with capacity up to 100kW on high yield farms (see below in this paragraph for the definition). Main beneficiaries were farmers, something that, as it was previously mentioned, made RES-E producers and potential RES-E investors express the complaint that the Ministry of Environment, Energy and Climate Change (YPEKA) are making discriminations and that their investments will lag behind although they are ready to realise them (PV Legal 2011, SPEF 2011). The grid connection procedure for that specific category bares a great resemblance with the general grid connection procedure described above. Nevertheless, more stages are added in that specific procedure and more specifically on the early stages.

VERIFICATION OF OCCUPATION/ FARM CHARACTERIZATION	**The farmer should apply for an endorsement from the Greek Payment Agency (O.P.E.K.E.P.E.) that its occupation is professional farmer. In parallel, it should submit an application to Regional Directorate of the Greek Ministry of Agriculture for the characterization of**

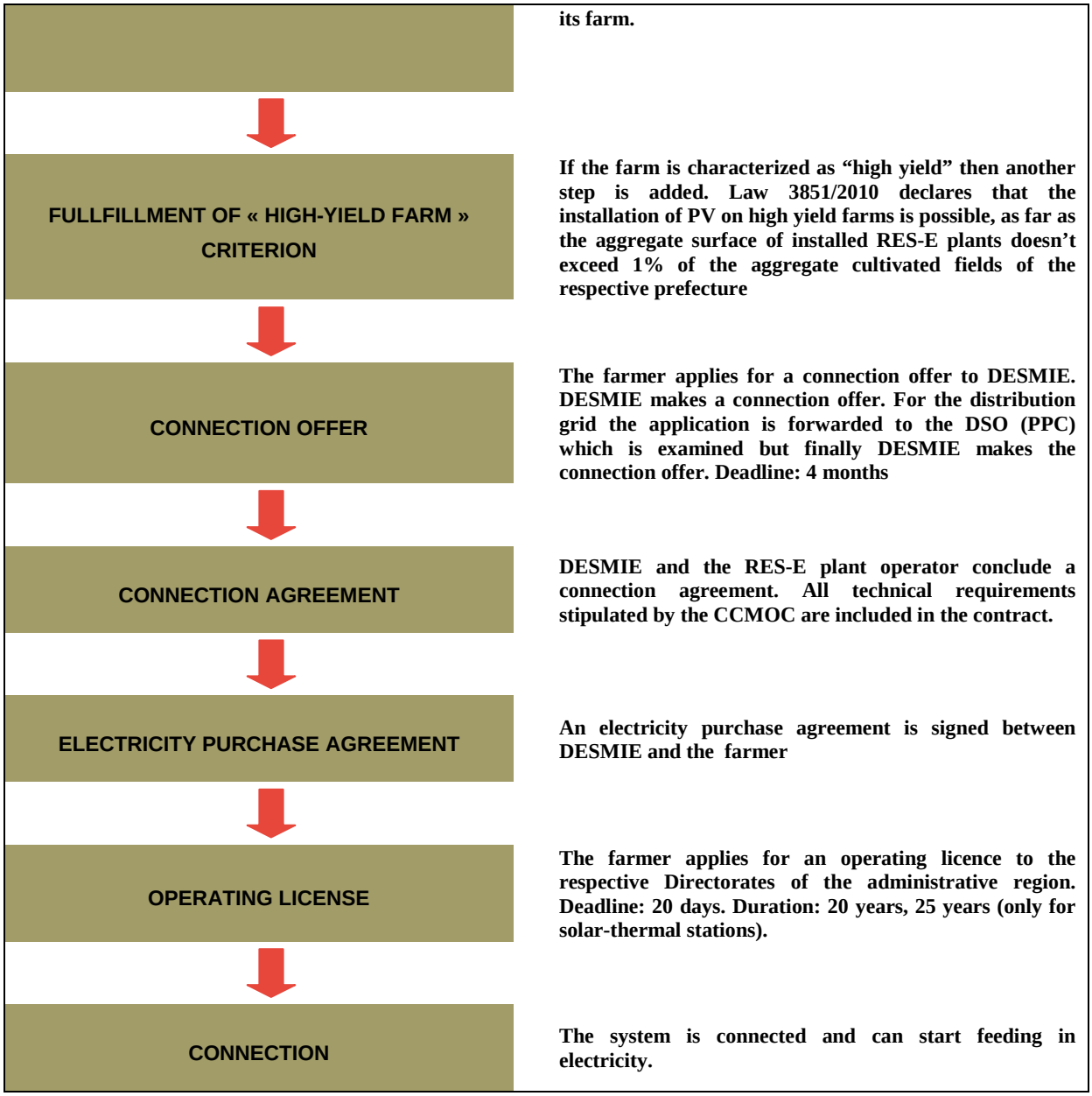

Diagram 3: Grid Connection Procedure for Small RES-E Plants Connected to the Interconnected System from Professional Farmers.

In order to be recognised as a high yield farm, the following procedure must take place. The first step is an endorsement from the Greek Payment Agency (O.P.E.K.E.P.E.) that the interested party is a professional farmer (FEK B 1049[4]). Apart from that, the farmer should submit an application to its Regional Directorate of the Greek Ministry of Agriculture for the characterization of its farm. The characterization follows the guidelines set in the joint ministerial decree FEK B 1528[5].

[4] FEK B 1049- http://newsite.desmie.gr/fileadmin/user_upload/Files/adeiodotisi/2010.07.12_FEK.1049_YA.249448.pdf
[5] FEK B 1528- http://newsite.desmie.gr/fileadmin/user_upload/Files/adeiodotisi/2010.09.07_FEK.1528_YA.168040.pdf

If the farm is characterized as "high yield" then another step is added. Law 3851/2010 declares that the installation of PV on high yield farms is possible, as far as the aggregate surface of installed RES-E plants doesn't exceed 1% of the aggregate cultivated fields of the respective prefecture (Art.7 Par.9 3851/2010). Afterwards, the grid connection procedure follows the same path as it was mentioned above and depending on the capacity of the installed plant. It should also be noted that submitted application until 11.10.2010 benefited from a prioritization of their application (YPEKA Circular no.26928[6]).

Special Programme "Solar On Rooftops"

This programme deals mainly with the installation of PV installation on rooftops of buildings and factories until 10KWp. Beneficiaries of that programme are natural persons or legal entities, which can be classified as "very small enterprises" (Art.1 FEK 1079[7]). The programme was initially applied to the interconnected system but with a new ministerial decree it is also applied to the non-interconnected islands but with a maximum capacity of 5kWp (FEK 1557[8]). The grid connection is shown schematically below:

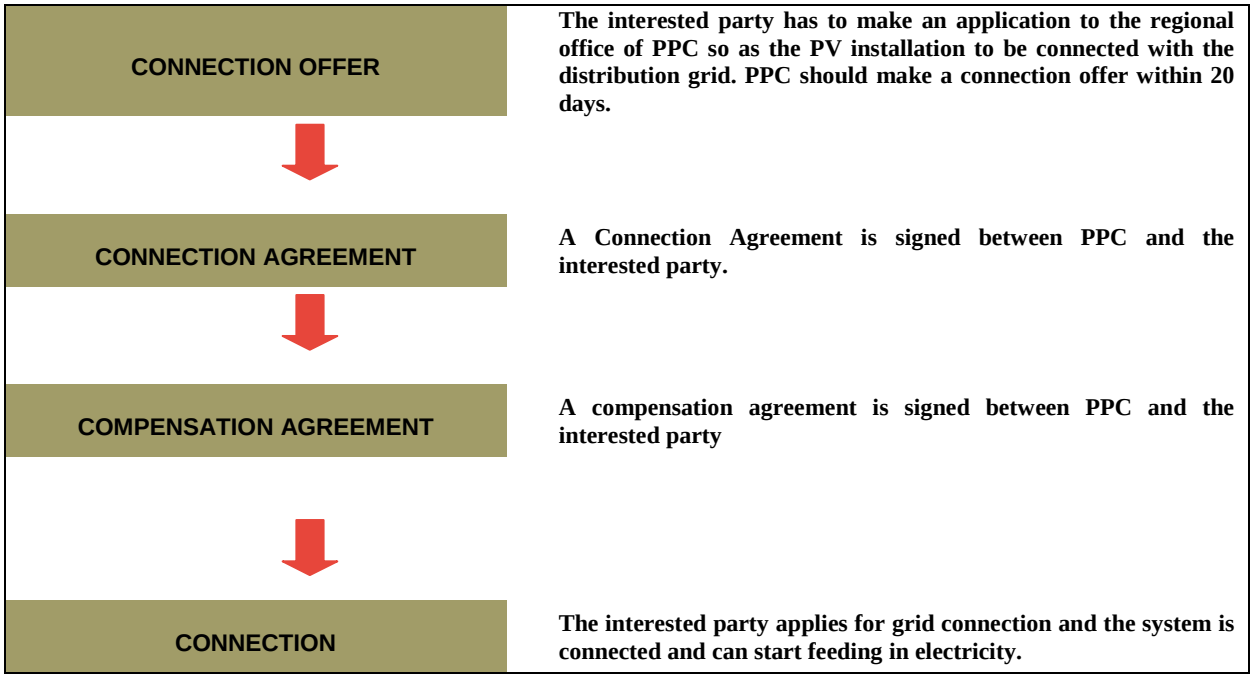

Diagram 4: Grid Connection Procedure for small PV installations on rooftops

The interested party sings a compensation agreement and not an electricity purchase as it was described in the previous grid connection procedures due to the fact that the interested party is already connected with the distribution grid as a customer and with the installation of a PV panel it will also

[6] YPEKA Circular no.26928 http://newsite.desmie.gr/fileadmin/user_upload/Files/adeiodotisi/2010.12.16_YPEKA_EG.26928.pdf
[7] Special Programme "PV on Rooftops"- Ειδικό Πρόγραμμα Ανάπτυξης Φωτοβολταϊκών Συστημάτων σε κτιριακές εγκαταστάσεις και ιδίως σε δώματα και στέγες κτιρίων http://www.ypeka.gr/LinkClick.aspx?fileticket=mz8ssdmgKhg%3d&tabid=541
[8] Replenishment Special Programme "PV on Rooftops"- Συμπλήρωση Ειδικού Προγράμματος Ανάπτυξης Φωτοβολταϊκών Συστημάτων σε κτιριακές εγκαταστάσεις και ιδίως σε δώματα και στέγες κτιρίων http://www.ypeka.gr/LinkClick.aspx?fileticket=LwVLx2p2Ne0%3d&tabid=555&language=el-GR

produce electricity for the grid. Finally, after those agreements are signed the interested party can apply for a grid connection to the local office of PPC (Art.4 Par.6 FEK 1079).

Obligation, legal responsibilities and enforcement of legal rights

The grid operator is obliged to connect RES-E Plants to the transmission or distribution grid (Art.11 3468/2006). Nevertheless, no concerns were expressed in relation to the enforcement of legal rights of the RES-E producer or from the authorities. Characteristically, the TSO spokesperson expressed the willingness of the operator to connect RES-E Plants into the transmission grid, but there are uncertainties which have to do mainly with the previous stages of the grid connection procedure, namely the production license and the AEC (DESMIE 2011). It was observed that although DESMIE was ready to connect an RES-E plant, the process stumbled upon a negative AEC (DESMIE 2011). This has to do mainly with a lack of carefully spatial planning policy in Greece (EWEA 2010).

Many efforts were made during the last thirty years as far as spatial policy in Greece is concerned. Improvement has only been incremental mainly due to the lack of consensus between the relevant stakeholders, and the inability of the authorities to enforce the law, where applicable. What is needed is merely a pragmatic spatial policy, which will take the peculiarities of Greek spatial development into account and above all it will have a consensual character. Laws regulating spatial planning should be carefully examined to identify room for improvement. What is even more important, the laws should be enforced.

Apart from that, the spokesperson of SPEF, the PV association, very interestingly pointed out that, in relation to the installation of PV, those installations should be located near the point of grid connection, preferably of the distribution grid. If a potential investor is willing to place a PV installation far from a connection point of the grid, then they should bear the cost of building the connection line (SPEF 2011).

The conclusion of a contract between both parties is obligatory. Both the authorities and the RES-E Producers associations do not consider the conclusion of a contract as a barrier for RES-E deployment. On the contrary, both sides expressed the necessity of a contract (SPEF 2011, ESIAPE 2011).

As far as the enforcement of a RES-E producer's legal rights is concerned, there is a possibility of legal action from the side of the RES-E Producer, if he does not agree with a decision taken by the specific authority, but this has to do mainly with license issues (ESIAPE 2011). Apart from that, there is no right for compensation in any way for the RES-E Producer (DESMIE 2011, PPC 2011).

Costs of grid connection

Connection charges are shallow as far as the **transmission grid** is concerned: the RES-E plant operator bears the costs of connecting the system. The RES-E plant operator also bears the costs of the measuring devices necessary to meter the electricity transmitted and received (Art.1 Par.5 3468/2006). The transmission grid operator bears the costs of expanding the grid (DESMIE 2011). As far as the

distribution grid is concerned, the RES-E Plant Operator bears all the costs related to the connection and the reinforcement of the grid (PPC 2011). Although the costs related to connection might be high, it was not considered as a drawback from a spokesperson of one association. On the side, there were complaints from another association that the distribution of costs is considered an unsolved problem and PPC overestimates the costs related to grid connection (ESIAPE 2011).

Both TSO and DSO take these costs into account when calculating the grid usage fees. Thus, they may pass on this cost to the consumer. The details are described below in the chapter about grid development.

Problems

As it was mentioned on page 19, the new grid connection procedure created some new issues, such as a "congestion" of old and new application for a connection offer, making it impossible for DESMIE to make an connection offer within 4 months, as it was formulated by 3851/2010.In addition, PPC characterized 16 regions as "congested"/ "saturated" and consequently it didn't accept any new application from interested investors from those areas. Nevertheless, RAE demanded a more detailed explanation on that matter as PPC did not explain the reasons for which the grid is saturated in those regions.

A better coordination between PPC, DESMIE and RAE is needed as far as this problem is concerned. It can be stated that practically PPC, as the dominant electricity generator in Greece, is not fully "unbundled" with operations of the transmission system (institutionally and theoretically an independent transmission operator exists) and of the distribution system (not unbundled). Nevertheless, after the new electricity law entered into force in August 2011, it remains to be seen if a clear "unbundling" will take place, as the law foresees a clear distinction/ "unbundling" of both transmission and distribution systems. "unchained" from the PPC one might expect that the relevant operators will be more able to coordinate their actions, locate problems and make decisions.

Apart from the plethora of applications resulting in a bottleneck effect, long waiting lines and a delay of the connection offer, one more concern was expressed in relation to the grid connection procedure. HELAPCO, the Greek solar association, has questioned the need of issuing multiple licences and more specifically the need of a production license, which constitute the first step of the grid connection procedure (PV Legal 2011). The association expressed the opinion that RAE, which is responsible for issuing that license is trying to examine the financial viability of the project and the licence issued is based on no environmental-related criterion. All in all, HELAPCO considers it merely as a remnant of the old, inefficient procedure and it should be abolished (PV Legal 2011). Nevertheless, it should be noted that all those problems are taken into account and the YPEKA, the Ministry of Environment, Energy and Climate Change, is trying to remedy that situation by issuing a Ministerial Decree concerning the regulations related with the issue of licences for RES-E plants.

A more careful planning as far as the deployment of RES is needed. Although the new law on RES introduced many novelties, the authorities were not prepared for the unexpected flow of application. A

better specification of the requirements as far as the grid connection procedure is concerned was needed. The respective authorities, namely the PPC, should be more efficient as far as the assessment of the applications of the interested RES investors is concerned. For the application of grid connection procedure a further simplification or a clearer definition of the requirements are needed.

Barriers identified			Solution proposed	Detailed description (Page)
Stand Alone	Cause	Consequence		
	New Grid Connection Procedure	**Congestion of applications**	A better coordination between PPC, DESMIE and RAE is needed.	24
	New Grid Connection Procedure	**long waiting lines**	A more careful planning as far as the deployment of RES is needed.	24
	New Grid Connection Procedure	**unexpected delays as far as the connection offer is concerned**	The respective authorities, namely the PPC, should be more efficient as far as the assessment of the applications of the interested RES investors is concerned.	24
	New Grid Connection Procedure	**Bottleneck effect**	The respective authorities, namely the PPC, should be more efficient as far as the assessment of the applications of the interested RES investors is concerned.	24
	Careless Spatial Planning	**Difficulty on locating where reinforcement is needed**	What is needed is a pragmatic spatial policy, which will take the peculiarities of Greek spatial development into account and above all it will have a consensual character.	23
Careless spatial planning results in a negative EIA			What is needed is a pragmatic spatial policy, which will take the peculiarities of Greek spatial development into account and above all it will have a consensual character.	23

Table 3: Connection: Summary of identified barriers and proposed solutions to overcome barriers

Literature and other sources

AEON (2010): ECORYS, eclareon, *Assessment of non-cost Barriers to Renewable Energy Growth in EU Member States* (Greece). Available at: <http://ec.europa.eu/energy/renewables/studies/renewables_en.htm> (last visit on 11 May 2011).

ESIAPE (2011): Seimanidis, Savvas, *Association of RES-E Producers- ESIAPE*. Interview on 30 May 2011.

DESMIE (2011): Kampouris, Ioannis, *Greek TSO-DESMIE*. Interview on 25 May 2011.

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PPC (2011): Anonymous, *Public Power Corporation Greece-DEI* Interview on 20 May 2011.

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SPEF (2011): Loumakis, Stelios, *Greek Association of Photovoltaic Producers- SPEF*. Interview on 8 May 2011.

Grid Operation

Summary

The operation of the grid provides favourable conditions for RES-E deployment. There is a purchase obligation for RES-E and a regime of priority dispatch. Apart from that, although RES-E plants are obliged to work in line with network requirements, the provision of ancillary services is not obligatory. In relation to the grid curtailment issue, there are general provisions included in the GGMOC so as to ensure the stability of the grid and a compensation mechanism is also foreseen.

Relevant legal sources

Law 3468/2006 and law 3851/2010 form the framework with respect to grid operation. Apart from that, FEK 1479 established provisions related to the purchase contract between the interested parties. In addition, the Greek Grid and Exchange Code regulates more technical details in relation to grid curtailment.

Obligations, legal responsibilities and enforcement of legal rights

There is a regime of purchase obligation for RES-E plants in Greece. As it was mentioned above, the RES-E plant operator, apart from signing a connection agreement, is also obliged to sign an electricity purchase contract with DESMIE for the interconnected system, or with PPC for non-interconnected islands (Art. 1 Par.1 3468/206). This contract has a duration of 20 years (25 for solar-thermal plants) (Art. 5 Par. 1 3851/2006). The purchase agreement contract stipulates that DESMIE or PPC are obliged to purchase electricity produced from RES-E plants in the interconnected system or the non-interconnected islands respectively (FEK 1479[9]).

In addition, there is also a priority dispatch regime for RES-E plants. More specifically DSO and TSO in the interconnected system, under the condition that grid stability is ensured, are obliged to give priority to RES-E plants (Art.9 Par.1 3468/2006). The same obligation is applied to non-interconnected islands (Art. 10 3468/2010).

In general RES-E producers should operate in line with network requirements. In general, the criterion "N-1" should be fulfilled (Art. 304) although in some areas, such as wind parks, that criterion is not obligatory, under the condition the integrity of the transmission grid is not endangered (Art. 305 GGMC). With respect to PV installations, plant operators should be able to modify the voltage of their installation within certain limits (184Vmin- 264V max) or else their installation is cut off the grid (SPEF 2011).

[9] FEK 1479- http://www.ypeka.gr/LinkClick.aspx?fileticket=nCH%2fZqR%2fZ%2fM%3d&tabid=555

The provision of ancillary services is currently not obligatory for RES-E producers and they are also freed from the obligation of paying related fees (DESMIE 2011, PPC 2011).

Grid curtailment

In relation to the interconnected system, grid stability is ensured with the criterion "N-1" (DESMIE 2011). In cases where grid stability is endangered and grid curtailment should be applied, DESMIE should inform beforehand the RES-E producers for grid curtailment (Art. 116 GGMC). Nevertheless under special circumstances and without any previous notice, DESMIE is entitled to shut down a RES plant (Art. 17 Connection Agreement DESMIE[10]). These special circumstances are not further elaborated in the GMOC.

A plausible solution to this problem could be grid development and reinforcement to specific located areas. Then, grid curtailment will not be considered as a permanent measure. However, in some cases grid curtailment may occur very seldom and to a very insignificant extend and the development of the grid may lead to inadequate rise of costs. In the cases it could be considered to accept grid curtailment, providing that adequate compensation mechanism is installed. This however should be considered with great caution and only in consent with RES-E industry.

Grid curtailment issues in Greece concern solely wind parks. As a matter of fact, it is due to the nature of the technology that the curtailment is applied only to wind parks. Because of the fact that wind parks are unforeseeable in comparison to PV installations as electricity generation is concerned, grid curtailment is seen as a measure that ensures grid stability.The current situation constitutes a clear violation of the obligation defined by RES-Directive to give priority to RES-E. Therefore the Greece government should urgently consider the introduction of curtailment rules that regulate the priority of RES-E and provide an adequate compensation in case grid curtailment would be necessary.

That is why there is also a special provision in 3851/2010 as far as the compensation due to grid curtailment is concerned. At the end of each calendar year, the Greek TSO or DSO pays each Wind Farm Operator additional remuneration which is equal to the remuneration corresponds to 30% of the energy cuts imposed during the previous calendar year. The above amount of energy cuts is raised every year by a maximum of 100%, so that the total remuneration the station receives is equal to the smallest amount between (Art. 5 Par. 4 3851/2010):

1. the remuneration it would receive if it operated with 2,000 equivalent hours, and
2. the remuneration it would receive if it operated without cuts.

[10]Connection Contract DESMIE-http://www.desmie.gr/up/files/%CE%A3%CE%A7%CE%95%CE%94%CE%99%CE%9F_%CE%A4%CF%81%CE%B9%CE%BC%CE%B5%CF%81%CE%AE%CF%82%20%CE%A3%CF%8D%CE%BC%CE%B2%CE%B1%CF%83%CE%B7_%CE%91%CE%A0%CE%95_11-4-11.pdf

Nevertheless, the spokesperson of DESMIE expressed his concern about the realization of such a compensation mechanism (DESMIE 2011).

With respect to the non-interconnected island, grid curtailment issues are regulated with the grid connection agreement. In contrast with the interconnected system, this agreement contains more precise indications about its enactment (PPC 2011). RES-E producers in that case are not eligible for compensation (FEK 1749).

Grid curtailment is a measure used more frequently in the transmission grid of the interconnected system (DESMIE 2011), whereas PPC had so far no need of curtailing generation in the distribution grid. In the non-interconnected island system, grid curtailment has a specific timetable, regulated by the grid connection agreement (PPC 2011). Taking into account the current number of RES-plants connected to the grid, curtailment is a solution which will continue to be implemented in the future (DESMIE 2011, PPC 2011).

That specific provision is mainly for the benefit of the RES producer. Small non-interconnected islands rely up to now exclusively on small (oil) power plants, located on the islands. RES, mainly wind parks, feed-in electricity only occasionally in the grid. Feeding-in more electricity than is needed to those fragile systems it will cause problems and might have harmful effects on the local communities. A radical solution might be that small interconnected islands must rely their electricity consumption based only on RES electricity generation and the existing power will only have a complementary role. However, this decisions lies on the political willingness to enforce such a promising measure. Apart from that a better interconnection of small neighbouring islands could also ameliorate the programming of electricity production from RES from those islands.

Problems

Further problems concerning grid operation are mainly technical, such as telecommunication issues with wind parks (DESMIE 2011) or in some cases, it has been witnessed that with the connection of a new RES-E plant older, neighbouring plants are temporarily cut off (PPC 2011).

Barriers identified			Solution proposed	Detailed description (Page)
Stand Alone	Cause	Consequence		
Grid curtailment concerns only wind parks			Because of the fact that wind parks are unforeseeable in comparison to PV installations as electricity generation is concerned, grid curtailment is seen as a measure that ensures grid stability.	28
Curtailment is seen as a permanent solution to ensure grid stability			A plausible solution to this problem could be grid development and reinforcement to specific located areas.	28
In non-interconnected systems (islands) curtailment is common and has a specific table			A radical solution might be that small interconnected islands must rely their electricity consumption based only on RES electricity generation and the existing power will only have a complementary role. A better interconnection of small neighbouring islands could also ameliorate the programming of electricity production from RES from those islands.	29

Table 4: Operation: Summary of identified barriers and proposed solutions to overcome barriers

Literature and other sources

DESMIE (2011): Kampouris, Ioannis, *Greek TSO-DESMIE*. Interview on 25 May 2011.

PPC (2011): Anonymous, *Public Power Corporation Greece-DEI* Interview on 20 May 2011.

SPEF (2011): Loumakis, Stelios, *Greek Association of Photovoltaic Producers- SPEF*. Interview on 8 May 2011.

Grid development

Summary

The law defines a clear procedure for a regular drafting of grid development plans. The main responsibility lies on the DSO (which also is the dominant generator) and at the TSO. The legislator does not explicitly include the integration of RES into the goals to be considered, which are still limited to reliability of operation and economic feasibility. However, the grid operators claim to fully consider this issue, which is explicitly covered in a chapter of the transmission grid plan, for which a formal public consultation procedure is in place. Representatives of independent power producers and of RES associations argue that their interests are not seriously considered in grid planning, also due to the conflict of interest due to the fact that PPC acts both as dominant generator and as DSO.

Obligations of grid operators towards RES-producers are binding only after the conclusion of a connection agreement contract. However, this can be signed only if the necessary grid infrastructure has been built, leading to a chicken and egg situation that does not enable RES producers to effectively pursue their rights.

Relevant legal sources

The law on the liberalisation of electricity market (2773/1999 and 3426/2005) defines the tasks of the grid operators concerning grid development. Ministerial decision FEK 492/2001 established the newly founded Greek TSO (DESMIE) and made it responsible for the operation of the transmission grid. The study for the development of the transmission grid, known as MASM is the main regulatory instrument for planning grid development in Greece. The respective obligations of the parties (DESMIE, PPC and RES- Producer) are defined in the "DESMIE Connection Agreement". Finally, the Greek Grid and Market Operation Code describes the allocation among the generators and the grid operator of related grid development costs, while some decisions of the Regulatory Authority on Energy define the allocation of costs between different categories of customers.

Regulatory framework for grid development

The regulatory framework for the development of distribution grid is set in Art. 22 of the law 2773/1999[11].For the transmission grid the same is set in Art. 18 of 2773/1999 in accordance with two ministerial decisions: FEK 268/2000[12], which announces the establishment of an independent

[11] Law 2773/1999- Liberalisation of the electricity market - Regulation of energy policy issues http://www.rae.gr/old/downloads/sub2/2773_99.pdf

[12] http://www.rae.gr/old/downloads/sub2/268%2812-12-00%29_PD328.pdf

unbundled TSO in Greece (DESMIE) and FEK 492/2001[13], which defined the duties of the then newly founded TSO.

According to Art. 22 of 2773/1999, the Greek DSO (namely PPC) is responsible for the operation and development of the distribution grid (Art. 22 Par.1 2773/1999). More specifically, it is responsible for developing and maintaining a technically effective and economic feasible distribution grid (Art. 22 Par.2 2773/1999). As far as the transmission grid is concerned, DESMIE is responsible for the operation and development of the transmission grid (FEK 492/2001 in accordance with Art.18 Par.2 2773/1999) and more specifically it is in charge of programming the development of the transmission grid, having as goals the preservation of a technically effective, economically feasible and integrated transmissions grid (Art. 5 FEK 492/2001). It must be noted that the integration of renewables is not included in the goals attributed by the legislator to the DSO and to the TSO. PPC is also the responsible operator and owner of the grids of non-interconnected islands and is responsible for ensuring the technical effectiveness and economic feasibility of electricity production so as to cover the electricity demand (Art. 23a 2773/1999). Also in this case, the integration of renewables is not a goal defined by the legislator.

PPC, acting as DSO and as owner of the distribution grid, possesses great flexibility as far as the decisions concerning grid development are concerned (PPC, 2011). For this reason, and due to the fact that the distribution grid is technically not too complicated, decisions concerning grid development are taken fairly easily (PPC, 2011). Nevertheless, "the absence of a legally unbundled DSO currently and the continued undertaking of DSO duties by an organisational unit integrated within PPC continue to prevent effective separation of the distribution network activity, in terms of decision making rights and functioning, from the competitive business of the integrated utility" (RAE 2010).

A better coordination between PPC, DESMIE and RAE is needed as far as this problem is concerned. It can be stated that practically PPC, as the dominant electricity generator in Greece, is not fully "unbundled" with operations of the transmission system (institutionally and theoretically an independent transmission operator exists) and of the distribution system (not unbundled). Nevertheless, after the new electricity law entered into force in August 2011, it remains to be seen if a clear "unbundling" will take place, as the law foresees a clear distinction/ "unbundling" of both transmission and distribution systems. "unchained" from the PPC one might expect that the relevant operators will be more able to coordinate their actions, locate problems and make decisions.

In practice, PPC as DSO is responsible of preparing and publishing a yearly development program for the distribution network. This plan lists all the necessary works needed for the next five years (Art. 23 Par. 2773/1999). The regional offices of PPC submit every year their proposals to the PPC HQ in Athens as an input to the central development plan is made. According to PPC, future RES deployment is taken into consideration while drafting the plan, though it is not explicitly included into the obligations defined in the legislative sources above (PPC 2011). Greece was obliged to formulate its targets as far as RES deployment is concerned and in addition to make projections as far as the RES energy mix is concerned. Nevertheless, such targets are not clearly defined in the relevant grid

[13] http://www.rae.gr/old/downloads/sub2/YA_7705_FEK%20492_2001.pdf

development plans. Nevertheless, as the RES sector is developing, it will be indispensable that the foreseen RES deployment will be taken into consideration. Unlike the case of the transmission grid described below, for the planning of the distribution grid no formal public consultation procedure is in place. RES producers and developers have no formal means to be included in this field.

It is expected that in the future RES producers and developers are entitled to express officially their opinion as far as grid development plans are concerned. Nevertheless, it would be advisable that relevant stakeholders such as associations of RES producers could be entangled in the decision making process.

Decisions concerning transmission grid development are taken by DESMIE. DESMIE is obliged to draft a study for the development of the transmission grid, known as MASM (Art. 6 Par.2 3426/2005[14]). MASM contains the timetable and the budget for grid reinforcement and grid development measures to be carried out in the next 5 years (MASM 2010). MASM can be seen as a regulatory instrument to achieve the strategic targets of the Greek energy policy (MASM 2010). MASM dedicates a chapter to grid development measures dedicated to the integration of RES, thereby identifying some general goals, mainly technical, with which the respective energy policy target could be reached. MASM mainly considers the deployment of wind power, analysing the potential of wind power integration in relation to the envisaged development works (MASM 2010).

The procedure leading to the adoption of MASM starts with a draft produced by the TSO, DESMIE. The draft is forwarded to the regulator RAE, and at the same time it is open for public consultation for around three months (no specific provisions exist on this matter). Once adopted by the regulator, the draft reaches the Ministry of Environment, Energy and Climate Change (YPEKA) for final approval (DESMIE 2011). The new draft law "on the Operation of Electricity and Natural Gas Markets"[15] includes a similar procedure, but the public consultation would be carried through in two iterations, once after the first draft of the TSO, and again after RAE has commented on it (DESMIE 2011). Thus, the interests of RES producers and project developers can be taken into account in the public consultation for the transmission grid plan (MASM), but these stakeholders have no mean to participate in the drafting phase.

Independent Power Producers express their frustration that the rational and effective development of the grid at both levels is effectively impeded by PPC, which acts simultaneously as the owner of the grids and as the dominant generator in competition to them (Mytilineos 2010). They asked PPC and the TSO DESMIE to participate in the strategic planning for the transmission grid, but so far unsuccessfully. They criticized the results of previous planning which caused a lack of infrastructures in areas with considerable wind potential (Mytilineos 2010, ESIAPE 2011). The same concern was also expressed by the spokesperson of the solar association SPEF, who argued that since the RES-Producers bear the total costs of distribution grid development, they should be entitled more influence on the planning (SPEF 2011), though it also recognized that some RES-producers may have

[14] http://www.rae.gr/old/downloads/sub2/N.3426_2005.pdf

[15] http://www.opengov.gr/minenv/wp-content/plugins/download-monitor/download.php?id=54

contributed to the current bottlenecks with irrational demands for grid connection and consequently grid development (SPEF 2011).

Obligations, legal responsibilities of the grid operator in relation to the RES-E producer

Obligations from both parties derive from the conclusion of the contract agreement. As discussed above, the conclusion of a contract agreement is obligatory before a RES-plant is connected to the grid (Art. 301 Par.7 GGMOC). The connection agreement includes specifically, which grid reinforcement works must be undertaken by whom (Connection Agreement DESMIE). The connection agreement includes provisions for the case that one of the obliged parties does not fulfil its obligations. If negotiations do not solve the issue, the disagreement can be settled in a civil law proceeding, (Art.9 Connection Agreement DESMIE).

However, despite the fact that the connection agreement should guarantee the rights of the RES-producer, the reality is totally different. The connection agreement is only the last step before the plant is connected to the grid. If the necessary reinforcement works have de facto not been executed, then the connection agreement cannot be signed, thus leaving the project developer without contract and without rights for compensation. All in all, it is a matter of willingness from the side of investor, and of whether he has the adequate capital to pay for the necessary works (SPEF 2011). In practice, a RES- Producer cannot legally demand from the operator to carry out the necessary development works and there is no claim for compensation (DESMIE 2011, PPC 2011).

The lack of an obligation to reinforce the grid could provide a serious block to investments in RES-E generation. For this reason, it may be advisable to introduce such an obligation in order to stimulate further RES-E investment and development. On the other hand, though, there is a high risk of unbalances in such context, meaning that an unbalanced introduction of such an obligation could become very unfavourable for grid operators and have in turn another negative effect. Therefore, the introduction of such an obligation should necessarily be preceded by extensive consultations and should be introduced in parallel to an incentive / penalisation system.

Regulatory instruments to encourage grid development

Beyond the MASM procedure described above, no other instruments that could encourage grid development with the purpose of integration of RES have been identified.

Grid development studies and planned improvements

For the transmission grid, see the section on MASM above. Other grid development studies have not been identified.

For the distribution grid, further improvements are expected in the field of smart metering. PPC is already installing smart metering devices in new buildings and is planning to replace the old counters (PPC 2011).

Allocation of costs borne by the grid operators

As it was mentioned both TSO and DSO may take into account grid development costs when calculating the grid usage fees. The costs are allocated fully to the customers of the grid (Art. 306 GGMOC). A recent decision of the regulator RAE[16] introduced a differentiation among user categories. In relation to the distribution grid, the same methodology is used in relation to the calculation of distribution network tariffs (RAE 2010).

Problems

A problem that should not be underestimated and it was mentioned by the authorities is the frequent negative reaction of local communities towards planned grid development works. Sometimes the resistance was so severe that the plan had to be cancelled (DESMIE 2011, PPC, 2011).

[16] RAE Decision 377/2010- http://www.rae.gr/old/elec_charges/RAE_377-2010_corr.pdf

Barriers identified			Solution proposed	Detailed description (Page)
Stand Alone	Cause	Consequence		
	DSO is practically not from PPC unbundled	**Conflict of interest of PPC, main DSO/generator**	A better coordination between PPC, DESMIE and RAE is needed.	34
	Little RES-E stakeholder inclusion in drafting the grid development plans	**Interests of RES-E producers are little considered in the transmission grid development plans**	It would be advisable that relevant stakeholders such as associations of RES producers could be entangled in the decision making process.	35
RES-E integration not fully taken in consideration			As the RES sector is developing it will be indispensable that RES deployment will be taken into consideration in the relevant grid development plans.	34-35
DSO and TSO are not attributed the goal of integrating RES-E by law			It would be advisable to ensure an approach that will ensure the rights of the RES producer and potential investor from the one side and the interests of public authorities from the other side .	36
Difficult to obtain reinforcement			See solution above.	36
Legal measures to obtain reinforcement are not viable options			See solution above.	36

Table 5: Development: Summary of identified barriers and proposed solutions to overcome barriers

Literature and other sources

DESMIE (2011): Kampouris, Ioannis, *Greek TSO-DESMIE*. Interview on 25 May 2011.

Energypress (2011): *«Πρεμιέρα» στις 20 Μαϊου για το εμπόριο ηλεκτρισμού με την Τουρκία- Premiere for the interconnection with Turkey*, Energypress, 2011. Available at: <http://www.energypress.gr/portal/resource/contentObject/id/09686ca2-832f-4ded-b7aa-c91a2c1efb44> (last visit 06 June 2011).

ESIAPE (2011): Seimanidis, Savvas, *Association of RES-E Producers- ESIAPE*. Interview on 30 May 2011.

MASM (2010): ΔΕΣΜΗΕ (Greek TSO-DESMIE), *Transmission Grid Development Study 2010-2014- Μελέτη Ανάπτυξης Συστήματος Μεταφοράς 2010-2014*, Αθήνα 2010. Available at <http://newsite.desmie.gr/fileadmin/user_upload/Files/masm/masm_2010-2014-RAE.pdf> (last visit 06 June 2011).

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RAE (2010): Regulatory Authority for Energy. 2010 *National Report to the European Commission*, Athens, Greece, November 2010, Available at: <http://www.rae.gr/old/K2/NR-Greece-2010.pdf> (last visit 20 May 2010).

SPEF (2011): Loumakis, Stelios, *Greek Association of Photovoltaic Producers- SPEF*. Interview on 8 May 2011.

Market integration

Summary

The electricity market in Greece is still very concentrated. There is one company that controls 95 % of the generation and 100 % of the supply market. The market consists of a Day-ahead market, real-time dispatch (intra-day dispatch scheduling) and an Imbalance settlement (RAE 2009 RAE 2010) and a Capacity Adequacy Mechanism for the partial recovery of capital costs. For all market actors it is compulsory to participate in the Day-ahead market.

Support mechanisms for RES-E are: priority dispatch, a feed-in-tariff, a special feed-in-tariff for small photovoltaic plants and an investment support up to 35-50 %.

Relevant Legal Sources

The basic legal framework is set with Law 2773/99, which is issued to harmonise the liberalisation of the electricity market in the provision of Directive 96/92/EC concerning the common rules for an internal electricity market.[17] At the same the Regulatory Authority for Energy (RAE) was legalised as a separate and independent body to supervise the Hellenic Transmission System Operator S.A. (DESMIE) and to be supervised by the Minister of Development.

The promotion of RES-E started in 1994. Res Law 3468/2006[18] defines the primary support mechanism for RES-E.

Law FEK 1079/2009[19] regulates the promotion of small roof-mounted photovoltaic systems.

Market Design

General availability of markets

The Greek wholesale market has been in operation since summer 2005 (RAE 2009). The market consists of a Day-ahead market, real-time dispatch (intra-day dispatch scheduling) and an Imbalance settlement (RAE 2009) and a Capacity Adequacy Mechanism for the partial recovery of capital costs.

[17] Law on the liberalisation of the energy market and on the regulation of issues related to energy policy: http://www.rae.gr/old/downloads/sub2/2773_99.pdf

[18] Law No. 3468/2006 Generation of Electricity using Renewable Energy Sources and High-Efficiency Cogeneration of Electricity and Heat and Miscellaneous Provisions: http://www.ypan.gr/docs/LAW_3468-2006__RES.doc

[19] Support scheme for PV systems. http://www.res-legal.de/fileadmin/translations/Greece_FEK_1079.pdf

To avoid dominant market abuse a regulated price cap and price floor is set by the Minister of Development Greece (Kellemenis, Soultati 2010).

The Regulatory Authority of Energy (RAE) and Hellenic Transmission System Operator (HTSO SA.) are the two corporate bodies that are responsible for the free electricity market.

The Public Power Corporation, S.A. (PPC) is still the dominant market player, controlling 95 % of the generation and 100 % of the supply market. However, according to the Memorandum of Understanding entitled 'Specific Economic Policy Conditionality' signed by Greece, IMF, ECB and the European Commission (MoU), the Greek government has to introduce further measures to open up the electricity market. Additionally, considering the wind target of 7500 MW by 2020 (1087 MW in 2009) and the high investment incentive from feed-in-tariffs, the renewable energy sector has a big potential to support further decentralisation in the market as well as the supply of stand-by and secondary reserve.

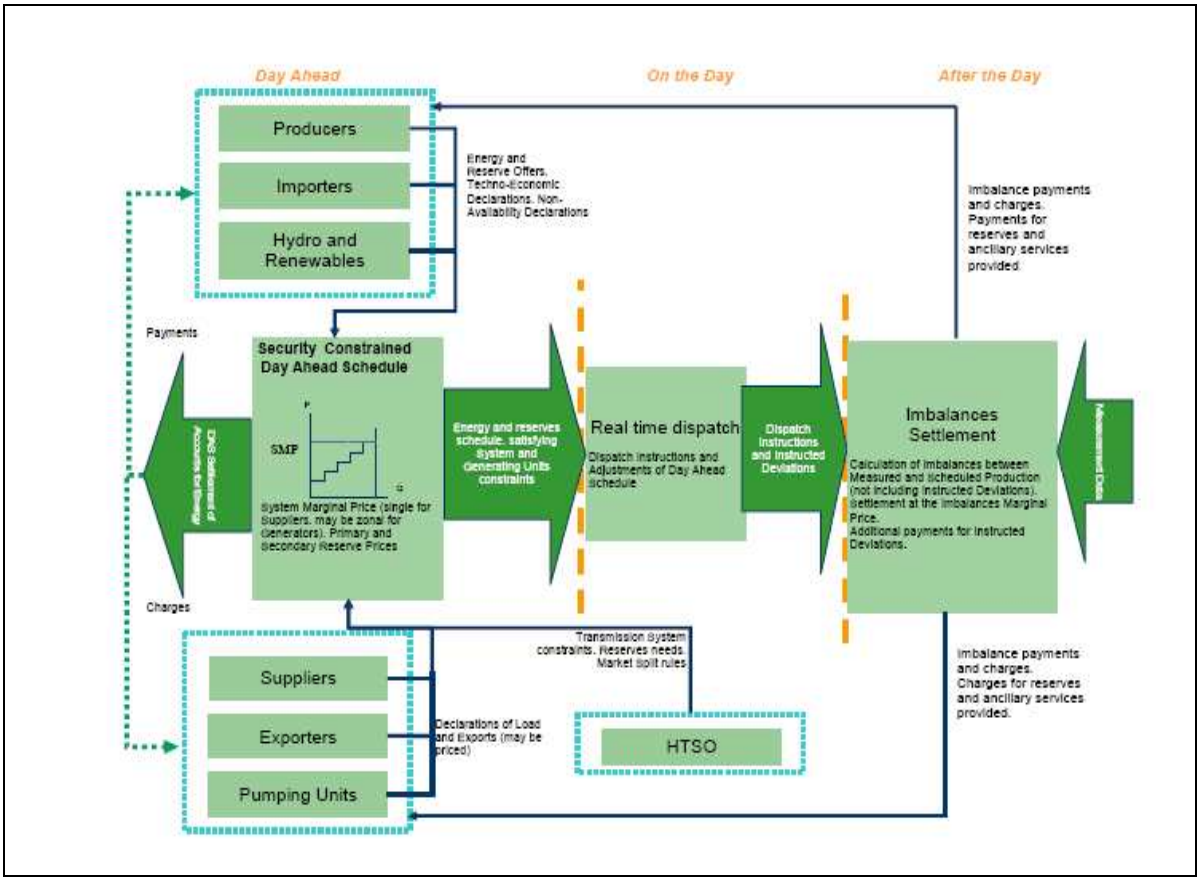

Figure 3: Greek Wholesale Electricity Market, Source: RAE, 2010

Day-ahead and Real Time Dispatch

The market is centralised in that for all market actors there is an obligation to participate in the wholesale market and more specifically in the Day-ahead market. Participants may conclude financial bilateral contracts but physical transactions have to be made within the power pool (RAE 2010).

Market participants offer their bids stepwise for each of the 24 hour periods of the next day. On an hourly basis the System Marginal Price (SMP) results as the market clearing price which is also the price paid to the producers. Gate closure of the Day-ahead market is every day at 12.30 pm. Afterwards the TSO regulates the electricity supply according to the bids and offers of the participants (Sakelaris et al. 2010).

In Real Time Dispatch (RTD) the TSO dispatches every five minutes to ensure system security (RAE 2009 RAE 2010).

Imbalances Settlement

There is no balancing market in Greece. The Imbalance settlement is an administrative procedure conducted through ex-post prices. Since 1 January 2009, the Day-ahead market provides simultaneously a schedule for the procurement of ancillary services. The TSO calculates for each dispatch day the imbalances in the system corresponding to each participant. The Imbalance Market Price is calculated on an hourly basis with the same algorithm as in the Day-ahead market. Electricity producers are in charge of balancing. Production offers of the Day-ahead market are firm. In the case of non-delivery producer are penalized for the amount of the shortfall in form of the ex-post imbalance price (RAE website ECRB 2011).

Support Scheme Design

General support scheme design

In Greece, there is a priority dispatch for RES-E. The general promotion system is a feed-in-tariff. For photovoltaic plants there is a special FiT. Besides, RES-E generation plants can apply for an investment subsidy covering up till 50 % of the total costs.

Feed-in Tariff I

The general promotion scheme is a feed-in-tariff which is paid by the TSO. The tariff is valid for 12 years and can be extended to up to 20 years. Tariff adjustment is made annually according to the average change in electricity generation costs or with consideration of the inflation rate (RESHAPING 2009). The tariff level varies according to technology and depends on the location (whether the plant is located on the mainland or on the islands.

FiT II - a specific scheme for small photovoltaic plants

Although Greece has a very high irradiation there are not many photovoltaic plants installed yet. A main challenge is the geographical landscape. Greece does not have many open areas to install PV plants, as the mainland and the islands are rather craggy and hilly. Thus, recently, there was a new support mechanism implemented (EWI 2010). On the mainland, there is a special feed-in method for smaller roof-top photovoltaic plants (capacity below 10 kW). The self-produced electricity is first deducted from the operator's electricity bill. If there is a positive net production the surplus gets

remunerated with the FiT II (FIT is set at 0.55 €/kWh) for a maximum 25 years. A tariff degression of 5 % a year is applied for new entrants between 2010 and 2019 (Ragwitz 2010). As soon as there is an extra roof-top capacity for each island the program will be implemented in a second phase (RE-SHAPING 2009).

Investment incentive up to 40 %

To support further implementation of RES-E all companies planning a RES-E generation plant are entitled to apply for an investment subsidy which covers 35-50 % of the total investment costs. The percentage depends on the regional zone and the promoted technology (Kaldellis 2011).

Main barriers for a further implementation of RES-E

The financial support for RES-E can be considered as satisfactory. However, the market access for RES-E operators is relatively difficult. Main barrier is the high administrative burden in Greece. In order to get promoted with the FiT operation generators have to apply for a special licence. The license can be refused and a typical application procedure to be completed takes more than 2-3 years (GreenNet-Incentives 2009).

Balancing responsibility for RES-E

There is no balancing responsibility for RES-E generation. Rather, the TSO is responsible for RES-E balancing. On the non-interconnected-islands a separate department of Public Power Corporation is responsible for dispatching electricity.

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NREAP Analysis

The table below presents an overview on the identified national barriers of the RES Integration study as well as on the respective NREAP content. Throughout the study, the consortium carefully analysed, if the identified barriers of this study are addressed in the national energy action plan and whether or not the NREAP does foresee a solution approach:

- The column “Barrier identified in RES Integration Study” lists the various barriers, which the present study identified and addressed. The list contains barriers from the section connection, operation as well as development.
- The column “Is the barrier Contested?” would indicate, whether stakeholders in the country under concern would oppose to the identified barrier, namely if they do not see the listed issue as a barrier to the system.
- The column “Section in NREAP” identifies, if and where the respective NREAP is addressing the barrier under concern. The column would list the specific section of the national action plan.
- The column “Summary of foreseen Measure” would contain a short description of the foreseen measure of the NREAP, to overcome the addressed barrier. The column would be empty, if the respective NREAP does not identify the barrier, respectively if the NREAP does not propose a solution to the issue.
- The column “Comments & Evaluation” would contain a short analysis of the proposed NREAP solution and would evaluate, whether the solution is an appropriate and credible option to overcome the existing issue. If the NREAP does not identify the barrier, this section may also contain a short summary of the identified issue.

For a detailed description of the identified barriers in the framework of the RES Integration study, we kindly refer to the sections above, regarding connection, operation, development and market integration of RES-E installations.

Barrier identified in RES Integration Study	Is the barrier contested?	Measures foreseen in NREAP		
		Section in NREAP	Summary of foreseen Measure	Comments & Evaluation
New Grid Connection Procedure			Not addressed in NREAP	
Congestion of applications			Not addressed in NREAP	
long waiting lines			Not addressed in NREAP	
unexpected delays as far as the connection offer is concerned			Not addressed in NREAP	
Bottleneck effect			Not addressed in NREAP	
Careless Spatial Planning			Not addressed in NREAP	
Difficulty on locating where reinforcement is needed			Not addressed in NREAP	
Careless spatial planning results in a negative EIA			Not addressed in NREAP	
Grid curtailment concerns only wind parks			Not addressed in NREAP	
Curtailment is seen as a permanent solution to ensure grid stability			Not addressed in NREAP	
In non-interconnected systems (islands) curtailment is common and has a specific table		**4.2.7 c)**	Some measures concerning the development of the grid infrastructure in order to increase the penetration of variable RES plant are mentioned concerning the interconnected system. However nothing is foreseen for the non-	Problem acknowledged only concerning interconnected systems.

			interconnected systems.	
DSO is practically not from PPC unbundled			Not addressed in NREAP	
Conflict of interest of PPC, main DSO/generator			Not addressed in NREAP	
Little RES-E stakeholder inclusion in drafting the grid development plans			Not addressed in NREAP	
Interests of RES-E producers are little considered in the transmission grid development plans			Not addressed in NREAP	
RES-E integration not fully taken in consideration			Not addressed in NREAP	
DSO and TSO are not attributed the goal of integrating RES-E by law			Not addressed in NREAP	
Difficult to obtain reinforcement		**4.2.6 h)**	The barriers against the development of the grid have been dealt with and public tenders were already published.	Barriers acknowledged but not further detailed
Legal measures to obtain reinforcement are not viable options			Not addressed in NREAP	

Table 6: Summary of identified barriers and treatment of barriers in NREAP