Solar urban planning

The Portuguese state of the art

Entity

Lisboa E-Nova

Developers

Joana Fernandes

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1. Political, Legal and economic framework

1.1. Describe the National policy in force regarding energy and renewable energy technologies.

National Energy Strategy

The Portuguese National Energy Strategy is define by the Cabinet Resolution nº169/2005, of 24th October and is set on the basis that the Portuguese energy scenario is characterized by a strong external dependence, with an energy demand growth rate significantly higher than GDP growth rate, and an energy system largely dependent on fossil primary sources (i.e. oil, natural gas and coal).

The Strategy having the following main goals, determines the main policy guidelines and most relevant measures for the energy sector:

- To guarantee the security of energy supply, through the diversification of the primary resources and energy services and energy efficiency promotion;
- To stimulate and favour competitiveness, in order to safeguard the consumers? rights as well as the competitiveness and companies efficiency;
- To ensure the complete energy process environmental sustainability, through the reduction of the environmental impact at local, regional and global scales.

This Strategy foresees the reorganization of the energy sector, mainly through five action axis, to be operacionalized through measures and legislative instruments, namely:

(i) the liberalization of gas and electricity market;
(ii) the establishment of two major competing operators in the gas and electricity sectors;
(iii) the development of a single transmission system operator for gas and electricity;
(iv) a strong promotion for the development of renewable energy;
(v) a plan implementation for the increase of energy efficiency.

The Targets for Renewable Energies implementation until 2010 were are also defined in the Energy Strategy, aiming at increasing the percentage of final electricity consumption from renewable energy sources to 39%. For that several measures regarding the development of RES technologies were set, such as defining adoption targets for wind (5100 MW until 2010), biomass and solar technologies. The targets established for PV in the cabinet resolution 63/2003 were of 150MW for grid connected systems until 2010 and are still in force. Nevertheless, since 2008 this implementation cap considers

not only PV systems but also solar thermoelectric technologies, as stated in the Decree Law 225/2007. This Decree Law also establishes the calculation procedure for determining each subsidized technology feed in tariff. Solar technologies feed in tariff are defined according to the type and size of the installation, distinguishing between ground and building mounted and installed capacity below or above 5kWp (with system capacities below 5 kWp being favoured).

National Action Plan for Energy Efficiency

The Resolution of the Council of Ministers No. 80/2008 approved the National Action Plan for Energy Efficiency, a document that covers a wide range of programs and measures to be essential for Portugal to achieve and surpass the targets set under Directive No. 2006/32/EC of the European Parliament and the Council of 5 April on the end-use efficiency of energy and energy services. This action plan sets ambitious energy efficiency policies, covering all sectors and aggregating the various measures adopted in a wide range of 12 programs.

Regarding solar technologies, the National Action Plan introduced the Renewable at the Time and Solar Thermal Programme.

The Renewable in the Time measure aims at promoting the existence of 75 thousand electricity-producing homes (165MW of installed power, distributed through 58.100 installations) until 2015. This programme sets as mandatory the installation of at least 2 sqm (on a basis of 1 sqm per 1 kW installed) of solar thermal to access a bonus on the kWh tariff, with exemption of the municipal licensing for small installations.

Within the Solar Thermal measure the goal is to achieve a solar thermal market of 175,000 sqm/year through dissemination campaigns, incentives programme for the installation of new solar thermal (fiscal benefit up to 30% of the investment within the Income Tax of Natural Persons, with a limit of €777), mandatory installation of solar thermal in new buildings, oriented programmes for specific segments (social dwellings, swimming-pools and showers, solar condominium). The targets for solar thermal systems adoption are defined for 2010 and 2015. For 2015 the targets are: 1.113.093 sqm of in residential houses and 272.572 sqm in services buildings.

1.2. National thermal building energy certification or building regulations.

On the 4th of April 2006, the Portuguese Government published the new Portuguese regulations for buildings, that transposes into the EU Directive 2002/91/CE:
The Portuguese official documents are:

Building Certification National System on Energy and Interior Air Quality (SCE) (Decreto-Lei n.º 78/2006, DR 67 SÉRIE I-A, 2006-04-04).(SCE Calendar (Portaria n.º 461/2007. DR 108 SÉRIE II, 2007-06-05) establishes that during the 1st phase: – 2007-07-01, only new dwelling buildings with more than 1000 sqm, and Commercial Buildings (New or Major Renovations) with more than 500 sqm (Commercial Centres, Super markets, and Heated Covered Swimming-pools) or 1000 sqm (all others) are considered; 2nd Phase – 2008-07-01: All New Buildings with a licensing process or building authorization and, in the 3rd Phase – 2009-01-01 : All Buildings, including existing buildings involved in a commercial operation of renting or selling are obliged to comply with SCE. The owners of these buildings have to exhibit the corresponding energy an indoor air quality certificate to concretize the operation but they are not obliged to install solar collectors.)

Air Conditioning Energy Systems Regulation (RSECE) (Decreto-Lei n.º 79/2006, DR 67 SÉRIE I-A, 2006-04-04) (It imposes as mandatory priority, the consideration in both new buildings and major renovations, with the exception of fault of technical availability demonstrated by the designer under a mandatory methodology, the usage of flat solar collector systems for hot sanitary water production (Clause 2.a, Article 32 of RSECE)).

Thermal Performance Building Regulation (RCCTE) (Decreto-Lei n.º 80/2006, DR 67 SÉRIE I-A, 2006-04-04) improves the already existing regulation, almost duplicating the thermal performance request in the new and renovated buildings and imposing the usage of solar thermal collectors for hot water production if there is favourable conditions for exposure (if the roof or cover runs between SE and SW without significant obstructions) in a base of 1sqm per person (the total can be reduced up to 50% if space is necessary for other important usages of the building).)
According to the Thermal Performance Building Regulation (RCCTE) 2nd Article – Application Framework, the exemptions are defined in the 9th point:

a) Buildings or fractions that, due to their characteristics are to remain open or in contact with the exterior for the large majority of the time and do not have any heating or acclimatization system.
b) Churches and processes industrial buildings, as well as garages, warehouses, cars maintenance facility and non residential agriculture buildings

c) Refurbishment actions in buildings sited in historical areas or classified as architecturally or architectonic protected ones
d) Military infrastructures.

1.3. Existing national renewable/solar thermal/solar photovoltaic ordinances.

Presently there is a national obligation for adopting solar thermal systems, as defined in RCCTE and RSECE. Exemptions do not have to comply with this obligation.

1.4. Describe the available subsidies at national level to solar technologies adoption.

The Portuguese Government launched in 2009 a campaign to promote solar thermal systems adoption in existing houses. The programme, developed within the context of the National Action Plan for Energy Efficiency support's the purchase of solar thermal systems kits, by bearing half of the system cost, in a straight partnership between the Government, financing institutions and marker suppliers. The business model is based on a standard solution where the financial institutions present three options to the consumer and account credit in preferential conditions. To the final consumer these advantages reflect on the system final price that is reduce to half of the original one as the remaining costs are supported by the equipments cost reductions by large scale economies and by the Government public co participation of 100 million Euros. This incentive intents to promote the accomplishment of a national target to install 250.000 sqm of solar thermal collectors, in more then 65.000 houses, by the end of 2009.

At national level the imposition for installing solar thermal collectors is also accompanied by tax exemptions and deductions, namely all the equipments for renewables have a VAT of 12% (instead of the conventional 20%) and these equipments are also beneficiated in fiscal deductions, it can be deductible in the individual income tax up to 30% of the total investment, to a maximum of 777 Euros. These tax exemptions and deductions are listed in the 2008 Portuguese State Budget and change according to the annual Portuguese State Budget.

Solar photovoltaic systems electricity production is subsidized when injected in the national electricity grid through feed-in tariff mechanisms. The feed-in-tariff mechanism is presented according to three types of financial frameworks, the independent power producer (IPP), the producer consumer (PC) schemes and the most recent one the Renewables at the time.

The Renewables at the Time regime comes in line with the National Action Plan for Energy Efficiency,

which entered in force with the approval of the Decree Law 363/ 2007 that establishes the legal framework applicable to the production of electricity through micro-production units. At the moment the most attractive and developed solution are PV systems, mainly due to the high feed-in tariff, 650Euros/MWh, for the initial 5 years, decreasing in the following years according to the total installed capacity. This framework is limited to an annual registered capacity of 10MW.

Between the IP and the PC frameworks, main differences are the consuming obligation, the tariffs and guarantee period, as well as the legislative procedure. Under the PC framework there is a local consuming obligation of 50% of the generated electricity. The overall value of the feed-in-tariff is set independently of the system size with a guarantee period of 10 years, after what the tariff is revised and a lower feed-in-tariff granted until the system reaches its end of life. Under the IPP framework the tariffs are set differentiating between systems with an installed capacity under and above 5kWp with a guarantee period of 15 years or until the systems delivers 21GWh per MWp installed.
The main advantage of the PC framework is the simplified administrative procedure subjacent to the licensing process when compared to the one associated with the IPP framework. The IPP framework is far more complex and due to the fact that, it is only valid until the national 150MW target is attained, the licensing process passes through the Portuguese Directorate-General for Energy and Geology (DGEG) that due to an excess of appliances in 2005, decided to froze the process, with still 22 MW capacity available for attribution under the IPP framework. (Rodrigues, 2006)
In May 2007, the Decree Law 225/2007 was revised in order to valorise PV installations in buildings, still differentiated according to the installed capacity above or under 5kWp and with a capacity cap for applying to the IPP framework of 50MW.

1.5. Financing mechanisms to solar technologies adoption.

Solar Thermal

Within the government programme, the financing institutions offer special credit conditions to the final consumer that wishes to install solar thermal collectors. This mechanism aims at accomplishing the national target to install 250.000 sqm of solar thermal collectors, in more then 65.000 houses, by the end of 2009.

Solar Photovoltaics

The Portuguese Government also lunched in 2008 the Renewable in the Time programme that aims at promoting the existence of 75 thousand electricity-producing homes (165MW of installed power) until 2015. This programme sets as mandatory the installation of at least 2 sqm (on a basis of 1 sqm per 1 kW installed) of solar thermal to access a bonus on the kWh tariff, with exemption of the municipal licensing for small installations. The most popular systems installed so far are solar photovoltaic systems as these installations receive the highest feed in tariff: 60c€/kWh. The financing

institutions also offer good credit conditions to allow private investors to install micro-generation systems.

1.6. National barriers hindering solar technologies adoption.

Within Lisboa E-Nova participation in the Intelligent Energy Europe Programme project PROSTO some of the barriers hindering solar thermal technologies adoption were identified. The barriers were defined according to three categories: communication with the market (impact on the decision to adopt solar thermal systems); administrative issues; and implementation issues. The most important communication barriers relate to lack of appropriate communication with the public and architectural integration projects, the idea of a high initial investment and the unclear message that is perceived with the different added value tax (IVA) for solar thermal systems and basic services as electricity and natural gas. The barriers related to administrative issues related to the lack of interaction in the licensing instruments and the still non existing need to deliver the basic technical solar thermal system project along with the architectural plan to adequate integration issues. Exceptions should also be precisely defined and the areas of airport influence and possible solutions should be defined according to airplanes security criteria. Implementation barriers related to the lack of a clear definition on solar thermal systems maintenance needs and the lack of monitoring systems that allow the quantification of solar systems production and contribution for the global energy mix.

As for solar photovoltaics, and following the work developed in the project PV Policy Group [PV Policy Group, 2009] specifically the Portuguese National Position Paper and Action Plan, the main barriers derivate from the stop and go effects that the government policies reflect on the market, namely the caps imposed within the micro-generation programme, per month and year. These caps difficult the access to the national grid and to the incentives associated. Also, the administrative procedures for licensing are long and demanding. Adding to this is the fact that presently no other attractive financing scheme is available for solar photovoltaic technology, namely the independent producer framework that has been frozen during 2005.

2. Technical Framework

2.1. Existing standards for solar systems and components.

Within the national legislation, solar thermal systems must comply with defined standards. According to the Decree-Law 80/2006, it is mandatory to account for the thermal building certification process the use of certified products, installed by certified solar installers (RCCTE, Annex VI, nº 4). All the equipments and components have to be certified products by Marca Produto CERTIF (“product brend”) or Marca Solar Keymark (“Solar Brend”) and all the systems must comply with a 6 years maintenance guarantee on system efficient operation (RCCTE, Annex VI, nº 4). As for systems

planning the quantitative obligation foreseen is 1 sqm of solar collector per building occupant (RCCTE, Art. 7, nº 2).

As for solar photovoltaic systems installed within the micro-generation programme, the technical requirements are assured by CERTIEL, a recognised entity that certifies electrical installations. In the weportal [Renovaveis na hora, 2009] there is a list available on the certified inverters and meters. As for the PV panels the only requirement is the EC brand.

2.2. Certification and other quality systems for solar systems products.

Solar thermal systems, equipments and components have to be certified products by Marca Produto CERTIF ("product brend") or Marca Solar Keymark ("Solar Brend"). A complete list for all the certified equipments is available at [Agua Quente Solar, 2009]

2.3. Existing certification schemes for solar systems installers and planners.

For solar thermal systems, a complete list for all the certified equipments and installers is available at [Agua Quente Solar, 2009]. Regular courses for installers are lectured by competent institutions.

For solar photovoltaic systems, a complete list for all the certified installers is available at [Renovaveis na hora, 2009] Regular courses for installers are lectured by competent institutions.

2.4. Are there R&D Centres working in solar technologies in your country? Please specify which and their working field. How is their interaction with the national solar market? Can they impulse the national solar market?

The Portuguese R&D sector on solar thermal technologies has its most strong presence in LNEG – National Laboratory for Energy and Geology. The Department for Renewable Energy Development develops R&D activities on solar thermal collectors (being also responsible for collectors testing and rehearsal) focusing not only on technologies but also on innovative applications and public policies.
AOSOL is also a Portuguese Company that developed its own CPC collector, having registered the patent for this technology, and that still operates R&D activities in CPC technology.
Also BOSCH, a private company operating a solar thermal factory of flat panels in Aveiro, Portugal, has also installed an R&D centre in the same location aiming at developing a solar thermal collector

specially adapted to the Portuguese clime and sunny conditions.

Regarding PV technologies, presently we can name eleven R&D centres working with PV technology. An accurate identification of the R&D units and their main competences revealed that Portugal has an adequate knowledge base to develop the PV technology, mainly in the field of thin films, crystalline silicon ribbons and in organic solar cells.

Laboratory of Photovoltaic Applications and Semiconductors (LAFS)

Center of Excellence in Microelectronics Optoelectronics and Processes (CEMOP) and Center for Materials' Research (CENIMAT)

Center of Semiconductor Physics, Optoelectronics and Disordered Systems (FSCOSD)

Group for Research and Applications on Microelectronics, Optoelectronics and Sensors (GIAMOS)

Thin Semiconductor Films Group, Physics Department (TSFG-PD)

Group of complexity and Electric proprieties at Centre of Physics (GCEP-CP)

Group of Functional Coatings at the Centre of Physics (GFC-CP)

Renewable Energy Department (DER – INETI)

Technology of Chemistry Industry Department (DTIQ – INETI)

Group of Molecular Chemistry at Center of Structural Chemistry (GMC -CQE)

Technology and Materials (TM- IT)

The main fields of action and investigation domains are summarized in table 1.

R&D Unit	Entity	Nº Members	Scientific Domain	Patents	PV Technology
LAFS	FC-UL	8	Physics	Yes	Crystalline silicon ribbons solar cells
CEMOP & CENIMAT	FCT-UNL	71	Materials	Yes	Thin films solar cells
FSCOSD	UA	56	Physics	No	Thin films solar cells Organic solar cells
GIAMOS	ISEL	12	Electronic	No	Thin films silicon solar cells
TSFD-PD	IST	5	Physics	Yes	Thin films silicon solar cells
GCEP-CP	UM	12	Physics	No	Thin films silicon solar cells
GFC-CP	UM	13	Physics	No	Thin films solar cells Organic solar cells
DER-INETI	INETI	26	Renewable Energy	No	Crystalline silicon ribbons solar cells Organic solar cells
DTIQ-INETI	INETI	70	Chemistry	No	Organic solar cells
GMC - CEQ	IST	15	Chemistry	No	Organic solar cells
TM-IT	IST	5	Materials	No	Organic solar cells

Regarding the Centre interaction with the market LAFS, the main unit dedicated to crystalline ribbon solar cells, is performing world class research for BP Solar. Depending on the results of the project a pilot production prototype may be implemented at LAFS' which may result, in the future, in successful technology
transfer to industrial level.

From a the detailed study conducted by Serôdio (2009) it was concluded that these centers present a knowledge base capable of fostering emerging PV technologies, namely through emerging technologies like organic solar cells and thin films based in micro and nanocrystalline layers.

3. Solar Market and Potential

3.1. Installed solar (thermal/photovoltaic) capacity at national level.

At the national level, solar thermal collectors installation present an yearly evolution on the installed capacity since 2003, when Portugal installed 9210 sqm, until 2008, when the installed capacity per year rose to 87.000 sqm. Presently accounts for a total installed/operational capacity of 390 000sqm. [Agua Quente Solar, 2009]

August 2009 [DGGE, 2009]	Installed Capacity (MW)	Energy Produced (GWh)
PV	80,9	122,1

3.2. Effective contribution of solar energy (thermal/photovoltaic) for the national energy mix.

Thermal contribution to Portugal's energy mix in 2007:24.10^3 toe [DGGE, 2009]

PV total contribution of 2,1.10^3 toe to the national energy consumption in 2007. [DGGE, 2009]

3.3. Technical/economical potential at national level (thermal/photovoltaic).

At the national level, the technical potential foresees 2.8 *10^6 sqm of solar thermal collectors. Until 2010, estimates within the initiative Hot Solar Water [Agua Quente Solar, 2009] point to a total installed capacity of 1*10^6 sqm. (equivalent to avoiding 850.000 ton of CO2 emissions). It is also important to outline the target established within the National Action Plan for Energy Efficiency to have

one in every 15 houses with solar thermal panels.

As for solar PV there are no official estimates at the national level.

3.4. Percentage of energy demand to be covered if such capacity would be reached (thermal/photovoltaic).

There is no official data.

3.5. Are there renewable technologies which are widely diffused in your country and that can therefore contribute in a renewable obligation?

The most diffused renewable technologies in Portugal at the urban scale are solar thermal and solar photovoltaics. Some minor scale and demonstrative applications of urban wind turbines exist, but until the moment its application is not generalized mainly due to the lack of data on probable performance and inexistence of integrated approaches in the built environment. Geothermal applications for buildings heating and cooling systems are also on an experimental phase (for example there is a system installed in the National Energy and Geology Laboratory Renewable Energy Department building) but is still very experimental. So, apart from solar technologies, there are no other technologies widely disseminated that can, by its presence in the market, contribute to the establishment of a renewable energy production obligation. Nevertheless it is very important to establish, at the urban planning level, minimum production rates from renewable technologies for the area under planning.

4. Stakeholders

4.1. Which are the stakeholders involved in promoting solar urban planning and what is their attitude towards renewables obligation (e.g. are building companies used to renewables)?

At the national level there are two associations related to solar technologies:
APISOLAR – Portuguese Association of the Solar Industry
SPES – Portuguese Society for Solar Energy

These two associations are the most important entities playing in the field of solar technologies promotion and dissemination focusing both sides of supply and demand, for which they are important

stakeholders to involve at the earliest phase.

There is also the national urbanism association, APROURB, which supports professionals in these areas and can therefore be a stakeholder to involve in the awareness raising actions and training initiatives focusing this group. As for architects, there is also a national association, OA, which can be involved in the awareness raising actions and training initiatives focusing this group.

Construction companies are also organized in a national association, AECOPS that provides support and information to the companies in the market. The solar thermal obligation imposed in 2006 was received with some constraints and some of the barriers are still being worked towards promoting a more efficient implementation. .The solar thermal obligation imposed in 2006 was received with some constraints and some of the barriers are still being worked towards promoting a more efficient implementation. The barriers are mainly due to the extra costs that have to be supported by construction companies when installing solar thermal systems, while the global outcome and the added values have to be passed on to the final consumer.

4.2. Which networks are available to promote and disseminate solar urban planning?

ADENE – National Energy Agency
APISOLAR – Portuguese Association of the Solar Industry
SPES – Portuguese Society for Solar Energy

All the organizations listed in point have a wide list of contacts and organize periodically dissemination and communication actions.

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