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Quantitative and economic assessment of the direct fiscal measures

Study of the Portuguese case

Final version

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I. Presentation of the Fiscal Measure

1. The Portuguese energetic context

Portugal has no fossil energy resources and has a strong dependence on imports of oil, natural gas and coal, which represent about 85% of total primary energy consumption. Despite this energy situation, Portugal is one of the European Union (EU) countries, which makes more use of its available renewable energy resources (mainly biomass and hydropower), as part of its energy mix[1]. In 2004 renewable energy contributed 14.9% of Portugal's total energy supply and 27.9% of total electricity supply compared to EU averages of 6.2% and 13.7% respectively[2].

Total primary energy supply (TPES) in Portugal was 27.3 million tonnes of oil equivalent (Mtoe) in 2005, a 2.8% rise over 2004 and an 8% rise over 2000[3]. Energy supply from solar and wind more than quintupled between 2000 and 2005, but grew by only 0.15 Mtoe in absolute terms.

The national energy policy has, therefore, the following objectives:

- to reduce energy dependence and develop endogenous resources;
- to reduce dependence on oil and coal and diversify sources and origins;
- to reduce the environmental effects of production/use of energy;
- to reduce the energy bill;
- to increase the efficiency of supply.

These goals are expected to be achieved through an energy policy based on renewable energies, rational use of energy and energy efficiency, natural gas projects and liberalization of the electric and natural gas sectors.

The international energy and environmental context is characterized by high tensions on the fossil energy prices and high environmental concerns which leads to a real growing interest for RES (Renewable Energy Sources) and low carbon energy generation technologies.

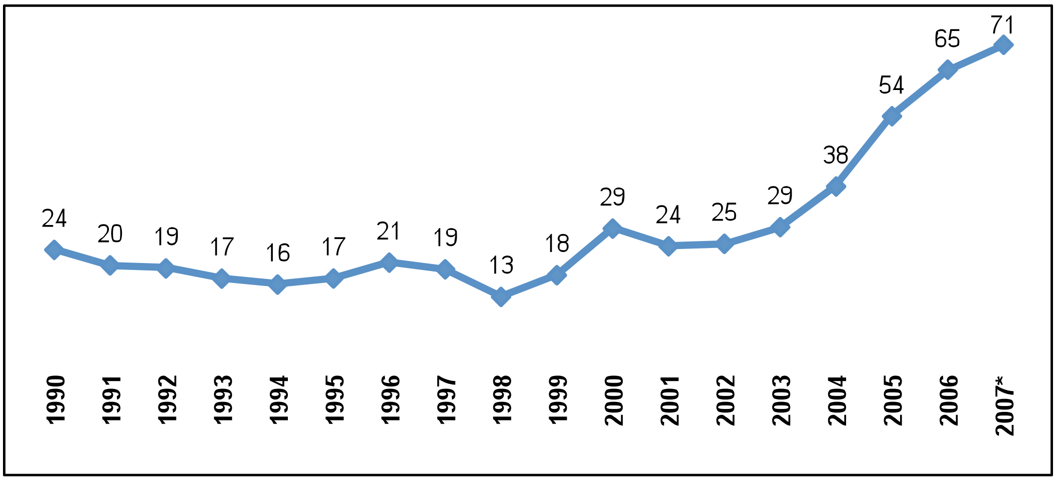
Since 2001 the oil prices started to rise which may influence consumer behaviours towards renewable energy sources and technologies as alternative energy supply systems.

[1] http://www.iea-pvps.org

[2] European Commission. Energy and Transport in Figures 2006.

[3] International Energy Agency, 2006. Standard Review of Portugal.

Figure 1 - Evolution of the nominal price of Brent barrel since 1990 in €



* estimated value for 2007

Source: DGEG Directorate-General for Energy and Geology

In the 90's the most relevant government's initiatives for promoting the use of RES and stimulating market development were the ENERGIA Programme (1994-1999) - partly supported by the EU Framework Programmes - and the Independent Power Producers (IPP) law, introduced in 1988, and further revised (1995 and 1999) for consistency with the implementation of a new regulatory framework for the electricity sector.

The IPP law allows for public or private entities or private individuals to generate electricity from any type of renewable energy source and sell it to the grid provided certain technical conditions for interconnection are guaranteed.

In order to comply with the EU Directive 2001/77/CE, the national commitment was to generate electricity from Renewable Energy Sources (RES) that represents 39% of the gross electricity consumption by the year 2010. In 2007, this target has been increased to reach 45%.

In 2001, a document[4] was approved by the Portuguese Government, called E4 Programme - Energy Efficiency and Endogenous Energies. This programme proposed a set of measures promoting an integrated and coherent vision, from supply to demand of energy, with the objective of improving the economy competitiveness and modernizing society. This programme was subsequently reviewed: first in 2003, as part of the National Energy Strategy, then in 2005 with the publication of Portugal's Technological Plan, and more recently in February 2007 with the review of the energy policy, where it were settled new goals for the energy sector.

[4] Council of Ministers Resolution nº 154/2001 - Set of multiple, diversified measures aimed at promoting a consistent, integrated approach to energy supply and demand.

In 2001/2002 a set of initiatives (legislation, incentive schemes) has been introduced, aiming at stimulating the market (private investors), not only for RES electricity, but also for CHP, solar thermal use and energy efficiency in buildings, namely:

- Decree-Law defining the conditions regulating the awarding and management of grid interconnection points for Independent Power Producers;
- Decree-Law establishing a range of favourable feed-in tariffs for RES electricity;
- Decree-Law revising the technical and tariff conditions regulating the CHP generation;
- National programme for supporting wide diffusion of solar thermal collectors;
- National programme on building energy efficiency;

The AQSpP (Solar Hot Water for Portugal) programme was launch in 2002, as an initiative of the Ministry of Economics and key actors in the national solar energy market, to promote **solar thermal** systems, being the main driving force for the development of the solar market, aiming at selling solar energy systems for water heating as a quality product/technology economically viable and technically reliable.

One of the main obstacles for the programme was to overcome the "bad reputation" solar collectors gained in Portugal in the 80's when problems were identified at all steps of the process, including manufacturing, installing and end-use.

Under the AQSpP initiative a set of integrated activities was planned and implemented in favour of developing and improving the solar thermal sector:

- increasing of the public awareness of solar water systems through advertising campaigns promoting the social-economical-environmental benefits of solar energy;

- providing a long warranty periods of six years for the equipment and introducing a certification process for the installers and by information campaigns;

- providing subsidies covering 20-40% of the investment cost of solar collectors through tax reduction for households or accelerating amortisation for the companies investing in solar equipment;

- reducing VAT to 12% (instead of 21% in 2007),

- creating a specific "observatory" to monitor the programme.

For **biomass** and **geothermal** sectors the national energy policy doesn´t mention a specific strategy, it's not clear the intention to implement direct measures in the household sector like in the solar thermal sector.

The major change at the national energy policy level was the publication of a new Government Cabinet Resolution (nº 169/2005), which stressed the strategy for the country's sustainable development. Improving energy efficiency, reducing CO_2 emissions and increasing the use of RES are some of the most significant objectives under this framework.

In the same year, the National Energy Strategy was approved, substituting for the previous 2003 strategy. The strategy defines the major political guidelines and most relevant measures in the energy area, with the following principal objectives:

- To guarantee security of energy supply, by diversifying primary resources and energy services and promoting energy efficiency.
- To stimulate and encourage competition, protecting consumers and promoting corporate competitiveness and efficiency.
- To guarantee the environmental adequacy of the energy process as a whole, reducing its environmental impacts on a local, regional and national level.

The major strategic guidelines, established to achieve these three objectives, include the liberalisation of the electricity, gas and fuel markets; creation of a competitive structural framework; growth of renewable energy supply; promotion of energy efficiency; an efficient and environmentally sound public supply of energy; reorganisation of the energy sector tax and incentive systems; energy perspective and innovation; and communication, awareness and assessment of national energy strategy.

The National Energy Strategy was further developed in 2007, namely regarding RES-E and biofuels in the transport sector. The national targets for 2010 regarding RES-E and for biofuels were increased (from 39% to 45% for RES-E and from 5.75% to 10% for biofuels).

Portugal's Kyoto target is to keep its annual greenhouse gas emissions during the first commitment period (2008 to 2012) to no more than 27% above Portugal's 1990 emissions. The last version of the National Programme for Climate Change (PNAC) was approved in 2006. PNAC quantifies Portugal's necessary reductions to comply with its Kyoto target and details policies and measures for all activity sectors.

There is a particular focus on the energy sector (excluding transport), which will account for between 18% and 24% of the national reduction. Measures related to renewable energy sources and energy efficiency improvements play a key role in meeting Portugal's target.

The Energy Efficiency Programme in Buildings launch in 2002 was implemented with the adoption in 2006 of new energy efficiency codes[5] and energy certification for buildings. This policy covers the services and residential sectors with the objectives of improving energy efficiency in new and renovated buildings and promoting the development of the use of RES.

The EU's directive on energy performance of buildings requires member states to establish an energy certification system for buildings and a calculation methodology for building energy performance. Portugal revised its current standards, with the two objectives.

[5] In April 2006, Portugal adopted new building codes in order to comply with European directive 2002/91/CE: the code on energy supplying systems in buildings (RSECE) and the code on thermal performances of buildings (RCCTE). The last one requires the use of solar thermal collectors for hot water production in new or renovated buildings (in the case where exposure conditions are favorable) on the basis of one square meter per person.

2. Historical background of the fiscal measure

The Ministry of Finance and Public Administration is directing favourable taxation towards households who gets tax deduction for investing in renewable energy (through household annual income tax[6]) to stimulate investment in renewable energy technologies.

The fiscal measure towards RES-Heat in the residential sector was launched[7] in 1991 with the objective to promote renewable energy use. This is the main incentive implemented towards individual households and the current characteristics of the measure (for 2007) are:

Measure	income tax deduction		
Focus	individual households (with main residence or secondary habitation), excluding persons with professional or entrepreneur incomes		
Renewable energy sources	direct and diffuse solar radiation, energy retained in forest or agricultural residues and wind energy		
Eligible appliances	Technology	Water heating	Surface heating
	New equipment[8] for heat generation using renewable energy sources (since 1991):		
	• individual solar thermal installations using flat or concentrated solar collectors	√	-
	• heat pumps	√	-
	• heating systems using biomass (fireplace insert, stove, woodboiler, etc.)	√	√
	New equipment for electricity generation using renewable energy sources (since 1991):		
	• solar photovoltaic panels and respective control and storage of energy system supplying electric energy for houses	-	-
	• wind power generation units below 5 kW of installed capacity and respective control and storage of energy system, supplying electrical energy for houses	-	-
	New Equipments for the production of electric and thermal energy (cogeneration) by microturbines with a capacity up to 100 kW using natural gas (since 2002)	√	√
Technical requirements	Any specific technical requirement is mentioned regarding minimal efficiency of the equipment (for their eligibility) neither technical competences for installers.		
Fiscal deduction	30% of the expenses with the equipment and installation (reported by an invoice or equivalent document) can be deducted from annual taxation of families' income with a fixed ceiling (€761 in 2007). Since 2001, it can't be cumulated with deduction regarding house loans' payments.		

[6] IRS – "imposto sobre o rendimento singular".

[7] Portaria nº 725/91 (29/07/1991).

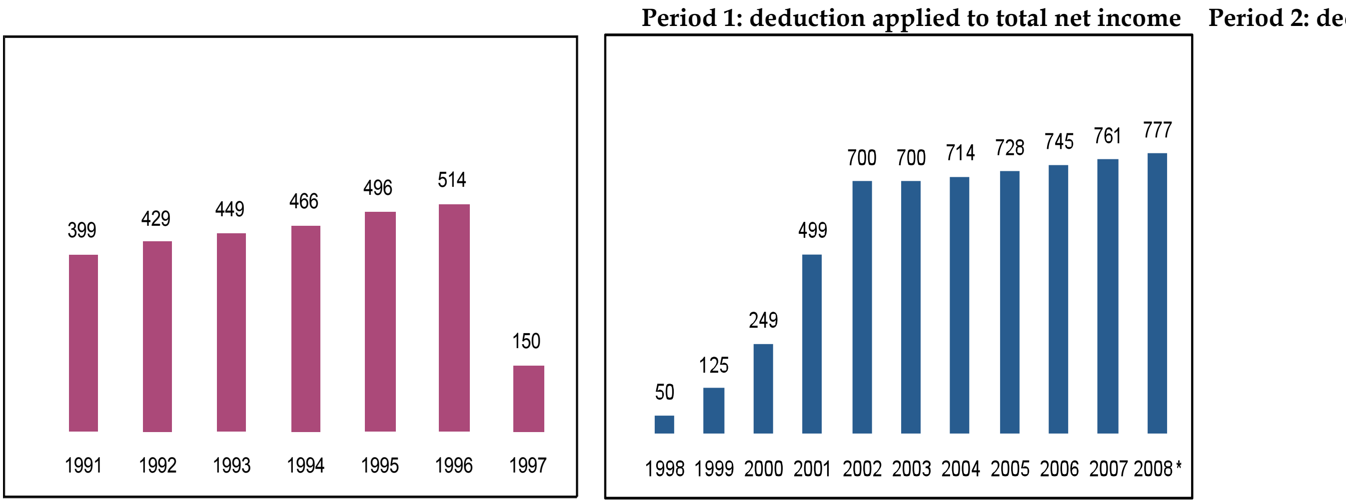
[8] Including complementary equipment indispensable for their use.

The maximum deduction is established each year by the annual State Budgets. The calculation of the deduction was not always the same. There are two distinct periods.

Between 1991 and 1997, the cost of renewable energy equipment could be deducted directly from the total net income, before the calculation of the income tax was applied. However a maximum value was defined each year regarding the fiscal potential deduction (see Figure 2).

After 1997 it was established a percentage of the expenses with renewable end-use technology (including equipment necessary to its functioning) that could be deducted from the calculated income tax. The percentage changed from 20% of total acquisition cost in 1998 and 1999, to 25% in 2000 and to 30% since 2001.

Figure 2 - Evolution of the maximum ceiling deduction (euros)



Source: Annual State Budget's.

(1) In 2001 the value goes up to 598.6 in case of complementary equipment.

* proposed value in the State Budget for 2008.

It is important to refer that since 2001 and until 2007 the RES-Heat tax deduction cannot be cumulated with deduction related to house loans' payments[9]. If a family has expenses with both categories only the highest deduction is considered. The impact of this limitation is substantial because many families have high house loan expenses.

The existence of this fiscal measure is announced occasionally through national promotion campaign in the media about the advantages of renewables and associated equipment acquisition.

A reference should be made towards the VAT applied to RES appliances which beneficiate from an intermediate VAT rate of 12% since 2002 instead of the normal VAT rate (21% in 2007) for appliances. However, this intermediate VAT rate is still

[9] For 2008, the two deductions are expected to be eligible for tax deduction (State Budget Proposal).

considered by the stakeholders as an obstacle to the market development because of the low VAT rate (5%) applied to electricity and natural gas.

Finally, there is a particular situation at the Madeira Autonomous Region[10] (Atlantic Islands), which has specific incentive for the use of solar thermal energy in the residential sector[11] cumulative with the fiscal measure describe above. This incentive scheme started in 2002 and should end in 2007. The continuity of this incentive scheme is being analysed. Until now the incentive was given to 486 families in the region.

The local legislation[12] is applied at the regional level and establishes an incentive scheme to the residential sector in the region, financing (subsidy) the acquisition of solar thermal systems for domestic use. This financial support is calculated by a specific formula with several parameters (like the collector type) with the limit of 1,000€ for a single household or 10,000€ for collective households. The VAT tax in that region is only 8%.

Analysing the type of dwelling in Portugal the share of single dwellings was of 56.8%[13], corresponding to 1.9 million houses, which represents an enormous potential for the RES-H when, for example, only about 18,400 solar thermal collectors were installed in the household sector in 2006 (see next chapter). So the tax measure should be reformulated and conjugated with other instruments to be more effective.

[10] About 250,000 inhabitants.

[11] SIEST –Incentive scheme to solar thermal energy.

[12] Regional Decree-Law nº 29/2001/M

[13] INE - National Institute for Statistics – Housing Survey for 1998.

II. Methodology to collect data

In this section is explained in more detail the methodology chosen to overcome the difficulties met with data collection for the analysis of the efficiency of the fiscal measure applied in Portugal.

The economic analysis of direct tax measure conducted in the household sector is related with three main technologies: solar thermal water heaters, biomass heating devices and geothermal heat pumps.

Official statistics regarding end-use technologies in the residential sector are very limited and it is difficult to get data about sales, prices and technology because the market has a small dimension, is strongly conditioned by the confidentiality and by the fact that data is not systematically collected.

To minimize these difficulties the methodology to collect data in each renewable sector was the following:

solar thermal	➢ Data collected from the annual survey implemented by ADENE (the national energy agency)[14] sent to the main actors in this renewable sector (manufacturers, installers, engineering companies or importers) since 2003. This survey has quantitative as well as qualitative information about the functioning of solar thermal market, for example the area of solar panel installed in the residential sector and some information on prospects and barriers in this market. ➢ From a sample of certified companies (installers and manufacturers) collect data related to the sales and prices.
biomass heating systems	➢ There are no surveys or other type of official data. The option is direct contact with the manufacturers and importers to have some quantitative and qualitative information (through a sample of the more relevant companies).
geothermal heat pumps	➢ There are no surveys or other type of official data. This is an emerging market in Portugal. We participated in a seminary about "Geothermal Heat Pumps promotion in Portugal"[15]. ➢ Contact the company[16] who made the drills for the installers to have more information on the national situation.

[14] http://www.aguaquentesolar.com

[15] The Seminary occurred on 21st of May, 2007, in EST Setubal installations, Setúbal, Portugal, with the objective to promote the Geothermal Heat Pumps Technology in Portugal (Ground Reach Project).

[16] GeoMinho, geology perforation.

III. Evaluation of the impacts

3. Impact on the market

3.1. Solar thermal

The potential market for solar energy in Portugal is high. Portugal is characterized by a good level of solar radiation and the potential market for solar panels was estimated[17] in 15 million m^2. The household sector is a particularly interesting market for this technology because solar water heating can supply economically about 50% to 75% of the final energy consumption for water heating for an average Portuguese family.

The commercialisation of solar collectors in Portugal started at the beginning of the 60's. According to ADENE[18] the collectors were imported from Israel by a Portuguese enterprise, still active in the Portuguese market. The systems were used in the domestic sector for hot water production and some of them were still in operation in the 90's. A "solar boom" occurred in Portugal in the late 70's - early 80's period, but the entrance on the market of a large number of new players (manufactures, importers and installers) was not followed by accompanying measures aiming to increase public awareness and to guarantee quality of products and services. Most of the systems installed in that period failed in short time and, as a consequence, the solar collectors bad image started growing. The falling of oil prices in the 80's also helped to the drastic and rapid drop of the solar thermal market in Portugal.

The growth in the m^2 installed peaked in 1985 at nearly 42,000m^2/year, with more than 20 companies active in this renewable sector. Since then, commercialisation of solar energy for hot water has steadily declined to 4,500m^2/year in 1999[19]. The market only recovers consistently after 2003 with the conjunction of several effects: (i) a high level of tax deduction, (ii) implementation of the AQSpP programme and (iii) a new increase in fossil energy prices (see figure 3).

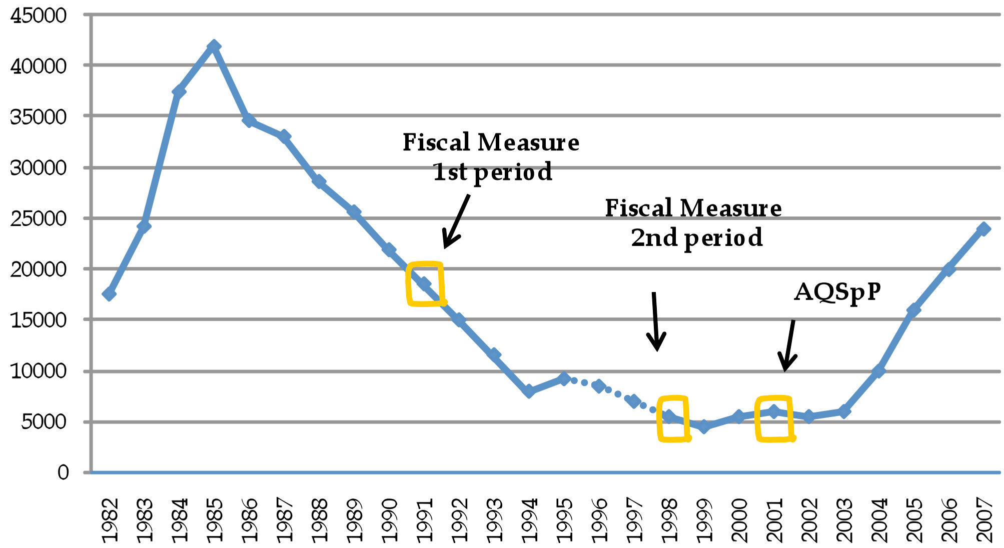
[17] Case study about Solar Hot Water Programme (React/Altener)

[18] ADENE, 2000. Portuguese Solar Thermal Market and Technology Assessment.

[19] EREC, 2004, Review of Policy Initiatives within the EU – Portugal.

Figure 3 – Evolution of the Portuguese total solar market

(m^2 installed between 1982 and 2007*)



Source: ESTIF (- - - - tendency)
* projection for 2007

The Portuguese total solar thermal market is rather small despite of the growing interest on renewable energy sources and its contribution to the environmental challenges. In October 2001, by launching the E4 Programme - Energy Efficiency and Endogenous Energies, the Portuguese Government has taken an important decision to foster the penetration of solar collectors in Portugal's energy market – the Solar Hot Water Programme – and set the indicative target of 1 million m^2 of installed collectors in 2010. The implementation of the Programme was supported by comprehensive information dissemination activities, promotion of "new" fiscal and financing incentives, testing and certification of solar collectors, training and certification of installers, as well as the creation of a "Solar Thermal Observatory" and the promotion of a solar hot water selling service.

Data related with the market evolution is not always consistent and systematic between different sources (see table 6 in annex), but in general shows an instable market along the years although with a recent increasing development. In 2007, the capacity installed in m^2 was estimated to reach 24,000 m^2, according to the ESTIF projections.

This renewable sector has showed increasing signs of development, with more qualified installers and producers operating in the market. There are 49 certified solar thermal collectors in Portugal (reported in the AQSpP programme's webpage)[20]. There is a good implementation of foreign marks, namely from Germany.

[20] November 2007.

Since 2003 an annual survey is implemented by ADENE (the national Portuguese energy agency) to collect data about solar thermal market in the framework of AQSpP programme. The questionnaire is sent to the main actors in this renewable sector (manufacturers, installers, engineering companies or importers).

Results from these annual surveys reinforce the idea of a growing market since 2003 caused by AQSpP programme and also by the international uncertainty about security and price of fossil fuels. This market is increasingly dominated by small systems for the residential sector (typically 4 m^2). Another important market is the tertiary sector with large systems installed.

Table 1 – Importance of solar thermal in the residential sector (Portugal)

	2003	**2004**	**2005**	**2006**
Total solar thermal systems installed (m^2)	9210	16088	18956	*28300*
Household sector (m^2)	5250	7079	10994	*18395*
Share of household sector	*57%*	*44%*	*58%*	*65%*

Source: Portuguese annual survey (http://www.aguaquentesolar.com)

However these results have some treatment problems related with the consistency and regularity of the answers. There are some difficulties in the survey implementation that are being studied and will be improved in the next survey. The awareness of the market actors to the importance of this process of data collection is low and they are not always collaborating with the necessary regularity or required quality.

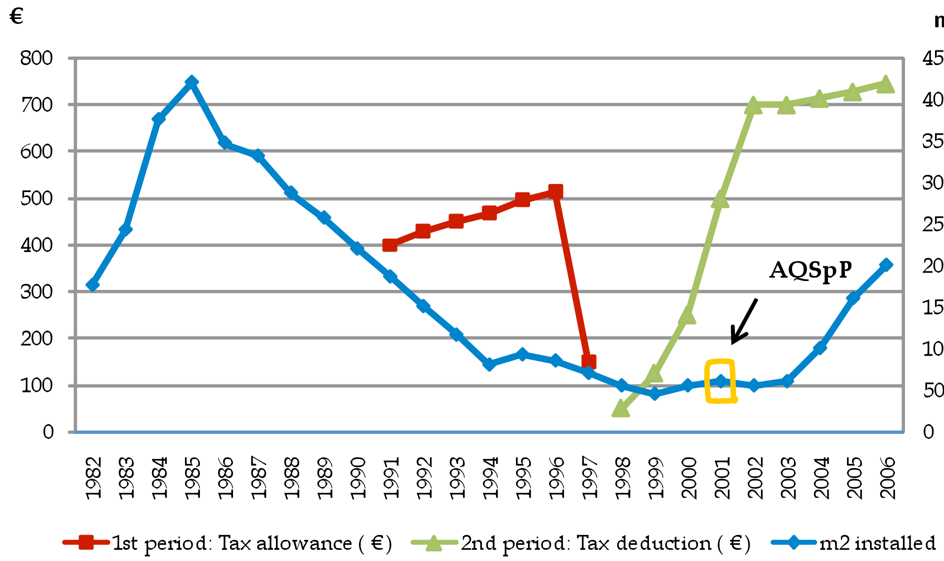
Market sales, according to the survey results have been growing (with few exceptions) since 2003, in many cases more than 50%. In this survey the actors in the market refer the perception that the fiscal measure was not a relevant factor for explaining this evolution and didn't enhance the efficiency level of the equipment sold.

The actors subscribe the urgency to review the fiscal measure in order to separate it from loans tax deduction as well as the necessity to apply the same VAT rate associated with electricity and natural gas consumption. Natural gas and electricity consumption benefit from a VAT rate lower than those applied to solar thermal equipment. This gives an indirect incentive to consume fossil fuels (directly or through electricity generation) rather than renewable energy sources.

With the national survey results it is possible to estimate the market sales' value for the year 2006. Considering an average price of 700€/m^2 and the capacity installed in the household sector in 2006 of about 18,400m², the market sales should represent about 13 million euros.

The following figure compares the evolution of m² installed annually since 1982 with the evolution of the maximum ceiling of the fiscal benefit to households (in €) since 1991. This figure shows clearly that there is no correlation between the implementation of the measure and the evolution of the solar market.

Figure 4 – Evolution of m² of solar collectors installed each year and defined ceiling for fiscal deduction (in €)



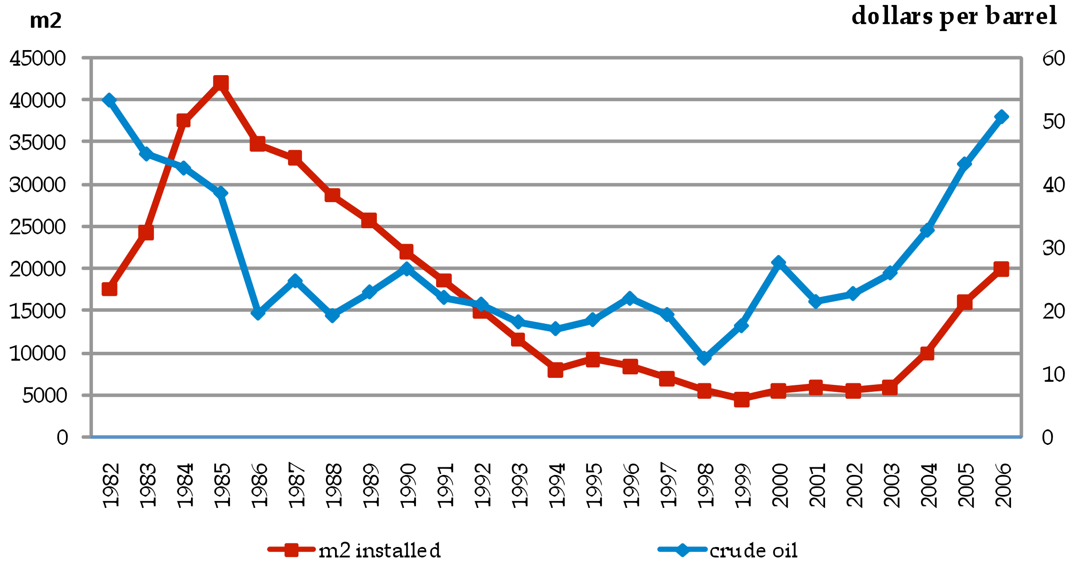
Source: ESTIF and Annual State Budgets.

The implementation of the fiscal measure during the first period has no effect on the decreasing solar market. Since 2002, during the implementation of the reformulated fiscal measure, the increase of the tax deduction, reinforced by the launch of the AQSpP programme in 2001 and the increase in international fuel prices, seems to provide a more positive effect than during the first period.

According to the IEA[21] the acceleration of the thermal solar collector market was caused by the implementation of the AQSpP programme and by the international uncertainty about security and prices of fossil fuels since 2003 (see figure 5). The market grows mainly by the perception of the need to change from the fossil fuels because of its growing price rather than by the public incentives like fiscal tax deduction.

[21] IEA, 2005. Solar Heating and Cooling Implementing Agreement, National Program Report, 2005, Portugal.

Figure 5 – Evolution of the Portuguese solar thermal market and the crude oil price per barrel ($2000) between 1982 and 2006



Source: ESTIF and Annual US Energy Information Administration.

Since July 2007, all new projects for buildings have to be in accordance with the new regulations which should strongly stimulate the solar thermal market in Portugal. The new Building Code[22] raises the requested thermal performances in new and renovated buildings and imposes the use of solar thermal collectors for hot water production if there is favourable exposure conditions (if the roof or cover runs between SE and SW without significant obstructions) in a base of 1m^2 per person (the total can be reduced to 50% if space is necessary for other important usages of the building).

3.2. Geothermal Heat Pumps

In this renewable sector few data is available and not always reliable. For example, considering the information of the EurObserv'er[23] there is only one ground source heat pump installed in Portugal corresponding to 0.2 MWth of installed capacity between 2003 and 2005. This information doesn't correspond to the domestic share of the market.

To have a better notion of the national market we participated in a seminar about "Geothermal Heat Pumps promotion in Portugal" [24]. We contact a company who made the drills for installers. According to this source, there are several geothermal

[22] Decree/Law nº 80/2006 (04/04/2006).
[23] EurObserv'ER 2005 and 2006.
[24] The Seminary occurred on 21st of May, 2007, at EST Setubal installations, Setúbal, Portugal, with the objective to promote the Geothermal Heat Pumps Technology in Portugal (Ground Reach Project).

pumps installed in domestic houses, but there is no way to have an exact notion of the whole picture.

Regarding the total market sales and market share per type of application at the present moment there is no available official data. We contact installers[25] which have the perception that this is a secondary market when comparing with other RES-H.

They also refer that the public in general is not yet aware of the advantages of this type of equipment, and the investment is very high for a standard Portuguese household so the demand remains very low.

This is an emerging market, for example some installers only started to sell 3 years ago imported heat pumps. The annual sales numbers are very low and relatively constant with some perspectives of growing in the future.

The actors in the market refer the perception that the fiscal measure doesn't participate in increasing the market sales.

3.3. Biomass heating appliances

There are no centralized or treated information for this market. It is only possible to have the perception that installers and importers representing several equipment brands are emerging revealing a recent market dynamics.

With a sample of actors we tried to estimate the total market sales. But until now we could not get any estimate of the total market sales or market share per type of application. Giving the lack of statistical data on biomass appliances' market, we did some estimates based on the following assumptions:

- annual biomass consumption for heating in the residential market: about 0.95 Mtep;
- investment in efficient appliances are dominated by woodstoves and fireplace-insert with capacity of 10 kW but open fireplaces are still the main combustion technology;
- the number of new single dwelling in the last years was about 20,000-25,000 per year.

Considering these assumptions, we estimate that the Portuguese biomass heating market (for efficient technologies) could represent 5,000-10,000 units sold each year. These assumptions and results will be discussed with invited people at the biomass focus group organised under the WP3 of the current project.

[25] See annex.

Some installers and importers[26] say that the market had a considerable evolution in the last ten years. In their opinion when the market was starting to develop the fiscal measure had more impact than now but still not so relevant because the fiscal measure (in the second period) cannot be cumulated with deduction related to house loans payments.

They also affirm that the quality of the equipment is increasing but the market is not so economically favourable as some years ago due to the very low economic growth in last 5 years.

Along the years other factors like institutional or utilities campaigns for the use of natural gas for example, did influence the public behaviour and biomass heating appliances market didn't develop as much as expected. Moreover, the required investment for biomass heating appliances (boilers) in residential buildings is very high when compared with other alternatives.

The actors in the market refer the perception that the fiscal measure didn't participate in increasing the market and didn't enhance the efficiency level of the equipment sold. They subscribe the necessity to review the fiscal measure as well the VAT applied (21% for biomass fuel and 12% for the equipment while the VAT for electricity and natural gas is 5%).

4. Impact on national RES industry

In the case of **solar thermal**, the number of companies on the market has varied over the years. Before 1978 there were only one or two companies on the market. After that there was a growth in the number of collectors sold, which peaked in 1985 at nearly 42,000m^2/year, with more than 20 companies active in this area. Since then, commercialisation of solar energy for hot water has steadily declined to 22,000m^2/year in 1990 and to less than 5,000m^2/year in 2002.

According to EREC[27] in 1990 the number of companies active in the field was 5 manufacturers and about 50 companies listed as installers, engineering companies or importers, perhaps with only 10 of them dealing with solar energy.

The market is rapidly changing with several companies appearing in the market, as producers or importers, and people interested in both formation courses given by INETI (National Institute of Engineering, Technology and Innovation): installers and designers of solar thermal systems. The next table shows the distribution by category of the market agents in 2005.

Table 2 – Solar Thermal market agents in Portugal (2005)

[26] See annex.
[27] EREC, 2004. Review of Policy Initiatives within the EU – Portugal.

Manufacturers	8
Importers	15
Installers	88
Designers	40

Source: IEA, Portugal- National Program Report 2005

Along the years the dynamic of the market had repercussions in the number of manufacturers, installers and importers. It is important to refer that the process of certification made some difference in the market evolution but the fiscal measure doesn't seem to have relevant influence on this dynamics.

The development of the different certification[28] schemes (products and professionals) was made in the frame of the Public Initiative "Solar Hot Water for Portugal" of General Directorate for Energy and Geology (DGEG) with the participation of INETI, ADENE, SPES (National Association for RES) and APISOLAR (National Association of Solar Industry).

Solar companies and manufacturers are organised in one association APISOLAR established since 1998. Actually they are 36 but many other companies are present in solar thermal market.

New requirements regarding the quality of equipments and the qualification of installers (certification process) has provided a context of confidence for RES-heat systems and namely solar thermal collectors. Actually (November 2007) there are 49 certified solar thermal collectors in Portugal (by Certif, the certification association).

In Portugal the solar thermal market for hot water is dominated, in the residential sector, by flat plate solar collectors (thermosiphon systems), manufactured in the country or imported. Vacuum collectors have been also commercialised in Portugal and, since 1994, a company started the production of CPC type collectors (Compound Parabolic Concentrators). The project NEGST[29] gives for the year 2005 the following characteristics for a typical solar collector installed in Portugal. According to this study, thermosiphon systems represent about 90% of the total market.

Table 3 – Estimated market shares of thermosiphon systems in Portugal (2005)

Typical collector area in m^2	4
Market Share in %	90
System price excl. VAT in €	2500
Installation costs in €	500

[28] A Certification scheme for solar installers was developed. Solar Installers can have a Certificate of Professional Proficiency (CAP), which is given by the General Directorate for Energy and Geology. The regulation of this Certification Scheme is the Portuguese regulation – Portaria nº 1451/2004 (26th November).

[29] http://www.swt-technologie.de/NEGST_WP1.E3b_SDHW_drainback_vs_ts_2006_03_26.pdf

Source: Project NEGST - New Generation of Solar Thermal Systems

For example the most common solar heating system for domestic water heating in Portugal is 4 m^2 collector area and 300 l storage tank. Thermosyphon systems are the dominant technology. The use of combisystems (space and hot water heating) in Portugal is very limited. The reasons for this are related to the low economic interest of such systems taking into account the short heating season.

The most common solar domestic water heating systems in Portugal are thermosyphon systems with either flat plate or low concentration CPC collectors and a horizontal storage tank. Forced circulation systems can also be used but they are not so common for this type of applications - single-family houses, typically with four persons.

The following table shows the existing retailers and the manufacturers[30] by type of certified solar collector and giving this information it is possible to state that glazed flat-plate solar collectors are more representative (about 73% of the total collectors certificated). In terms of manufacturers only 11% of them are national companies.

[30] November 2007

Table 4 – Solar Collectors Certificated in Portugal 2007

(November 2007)

Distributors	Manufacturers	Certificated Solar Collectors	
		Technology	Nº
ACM - António Cecílio Martins, Lda.	Norquente, Energias Renováveis, Lda	Flat	1
ALSOLAR - Instalações de Energia e Água, Lda	Consolar GmbH - Solar Heizungssysteme	Flat	1
AO SOL - Energias Renováveis, Lda.	AO SOL - Energias Renováveis, Lda.	Parabolic (CPC)	1
Aquaterm	Schüco International KG	Flat	1
Boilernox, Lda.	IMS Calefaccion, SA	Flat	1
CIRELIUS, Materiais para gás e aquecimento, Lda.	GASOKOL, GmbH	Flat	1
COBRAL	Maltezos	Flat	3
DIGAL - Distribuição e Comércio, SA.	Solahart Industries PTY Ltd	Flat	3
DIMITRIS - Metalúrgica e Metalomecânica, Lda.	Maltezos	Flat	3
Ecopower, Equipamentos e Serviços de Energia, Lda	A&G. SAMOUEL S.A. SIGMA	Flat	1
Eduardo Jorge Domingues Monteiro	Eduardo Jorge Domingues Monteiro	Flat	1
ENSACO - Portugal Energia Solar	Sunda Solartechnik GmbH	Vaccum collectors	4
ERL - Energias Renováveis Lucena, Lda	Thermomax Ltd.	Vacuum collectors	4
ESTECENERGIE, Lda.	ESTEC	Vacuum collectors	1
Galécia - Produtos para a Indústria e Construção, SA.	Ritter Solar GmbH	Vacuum collectors	1
Galécia - Produtos para a Indústria e Construção, SA.	SUNERG	Flat	1
JORO, Importação, Comercialização, Distribuição de Equipamentos e Assistência Técnica, Lda.	Solahart Industries PTY Ltd	Flat	3
NOVAMBIENTE - Sociedade Consultora e de Planeamento em Energias Alternativas, Lda.	DIMAS, SA.	Flat	1
Petrotank	Cicero Hellas SA	Vacuum collectors	1
REHAU - Indústria e Comércio de Polimeros, Lda.	GREENoneTEC Solarindustrie GmbH	Flat	1
REHAU - Indústria e Comércio de Polimeros, Lda.	REHAU AG + CO	Flat	1
Robert Bosch	Solar Diamant Systemtechnik GmbH	Flat	1
Roth Werke GmbH	Roth Werke GmbH	Flat	1
Roth Werke GmbH	Roth Werke GmbH	Vacuum collectors	1

Distributors	Manufacturers	Certificated Solar Collectors	
		Technology	Nº
Sedical, S.A.	Max Weishaupt GmbH	Flat	1
Solargus, Fábrica de Radiadores do Alva, Lda	Solargus, Fábrica de Radiadores do Alva, Lda	Flat	1
SOlution Portugal	Solution Solar Technik GmbH	Flat	4
Sousa Pedro Comercial Lda	Solimpeks Solar Energy Corp.	Flat	1
VELUX Portugal Lda	VELUX A/S	Flat	2
VOLTER Albuquerque & Freitas, S.A.	Nau GmbH	Flat	1
Yazaki Saltano Portugal	Yazaki Resources Co, Ltd.	Flat	1

Source: http://www.aguaquentesolar.com

Considering the data limitation already referred, it is not possible to compare the market trend for the period before and after the implementation of the measure.

Regarding the future (next decade) it is possible to perspective a large market development. The case of an important Portuguese manufacturer (Vulcano owned by Bosh), which made a recent investment of 12 million euros in a factory in Portugal to produce 150,000 solar collectors per year for export but also for internal market, shows that perspectives are of a growing market.

In the case of **geothermal heat pumps** and **biomass heating appliances** there is no official available information about the market. So only direct contacts with manufacturers, distributors and installers gave us some qualitative information about the impact of the measure.

The geothermal heat pump market should be a fast growing market but is still very incipient for the time being in Portugal. The appliances are all imported so the market actors is dominated by installers. The perspective of the actors in the market is that this market will grow in the following years but slowly because of the high required investment and the lack of information and examples regarding these new technologies in Portugal.

The biomass heating market is a traditional market characterised by a lot of actors (equipment sellers, installers and biomass suppliers) and by a lack of organisation and quality requirements.

In both markets the perspective is to increase the number of actors participating in the market.

5. Impact on prices

According to some installers[31] the fiscal measure has no effect on prices of solar thermal equipment, biomass heating systems as well as heat pump appliances. There are different prices according to the technology and along the years there are no significant changes on the average selling prices.

From the annual survey sent to the main actors in **solar thermal sector** it is possible to know the price range per m² installed, but this information only started to be collected in 2006, so historical values are not available. In 2006 the average prices was 700€ per m² installed. For a typical thermal solar system (4 m² for a family of 3-4 persons) the average price in the market is 2400€ (the price includes the installation cost). Including the VAT the average price rise to near 2700€ and therefore the value calculated to define the potential income tax deduction (30% of total costs) is above the ceiling (745€). Such an investment corresponds to 16% of the annual average national gross income (i.e 2.2 months of income).

Solar thermal	**2006**	*Average national gross income 2006*	
		Yearly 16800€	*Monthly 1200€*
Average price in €/m²	700€		
For a Household - 4 m2	**2400€**		
Plus VAT 12%	2688€	*16%*	*2.2 months*
30% tax deduction	806€		
Deduction ceiling	745€		

In the case of **geothermal heat pump** appliances for residential hot water the professional contacted in the market did not report any major price growth in the sector. The average price for the equipment and respective installation was in 2007 around 3000€ for heating water in a household of 250m² (with horizontal extraction)[32]. For heating the house and hot water the average price goes up to 12,500€.

In the next table is presented the average price in each case of final use analysing the importance of this investment with the annual average national gross income (per year and per month). As for solar thermal equipment, the value calculated to define the potential income tax deduction (30% of total costs) is above the ceiling (745€) in all cases.

[31] See table 7 in annex.
[32] Source: Geotermia de Portugal.

For an investment on water heating system, the total cost corresponds to 20% of the annual average national gross income or 2.8 months of income.

Geothermal	**2007**	*Average national gross income 2006*	
		Yearly 16800€	*Monthly 1200€*
For a Household - 250 m2			
Water heating	**3000€**		
Plus VAT 12%	3360€	*20%*	*2.8 months*
30% tax deduction	1008€		
Deduction ceiling	761€		
Water and space heating	**12500€**		
Plus VAT 12%	14000€	*83%*	*11.7 months*
30% tax deduction	4200€		
Deduction ceiling	761€		

In a highly segmented market of heating systems using **biomass** (equipment with different design, performance etc.) we collected data from installers and distributors and establish national average prices per appliance for 2007.

Biomass	*2007*			
	Price (without VAT)	*Including VAT (12%)*	*30% tax reduction*	*Deduction ceiling*
10 kW Closed fireplace insert	1100€	1232€	370€	*761€*
10kW Stove	2000€	2240€	672€	761€
20kW Boiler	4500€	5040€	1512€	761€

Note: The values may oscillate according to the house dimension and to the house location

For biomass heating devices like inserts and stoves, the investment is lower when comparing with other renewable heating systems and more accessible when considering the average annual national gross income. Furthermore, for these equipments the 30% tax reduction is fully received.

Biomass	*Total cost*	*Average national gross income 2006*	
		Yearly 16800€	*Monthly 1200€*
10 kW Closed fireplace insert	1232€	*7%*	*1 month*
10kW Stove	2240€	*13%*	*1.9 months*
20kw Boiler	5040€	*30%*	*4.2 months*

6. Cost of the measure

Before analysing the cost of the measure it is important to have an idea of the number of households in Portugal and to refer that the households' annual gross incomes are given by the Ministry of Finance and Public Administration for the year 2005 (last year with available data).

In 2005 about 4.3 million households declared annual gross income of 72,172 million euros. The median gross income of a Portuguese household was approximately of 25,600€ in 2005 (5th level: 19,000€ to 27,500€).

Table 5 – Household Annual Gross Income in 2005

Levels	Households Annual Gross Income (€)			Fiscal Declarations in 2005			
				Number of Households		Million €	
1	0	to	5000	729008	17%	2123	3%
2	5000	to	10000	1293887	30%	9423	13%
3	10000	to	13500	590926	14%	6879	10%
4	13500	to	19000	579819	14%	9277	13%
5	19000	to	27500	457446	11%	10367	14%
6	27500	to	32500	148447	3%	4429	6%
7	32500	to	40000	149838	3%	5399	7%
8	40000	to	50000	121536	3%	5410	7%
9	50000	to	100000	182325	4%	12186	17%
10	100000	to	250000	37602	1%	5120	7%
11	>	250000		3434	0%	1559	2%
	TOTAL			**4294268**	**100%**	**72172**	**100%**

Source: Ministry of Finance and Public Administration

Considering the available fiscal information for the period 2003 to 2005, it can be stated that the fiscal deduction related with investments in renewable energy equipment was used by few households, around 15,000 each year (see figure 6), which represents only 0.4% of total number of households with fiscal declaration. At the same time, more than one million of households (25% of total fiscal households) used house loans payments' deduction and therefore could not benefit or only marginally[33], from fiscal deduction with investment regarding renewable energy equipment (see figure 7).

Considering the fact that the fiscal deduction could not be cumulated with the house loans payments[34] deduction between 2001 and 2007 or its benefit is only marginal, the relative minor importance of this measure is evident. Households who used this fiscal deduction represent only 1.5% of both types of households (who benefit from fiscal deductions with renewable equipment and/or house loan payments).

[33] For a household which benefit already from a house loan deduction and also invests in a renewable energy supply system which could give a higher fiscal deduction, the additional deduction would have been in 2007, considering each deduction ceiling, around 190€ (761-574) for an investment of more than 2500€.

[34] Interests and amortizations.

Figure 6 - Evolution of households who benefit from the renewable deduction

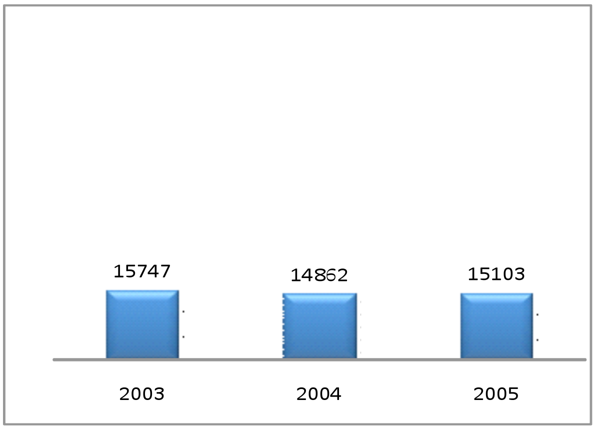
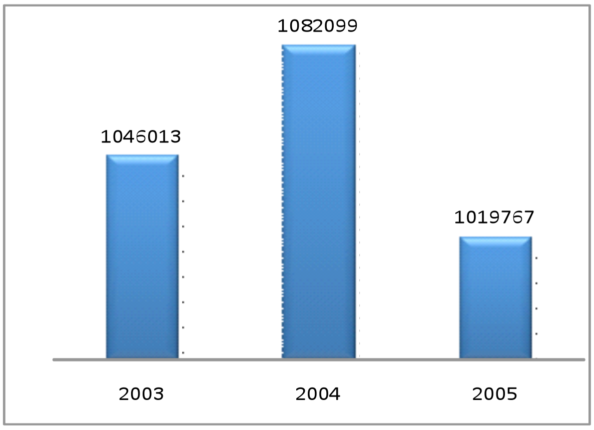


Figure 7 - Evolution of households who benefit from the house loan payments' (1) deduction



Source: Ministry of Finance and Public Administration

(1) Interests and amortizations

As the personal annual income declaration is currently structured it is not possible to know the relative importance of the different renewable heating sectors under study. This fiscal declaration only requires information on the cost to be deducted and doesn't discriminate between renewable supply systems.

Between 2003 and 2005 the total annual value deducted by households with renewable energy equipment investment was around 5 million euros in each year (see figure 8). This value has to be related with the turnover generated with sales on renewable energy systems. Considering, on one hand, the annual sales for solar thermal collectors and estimated values for biomass heating systems (for geothermal heat pumps the market is still marginal) and, for the other hand, the average price of each appliance (including installation cost), we can estimate the overall turnover in the range of 70-90 million euros in 2007. Furthermore, this turnover generated VAT in the range of 8 to 11 million euros.

Figure 8 - Evolution of the renewables deduction (M€)

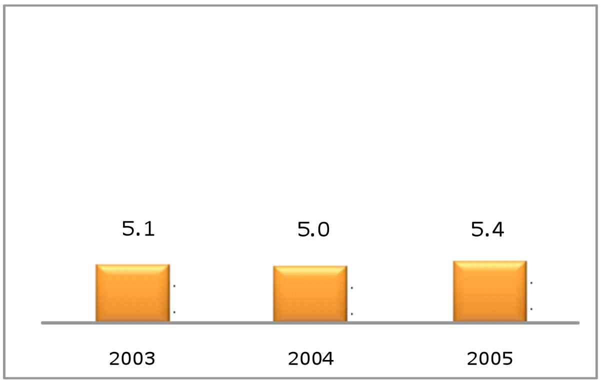
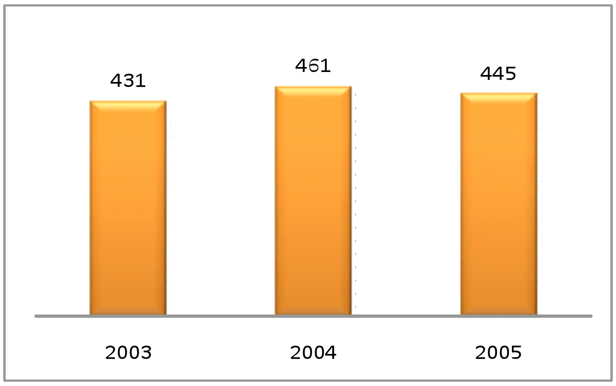


Figure 9 - Evolution of the house loans payments (1) deduction (M€)



Amortizations

In average the value deducted per househo

(1) Interests and Amortizations

In average the value deducted per household with renewable energy equipment investment has been growing since 2003 (see figure 10). Despite this increase, the tax deduction is not used at its maximum ceiling which was 728€ in 2005 and the average deduction was only about 359€ for the same year.

The main explanation for these results is that the number of new systems is low and that deductions claimed are mainly related with complementary equipment (partial substitution of equipment, small investments in fireplace inserts, stoves, etc.).

Figure 10 – Average renewable deduction per household and maximum ceiling (€)

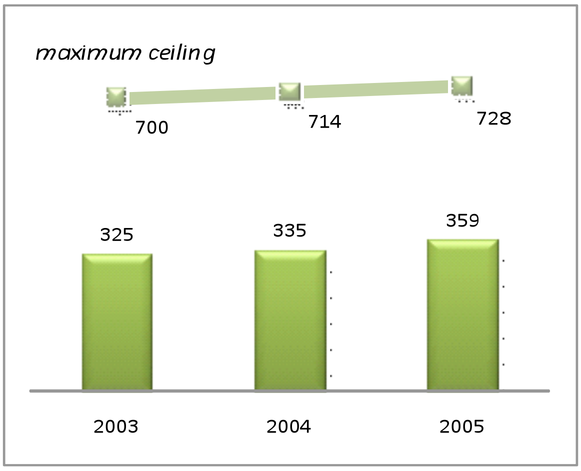
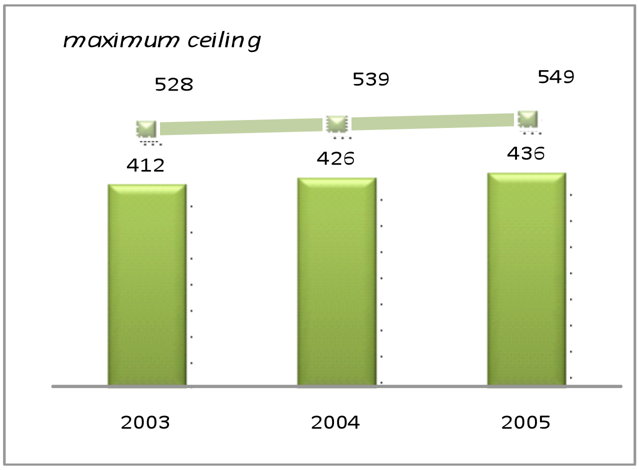


Figure 11 – Average house loan payments' [1] deduction per household and maximum ceiling (€)



Source: Ministry of Finance and Public Administration

(1) Interests and Amortizations

To simulate the impact of the tax deduction at different levels of household annual gross income we did an exercise considering the following hypothesis:

- ✓ Simulation for 2005 (last year with fiscal data available).
- ✓ A household of 3 persons (parents and one son).
- ✓ Maximum income tax deduction with renewable equipment investment (728€ in 2005).
- ✓ Other types of fiscal deductions are not considered here.

The results of this exercise are the following:

Figure 12 – Impacts of the tax deduction with renewable energy equipment investment, by household annual gross income level in 2005

2005 Income Levels	*1*	*2*	*3*	*4*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Average gross monthly income (€)	*208*	*520*	*831*	*1,039*	*1,143*	*1,619*	*2,131*	*2,574*	*3,180*	*4,774*	*9,725*	*32,423*
Average gross annual income (€)	**2,912**	**7,283**	**11,640**	**14,546**	**15,999**	**22,663**	**29,838**	**36,034**	**44,517**	**66,837**	**136,157**	**453,923**
Income tax (%)	10.5%	10.5%	10.5%	13.0%	13.0%	23.5%	23.5%	34.0%	34.0%	37%	40%	40%
Colectable Income (€)	**0**	**425**	**882**	**1,253**	**1,442**	**2,965**	**4,651**	**6,125**	**9,009**	**16,311**	**42,458**	**169,565**
Family deductions [1] (€)	525	525	525	525	525	525	525	525	525	525	525	525
Renewable Equipment deduction (€)	0	0	358	**728**	**728**	**728**	**728**	**728**	**728**	**728**	**728**	**728**
Income Tax to pay (€)	**0**	**0**	**0**	**0**	**189**	**1,713**	**3,399**	**4,872**	**7,756**	**15,059**	**41,206**	**168,312**

(1) Deductions related to the family composition.
Source: Ministry of Finance and Public Administration

For each level of household annual gross income it was considered the average income and calculated the respective income tax to pay, considering the income taxes for each income level and the deductions of a family with 3 persons.

It was simulated for which annual gross income the household doesn't pay any income tax and benefits from the maximum deduction from renewable investment (728€). This would happen if the household earned an annual gross income of 14546€ (level 4 in blue in the figure above). This is the minimal annual gross income to benefit from all the tax deduction with renewables costs, corresponding to a household monthly gross income of 1039€.

For the average gross national income of 16807€ in 2005 (also in the 4th fiscal category) the tax credit is used totally.

In conclusion, this simple exercise reveals that for household annual gross incomes above the minimal annual gross income simulated for all levels, 14546€, the household starts to pay income tax which means that they would benefit more from the fiscal measure if the maximum value was higher.

7. Avoided CO_2 emissions and energy savings

Regarding a standard solar thermal system to heat water (4 m^2) for a family of 4 persons the avoided CO_2 emissions is about 800/1100 kg and the energy saved is about 77%. The energy savings in a year with, for example, a thermosiphon solar water heater (flat plate), when comparing with the other systems, range between 158€ and 335€[35].

With a market of 18395 m^2 of individual solar thermal installed in 2006, (according to the national survey) or about 4600 systems (average of 4m^2 by system) the amount of carbon emissions avoided ranges between 3700 and 5100 Mg of CO_2. These values are not significant; representing about 0.1% of national reduction target under the National Climate Change Programme[36] (3727 Gg of CO_2 emissions).

The Ground Source Heat Pumps (GSHP) use the moderate and constant value of the ground temperature along the year to supply heating and cooling in an efficient way. In the seminary about "Geothermal Heat Pumps promotion in Portugal" it was referred that studies demonstrate that GSHP are an alternative to traditional heating and cooling systems as they reduce fuel consumption and CO_2 emissions and as the variable costs are much lower. For the case of Portugal there is no specific study available. Some actors in the market refer an economic saving representing about 75% of annual expenses, and the avoided CO_2 emissions are about 523kg/year.

In the case of biomass heating appliances the savings referred by the actors in the market are also significant when comparing with conventional appliances.

[35] An exercise done by the Portuguese association consumer's defense in 2005.
[36] RCM nº104/2006.

IV. Preliminary conclusions

In Portugal RES-heat systems are not yet publicly perceived as a standard option. The industry is still too small and fragmented to play a strong role when compared with electricity and gas utilities. Direct marketing or use of mass media have so far been possible only when public authorities have directly supported specific initiatives.

National measures implemented since 2002 to develop the solar thermal market (on one hand, equipment certification, professional training and certification and public campaign and in other hand, the strong increase in fiscal deduction) seem to have induced a small increase in the solar market. However, at the same time energy prices increased strongly, so it is difficult to assess the relative weight of each factor in the evolution of the renewable market. Still the annual sells are far from the objective set in the national programme for solar water heating for 2010 (1 million m^2).

Since 1991 a fiscal incentive for residential sector of new renewable equipment is established by the Portuguese fiscal legislation within the Personal Annual Income Tax. Since 2001 and until 2007 tax deductions associated to investment on renewable equipment cannot be added to other dwelling' expenses.

The existing income tax deduction is not considered by the actors in the market an effective instrument to stimulate the selling of renewable energy appliances in the household sector. Despite its increase, the amount of the tax deduction is still considered too low when compared to the average investment cost (2500 to 3500€). Most potential consumers consider fiscal incentive not attractive enough. Furthermore, since most Portuguese families use house loan deduction in their income tax declaration, the probability to benefit from an investment in a renewable equipment is low as shown by the low number of families using this fiscal measure each year (about 15,000 during 2003-2005).

The national consumer defence association[37] gives the example of thermal solar collectors with a cost that can vary between 1750€ and 5000€ which represents a high level of investment in renewable energy technologies with a long return investment period (6 to 9 years). With the incentive to deduct 30% of the investment cost to the income tax, with a limit of 761€ in 2007, the measure is only considered attractive if this fiscal deduction is separated from deduction related with house loan payments. This association recommends others incentives to stimulate the installation of these equipments like granted credit, for example. The indirect tax applied to the equipments through VAT, although reduced to 12%, is not competitive with gas or electricity which benefit from a 5% VAT.

High investment cost and low real incentive impose a barrier to the RES-heat market development. The limited growth of renewable equipment in recent years might have been also the consequence of other internal factors like a weak economic growth in Portugal (the average annual GDP variation was of 0.6% between 2000 and 2005) and relatively low energy prices (expressed in euros) during 2000-2004.

[37] DECO.

It is also important to underline the recommendations made by some actors in the market (most of them installers of imported equipment). According to them it is necessary to improve some aspects of the fiscal measure (e.g. more public information and independency from other fiscal deductions), to promote the targeted RES, to follow the efforts implemented to enhance the efficiency of the RES equipment sold on the market and to contribute to consumer's knowledge regarding the RES sectors (through installers or sellers).

Main preliminary conclusions from the Portuguese case:

- Technologies using RES in the domestic sector are not sufficiently known by the public and/or are globally very expensive (the current tax deduction scheme does not give a real incentive to boost the development of these RES sectors).
- Two of the three RES sectors (solar thermal and geothermal heat pumps) are not important in terms of employment and they are dominated by imported technologies, therefore the government has low interest in supporting the development of these technologies.
- The way this fiscal measure was structured since 2001 seems to show that the government was giving more importance to support the building sector (with high national effects in terms of employment and economic growth) than RES penetration in the domestic market (deduction for investments in renewable equipments cannot be cumulated with house loans).

Annex

Table 6 – Development of solar thermal market in Portugal (1982-2006)

	ADENE		EurObserv'ER		ESTIF	
m²	cumulated	installed	cumulated	installed	cumulated	installed
1982						17590
1983						24265
1984						37530
1985					121385	42000
1986						34700
1987						33133
1988						28690
1989	130000					25690
1990	150000				265558	21960
1991	170000					18600
1992	178000					15040
1993	185000					11600
1994	193000					8000
1995	200000				330448	9233
1996	208000					
1997	215500					
1998	222500		173200	8000		
1999	230500		160200	8000		4500
2000	238000		220500	5200	239663	5500
2001			210900	6000	210963	6000
2002			199900	6000		5500
2003		9210	124890	10000	160640	6000
2004		16088	109200	10000	144950	10000
2005		18596	125200	16000	160950	16000
2006		28300			180950	20000
2007						24000

Sources:

- ADENE (National Energy Agency) - "SOLMED I - Portuguese Solar Thermal Market and Technology Assessment" document prepared by Adene – Agência para a Energia (2000), and results from national Survey.
- EurObserv'ER – "Solar Thermal Barometer".
- ESTIF – "Solar Thermal Markets in Europe – trends and market statistics", "Sun in Action II" ESTIF uses general assumptions to calculate the solar park in operation: systems installed until 1989 have an average lifetime of 15 years; systems installed in or after 1990 have an average lifetime of 20 years.

Table 7 – List of Interviewed persons

Ministry of Finance and Public Administration **Division of Income Personnal Tax (IRS)**	José Harthley
National Energy Agency **ADENE**	Luis Silva Filipe Camilo
APISOLAR	João Oliveira
Industrialists and Installers	• **Geotermia de Portugal** Rui Silva
	• **Chama – Equipamentos Térmicos Lda** Sónia
	• **TEPAL - Indústria e Comércio de Equipamentos, Lda** Luis Mascarenhas
	• **Energium - Energias Renováveis e Eficiência Energética, Lda.** Nuno Fernandes
	• **MLE – Soluções de Climatização** Mario Escobar
	• **Luz Solar, Energias Alternativas Lda** Bengler

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- Portuguese Solar Annual Survey from 2003 to 2006 (www.aguaquentesolar.com/observatorio/emPortugal/index.asp)