Are energy efficiency obligations an alternative? The case-study of Portugal

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Keywords

policy instruments, energy end-use efficiency, demand-side management, energy efficiency obligation

Abstract

The EU Energy Efficiency Directive (EED) sets up an energy efficiency obligation (EEO) scheme under which a savings target is defined as, at least, 1.5 % of the annual sales of energy to final customers, averaged over the three-years period from 2010 to 2012. Portugal has some years of experience of involving electric utilities in the promotion of demand-side energy efficiency. Since 2007 a voluntary mechanism, Demand-Side Efficiency Promotion Plan (PPEC), that invites the participation of utilities, as well as other entities, for the promotion of energy efficiency in consumption, has been in place. Under this mechanism, utilities are invited to submit proposals of measures that should contribute to the reduction of electricity consumption. The proposed measures are evaluated and the most promising, according to a set of criteria, are selected to be financed with funds raised from all electric energy ratepayers. More recently a 20 % contribution of the promoter and/or customer was imposed to the implementation costs of those measures. In the 2013/2014 PPEC edition, utilities proposed measures that should contribute annually to 154 GWh of avoided consumption. The avoided annual consumption of the selected measures was estimated to be around 117 GWh. Both figures are far from the 760 GWh that results from the 1.5 % target set by the EED, without considering any of the exceptions allowed in the Directive. However, during the lifetime of the Plan, proposals made by utilities reached values not so far from the Directive targets, which suggest that utilities might be ready to participate in an EEO scheme. Additionally, the

funds collected from tariffs to invest in the PPEC mechanism are limited. In the paper, the Portuguese PPEC is presented and the participation of electric utilities is highlighted. Based on PPEC results, a mandatory involvement could actually be a more effective way of getting utilities involved in energy efficiency promotion in Portugal.

Introduction

The involvement of utilities in programmes that intend to influence customer consumption habits, Demand-Side Management (DSM) programmes, started after the oil crises of the 70's. By then, the sector was in a regulated environment, where utilities were mostly vertically integrated and quite a number of them publicly-owned. The deregulation of the electricity industry that started in the 1990s, threatened the involvement of utilities in DSM programmes. During this period utilities were more focused in the restructuring process and, due to uncertainties on the availability of funds and to the new regulatory environment, investments in DSM dropped sharply. The availability of funds to energy efficiency (EE) programmes managed by utilities is a key factor to involve utilities in developing EE programmes. Altogether, the risks of not recovering programme costs, of revenues losses, or falling profits, may be discouraging. The participation of utilities in the promotion of EE measures is mostly carried out under mandatory regulations. Mainly through the imposition of savings targets - Energy Efficiency Obligations (EEO) -, utilities become involved in the promotion of EE. In 2011, the role utilities played in promoting energy efficiency in consumption was estimated by IEA to be approximately USD 12 billion (Heffner, et al., 2013). According to the same source, the most responsible were

EU 27 energy utilities that spent USD 2.5 billions and the US with USD 9.1 billions. Although an apparent paradox, the relationship energy suppliers have with customers, ready access to capital, human resources with know-how, and a familiar brand name, are reasons that may justify the involvement of energy suppliers in fostering energy efficiency in consumption (IEA, 2010).

When under EEO, European energy utilities look for ways to "make a business virtue", such as the development of new business lines or customer retention strategies, while fulfilling their obligations (Heffner, et al., 2013). Energy providers in US and Canada use energy efficiency obligations, or Energy Efficiency Resource Standards (EERS), as a way to improve the utilization of existing installations and postpone/avoid adding new capacity.

Under the EU2020 strategy, the overall EU savings target reaches 1,474 Mtoe (eceee, 2013). The Energy Efficiency Directive (EED) is a key element to achieve the EU's 2020 target for 20 % energy savings. Besides this target, the EED sets two more: (1) each MS is required to set an indicative savings target, and (2) an EEO target. This one should be set annually and "shall be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5 % of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013" (European Parliament & Council of the European Union, 2012). Although EEOs were previously set as part of the 2006 Energy Services Directive, only some few MS implemented them (eceee, 2013). The EED gives alternatives to the implementation of EEO, regarding the 1.5 % annual savings target. Those alternatives are (1) already existing measures that will keep delivering new energy savings each year, for the period 2014-2020, and (2) a mixture of EEO and alternative programmes, including national energy efficiency programmes, that, together, deliver the annual savings target. Some policy measures are highlighted as possible ways to achieve the savings target. That include (1) energy or CO₂ taxes with the effect of reducing end-use energy consumption; (2) financing schemes and instruments or fiscal incentives for the adoption of energy efficient technologies or techniques that reduce end-use energy consumption; (3) regulations or voluntary agreements; (4) "standards and norms, including building codes that aim at improving the energy efficiency of products, buildings and services, provided they exceed the minimum requirements in the MS as required by EU legislation, including Eco-design and EPBD, the latter using the cost-optimal level"; (5) energy labelling schemes, in addition to the ones already mandatory; and (6) training and education, as long as they actually contribute to the reduction of end-use energy consumption through the use of energy efficient technologies and techniques (eceee, 2013).

Not all MS intend to implement EEO, with or without a combination of measures, as a result of the EED (Table 1¹). Several countries count several years of experience with EEO. Most of them have been adjusting the regulatory instruments in order to overcome some identified mismatches. The Flemish region of Belgium, Denmark, France, Italy, and the United Kingdom have already a long experience with EEO. Some countries with none or little, involvement of utilities in fostering EE, are determined to move forward with EEO. Such are the cases of Austria, Bulgaria, Estonia, Hungary, Ireland, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, and Spain.

Portugal has set 22.5 Mtoe to be the primary energy consumption in 2020, which corresponds to a more ambitious objective than the 30 Mtoe that results from the 1,474 Mtoe objective for the EU as a whole (Presidência do Conselho de Ministros, 2013). Portugal has in place some mechanisms to foster energy efficiency, such as, the Energy Efficiency Fund, the Innovation Support Fund, the Energy Efficiency in Public Administration Programme, and the Demand-side efficiency promotion plan (PPEC).

In the following section a description of PPEC is presented, followed by a reflection on the voluntary involvement of electric utilities is the promotion of energy efficiency in Portugal. The paper ends with some considerations on the conditions of adopting EEO in Portugal.

Portuguese Demand-side efficiency promotion plan

In 1998 the first regulatory framework that fosters the involvement of electric utilities in the promotion of EE on the demandside was approved. The tariff regulation code approved in 1998 (Despacho n.º 16 288-A798, 15th of September) established that the costs associated to demand-side projects, are to be included in the revenues from the tariffs applied to electricity consumption. This methodology was first applied in the first regulatory period, between 1999 and 2001. The Tariff regulation of 2001 (DR, 2001), imposed that supply tariffs of the public electricity system provided revenues that should include reimbursement of the costs associated to demand-side programmes, as well as 50 % of the associated benefits. The public electricity distributors were required to present Demand-side Management Plans (PGP - Planos de Gestão da Procura) for each year of the regulatory period. These PGP contained a set of measures to promote EE in consumption that should be implemented in each year of the regulatory period. These rules were applied in 2002-2004 and 2005. 2005 was considered a transitory period, due to the reform of the electricity sector.

The Demand-side efficiency promotion plan (PPEC) rules were published in 2006 (Despacho n.º 16 122-A/2006, de 3 de agosto) and improved two years later, in 2008 (Despacho n.º 15 546/2008, de 4 de junho). Some improvements were made in 2010, under the same regulatory framework.

PPEC is a voluntary mechanism that has the objective of promoting measures intended to improve efficiency in electric energy consumption, through actions proposed by electricity suppliers, distribution and transport network operators, consumer organizations, business associations, energy agencies, higher education institutions, and R&D institutions. These actions target energy customers from different sectors, and are subjected to a selection procedure, whose criteria and corresponding weights are defined in PPEC rules. The plan is implemented through a tender mechanism that allows the selection of EE measures to be implemented by their promoters

^{1.} Article 3 indicative national energy efficiency target for 2020: http://ec.europa. eu/energy/en/topics/energy-efficiency/energy-efficiency-directive (consulted in 26 of February 2015).

EU Member State	Article 3 indicative national energy efficiency target for 2020	EEO?
Austria	Final energy consumption of 1,100 PJ	Yes (AEA, 2014)
Belgium	18 % reduction in primary energy consumption by 2020 relative to the Primes 2007 baseline (53.3 Mtoe)	No; Yes for Flanders (The Coalition for Energy Savings, 2014)
Bulgaria	Increase of energy efficiency by 25 % until 2020 (5 Mtoe primary energy savings in 2020) and 50 % energy intensity reduction by 2020 compared to 2005 levels	Yes (Ministry of Economy and Energy, 2014)
Croatia	Increase in energy efficiency resulting in final energy consumption reduction of 19,77 PJ in 2016 and 22,76 PJ in 2020	No (The Coalition for Energy Savings, 2014)
Cyprus	0.463 Mtoe energy savings in 2020 (14.4 % reduction in 2020 compared to a reference scenario)	No (Ministry of Commerce, Industry and Tourism, 2013)
Czech Republic	47,84 PJ (13,29 TWh) savings of final energy consumption (preliminary data)	No (Concerted Action for the Energy Efficiency Directive, April 2015)
Denmark	Primary energy consumption of 744.4 PJ (17.781 Mtoe) in 2020	Yes (Concerted Action for the Energy Efficiency Directive, April 2015)
Estonia	Stabilisation of final energy consumption in 2020 at the level of 2010	Yes (Majandus- Ja Kommunicatsiooni-Ministeerium, 2014)
Finland	310 TWh of final energy consumption in 2020	No (Unkown, 2014) (Concerted Action for the Energy Efficiency Directive, April 2015)
France	17.4 % reduction of final energy consumption in 2020 compared to a baseline	Yes (Directorate General for Energy and Climate, 2014)
Germany	Annual improvement of energy intensity (energy productivity) by 2.1 % p.a. on average until 2020	No (Federal Office of Economics and Export Control, and Federal Agency for Energy Efficiency, 2014)
Greece	Final energy consumption level of 20.5 Mtoe	No (Concerted Action for the Energy Efficiency Directive, April 2015)
Hungary	1,113 PJ primary energy consumption in 2020 (236 PJ savings compared to business-as-usual), resulting in 760 PJ final energy consumption	Yes (The Coalition for Energy Savings, 2014)
Ireland	20 % energy savings in 2020 along with a public sector energy saving target of 33 % (resulting in energy savings of 31,925 GWh)	Yes (Concerted Action for the Energy Efficiency Directive, April 2015)
Italy	20 Mtoe primary energy reduction by 2020, 15 Mtoe final energy reduction by 2020	Yes (Ministry of Economic Development, 2014)
Latvia	Primary energy savings in 2020 of 0.670 Mtoe (28 PJ)	Yes (Concerted Action for the Energy Efficiency Directive, April 2015)
Lithuania	17 % reduction in final energy use compared to 2009 level (reduction of 740 ktoe)	Yes (Minister for Energy of the Republic of Lithuania, 2014) (Concerted Action for the Energy Efficiency Directive, April 2015)
Luxembourg	Preliminary target value for 2020 of 49,292 GWh or 4,239.2 ktoe final energy	? (The Coalition for Energy Savings, 2014)
Malta	22 % energy or 237.019 toe savings target by 2020	Yes (Concerted Action for the Energy Efficiency Directive, April 2015)
Netherlands	1.5 % energy savings per year (partial)	No (Unkown, 2014) (The Coalition for Energy Savings, 2014)
Poland	13.6 Mtoe primary energy savings in 2020	Yes (Concerted Action for the Energy Efficiency Directive, April 2015)
Portugal	Reduction of primary energy use in 2020 by 25 % compared to projections	No (Presidência do Conselho de Ministros, 2013)
Romania	Reduction of 10 Mtoe (19 %) in the primary energy consumption	No (The Coalition for Energy Savings, 2014)
Slovakia	3.12 Mtoe of final energy savings for the period 2014– 2020	Yes (Concerted Action for the Energy Efficiency Directive, April 2015)
Slovenia	10.809 GWh energy savings by 2020	Yes (The Coalition for Energy Savings, 2014)
Spain	20 % energy savings to be achieved by 2020	Yes (Ministry of Industry, Energy and Tourism – State Secretariat for Energy, 2014)
Sweden	Energy use shall be 20 % more efficient by 2020 compared with 2008 and a 20 % reduction in energy intensity between 2008 and 2020	No (Cabinet meeting of 24 April 2014, 2014)
United Kingdom	Final energy consumption in 2020 of 129.2 Mtoe on a net calorific value basis	Yes (Department of Energy & Climate Change, 2014)

Table 1. Targets proposed by MSs under the EED as well as their intention to implement EEO.

and partially funded by PPEC's budget. The PPEC experience, as one of non-mandatory involvement of electricity utilities in the promotion of energy efficiency, was before published by the same authors (Sousa, et al., 2013a, 2013b).

The measures proposed to this mechanism should promote the reduction in electricity consumption or load management (LM) actions, on a permanent and accountable basis. The energy consumption reduction effect of the measures must not have been accounted for in any other specific measures. Information disclosure measures may qualify, even not having accounted for impacts, they may promote more rational behaviours and awareness and allow more informed decisions regarding the adoption of more energy efficient solutions. It is expected that the benefits of these actions remain long after the measure itself, therefore it is important to reach as many customers as possible in order to increase the spill over effect of the incentives.

Regarding the type of promoters, there are two different tenders. One of them allows measures proposed by all types of promoters, and the other only allows promoters that are not electric utilities. This distinction allows actors not included in the electricity sector to enter the tender, increasing the number of winning proponents. On the other hand, many of the proponents are regional institutions, with greater proximity to customers and to a different target audience that can be reached with companies that act at a national level. Each non-utility promoter must choose between the two tenders. In order to allow a larger number of actors involved, two restrictions were imposed: the maximum amount allowed to each candidate measure is one sixth of the total budget in that tender, and each promoter can only have two winning measures. Tenders for entities that are not electricity sector agents were created by the 2008 rules. Other restriction was also created by the same regulatory framework, but regarding the tender for all promoters, setting the maximum amount to finance a measure to one third of the budget of the respective tender.

In the tender for all promoters, the main goal is to maximize the economic benefits. In the tender for non-utilities some restrictions are imposed in order to value more the spill over effect and the share of the benefits, reducing the value of the economic benefit and the possible hoarding of the available funds.

Measures are classified into one of two types: Tangible or "hard" and Intangible or "soft" measures. Tangible measures are the ones that are related to the installation of equipment with energy efficiency levels above the market standard. Intangible measures are those related to the disclosure of information regarding an efficient use of electricity aiming at more energy efficient consumer behaviours. Some examples of intangible measures are training courses, information disclosure campaigns, and energy audits.

Each tangible measure targets a specific consumer segment. The consumer segments are Industry and agriculture, Commerce and services, and Residential. The financial incentive is divided among consumer segments, ensuring that all consumer segments can receive incentives from PPEC. Since the financial incentives of PPEC come from a System Benefit Charge (SBC) paid by all electric energy customers, it is important to ensure that all customers may benefit from the measures funded by PPEC. Tangible measures in the tender for all promoters are ranked within the consumer segment they are addressed to. The result will then be three ranked lists of measures, one for each consumer segment. In the tender for non-utilities, the measures are not separated by consumer segment. Intangible measures are ranked in each type of promoters tender, resulting in two more lists of measures. In all lists, measures are ranked in decreasing order of merit. Intangible measures can be fully financed by PPEC. The 2008 rules imposed a limitation for tangible measures, where only eighty per cent of the total cost of the measure can be paid by PPEC. This measure was considered important to ensure diversity of promoters and measures, preventing the hoarding of public funds. The diversity of promoters is important since different promoters choose different type of measures, means of implementation and disclosure, increasing the number and diversity of potential beneficiaries. On the other hand, the bigger the measures, the higher the risks, in case of non-implementation (ERSE, 2008).

In Figure 1, the two tenders are presented, with the type of measure in each tender and the consumer segment for each type of measure, resulting in six different tenders, each with its own budget.

The methodology adopted by the regulator for ranking the measures is based on an additive aggregation model that intends to value those measures that, among other characteristics, present higher economic profitability; are accessible to a large diversity of consumers and; have innovative characteristics. Thus, a set of criteria were selected to reflect those objectives. Tangible and intangible measures are subject to different sets of criteria. Only tangible measures with a positive Net Present Value (NPV), from a societal perspective, are eligible. The societal perspective includes the societal benefits and costs. The societal benefits include the avoided costs and the environmental benefits resulting from non-supplied electricity. The societal costs include the costs related to the equipment to be installed, administrative costs, and transaction costs for the promoter or the participant customer (ERSE, 2008). The costs of the measures can be divided among PPEC, customers, promoters and other partners that share the costs.

The set of criteria to evaluate tangible measures comprises two different types of criteria, addressed as metric (quantifiable characteristics of the measures) and non-metric criteria. The metric criteria are the benefit-cost analysis, the scale risk and the weight of the investment in equipment in the total cost of the measure. The remaining non-metric criteria are: quality of presentation, ability to overcome market barriers and spill over effect, equity, innovation, and promoter experience in similar programs (ERSE, 2008).

As for the tangible measures, intangible ones are ranked according to a set of criteria and their weights, with the overall performance value (OPV) obtained through an additive aggregation model. The criteria used to evaluate intangible measures are the same non-metric criteria used to assess tangible measures, although some differences in the allocation of score may exist.

The OPV of each measure corresponds to the sum of the performances of each measure under each criterion, multiplied by the weight for that same criterion, resulting in a list of measures ranked by decreasing order of the OPV.

The selected measures will be those, starting from the top of the ranking list until the last one within the budget provision. The last measure may have to be resized to comply with the available budget.



Figure 1. Tenders, type of measures, and consumer segments in PPEC (adapted from ERSE, 2010).

Table 2. Expected budget amounts for each PPEC	edition (millions of euros) divided by	y tender, type of measures and consumer segment.
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	2007	2008	2009–2010	2011–2012	2013–2014
Intangible measures (All promoters)	2.0	2.0	3.5	3.5	3.0
Tangible measures (All promoters) – Industry and agriculture – Commerce and services – Residential	3.0 2.5 2.5	3.0 2.5 2.5	5.8 4.9 5.3	5.8 4.9 5.3	5.1 4.3 4.6
Intangible measures (Non-electricity sector companies)	-	-	1.5	1.5	3.0
Tangible measures (Non-electricity sector companies)	-	_	2.0	2.0	3.0
Total	10.0	10.0	23.0	23.0	23.0

Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).

Electricity utilities participation in PPEC

In this section the characterisation of the participation of electric utilities in PPEC will be presented. With this analysis we intend to demonstrate that there is a valuable experience from the voluntary participation of utilities in fostering EE. Setting a savings target could be the next step.

As said before, only the measures proposed to this mechanism that were considered eligible, by fulfilling PPEC rules, are then evaluated and sorted in a merit order. PPEC funds come from a levy of 0.2 % on end-use on electricity prices (Swanson, 2012). Since the financial incentives of PPEC are paid by all electric energy customers, it is important to ensure that all customers may benefit from the measures funded by PPEC.

PPEC editions happen every two years, with the exception of the first two editions (the 2007 and 2008) that were annual. The

budget amounts available for each PPEC edition are presented in Table 2.

By comparing the expected budget amounts for each PPEC edition (Table 2) with the total amount of the costs of proposed measures (Table 3), it is possible to see the high level of participation. This is a clear sign of the success of the PPEC mechanism and the willing of different authors to participate.

The participation of the utilities has been decreasing in relative terms (Table 4): this is a consequence of the participation of non-utility promoters, since the number of utilities participating in PPEC editions has remained approximately constant, with only minor variations. In last PPEC edition and in order to correspond to this growing interest that PPEC has arisen among non-electricity sector entities there was a transfer of funds from the all-promoters tender to the tender for non-electricity sector companies (Table 2). The number of

Table 3. Costs of the candidate measures to each PPEC edition (in millions of euros).

	2007	2008	2009–2010	2011–2012	2013–2014
Eligible proposed measures	26.6	46.3	58.1	57.1	58.8
 Intangible measures 	7.3	8.7	18.3	18.3	28.2
– Tangible measures	19.3	37.5	39.8	38.8	30.6

Source: (ERSE, 2013).

Table 4. Electric utilities participation in each PPEC edition.

PPEC Edition	Number of utilities/ number of promoters	Number of utilities (%)	
2007	6/8	75	
2008	9/21	48	
2009–2010	10/29	38	
2011–2012	12/48	25	
2013–2014	9/65	14	

Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).

Table 5. Number of measures proposed by utilities and non-utilities.

	2007	2008	2009–2010	2011–2012	2013–2014
Utilities	58	81	85	72	87
Non-utilities	4	32	36	74	120
Total	62	131	125	159	207

Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).

participating utilities rounds 50 % of the licensed ones (ERSE, 2012). Nevertheless, one of the utilities represents 54 % of the consumption in the unregulated market, with a share of 81.2 % of the electricity consumption in Portugal mainland (ERSE, 2014).

Besides the number of participating agents, the number of proposed measures has also been increasing which is also an indicator of the importance that the promoters assign to this mechanism (Table 5). The number of measures proposed by utilities has been increasing, except for the 2011–2012 edition, and the number of measures promoted by non-utilities has also been increasing, but at a higher pace. The increasing rate of participation is only possible with the development of a network of collaborators and suppliers of equipment, as well has new competences in designing and implementing EE measures.

The number of tangible measures considered eligible has been increasing (except for the last PPEC edition), and so does the number of approved measures. In the last PPEC editions, more than half the number of the eligible tangible measures was approved (Figure 2).

Regarding the measures proposed by non-utilities, there seems to be a preference for intangible measures (Figure 3), markedly in the 2011–2013 PPEC edition, where the number of eligible measures more than doubled, comparing to the number of measures of the previous edition. The existence of a tender for agents that are not utilities, since the 2009–2010 edition, has been allowing non-utility entities to implement a relatively important number of measures.

As it was expected, tangible measures have higher average costs than intangible ones (Figure 4). Although the number of tangible measures proposed by non-utilities has slightly increased in the 2011–2012 PPEC call (Figure 3), the average societal cost of each measure is almost three times higher than in the previous one (Figure 4). The societal costs include the financial costs incurred by the participant customers, by all electric energy customers (financed through PPEC), by the promoters or other entities. Regarding the utilities participation, the average societal cost of the approved measures decreased since last PPEC edition, in contrast to the increasing trend observed in the previous calls. As for the intangible measures, the average costs are, lower when compared with tangible measures average costs.

Regarding the number of intangible measures proposed by non-utilities in the 2011–2012 edition, it was more than two times the number of the previous edition although the societal costs remain similar.

For the last PPEC editions, the PPEC share in the costs of tangible measures is capped at 80 % of the total costs. This resulted in an increase of the share of other parties in the costs, as can be seen in Figure 5, being customers the next main contributor after PPEC. Since tangible measures are based on the



Figure 2. Number of eligible and approved measures proposed by utilities for each PPEC calls for proposals. Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).



Figure 3. Number of eligible and approved measures proposed by non-utilities entities, for each PPEC edition. Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).



Figure 4. Average societal costs of the eligible measures in each PPEC edition. Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).



Figure 5. Costs of the measures proposed by utilities distributed by PPEC, consumers, utilities and third-party. Sources: (ERSE, 2007a, 2007b, 2009, 2010, 2013).

installation of energy consuming equipment, customer costs are in fact their contribution to the equipment costs. In last PPEC edition, the utilities contribution to the costs was reduced and customers share was increased. According to programme entitled Policies for Energy Provider Delivery of Energy Efficiency (PEPDEE), from the analysis of several energy efficiency programmes, 25 % of the implementation costs of large-scale energy efficiency programmes come from an utility or government type entity, the remaining being driven by private investments (Heffner, et al., 2013). In Portugal, the situation is different, with more than three-quarters coming from the PPEC budget. In fact, PPEC budget comes from a levy on the costs of electricity, paid by all customers, a similar situation to other countries which implemented an EEO.

The 2009–2010 PPEC edition is not only earmarked as the edition with the highest cost, but also as the edition with the highest annual avoided consumption (Table 6). This was mostly due to measures aiming the distribution of large numbers of compact fluorescent lamps.

Figure 6 compares the avoided consumption values of the proposed and the selected measures, to the 1.5 % target of article 7, considering the 50,589 GWh of average annual electricity consumption during 2010–2013. It is important

Table 6.	Annual avoided	consumption	of tangible	measures	promoted b	Jy
utilities						

	Annual Avoided consumption (GWh)
2007	74.3
2008	157.2
2009 and 2010	444.4
2011 and 2012	191.9
2013 and 2014	157.6

though to keep in mind that the 1.5 % target can be obtained regardless of the energy source.

The avoided final energy consumption expected from the last two PPEC editions are well below the 760 GWh that is required to meet the 1.5 % target set by the EED, without considering any of the exceptions allowed in the Directive. However, proposals made by utilities in the previous edition have reached near 60 % of the Directive targets.

Targets are important in policies regarding energy efficiency (Heffner, et al., 2013). It is the authors' opinion that setting a savings target would be an important step. Also performance incentives and penalties play an important role in keeping obliged parties involved in meeting their target (RAP, 2012).

Comparing the part of the costs of each saved kWh allocated to the PPEC budget (CSk PPEC), the societal costs of the measures financed (Societal CSk), both the one that resulted of the first PPEC edition (2007) and the ones that are expected of the last four PPEC editions, to the additional costs incurred in paying renewable kWh above market costs in order to stimulate RES (AMCRE), we can see that saving energy is much less expensive (Figure 7). The AMCRE are justified by political decision makers by the need to reduce CO_2 emissions as well as to diversify energy sources. The values paid for each kWh produced by renewable source were between 2.3 and 6.25 times more expensive than the unitary cost of the PPEC investment in energy saving. In this analysis only tangible measures are taken under account.

In Figure 8 the societal benefits from PPEC funds, for each consumer segment and for each PPEC edition is presented. The benefits to the industrial and agriculture segment show no specific trend with the maximum value obtained in the 2009–2010 edition. On the other hand the services and commerce segment benefit from an increase of the societal benefits, with the exception of a slight decrease in last PPEC edition. For the residential sector the societal benefits have been decreasing with the exception of the 2009–2010 PPEC edition.



Figure 6. Comparison between avoided final energy consumption of proposed and selected measures, and the 1.5 % target. Source: (REN, 2011, 2012, 2013).



Figure 7. CSk PPEC, Societal cots and AMCRE. Source: (Apolinário, et al., 2007; Apolinário, et al., 2009; ERSE, 2009, 2010, 2011, 2014a).



Figure 8. Societal benefits, in euros, from each euro of PPEC funds invested. Source: (ERSE, 2007b, 2009, 2010, 2011, 2014a).

Conclusions

Although the involvement of utilities in the promotion of DSM has been regulated for fifteen years, a stronger commitment in Portugal has only been seen in the last five or six years. The regulator has developed a structured approach to adapt the regulatory framework, using the previous experience and the information gathered through public consultation to other entities interested in this subject.

The promotion of EE at the consumer side has been mostly driven by the Portuguese regulator, first with the PGP and more recently by the PPEC mechanism. In the PGP only intangible measures were implemented although the costs of the measures were recovered by the promoters and the benefits where equally shared between the promoter and the consumers.

EE fostering by utilities was then redeemed in 2007, with voluntary participation by utilities, under the PPEC mechanism. The 2007 PPEC edition allowed full recovery of the costs. After that, only 80% of the costs can be recovered for the tangible measures. Even knowing that the EE programmes would contribute to a reduction in revenues, the participation of utilities has been steady, based on the number of proposed measures. Nowadays, not only lost revenues are not addressed nor is the total cost of the measures fully paid by PPEC funds. Utilities are investing in programmes that reduce their revenues. In a competitive environment this is an apparent paradox. Nevertheless, they keep participating in the programme, probably driven by the improvement in their public image (Apolinário, et al., 2012). However, energy savings amounts have decreased in last PPEC editions. Setting compliance targets, as well as performance incentives and penalties, would make utilities participation more effective in obtaining energy savings. The level of commitment of utilities in EE fostering on a voluntary basis provides the authorities a reference framework for defining the EEO requirements, which should rationally exceed that level of voluntary commitment.

Great Britain has 20 years of experience of obligations on suppliers and, according to the Department of Energy & Climate Change (2014), these obligations are "one of the most successful means of increasing the uptake of energy efficiency measures". Even though Portugal does not have 20 years of experience in EEO, it has 14 years of experience in stimulating electric utilities to promote energy efficiency in a different regulatory environment. Besides setting savings targets, another step should probably be extending the mechanism to other fuels.

The participation of utilities in PPEC edition of 2009–2010 resulted in avoided consumption values that reached 59 % of the Article 7 target. This gap may be reduced by means of an EEO scheme implementation but it surely requires other complementary mechanisms that go beyond the electricity sector. The accumulated experience from five PPEC editions, in selecting technologies, allocating costs, designing measures, finding partners to deliver equipment and partners to implement measures has certainly created conditions for utilities to successfully participate in an EEO scheme. Additionally, the observed cost of the saved kWh within the PPEC shows the high societal value of energy efficiency measures, in contrast with the usual high costs of renewable electricity production included in tariff prices. The voluntary involvement of Portuguese utilities in implementing energy efficiency measures corresponds to a clearly advantageous situation for implementing EEO, especially when compared to situations in other countries adopting EEO without prior experience of energy efficiency promotion. There are reasons for the voluntary efforts of utilities which would pave the way to the fulfilment of EEO. Overcome the present gap to the overall 1.5 % target is a necessity of the national energy policy. The methods, instruments and routines created within PPEC are a guarantee of verifiable results, since M&V is mandatory in the present specifications of PPEC calls.

The Portuguese experience and the experience of other countries can certainly help countries in taking stronger commitments regarding energy savings.

References

- AEA. (2014). NEEAP 2014 First National Energy Efficiency Action Plan of the Republic of Austria 2014 in accordance with the Energy Efficiency Directive 2012/27/EU. Vienna: Austrian Energy Agency.
- Apolinário, I., Barros, C. C., Santo, C. E., Ferreira, A., Ferreira, L., Madeira, B., et al. (2012). Results from a competitive tender mechanism to promote energy efficiency in Portugal. 9th International Conference on the European Energy Market, May, 10-12, 2012. Florence: IEEE.
- Apolinário, I., Correia de Barros, C., Coutinho, H., Ferreira, L., Madeira, B., Oliveira, P., et al. (2009). Promoting Demand Side Management and Energy Efficiency in Portugal. CIRED2009 – 20th International Conference on Electricity Distribution, (pp. 8–11). Prague.
- Apolinário, I., Felizardo, N., Garcia, A. L., Oliveira, P., Trindade, A., Vasconcelos, J., et al. (2007). 'Economic Criteria for Evaluating Demand Side Management Measures in the Context of Electricity Sector Regulation. Minerals & Energy – Raw Materials Report, 22 (3), 135–147.
- Cabinet meeting of 24 April 2014. (2014). Sweden's Third National Energy Efficiency Action.
- Concerted Action for the Energy Efficiency Directive. (April 2015). National EED Implementation Reports. Concerted Action for the Energy Efficiency Directive.
- Department of Energy & Climate Change. (2014). UK National Energy Efficiency Action Plan. London.
- Directorate General for Energy and Climate. (2014). Energy Efficiency Action Plan for France – 2014. Paris: Ministry of Ecology, Sustainable Development and Energy.
- eceee. (2013). Understanding the Energy Efficiency Directive – Steering through the maze #6: A guide from eceee. Stockholm: European Council for an Energy Efficient Economy (eceee).
- ERSE. (2007a). Plano de Promoção de Eficiência no Consumo de Energia Eléctrica para 2007. Lisboa: Entidade Reguladora dos Serviços Energéticos.
- ERSE. (2007b). Plano de Promoção da Eficiência no Consumo de Energia Eléctrica para 2008. Lisboa: Entidade Reguladora dos Serviços Energéticos.
- ERSE. (2008). Plano de Promoção da Eficiência no consumo de Energia elétrica PPEC – Documento de Discussão. Lisboa: Entidade Reguladora dos Serviços Energéticos.

ERSE. (2009). Plano de Promoção da Eficiência no Consumo de Energia Eléctrica para 2009–2010. Lisboa: Entidade Reguladora dos Serviços Energéticos.

ERSE. (2010). Plano de Promoção da Eficiência no Consumo de Energia Eléctrica para 2011–2012. Lisboa: Entidade Reguladora dos Serviços Energéticos.

ERSE. (2011). PPEC 2007: Balanços e resultados. Lisboa: Entidade Reguladora dos Serviços Energéticos.

ERSE. (2012). Agentes do Sector. Obtido em 09 de 08 de 2012, de Entidade Reguladora dos serviços Energéticos: http:// www.erse.pt/pt/electricidade/agentesdosector/Paginas/ default.aspx.

ERSE. (2013). Plano de Promoção da Eficiência no Consumo de Energia Eléctrica para 2013–2014. Lisboa: Entidade Reguladora dos Serviços Energéticos.

ERSE. (2014). Resumo Informativo Mercado Liberalizado Electricidade. Lisboa: ERSE.

ERSE. (2014a). Plano de Promoção da Eficiência no Consumo de Energia Elétrica para 2013–2014 – Impactes e Benefícios das medidas aprovadas. Lisboa: Entidade Reguladora dos Serviços Energéticos.

Federal Office of Economics and Export Control, and Federal Agency for Energy Efficiency. (2014). 3rd National Energy Efficiency Action Plan (NEEAP) 2014 for the Federal Republic of Germany. Berlin: Federal Ministry for Economic Affairs and Energy.

Heffner, G. C., Pont, P. d., Paton, C., Roy, L., & Limaye, D. (2013). Energy Provider-Delivered Energy Efficiency. Paris: OECD/IEA.

IEA. (2010). Energy Efficiency Governance. Paris: OECD/IEA.

Majandus- Ja Kommunicatsiooni-Ministeerium. (2014). National Energy Efficiency Action Plan – Estonia's Communication to the European Commission under Article 24 (2) of Directive 2012/27/EU. Tallinn: Majandus- Ja Kommunicatsiooni-Ministeerium.

Minister for Energy of the Republic of Lithuania. (2014). Energy Efficiency Action Plan 2014. Vilnius: Minister for Energy of the Republic of Lithuania.

Ministry of Commerce, Industry and Tourism. (2013). Annual Report on the Progress Achieved towards National Energy Efficiency Targets. Nicosia.

Ministry of Economic Development. (2013). Annual report on energy efficiency – Results achieved as of 2011 and targets for 2020. Roma: Ministry of Economic Development. Ministry of Economic Development. (2014). Italian Energy Efficiency Action Plan. Roma: Ministry of Economic Development.

Ministry of Economy and Energy. (2014). National Energy Efficiency Action Plan 2014–2020. Sofia: Ministry of Economy and Energy.

Ministry of Industry, Energy and Tourism – State Secretariat for Energy. (2014). 2014–2020 National Energy Efficiency Action Plan. Madrid: Ministry of Industry, Energy and Tourism.

Presidência do Conselho de Ministros. (10 de abril de 2013). Resolução do Conselho de Ministros n.º 20/2013. Diário da República, 1.ª série – N.º 70, pp. 2022–2091.

RAP. (2012). Best practices in designing and implementing Energy Efficiency Obligations Schemes. Stockholm: IEADSM.

- REN. (2011). Dados técnicos/Technical data 2010. Lisboa: REN.
- REN. (2012). Dados técnicos/Technical data 2011. Lisboa: REN.
- REN. (2013). Dados Técnicos eletricidade 2012. Lisboa: REN.

Sousa, J. L., Martins, A. G., & Jorge, H. M. (2013). Dealing with the paradox of energy efficiency promotion by electric utilities. Energy, 57, 251–258.

Sousa, J. L., Martins, A. G., & Jorge, H. M. (2013). Worldwide non-mandatory involvement of electricity utilities in the promotion of energy efficiency and the Portuguese experience. Renewable and Sustainable Energy Reviews, 22, 319–331.

Swanson, S. (2012). Regulatory Mechanisms to Enable Energy Provider Delivered Energy Efficiency. Montpelier (Vermont – US): Regulatory Assistance Project.

The Coalition for Energy Savings. (2014). Implementing the EU Energy Efficiency Directive: Analysis of Article 7 Member States reports. The Coalition for Energy Savings.

Unkown. (2014). Finland's National Energy Efficiency Action Plan NEEAP3.

Unkown. (2014). Third National Energy Efficiency Action Plan for the Netherlands.

Acknowledgements

This work has been supported by the Fundação para a Ciência e a Tecnologia (FCT) under project grant UID/MULTI/00308/2013.