

# *Preparing Energy Efficiency Mechanisms in the Portuguese Electricity Sector*

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## **1 - SYNOPSIS**

The paper analyses and gives suggestions on the implementation of mechanisms for energy efficiency in the new Portuguese electricity regulation.

## **2 - ABSTRACT**

The paper gives an overview of the electricity restructuring process and its components. Portugal is presented as a representative case of a restructuring process, moving from a public monopoly situation to a moderate liberalisation required for the completion of the European Electricity Internal Market. An analysis is made regarding mechanisms explicitly created for the promotion of energy efficiency as for possible inherent ones. It is shown that further technical and institutional developments have to be carried out to implement these mechanisms.

## **3 - INTRODUCTION**

The preoccupation in maintaining principles of public service, like the uniformity of tariffs and the universality of supply, influences greatly the Portuguese restructuring process, by limiting in some way the introduction of competition. According to the legislation, the regulator should be concerned with the « economic efficiency [...] and should encourage the regulated companies to behave in accordance with the public interest. Public interest includes more than the basic aspects of public service like the universality of services, the reliability of the electricity system, the stability and justice of prices, but also aspects of general interest like the promotion of energy efficiency and environmental protection » (ERSE, 1998a). It is how these last aspects – promotion of energy efficiency and environmental protection – are treated that we are going to analyse.

This paper presents the first results of an analysis carried out as part of a research project aiming at proposing evaluation tools for energy efficiency and Demand-Side Management mechanisms. The Portuguese electricity sector will be the object of this research project. The experience acquired on energy efficiency and DSM in Portugal, namely within Centro para a Conservação de Energia and the research experience from Ecole des Mines were the bases for the results presented. This paper is also a contribution to integrate energy efficiency and Demand-Side Management in the new organisation of the electricity sector in Portugal.

We pretend to demonstrate that regulation can have an important role in promoting energy efficiency and DSM but that political action is also necessary, possibly as part of an environmental policy. The institutional panorama in the energy sector has also implications that are taken into consideration.

The paper starts by presenting a framework to characterise the electricity sector restructuring process in general. The Portuguese situation is reviewed and the choices made regarding the completion of the European Union Internal Market exposed. The possible mechanisms for energy efficiency are then presented as well as the need for modifications, and some recommendations for their development are given. Finally, the implications of the institutional panorama for energy efficiency and DSM are presented.

## 4 - SHORT OVERVIEW OF RESTRUCTURING AND ITS POSSIBLE COMPONENTS

The electricity sector restructuring appears in a global trend to liberalise public services that have often been provided by monopolies like the postal services, the telecommunications and the railways. In this paper, we propose to characterise the electricity sector restructuring by five major components:

- **Commercialisation**, through the introduction of commercial objectives in the management of the companies. This implies full cost recovery, which frequently includes keeping separate accounts for different functions. It may lead to new tariff structures differentiated between customers;
- **Privatisation**, total or partial, of one or more of the typical functions (generation, transmission, distribution and supply);
- **Unbundling**, in which the functions are split, even if this unbundling is just an accounts separation within a single company, like the solution encountered in the EU-Directive on Internal Market of Electricity (IEM);
- **Competition** in the generation and in the retail market. The latter is the most drastic change possible in the reform process and is limited in some countries;
- **Internationalisation**. A larger international participation of electricity companies occurs, even for countries with traditional monopolistic national companies. Restructuring in developing countries is another factor contributing to the internationalisation of companies from developed countries.

There are other trends associated with this process, regarding which it is often difficult to determine whether they are a cause or a consequence:

- The expansion of utilities' activities by providing energy services to the customers. This is a way for the utilities to avoid the downsizing that would be needed to reach a higher efficiency in their traditional activities. Energy services are also a means to retain customers - soon free to choose their supplier - by creating a closer relationship with them;
- The diversification, when utilities get involved in activities not directly related to the energy field. In France, EdF-Electricité de France tried to be involved in the telecommunication sector and has not been allowed to do so due to a "principle of speciality" stated by law. Conversely, EDP-Electricidade de Portugal has been authorised to diversify their activities;
- The "small is beautiful" effect in generation due to the development of more energy efficient technologies (Combined Heat and Power - CHP, combined cycle, or the combination of both), less capital intensive, decentralised by nature, that avoid losses and delay investments in transmission, reducing the former economy of scale effect dominant in the past.
- The largest investments in transmission and distribution networks have been done in EU and developed countries where electrification covers almost the whole territory. Therefore, it is now possible to carry out a more commercial exploitation. This situation exists also concerning power plants in some of EU countries (e.g. France, Spain, and Portugal).

As a consequence of these changes, the legislative and regulatory frameworks of the electricity sector need a complete re-organisation, including special attention to social and environmental concerns.

The restructuring process has evolved differently in and even within the various countries that have introduced changes. A large number of combinations of the principal components mentioned can thus be found.

The following graph presents the market share open to retail competition in the European Union. This component is perhaps the most important one since it measures the degree of liberalisation of a market. However, analysis of the figures presented have to be carefully made. In fact, the percentage corresponds to the part of the market allowed to change supplier that, due to various conditions, might not introduce significant changes in reality. This can happen due to many reasons that prevent eligible customers from changing supplier, like the high prices of meters in Germany, the limited interconnection capacity between some EU countries, advantage of already established companies.

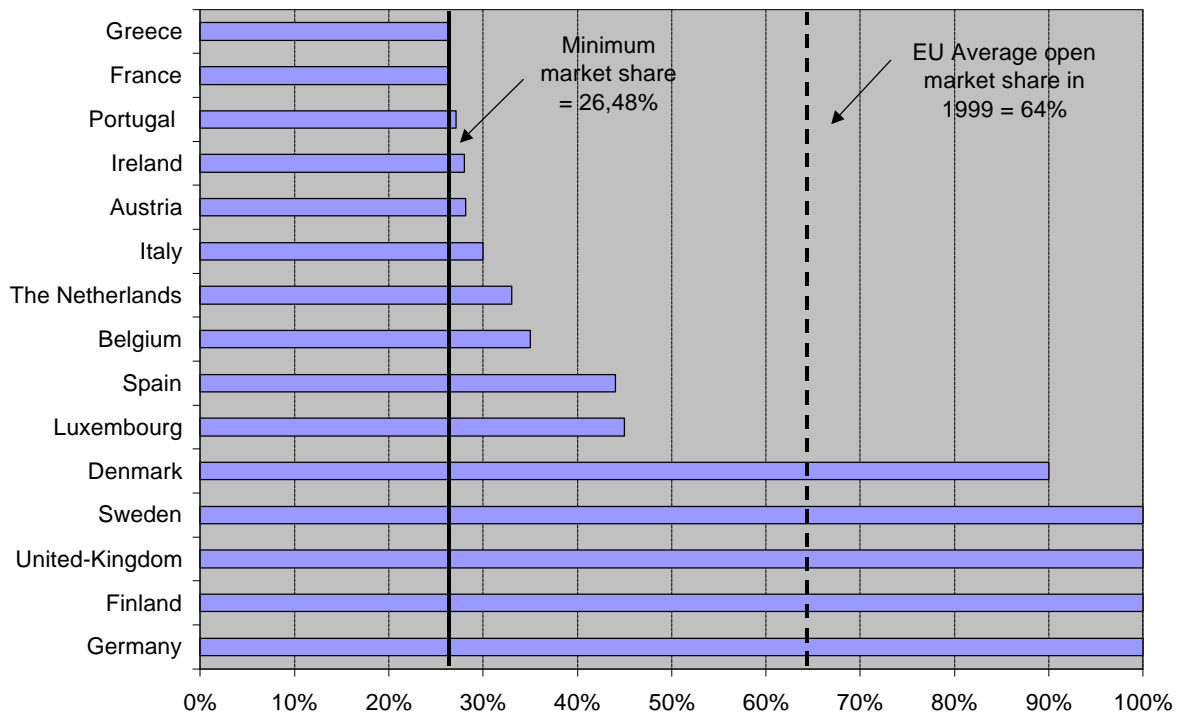


Figure 1: Status of the market share open to retail competition in Europe –Expected situation after 19 February 1999 (sources: ERSE, EC-DGXVII)

## 5 - THE RESTRUCTURING PROCESS IN PORTUGAL

Portugal can be considered as “what could be closest to a typical” changing market, if “typical” exists. All the ingredients can be found: unbundling, commercialisation and privatisation of the former monopoly company, establishment of an independent regulator and progressive introduction of competition. All this has been decided and partially done, at least to the extent necessary to comply with the EU-Directive on Internal Market of Electricity. In fact, Portugal seems to manage well in reaching a number of quantifiable “externally” established objectives.

### 5.1. Short description of the Portuguese electricity system

Generation is about dominated by black coal that accounts for 54 % of total production. The second energy source is hydroelectricity (34% in a “normal” year, in terms of precipitation), which is approaching saturation and therefore diminishing in importance. Combined heat and power already accounts for 10 % and a first combined-cycle power plant using natural gas has just been built.

The electricity demand is expected to grow at an annual rate of 3,5%, which corresponds to doubling the consumption within the next 20 years. It should be noted that the electricity consumption has grown at an annual rate of 6% over the last 20 years.

The total generating capacity, about 10 GW, corresponds to some overcapacity, as stated by Martins “It is easy to recognise a situation of growing excess capacity, with negative effects on stranded costs” (Martins, 1997). This situation is due to the heavy investments made in bulk generation and the high growth of independent production.

## 5.2. The Portuguese restructuring process

The following figure illustrates the evolution from the monopoly of EDP-Electricidade de Portugal towards the introduction of competition.

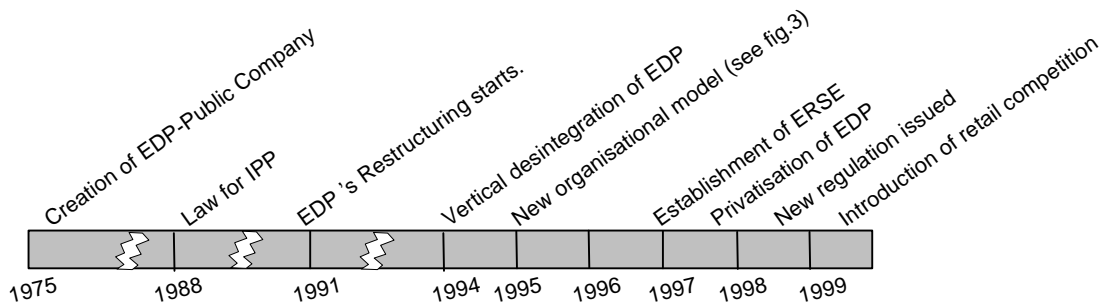


Figure 2: Chronological evolution of the electricity sector

### Unbundling

The restructuring process started in 1991. Legislation relative to the delimitation of functions was published. In the same year, the restructuring process of EDP-Electricidade de Portugal started and ended with a vertical disintegration of the company, after the change of EDP's legal status from a state owned to a public limited company. EDP was split into independent subsidiary companies, which are under the strategic control of a holding company. This holding still represents somehow the public utility EDP. The links are evident since the presidents of the subsidiary companies are also board members of the holding EDP. The most important subsidiary companies are a production Company, a grid company (concessionaire of the national grid) and four regional distribution companies. Collaboration is especially strong between the distribution companies.

### Privatisation

The restructuring process has included the privatisation of the holding Grupo EDP. Two phases have taken place, one of 30% of the capital in June 1997 and another in June 1998, leading to the privatisation of close to half of the Holding. This was the largest privatisation process ever held in Portugal and was considered a "success".

### Commercialisation

The commercialisation was somehow imposed by unbundling (with legal and accounts separation), privatisation and competition introduction. It started even before the legislation was published and caused important organisational changes including downsizing and anticipated negotiated retirements.

### Definition of organisational framework for competition introduction

The organisation model of the Portuguese Electricity System was established in 1995. Within this model, two subsystems coexist:

- The Public Electricity System (SEP), which has public service obligations. Its purpose is to fulfil the needs of the consumers, according to the principle of tariffs uniformity;
- The Independent Electricity System (SEI), which has no public service obligations. The SEI has two components: a non-binding subsystem (SENV - Non-binding Electricity System) ruled by market relations, and "special" producers using renewable energies sources or combined heat and power, which are under specific legislation.

« Relations between SEP and SEI are those which are determined by law (acquisition of electric power produced from renewable energy sources and by cogeneration plants) and those which arise from an advantageous co-operation for both, SEP and SENV » (Santana, 1998). However, the SEI is still very little developed and the former monopolistic national electricity company, EDP, continues to have a role of utmost importance in the sector.

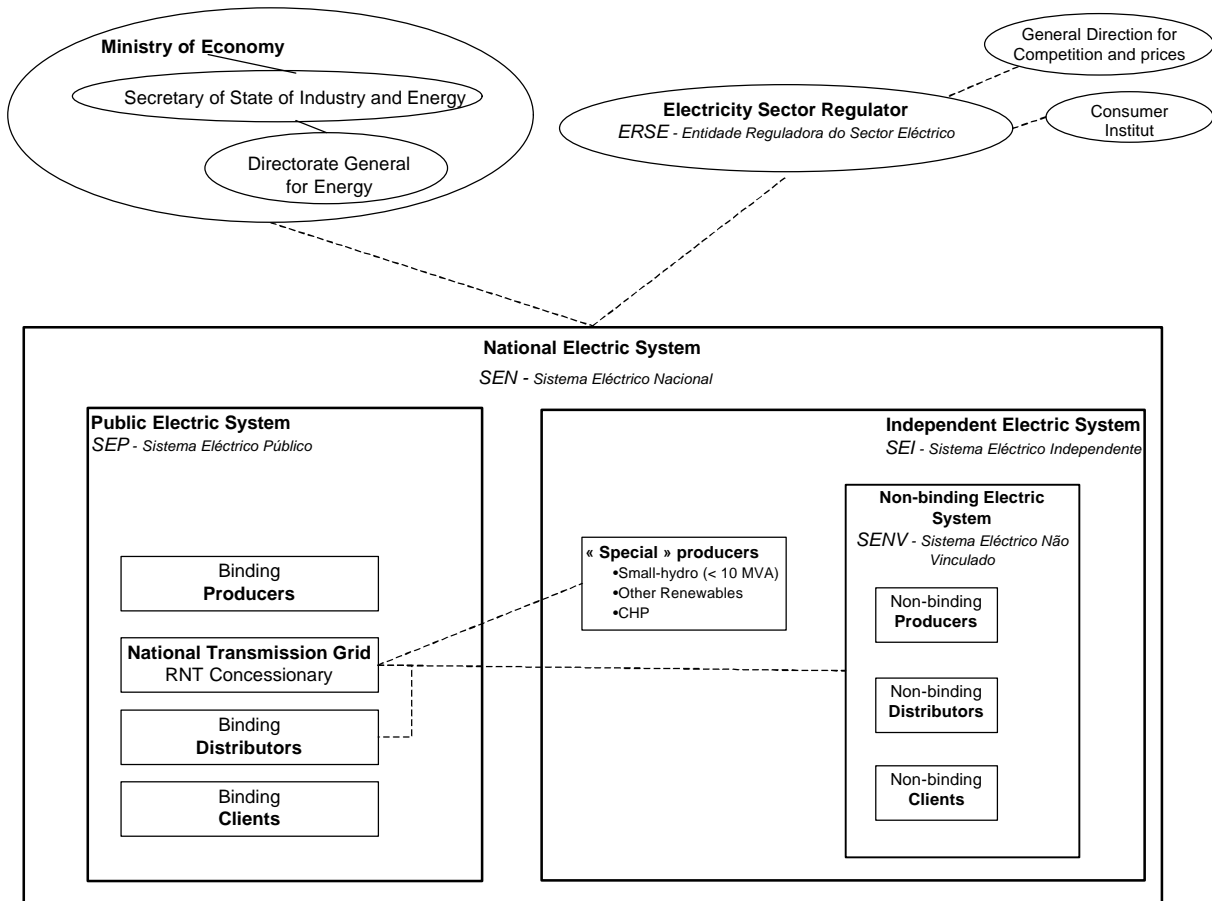


Figure 3: The new organisation of the electricity sector in Portugal

### Introduction of retail competition for part of the market

The introduction of retail competition is perhaps the ultimate phase of the whole process. It is open according to the 96/92/EC Directive on the Internal Electricity Market, which means to the largest consumers (“eligible consumers”). The national market share is, at least, the EU share of electricity consumed by final consumers using more than 40 GWh per year. This share has been fixed to 26,48% for 1999 (ERSE, 98).

The IEM Directive leaves the Member States to define the eligible consumers. In Portugal, the rules are as follows:

- All consumers with more than 100 GWh/year are immediately eligible;
- Distribution companies are eligible but only for 8% of the electricity they purchase;
- Consumers with more than 30 GWh/year in 1999, 20 GWh in 2000 and 9 GWh in 2001 are allowed to choose their supplier. There is also the possibility for consumers with more than 9 GWh to change supplier from now against the payment of a compensation proportional to the number of months of the anticipation. This consumption includes auto-production.

According to the impact scenario from (ERSE, 1998b), only consumers representing 5% of the total consumption might change supplier and leave the public system (SEP) in 1999. This percentage is expected to augment to between 8 and 13% in 2001. Despite this relatively small figure, the impact on consumers under SEP may be quite important. According to the same study, tariffs would increase by more than 3% and 5% for low voltage and medium voltage consumers respectively, despite the effect of a mechanism that shifts the impact to all consumers through a non-bypassable levy when the impact is higher than a given calculated value. This is due to the high weight of fixed costs over the variable costs in the SEP.

Note that retail competition was formally established in 1995 for consumers using more than 100 GWh/year per site, including auto-production. However, it was only at the end of 1998 that the rules necessary to actually change supplier were adopted, for example the tariff definition for the access to the transmission grid.

### **Constraints to the liberalisation**

The bases to liberalise the sector have now been established. However, there are some specific constraints that do not seem to favour the development of the Non-binding System, some being mentioned by ERSE:

- Generation overcapacity in the public system, which will increase with the development of independent power producers and auto-producers using Renewable Energy Sources (RES) and Combined Heat and Power (CHP) under a special regime;
- The few existing producers in the non-binding system (SENV) are relatively small hydro power plants which can not guarantee a stable supply of energy;
- Limited interconnection with Spain and limited access to the European internal market due to the geographical location and the small interconnection capacity between Spain and France.

### **5.3. The regulation process**

The government has traditionally assumed the regulatory role. The creation of an independent structure to regulate the electric sector, the Electric Sector Regulatory Entity (*Entidade Reguladora do Sector Eléctrico – ERSE*) was decided in 1995, with the legislation set that established the basis for the new organisation of the electricity sector.

ERSE is a corporate body under public law which was established in February 1997 (DR, 1997) (Santana, 1998). Its objectives are:

- a) “ To provide the necessary conditions for SEP to efficiently meet the electricity demand of the system’s clients;
- b) To protect consumer interests in terms of prices, services and quality of supply;
- c) To ensure that the National Transmission Grid concessionaire and the electricity distribution companies have the necessary conditions to [...] fulfil their concession contract and respective licensing obligations;
- d) To promote competition in situations in which there exists the potential to improve the efficiency of the electricity sector’s activities;
- e) To ensure that the regulation rules are objective so that the commercial relations among the operators are transparent and non-discriminatory;
- f) To contribute to the ongoing improvement of the technical, economic and environmental operation conditions of the means to be used from production to consumption of electricity”.

### **The public discussion**

The regulatory process was conducted in an open dialogue and discussion that included the following phases:

- an « announcement of the proposal of regulation », was launched calling for contributions, followed by a one-day public debate ;
- a « proposal of regulation » was then launched calling for comments. This proposal was also followed by a public discussion.

However, even with this « dialoguing approach » undertaken, the contributions have not been, in the authors opinion, very fruitful. Only the traditional voices were able to participate: utilities, large industrial consumers

and their associations, some university professors and a few experts. Other typical influent actors in other European countries were not able to give a valuable contribution or were not interested in participating. These include consumer associations, governmental and non-governmental environmental organisations, and trade unions.

Various factors contributed to this situation. Due to the existence of the EDP monopoly, the organisation of the electricity sector was not subject to research or even discussion. This differs from other countries where consumers own the companies or where there is a strong identification or controversy with a certain technology (for example the “nuclear option” in France and in Germany). Furthermore, energy is not an issue as important as in other European countries where the climate contributes to a higher preoccupation with energy issues. Local actors, very active in other countries in the energy field, have rarely been involved in this discussion since they have not developed any expertise in this domain.

This lack of will or capacity of the actors to contribute has reduced the traditional problems in accepting the new regulation and globally the whole reorganisation of the sector. However, it also brings difficulties that the regulatory body has to overcome like the lack of statistical data or the recruitment of experienced personnel independent from EDP. This last effect can cause a pressure for the personnel seconded by EDP to the regulator, since they might have to take decisions not desired by their real employer. A situation of capture can then happen which is of course not desirable: “the worst thing that can happen to an independent regulatory authority is its capture by the companies from the sector regulated” (Vital Moreira, 1998). It was maybe to avoid this situation that part of the personnel resigned from ERSE and asked to come back to EDP.

### **An experimental period**

The urgency in adopting a new regulation in order to comply with the European legislation has been accepted by the ERSE who recognises that (ERSE, 1998a) the “transitory character of this phase in the electricity sector implies a regulation with the maximum flexibility [...] and also urgency in order to give the actors the possibility to maximise their experience and profit [...] in this context it is preferable to choose solutions of the greatest simplicity”.

Therefore the new set of regulations was approved in the end of 1998 will allow to understand the transformations, how the actors position themselves, and to collect “more quantitative information necessary for a better understanding of some situations and to a cost-benefit evaluation of alternative solutions” (ERSE, 1998a).

Revisions of the regulations will be done in 2001, with a longer-term perspective, taking into account the transformations observed.

The decisions regarding the IEM-EU directive are shown in the following table.

**Table 1 – Choices made in Portugal regarding the IEM EU-Directive**

Production	- Tendering procedure for new capacity within the Public Electricity System (SEP). “Long term planning” for SEP is the formal responsibility of the government (Directorate General for Energy), on proposal from the concessionaire entity of the National Grid; - Authorisation procedure for new capacity within the Independent Electric System
Transmission	- Third Party Access to the Transmission and Distribution Networks to Non-binding consumers and producers through the payment of regulated tariffs for the use of the mentioned networks. - The Transmission National Grid is the single buyer within the Public Electricity System
Eligibility	- Consumers >30 GWh/year in 99 - Distribution companies for 8% of the power they purchase - Total: 27,11%
Unbundling	- Legal separation exists. The former vertically integrated company EDP has been split up in 19 companies under the control of a holding. It includes one company for Generation, one for Transport, and 4 for Distribution. Other production companies exist
Privatisation	- Almost half of the holding EDP. Private production companies exist.

Concerning energy efficiency, the current period is therefore crucial since it is the opportunity to design solutions and mechanisms that will allow the realisation of the existing energy efficiency potential. It is also an opportunity to design mechanisms to comply with the climate change commitments, when this policy exists.

## 6 - THE NEW REGULATION: ROOM FOR DSM AND ENERGY EFFICIENCY?

The actual Portuguese situation is not favourable to energy efficiency. However, ERSE’s legal objectives mention that it should “contribute to the ongoing improvement of the technical, economic and environmental operation conditions of the means to be used from production to consumption of electricity”. In the Announcement of a Proposal for Regulation, it was mentioned that “the question is what shall be the contribution of the regulation for a more rational use of energy [...] the qualitative and quantitative evaluation of recent experiences in this area should constitute the point of departure to the development of future actions, which will include necessarily a regulatory component, but will not be limited to this dimension due to the importance of this issue to the implementation of the energy and environmental policy defined both at national and European level”. This can be seen as a “call for ideas” that receives just a few answers: also in this area, the expertise capacity has never been developed.

Later came the Proposal for Regulation, which included some instruments. This time, ERSE asked deliberately for contribution “ERSE thanks all the suggestions that allow to better evaluate the impact of these measures”. Unfortunately, this is not an easy task and if a lot of qualitative material is available, quantitative is still rare.

In this chapter, some instruments adopted are analysed, with special attention to the conditions required for their implementation.

### 6.1. Explicit mechanisms

The instruments described in this first section are explicit mechanisms specifically created for the promotion of DSM and energy efficiency.

#### 6.1.1. Recovery of additional costs of CHP and renewable energies

Independent Power Producers and auto-producers using Renewable Energy Sources (RES) and Combined Heat and Power (CHP) plants are covered by a specific legislation, which is not under the responsibility of ERSE.



This legislation obliges the Public Service System to buy the electricity produced. The price is defined by legislation as follows:

- up to 10 MVA, it is index-linked to one option of the regulated retail prices;
- for the part of the electricity sold over 10MVA, it is based on avoided costs, plus remuneration for the environmental externalities avoided. This is a real mechanism to internalise higher internal costs of other generating techniques (DR, 1999).

In some cases, electricity produced from renewable energy sources has higher costs than that produced in other power plants connected to the public service system. This eventual additional cost is included in a component of a non-bypassable levy - « global use of the system » -, which applies to all users of the Transmission Grid.

#### 6.1.2. DSM investment recovering through tariffs

This mechanism allows distribution (which also includes supply) companies to recover their costs of DSM activities. This is done by introducing a *DSM component* in the revenue formula used for fixing the prices. This formula also includes a RPI-X factor, being RPI the Retail Price Index and X a specified productivity offset parameter. A maximum amount of the *DSM component* will be fixed annually and each investment needs authorisation from ERSE (it is 0 for 1999, and also for 2000 and 2001 but these amounts can be modified). However, no rules have been yet defined regarding the authorisation process. These rules are a pre-condition for the functioning of this mechanism since they provide the necessary transparency and allow the companies to assess the possibilities of having their project accepted. The definition of such a methodology for DSM programme evaluation would also have an awareness effect or would even give an incentive for creativity within the distribution/supply companies. On the other hand, this mechanism does not compensate the utilities for loss revenue which might prevent programmes of energy conservation from being proposed.

### 6.2. Inherent mechanisms

This second section describes some implicit mechanisms that might result in incentives for DSM and energy efficiency if some modifications are done.

#### 6.2.1. Demand-Side Bidding

Demand-Side Bidding can roughly be defined as a scheme aimed at treating offers for demand reductions in the same manner as generation offers (IEA-DSM, 1998) and can take different forms:

- an actual demand reduction or reductions compared to forecasted demand levels;
- a time scale for load reductions or for noticing the reduction;
- regarding the type of reduction, it can be directly controlled by the utility or based on simple information;
- regarding the definition level of the bidding process, it can vary from formal bidding to the possibility for presenting proposals.

Organising Demand-Side reductions brings more difficulties than traditional generation bidding, since it requires:

- monitoring and control mechanisms, often expensive and exigent in terms of technical conditions. This includes the availability of communication means and the feasibility of installing them;
- a definition of a base case against which the reductions will be calculated;
- the reception of significant bids, due to the distributed nature of the demand. This can be done through aggregation of smaller loads, like bringing together a group of consumers or a significant number of different premises of a customer. This also requires the development of load aggregation;
- knowledge and expertise that are missing. Conversely, generation is a field where knowledge is well developed.

It would be an abuse to state that the Portuguese regulation offers such a scheme. However, it opens the possibility for distribution companies or association of consumers to “propose measures that might contribute to provide services of the systems and the adequate commercial conditions” (ERSE, 1998a). Distributors or

consumers have to take the initiative by presenting a proposal to the National Grid entity that, after giving an opinion, sends the proposal to the regulator for approval. This is clearly not a Demand-Side Bidding process.

However, a potential for development of load aggregation exists. This could be performed by entities representing consumers who could propose a reduction of their consumption or offer the possibility of load shedding under specific conditions.

The regulator mentions the potential for DSM in its own comments to the regulation. However, this “potential mechanism” needs to be better defined in the regulation for four main reasons. Firstly, because it does not provide a consistent “appealing” framework for demand bids. Secondly, it requires an initiative from the demand-side; thirdly, it requires capacity to propose a new framework and the remuneration for it; fourthly, bidders face the risk of not having their proposals approved, since the evaluation criteria are not defined.

The Demand-Side incapacity to get organised is one of the traditional market barriers (payback gap, lack of expertise, high transaction costs etc.). Furthermore, the lack of expertise in Portugal in this field is evident and it is unlikely that the market will be able to come up with such elaborated initiatives. This is certainly an important complement to add in the next regulation phase.

#### *6.2.2. Tariffs in a restructured sector as an incentive for DSM*

Tariffs remain the principal inherent mechanism for Demand-Side Management. The fundamentals of marginal tariff structure applied to electricity as a final product need now to be somehow re-visited: unbundling and competition introduced an enormous complexity into the tariff making process and in the way transactions are done and the costs perceived by the actors.

We believe that there is still room to give appropriate use of tariffs signals in order to influence the interest of actors in doing load management. These tariff signals could change the way cost and benefits are calculated and makes the investment efforts more evident to the companies. For example, the distributors have to pay to the generators for power and to the transmission grid operator according to specific measuring and billing rules. A correct definition of tariffs to the final consumers may lead distribution companies to negotiate load management or load reduction with their customer where and whenever this would be cheaper for them, in a short or long term perspective.

A thorough analysis with quantitative simulations has to be made and will certainly allow taking conclusions on the incentives inherent to tariff making and on which modifications or new mechanisms could be introduced in order to make the best use of the resources.

## **7 - THE INSTITUTIONAL PANORAMA AND ITS IMPLICATIONS FOR DSM AND ENERGY EFFICIENCY**

The energy sector in Portugal is facing two main contradictory processes regarding energy efficiency. On one hand the situation in the electricity sector (and the energy sector in general) is not favourable to energy efficiency. EDP has just been privatised and to promote consumption reductions was simply seen as jeopardising the success of the privatisation process. Thus, people have moved from passive consumers that have always made limited complains regarding the high price of electricity, to active shareholders that are strongly protesting due to the decrease of tariffs established by ERSE. As new shareholders, their main concern is now the share price and the impact of the competition introduction. Another unfavourable condition for energy efficiency is the recent introduction of natural gas that has been accompanied by aggressive campaigns to create a demand.

On the other hand, energy efficiency is the most effective way to reduce greenhouse gas emissions and most of the Annex I countries of the Kyoto Protocol are establishing rigid energy efficiency policies. However, being included in the European Union “Bubble”, Portugal got the permission to increase its CO<sub>2</sub> emissions by 40% (forty) by 2008-2012 comparing to 1990 levels. The position of the Government is that, due to its low

development level (lowest GDP per capita in the EU), the lowest consumption and CO2 emissions per capita, and the need to grow economically, Portugal should have the right to raise its emissions. However, while the most of the EU countries are decreasing their energy intensity of the GDP (the EU average decreased 10% between 1985 and 1996), this indicator augmented 12% in Portugal between 1985 and 1996 (EC, 1998), thus demonstrating the need for an energy efficiency policy.

The electricity sector restructuring is an opportunity to introduce both inherent and explicit mechanisms for DSM and energy efficiency. But this requires the development of evaluation methods, organisation capabilities and expertise.

Although regulation can give a significant contribution in creating and specially in implementing some mechanisms for DSM and Energy Efficiency, the role of the regulatory authority is limited. Political actions are necessary to create other mechanisms, like the establishment of levies.

A policy for energy efficiency needs interaction and information exchange between the actors in the field, which is scarce in the actual institutional panorama. The creation of an energy agency with effective means would contribute to improve this situation by realising the study of technical economic potentials and the follow up on the field of political and regulatory actions. Having succeeded to restructure the electricity sector, the priority should now be to have a longer-term perspective, giving attention to environmental aspects through energy efficiency.

## 8 - ACKNOWLEDGEMENTS

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