UNIVERSITÀ DEGLI STUDI DI PADOVA

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DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Corso di Laurea Magistrale in Ingegnera Elettrica

TESI DI

LAUREA MAGISTRALE

Analysis of How Energy Efficiency Policies Could Perform in a Liberalized Market

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Anno Accademico 2013-2014

ABSTRACT

The changes addressed to a retail market, due to the liberalization of electricity market, may have an impact on the effectiveness of energy efficiency policies, which in most cases are calibrated to act on consumers. In many countries, the liberalization process is still going on and in those in which it was completed, due to the limited number of years that have passed, available data is not sufficient to understand how energy efficiency policies perform under a liberalized market.

This thesis tries to give an answer to this question through a rational analysis of the possible benefits and problems that might occur. Before, a description of the most important energy efficiency policies currently active in the European landscape is provided together with an illustration of more obvious critical issues. After, attention is instead paid to issues relating to energy efficiency that may arise from the liberalization of the electricity market. Finally, the part most significant in application terms is treated, namely how the common policy instruments for energy efficiency could perform in a liberalized market.

Keywords: liberalized electricity market; energy efficiency policies; energy efficiency policy instruments; energy efficiency obligations systems

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1 INTRODUCTION

Energy efficiency is on the focus of national energy policies in many countries thanks to the potential benefits that its improvement can offer. Its supporters commonly cite benefits such as energy saving (reduction in energy consumption), environmental improvement (reduction in greenhouse gases and other pollutants), increased energy security, improved consumer welfare, increased economic competitiveness, and job creation (Schnapp, 2012). Because these benefits are widely shared, great efforts have been carried out during the last four decades to understand the potential of energy efficiency, its effects, and its weaknesses in order to develop more effective energy efficiency policies. Parallel to this, always in the energy sector, there has been another important change that has required a long gestation period and very high attention: the liberalization of the electricity market. This began more than 20 years ago in Great Britain and later many other nations have followed the Great Britain's lead and introduced comprehensive electricity sector reform programs. The scheme commonly adopted was to introduce competitive wholesale markets in the generation sector, to create legal monopolies with the presence of basic performance in the transmission-distribution sectors, and to introduce competition between suppliers in the retail supply sector. Precisely the changes addressed to a retail market, which by its nature is in close contact with end users, may have an impact on the effectiveness of energy efficiency policies, which in most cases are calibrated to act on consumers.

At this point a question begins to arise: how will energy efficiency policies perform in liberalized markets? In many countries, the liberalization process is still going on and in those in which it was completed, due to the limited number of years that have passed, available data is not sufficient to provide an answer.

The objective of this thesis therefore is to try to give an answer to this question through a rational analysis of the possible benefits and problems that might occur. Before, to contextualize the discourse, a description of the most important energy efficiency policies currently active in the European landscape will be provided together with an illustration of more obvious critical issues. After, attention will instead be paid to issues relating to energy efficiency that may arise from the liberalization of the electricity market. Finally, the part most significant in application terms will be treated, namely how the common policy instruments for energy efficiency could perform in a liberalized market.

To better understand the structure of this thesis, a scheme is provided in the figure below:

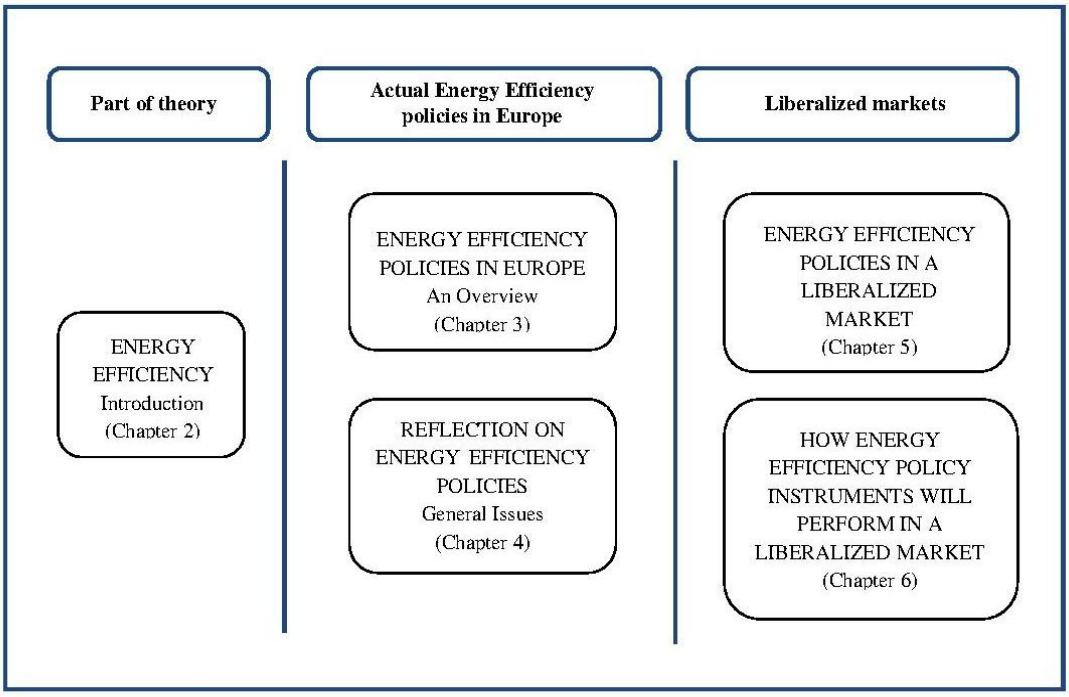

Figure 1 - Structure of thesis
Source: Own elaboration

2 ENERGY EFFICIENCY – Introduction

Energy efficiency is considered one of the most important points in the energy strategy of many countries. This is because it is considered a valuable means to address challenges like dependence on energy imports, scarce energy resources, and the need to limit climate change.

This work, anyway, is not focused on the potential or less of energy efficiency, but on how energy efficiency policies are performing now and how they will perform under a liberalized electricity market. Before beginning to treat this argument a general introduction is given on basic concepts of energy efficiency policy. This is necessary because in this way the understanding of treated topics will be more immediate.

The upcoming part is an explanation about the difference between energy efficiency and energy savings, followed by a description of the energy efficiency paradox. Finally, the chapter closes with an illustration of the typical instruments for promoting energy efficiency.

2.1 Energy efficiency vs. Energy savings

To understand the difference that distinguishes these two terms, it is necessary to begin with their definition. "Energy efficiency means that we use less energy inputs while maintaining an equivalent level of economic activity or service. Energy savings is an absolute decrease of energy consumption and can be done through increased energy efficiency, behavior changes or even decreased economic activities" (EC, 2011). The terms 'energy efficiency' and 'energy savings' are often seen as interchangeable, but there is a significant difference between the two. An increase in energy saving always leads to a reduction in energy consumption, whereas an increase in energy efficiency does not always turn into a reduction in energy consumption. The latter statement can be explained considering the situation in which the rebound effect (it will be widely explain in section 2.2.2) is very significant, precisely in this case, indeed, there is an increase of energy demand despite an increment of energy efficiency. Therefore, sometimes even if products and processes are becoming more efficient, the energy consumption keeps increasing.

2.2 The Energy Efficiency Paradox

Now that the difference between Energy efficiency and Energy saving has been explained, it is appropriate to add that energy efficiency is interested in two paradoxes. The first paradox

(known as the energy efficiency gap) relates to the fact that energy efficiency and conservation measures have not been widely implemented despite their apparently large socio-economic benefits and the second (known as the Rebound Effect) is linked to the growth of total energy consumption despite the large improvements in energy efficiency (Linares and Labandeira, 2010). To better understand these two paradoxes it is necessary to explore them more deeply in the sections below.

2.2.1 The Energy Efficiency Gap

Linares and Labandeira (2010) explain the energy efficiency gap by claiming that although energy efficiency and conservation seem to present clear economic and environmental advantages, the level of investment in them does not reach the levels which would correspond to such benefits. This can be seen as a reflection of the presence of barriers. These Barriers exist due to market failures, behavioral problems of customers and regulatory failures. The Impact Assessment (EC, 2011), part of the European Energy Efficiency Plan 2011, can help to illustrate which barriers generally hinder investments in energy efficiency.

The following lines provide an overview on these barriers:

Energy market prices

Energy market prices do not reflect all costs to society and this leads to not having an optimal level of investment in energy efficiency. The costs that are not taken into account are related with environmental externalities such as pollution, greenhouse gas emissions, depletion of resources, and geopolitical dependency.

Harmful subsidies, regulated prices and negative incentives

Harmful subsidies are all those subsidies present to support primary energy sources. These had a value of US$ 557 billion in 2008 (IEA et al., 2010) and they can lead to distorted price signals. Regulated prices, notably for gas and electricity, that are still present in some countries can also distort price signals. Finally, negative incentives are another problem, for example: higher taxes have to be paid on a building because its price is increased due to the implementation of energy efficiency measures.

Imperfect and Asymmetric information

Consumers often have a limited knowledge and little information about benefits and possible energy efficiency solutions available on the market or the ways in which they can be carried out or supplied.

Asymmetric information is a special form of imperfect information. Different subjects present in the market have a different level of knowledge, for example, providers of energy efficiency solutions are more informed about energy efficiency technology than consumers, who sometimes do not realize the potential of reducing their energy bills or who do not know their energy consumption.

Sometimes consumers have all the information, but due to bounded rationality there is not a perfect decision making process. For example, investment decisions for energy efficiency equipment have to be discounted over a long-term period; even though this calculation process comes to the right result, consumers prefer to decide on traditional or non-logical rules.

Split incentives or principal-agent problem

In the energy efficiency field there are often two types of split incentives. The first is related to the fact that, those who benefit from these advantages are not those who have paid for the energy efficiency improvements. For example, in the case of a landlord-tenant, where the landlord should invest in building renovation works, but the tenant normally pays the energy bill and benefits from its reduction. Due to this, the landlord will not be interested in investing in high efficiency equipment because he will try to minimize his investment, given that the reduction of his tenant's energy bills it is not one of his priorities. The second can be found in liberalized electricity markets. Here, electricity retail companies are the perfect choice to deliver energy efficiency measures to consumers, but this is in contrast with the business model of these companies because an increase of energy efficiency corresponds to a reduction in the need of energy and therefore a reduction of sales.

Missing or incomplete markets

Missing or incomplete markets generate a problem related to the low number of trained professional (such as architects, energy auditors, builders, installers, sales assistants) and the lack of infrastructure. All of this may start a vicious circle because the lack of a credible and

mature offering market prevents the emergence of a dynamic demand market which in turn is a barrier to the uptake of the offering market.

Financial barriers

The funding of energy efficiency measures can become a barrier for their diffusion. Sometimes the cost of interventions can be too high, therefore bringing the potential interested subject to turn to the credit market. However, it is not always said that the latter accepts the request. Indeed, so-called credit-worthiness is often insufficient to borrow money, even if it is a beneficial investment.

In many cases energy efficiency interventions are small scale and decentralized. This leads to an increase in transaction costs and further slows the uptake of financial products (EC, 2011).

Regulatory failures

The problem of investment in energy efficiency is, in some countries, due to the lack of a comprehensive policy framework including regulatory and support instruments, and poor enforcement. Moreover, frequent changes in the legal framework introduce a climate of risk which can discourage investors. Finally, energy efficiency and savings are often considered too technical and for this reason their political visibility is not high enough, therefore reducing the interest of politicians.

2.2.2 The Rebound Effect

The Rebound Effect can be explained as the phenomenon whereby, in spite of certain improvements in the energy efficiency of individual products (e.g. appliances, cars and buildings), overall energy consumption, linked to their use, doesn't decrease in a proportional way, rather in some cases consumption can be equal or greater. To better understand this phenomenon it is interesting to take into account the following example: “even if cars produced today are more efficient, the overall energy consumption of the car fleet grows because we use them more regularly and buy bigger ones” (EC, 2011).

The Rebound Effect can be also considered a way for measuring to some extent the difference between energy efficiency and energy conservation: the latter is an absolute reduction in energy demand, whereas the former is a relative measure. (Linares and Labandeira, 2010).

2.3 Typical Energy Efficiency Policy Instruments

Before beginning with an explanation of all policy instruments it is important to introduce a phenomenon known as *Free-Riding Behavior*, which occurs when agents receive incentives to realize energy efficiency measures that would be implemented also in the absence of incentives. For example: a consumer uses incentives for the replacement of his boiler, but not because he wants to buy a more efficient one, but because it is broken (therefore he would buy a new one anyway). This can be considered as a waste of resources because incentives help the realization of energy efficiency interventions, which would have been executed anyway.

After this small parenthesis on this phenomenon harmful to the economic efficiency of energy efficiency policies, the discussion can return to concentrate on policy instruments.

Technological Standards

Technological Standards can be defined as minimum energy efficiency requirements for energy equipment (Linares and Labandeira, 2010). These instruments can be considered interesting for politicians because they are easily implementable, customers very often do not have a way to know the costs, and they permit the possibility of good results in terms of efficiency on products on which they are applied. Moreover, they can help to overcome some barriers. Given that Standards are applied on all products within a product category, they can address the problem of false decisions making linked to bounded rationality. Or given that only the producers are interested in the implementation of standards on their products, Imperfect and Asymmetric information is partially solved. Not completely because, for example, consumers do not know how much they will save, or if energy prices will increase or decrease in the future (thus making the use of the appliance less interesting).

Taxes

The act of taxes on the price signal is considered by many economists to be the most powerful instrument for promoting energy conservation and efficiency (Linares and Labandeira, 2010). However, recent research (Jossoe and Rapson, 2013) has demonstrated that the combination of taxes and information policies has provided greater benefits than the use of only taxes and also it is possible to deduce that information policies can be considered an instrument more powerful than taxes for the promotion of energy efficiency.

Taxes can adjust the prices for energy to reflect the environmental externalities. For example, a tax set on fossil fuels, affects the costs of production and the selling prices.

Subsidies

Subsidies provide direct financial incentives for investments in energy efficiency. They have the form of direct payments to tax credits, they are highly popular socially and politically, and often they are used for promoting the sale of efficient appliances. Experts (e.g. Jaffe and Stavins 1995, Hasset and Metcalf 1995) found that subsidies were more effective than an equivalent price increase. However, they also have a negative aspect, in fact they allow (and certainly favour) the rebound effect by reducing the effective price of energy, and promote free-riding (Linares and Labandeira, 2010).

Information Policies

Information Policies can be defined as instruments with the purpose of reducing information deficits in order to foster investments in energy efficiency. The two principal ways to provide information are energy audits and labeling. The first is often used by utilities to inform consumers about their consumption behavior in order to invite them to consume energy in periods of lower demand, thus contributing to the reduction of demand peak. The second is known to consumers as Energy Star or energy consumption labels. These labels have the purpose to inform consumers about the energy consumption of appliances and about their level of efficiency, thus promoting the transparency of the market and competition between producers to produce more efficient appliances.

Energy Efficiency Obligations

Energy Efficiency Obligations change based on how they are practiced, the interest of energy sectors, the methods of financing, and the complexity country by country, but the basic idea is always the same, namely to impose on retail companies to achieve a predetermined value of energy savings. One of the most important differences is the presence or not of white certificates. These represent a certain amount of energy saved that can be exchanged between the different subjects present in the market, such as: Obligated parties, Non-Obligated parties and ESCO (Energy Service Companies).

Energy Efficiency Obligations are used frequently in European countries and they are one of the most important instruments indicated in the DIRECTIVE 2012/27/EU for achieving the 2020 European objectives.

More details about these instruments are provided in chapter 3.

3 ENERGY EFFICIENCY POLICIES IN EUROPE – An Overview

After the motivations that have led to develop this thesis and after a wide introduction on energy efficiency in general, Energy Efficiency Paradoxes and instruments for its promotion, it is time to begin focusing on the European policies framework associated with the spread of energy efficiency measures.

The last chapter also describes the instruments for energy efficiency promotion but in totally generic way, instead in the following the real situation of the European framework is presented, through an introduction of the main energy efficiency policies in Europe.

Its primary purpose is to provide a detailed description of the schemes that characterized the policies in states like: Denmark, Belgium (Flanders), Italy, France and Great Britain, in such a way to understand how they work, their results, energy sectors interested, methods of financing and complexity. However before starting with this description, it is necessary to introduce, given its importance, the European Directive 2012/27 whose purpose is to lead all Member States to achieve the goals set for 2020, in order to improve the Union's security of supply, reduce greenhouse gas emissions in a cost effective way and create high quality jobs in several sectors related to energy efficiency.

Therefore the chapter is structured in this way. The first section presents an overview on the Directive 2012/27/EU, while the subsequent sections describe the energy efficiency policies of Denmark, Flanders, Italy, France and Great Britain.

3.1 Directive 2012/27/EU

The purpose of this Directive is to create a common framework in Europe for the promotion of energy efficiency measures and for defining rules necessary to remove the barriers in the energy market and to overcome market failures. Moreover, it lays down that each Member State shall set an indicative national energy efficiency target, based on either primary or final energy consumption, primary or final energy savings, or energy intensity. In phase of definition of targets each Member State has to remember that the Union's 2020 energy consumption has to be no more than 1474 Mtoe of primary energy or no more than 1078 Mtoe of final energy (European Parliament and Council of the European Union, 2012).

Returning to the purpose the common framework is created through guidelines which have the goal to uniform as much as possible the actions undertaken in each Member State to achieve the national targets. In the lines below are summarized the most important parts of guidelines related with end-use energy sector.

Article 4 Member States shall establish a long term strategy for mobilizing investment in the renovation of the national stock of residential and commercial buildings, both public and private. A first version of the strategy shall be published by 30 April 2014 and update every three years thereafter and submitted to the Commission as part of the National Efficiency Action Plans.

Article 5 Each member State shall ensure that, as from 1 January 2014, 3% of the total floor area heated and/or cooled buildings owned and occupied by its central government is renovated each year to meet at least the minimum energy performance. Moreover, they shall encourage public bodies at regional and local level, and social housing bodies governed by public law to adopt an energy efficiency plan, put in place an energy management system and use, where appropriate, energy service companies, and energy performance contracting to finance renovations and implement plans to maintain or improve energy efficiency in long term.

Article 6 Member States shall ensure that central governments purchase only products, services and buildings with high energy-efficiency performance, insofar as that is consistent with cost-effectiveness, economical feasibility, wider sustainability, technical suitability, as well as sufficient competition.

Article 7 Each Member State shall set up an energy efficiency obligation scheme. That scheme shall ensure that energy distributors and/or retail energy sales companies achieve a cumulative end-use energy savings target by 31 December 2020. As an alternative to setting up an energy efficiency obligation scheme, Member States may opt to take other policy measures to achieve energy savings among final customers. These may include the following policies or combinations thereof:

- energy or CO_2 taxes that have the effect of reducing end-use energy consumption;
- financing schemes and instruments or fiscal incentives that lead to the application of energy-efficient technology or techniques and have the effect of reducing end-use energy consumption;

- regulations or voluntary agreements that lead to the application of energy-efficiency or techniques and have the effect of reducing end-use energy consumption;
- standards and norms that aim at improving the energy efficiency of products and services, including buildings and vehicles;
- energy labeling schemes;
- training and education, including energy advisory programs;

Article 8 Member States shall promote the availability to all final customers of high quality energy audits which are cost-effective and carried out in an independent manner by qualified and/or accredited experts according to qualification criteria, or implemented and supervised by independent authorities under national legislation.

Article 9 Member State shall ensure that, in so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity, natural gas, district heating system, district cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use.

Article 10 – 11 Where final customers do not have smart meters, Member States shall ensure that billing information is accurate and based on actual consumption, for all the sectors covered the Directive, including energy distributors, distribution system operators and retail energy sales companies, where this is technically possible and economically justified. Moreover, customers must receive all their bills and billing information for energy consumption free of charge and they have access to their consumption data in an appropriate way and free of charge.

Article 13 Member States shall lay down the rules on penalties applicable in case of non-compliance with the national provisions adopted and shall take the necessary measures to ensure that they are implemented.

Not only the end-use of energy is taken in consideration by the Directive, also for the energy supply sector are present some guidelines. These affecting, for instance, the promotion of the efficiency in heating and cooling (in particular high-efficiency cogeneration) or energy transformation, transmission and distribution sectors. In the latter, Member States besides ensure the implementation of energy efficiency measures in the network infrastructure, shall ensure that national energy regulatory authorities, through the development of network tariffs

and regulations, provide incentives for grid operators to make available system services to network users permitting them to implement energy efficiency improvement measures in the context of the continuing deployment of smart grids.

Moreover, each Member State shall ensure that information on available energy efficiency mechanisms and financial and legal frameworks is transparent and where the level of technical competence, objectivity and reliability is insufficient, initiate training programs for providers of energy efficiency services, energy audits, energy managers and installers.

By 30 April 2014 and every three years thereafter, Member States shall submit National Energy Efficiency Action Plans. The National Energy Efficiency Action Plans shall cover significant energy efficiency improvement measures and expected and/or achieved energy savings, including those in the supply, transmission and distribution of energy as well as energy end-use. Moreover, every year, Member States shall report on the progress achieved towards their targets. These annual reports and the National Energy Efficiency Action Plans are evaluated by Commission and assessed the extent to which Member States have made progress towards the achievement of the national energy efficiency targets.

Finally, in the last part of the Directive, between the annexes, are illustrated the common methods and principles for calculating the impact of energy efficiency policies indicated in the article 7. Obligated, participating or entrusted parties, or implementing public authorities may use one or more of the following methods:

- deemed savings, by reference to the results of previous independently monitored energy improvements in similar installations. The generic approach is termed ‘ex-ante’;
- metered savings, whereby the savings from the installation of a measure, or package of measures, is determined by recording the actual reduction in energy use, taking due account of factors such as additionality, occupancy, production levels and the weather which may affect consumption. The generic approach is termed ‘ex-post’;
- scaled savings, whereby engineering estimates of savings are used. This approach may only be used where establishing robust measured data for a specific installation is difficult or disproportionately expensive;
- surveyed savings, where consumers’ response to advice, information campaigns, labeling or certification schemes, or smart metering is determined. This approach may

only be used for savings resulting from changes in consumer behavior. It may not be used for savings resulting from the installation of physical measures.

3.2 Denmark

Since 1970, energy efficiency has been one of the top priorities of the Danish political agenda. The regulation framework has been changed and updated many times during the past years with the introduction of energy tax on households (1977) and CO_2 tax on all sectors (1996) (Togeby et al. 2009).

In 1996, the ability to define agreements between the energy intensive firms and Danish Energy Agency was implemented (Energi Styrelsen, ES). In these agreements, which were linked with the green tax system, both parties established the amount of energy savings after an analysis of the potential savings. The achievement of the predefined targets permitted the firms to obtain a reduction of the amount of taxes payable. This scheme in 2010 was limited to the electricity used in heavy industry processes and to heating the industrial spaces, making it thereby accessible only for the largest electricity consumers (Sàenz de Miera et al., 2013).

In conjunction with the actions implemented in 1996, in the following year the Electricity Savings Trust (EST) was created with the aim to promote cost-effective electricity savings in households and public institutions. The activities are primarily information activities, voluntary agreements and technology procurement.

Subsequently, in 2006 an energy efficiency obligations system was imposed on all the electricity, natural gas, and district heating grid companies. Initially, the obligations were intended only for the sectors listed above, thus excluding the commercial oil companies. However, the latter have chosen voluntarily to join, widening the system to all energy providers. The strong points of this system are the simplicity of its regulatory framework (there is only one regulator, the Danish Agency of Energy) and the wide freedom that the energy providers have to choose the energy efficiency measures to implement. In fact, they can choose to develop them in any energy sector (except transport) and everywhere in the country (not only in the areas which them compete). Moreover, the electricity providers can achieve the targets through their commercial branch (the most frequent choice). Energy savings can be calculated as a specific calculation, or they can be based on standard values. The first is an engineering calculation based on individual factors about the project, while the second is a catalogue of standard values for approximately 200 savings project (new window,

isolation, new appliances, new boiler, etc) (Togeby et al. 2009). The system does not provide public subsidies, whereby the providers can recover their investments through the increase of customer tariffs. Sanctions are not provided and the cost of this scheme in 2011 was about 5,6 cent.€/kWh, including administrative and implementation costs. In the first years of introduction, the results of the obligations scheme were above the target. Indeed, the first objective set was a saving of 7,5PJ in the period 2006-2013, which thanks to the success of the obligations system, was increased to 10,3PJ for 2010. This change has led to estimated savings of 1,5% of the consumption of 2006 in the period 2010-2020 (Sàenz de Miera et al., 2013).

The obligations system is a part of wider action plan in which are adopted other different energy efficiency measures such as: building codes, labeling of appliances, and directives on public sector savings.

Also, in 2006 the system of buildings labeling introduced in 1979 was modified. The updated version of the energy labeling scheme for buildings requires that all buildings are labeled before they are sold. The labeling report consists of a label (A to G) with individual recommendation on how to reduce the energy consumption. The energy label is calculated based on information about building physics and its cost is borne by the owner (650€ per label in 2009). Also new buildings must be labeled before they are taken into use. This can act as a control of the building code. Labeling is obligatory but without specification of possible sanctions. The impact of the labeling on total saving was defined close to zero. For instance, after a study on gas natural consumption on 4000 small buildings with and without an energy label, Kjærbye (cited by Togeby et al., 2009) did not find significant difference between the two cases.

Finally, in 2008 the European Union Greenhouse Gas Emission Trading Scheme (ETS) was added, which applies to most installations with a capacity above 20MW. These include the energy sector (electricity generation and district heating) as well as industrial installations (Togeby et al., 2009).

3.3 Flanders (Belgium)

In the period of 2003-2012, energy efficiency obligations on electricity distribution operators were introduced. For achieving the targets, the Flemish system permitted the implementation

of saving measures in other energy fields beyond electricity, providing a high amount of flexibility. Moreover, a banking technique was permitted, which is the possibility to use the saving surplus produced in a given year in the following years.

The majority of the measures that were implemented were linked to the interventions on customer's buildings like: isolation, solar thermal panels, double glazing (in residential or non-residential buildings). Afterwards, for recovering the costs, electricity providers had the option to gain access to regional subsidies and to increase their electricity tariffs. The last option was linked to the approval of the government's budget allocated to energy efficiency measures. Every year, each electricity provider must provide the action plan to the Flemish Energy Agency (VEA) with a detailed explanation about the measures that they would like to develop in the following year and with a calculation of the energy savings obtainable. Once received and evaluated, only the plans that obtained the approval from the institutions could be executed. In cases of failure to achieve the target defined, the provider had to pay a fine of 0,10 €/KWh (for each KWh not achieved) to the Energy Fund (Sàenz de Miera et al., 2013).

The goals of this system were very modest and, as it is possible observe in the graph below, they were overcome widely every year (except 2006).

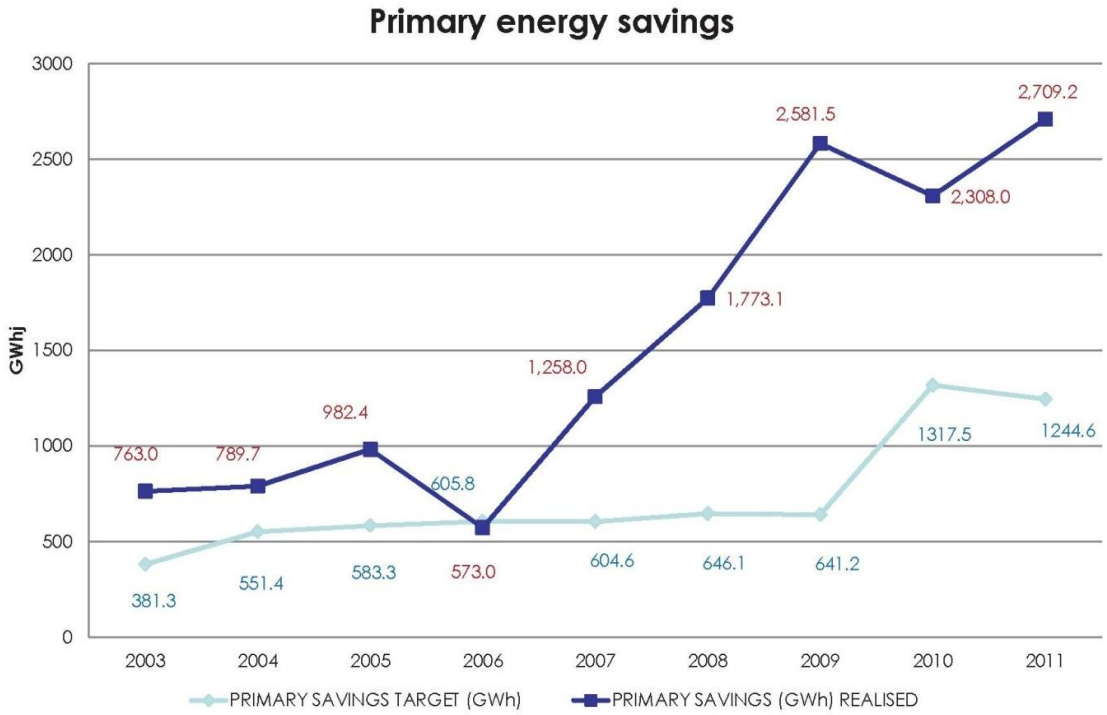

Figure 2 - Primary energy savings in Flemish system
Source: VEA (Varese, 2013)

Before 2007, the targets were set on primary energy saving. Afterward, in the period 2007-2008, a new target of 2% savings was set (annually target and respect the previous year) on consumption on low-voltage customers (<1000V) and 1% savings on high-voltage customers (>1000V). From 2008 to 2010 a target of 2% on consumption of residential customers and 1,5% on non-residential customers was set. In the end, in the period 2010-2012, a target of savings of 2,5% was set on consumption of customers of small operations (less than 2500 clients) and 3,5% on consumption of customers of operations with more than 2500 clients. The costs for the implementation of the measures (administrative costs are excluded) are summarized in the graph below and their increase is related to the increase of energy saved.

BUDGET SPENT in EURO	RESIDENTIAL PREMIUMS	NON RESIDENTIAL PREMIUMS
2003	4.018.743	4.733.878
2004	8.986.896	4.162.575
2005	9.195.059	6.100.168
2006	8.398.854	4.265.345
2007	17.999.275	7.415.853
2008	30.671.183	9.886.021
2009	41.940.629	12.175.290
2010	43.089.622	10.860.877
2011	53.201.607	11.513.260

Figure 3 - Costs for the implementation of the measures in Flemish system
Source: VEA (Varese, 2013)

Despite the good results in terms of energy saved, in 2012 the decision was made to change a part of the system. No longer were there energy saving targets, but instead obligatory actions for electricity distribution system operators, who must draw up an evaluation report every year before the 1st of May on the execution of the actions during the previous year. This change was justified by the difficulty to set a target that is both ambitious and realistic (too low: due to banking, risk of putting on hold new actions, too high: fines for distribution system operators), the absence of uniform actions in Flemish region (due to the freedom to chose the measures to implement), and the fairly high administrative burden of handing in and evaluating of action plans (Varese, 2013).

An interesting aspect of the old and new system is the particular attention, from both public and private, to low income households through subsidies to purchase efficient appliances or for insulation of walls and roofs.

3.4 Italy

In 2005, Italy introduced the system of white certificates (TEE: Titoli di Efficienza Energetica), which is characterized by a mechanism of obligations on electricity and natural gas distribution operators (interventions of saving on final costumers) and a mechanism of the market, through which agents may trade their certificates.

The obligated parties fulfill their energy saving obligations through the cancellation of a number of TEEs corresponding predetermined objectives of saving. The TEEs (each one with a value of 1 TOE of primary energy and with a propriety of banking) must be returned by obligated distributors to GSE by 31 May of the year following that of the obligation. The evaluation of the savings is made with three different methods:

- *Standard* (based on technical data sheet deliberate AEEG): the savings are calculated in relation to the number of physical units of reference installed, for instance: number of fluorescent bulbs;
- *Analytical* (based on technical data sheet deliberate AEEG): the savings are calculated according to an algorithm and the measure of few operating parameters of considered system;
- *Consumptive*: the savings are calculated through a monitoring plan, which consider all the external factors that could condition the saving.

The scheme is thought to have not only obligated parties active in the realization of energy saving interventions, but also other subjects. Indeed, in the system there are: obligated distributors (more than 50.000 clients), non-obligated distributors (less than 50.000 clients), ESCO (Energy Service Companies), parties who have actually appointed a person in charge of conservation and rational use of energy and finally companies operating in the industrial, residential, service, agricultural, transport and public service sectors, provided that they have appointed a person in charge of conservation and rational use of energy, or that they have put in place an energy management system certified under the ISO 50001 standard.

The scheme establishes that, when the measures are implemented (in all the sectors indicated by the law), agents send a request of recognition to the manager of electric service (Gestore dei Servizi Elettrici, GSE). The request is verified by ENEA (National agency for new technology, energy, sustainable economic development) and, if the valuation is positive, the GME (Manager of Electric Market) will send corresponding white certificates. The procedure

is equal to all the subjects present in the system and it is the only way to obtain the TEEs directly from the GME. If the obligated parties do not want first person implementation of the measures on customers, they can purchase white certificates through bilateral contracts or in a market where they are sold by non-obligated subjects present in the system, or by obligated parties that have them in surplus. The cost supported by obligated distributors for fulfilling the obligations is recovered through a "unitary contribution on tariff", which is established annually and applied equally on all consumers.

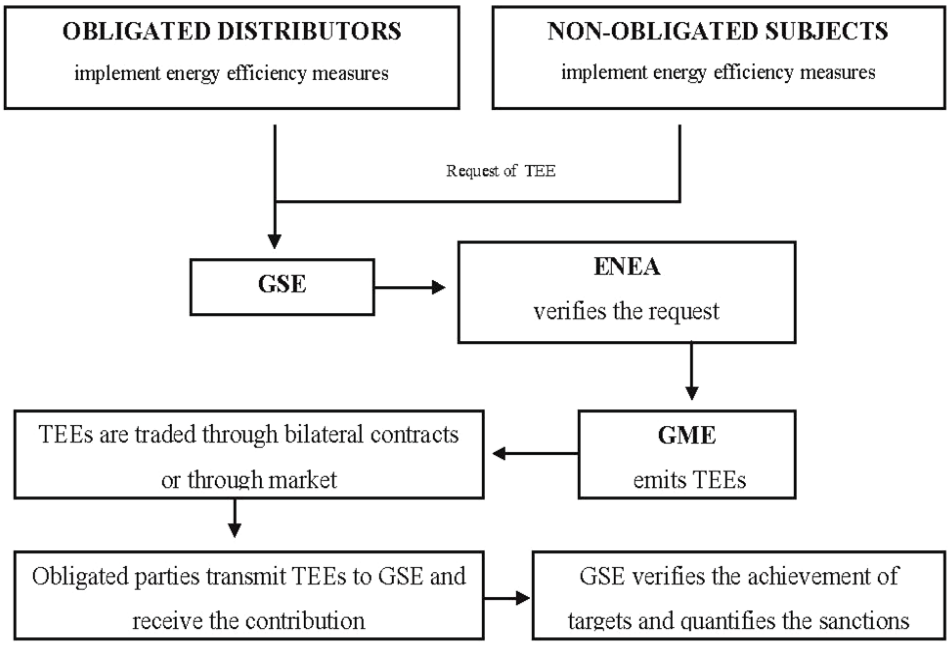

Figure 4 – Italian system of white certificates
Source: Own elaboration

Until December 2007, the measures for achieving at least 50% of the target had to be implemented for in the obligated subject activity area (electricity or natural gas sectors). After December 2007, this obligation was eliminated and now they have the option, as evidenced by the high number of TEE types (8 different types), to implement the energy efficiency measures in many different sectors besides electricity and natural gas. For instance: the transportation sector, emission reduction, technological innovations or primary energy.

The annual objective for the following year for each obligated party is established considering the share of the national total distributed amount of electricity or gas in the year before (For example: the targets for the 2013 are decided in 2012 considering the energy provided in 2011) and the method by which the sanctions are applied can be defined flexibly. Indeed, in

cases of failure to achieve the target of saving, a sanction is not always expected. If an obligated subject achieves at least the 60% of its target, he can compensate the missing part in the following year to avoid the sanction. However, if he does not achieve the 60%, he has to pay the sanctions and still has to compensate the missing part in the following year.

Listed in the table below are all the targets and the tariff contributions in the period 2005-2010.

Reference period	Targets [toe]	Tariff contribution [€/TEE]
2005 (Gen 05-May 06)	155.911	100
2006 (June 06-May 07)	311.758	100
2007 (June 07-May 08)	633.382	100
2008 (June 08-May 09)	2.200.000	100
2009 (June 09-May 10)	3.200.000	88,92
2010 (June 10-May 11)	4.300.000	92,22

Figure 5 – Targets and tariff contribution of TEE system
Source: AEEG 2012

As it is possible to observe in the reference period 2008, the government decided to increase considerably the target (tripling the amount). This has led the system of white certificates to have difficulty to achieve the objective that year and also those of the following years. For instance, in 2010 only 62,3% of the national target was achieved, due to the fact that 38 distributors had exceeded the quota of 60%, 5 had not exceeded it, and 3 had not sent communication about their results (AEEG, 2012).

In Italy other mechanisms for development of energy efficiency are present besides the white certificates system, such us: minimum standards of energy performance of buildings, incentives for eco-friendly cars and trucks up to 3.5 tons, deduction from the income taxes for intervention on electric motors and deduction from the income taxes for intervention on existing buildings (MISE, 2011). The latter was introduced in February 2007 and permits deduction from the income taxes up to 55% of the cost sustained to implement certain types of energy efficiency renovations or sources of renewable energy in existing homes. These include the replacement of the heating system, attic and wall insulation, windows and doors replacement, the entire building exterior, and solar panels to be used for heating water. To obtain the tax credits it is necessary to provide a professional engineer's certification of the renovations and the estimated energy savings (Alberini et al., 2013).

If the situation is analyzed as a whole and not only through the white certificates system, the policies introduced in Italy have provided better results than expected. This is clearly shown by observing the data contained in the Energy Efficiency Action Plan 2011. The annual energy saving achieved by 2010 was 47,711 GWh (while the expected was 35,658), and about 70% of that saving, amounting to 31,427 GWh, came from the residential sector (PAEE, 2011).

3.5 France

In July 2005 energetic savings certificates were introduced after the liberalization of energetic market. It is possible divide the time of introduction of energy savings system into 4 parts, the first: July 2006 - July 2009, second: July 2009 - December 2010 (no obligations on providers), the third: January 2011 - December 2013 and the last: 2013 - 2016. Savings obligations concerned providers of electricity, gas, air conditioning (cold and warm) and oil for household heating, in the first period. Afterwards, in the third period they were extended to providers of traction fuel, leading so the obligated parties at a number of 2080 companies. Moreover, admitted to the system were: local and regional authorities, public housings and the ANAH (national agency of housing) (Varese, 2013).

The target defined for the first period was to achieve savings for 54 TWh cumac, a target that was exceeded by 20%. For the third period was decided to realize 345 TWh cumac of savings and 90 TWh of those had to come from traction fuel providers. The costs for achieving the target of the first period (2006-2009), were 700.000€/year for administrative costs and 210 million € (or 0,39 cent.€/kWh) for the implementation of the measures.

Cumac is an abbreviation of "accumulation and actualization" and it is the unit of measure used in French system of white certificates. Accumulation indicates that is considered total saving obtained during all life of the implemented measure. Actualization indicates that is applied discount rate (4%) for actualize the value of saving.

Certificates (Certificats d'économies de l'énergie, CEE) are implemented by Directorate-General of Energy and Climate (DGEC), part of Ministry of Ecology, Sustainable Development and Energy. National Office of CEEs (PNCEE) examines and evaluates the proposals for CEE. The procedure for obtaining the certificates is not complicated. It involves an agent sending a request at PNCEE and after a period from 1 to 6 months, in relation with the complexity of measures, the applicant receives the answer. The minimum size must be at

least 20 GWh cumac and this is a high quantity for small implementations, but system gives the possibility to aggregate the requests, for achieving the minimum threshold. The costs of investment afterwards can be transferred by obligated parties on their customers through the increment of electricity tariffs.

This system involves the payment of a fine (0,02 €/KWh cumac) for every KWh that is missing to achieve the targets. Obligated parties can reach their targets in three ways:

- introducing an incentive for encouraging their customers to invest in energy efficiency measures;
- purchasing CEEs in the market;
- investing directly in projects to obtain certificates.

If it is chosen to invest directly in projects, in turn, there are three possibility:

- Standardized operations: measures agreed in advance and formally adopted. French departments are categorized in 3 different climate zones for helping the agents to decide the suitability of the interventions in each situation. The saving in this case is calculated by summing the contribution of each standard measure defined through technical data sheets (known as “fiches”);
- Specific operations: measures that have not been standardized, due to be less frequent or because it is difficult to standardize the number of CEEs. To help agents in the implementation of the measures and in the evaluation of the savings, there is a manual realized by ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie), DGEC and ATEE (Association Technique Energie Environnement);
- Additionally, have been approved programs in addition to CEEs system, through which improve the energy efficiency of families suffering energy precariousness and poor access to housing. The participation in this program permits to receive a certain number of CEEs.

For standardized operations are present a total of 270 standard measures, principally in the building sector (residential and commercial - insulation, lighting, heating system), but even in industrial sector, transport, agriculture and in the grids (electric and gas).

Instead, if it is chosen the market solution, obligated parties can purchase the certificates in the EMMY, the national register of energy saving certificates, which puts in contact buyers

with sellers and publishes the average monthly price like a reference to decide the right selling price of certificates.

In the end, the companies or the agents non-admitted, can associate with the obligated parties to carry out their projects. The terms of the cooperation are decided together, as well as the financing and help that will receive the non-admitted agents from the obligated parties.

During the workshop on Suppliers Obligations and White Certificates in Varese 2013 were illustrated praises and criticisms on French system, obtained from years of experience on this scheme (Varese, 2013). These assessments are listed in full in the lines below.

- The CEEs scheme has been well accepted, notably because energy efficiency measures targeting their clients may be beneficial to the energy suppliers.
- The scheme works: all major suppliers have fulfilled their energy saving obligations during the first period and have adapted their commercial policy to include energy efficiency issues.
- The definition of standardized actions is an efficient way to encourage actions and limit administrative costs.
- The freedom left to energy suppliers (for example, an electricity supplier can realize saving actions in the transport sector) and the ability to trade certificates enhance the cost efficiency of the scheme.
- Legal entities who are not under obligations don't massively participate.
- A need for simplification of CEE applications is expressed by most stakeholders.

3.6 Great Britain

In January 2013 Green Deal was introduced in Great Britain, in replacement to the two programs present at that moment : CERT (Carbon Emissions Reduction Targets) that was active from 2008 to 2012 and CESP (Community Energy savings Program) that was active from 2009 to 31 December 2012. The main characteristic of this scheme is to finance energy efficiency measures on households and firms, with the particular mechanism that investment costs are recovered with the money saving in the bill. Moreover, in cases of low income households or interventions with high technical difficulty, was introduced another program in addition at Green Deal, called ECO (Energy Company Obligation), which covers financially the measures implemented in these particular situations.

Green Deal

Green Deal is managed by Department of Energy & Climate Change (DECC) and will be in force up to 2020. It's principally a financial instrument, studied to overcome the high initial investment costs that are one of the principal barriers for the diffusion of energy efficiency measures. The electricity operators provide the money to households and firms for the initial investment; money that afterwards is recovered through the house's electric bills. It is very important to focus on this point because the debt is not on the customer but on the houses where he lives, hence if he changes domicile, the debt will not be paid by him but by the new tenant.

The procedure to obtain the access at Green Deal program may be divided in four different steps:

- the client has to contact an independent advisor (who might not be free) for define the possible measures that can be implemented and to estimate the amount of energy that will be saved;
- after the first step the client has to contact an accredited firm (Green Deal provider), which discusses the implementation and the financing of the measures proposed by the advisor;
- if the client and the accredited firm arrive to an agreement, the firm will contact the installation company for implementing the planned measures;
- finally, the client will find the installments to repay the investment on his electricity bill.

Observing the last step of the procedure described above, it is clear that the economic capacity of the client to repay the investment is very important. For this reason to ensure that the total amount of the monthly bill remains the same, is present a rule, called "*Golden Rule*": the energetic saving must be economically greater or equal to the part of the bill intended to repay the investment.

Moreover, it is important to specify that also if the investment is repaid by clients through a quota in their electricity bills, the accredited firms that are financing the interventions are repaid. These take the money from a Special Purpose Vehicle formed by banks, pension funds, particular investors, and Green Deal Finance Company (Sàenz de Miera et al., 2013).

To decide the type of measures to be implemented, the independent advisors can use a list of measures which have been approved for the Green Deal. A corresponding list of products, materials and specification standards is contained in a publicly available Code of Practice and updated regularly to enable a dynamic market in technological improvement (DECC, 2010). The measures ranging from installation of equipment for heating, ventilation and air conditioning more efficient, up to the micro generation, also passing for isolation of floor, roof and walls, double glazing, isolation of doors and efficient lighting (Sàenz de Miera et al., 2013). The calculation of total savings of each operation is performed by adding the contribution in terms of savings (defined in Code of Practice) provided by each implemented measure.

According to the DECC, the program is expected to help to implement energy efficiency measures in 230,000 homes each year until 2020 and reduce the emission of houses and firms for a total of 4,5 millions tons of CO_2 every year (Sàenz de Miera et al., 2013).

At October 2013 were accredited 2687 independent advisors and 112 accredited firms, also 101.851 GD Assessments were lodged (DECC, 2013).

ECO (Energy Company Obligation)

The program of obligations on the energetic companies, activated 1 January 2013 up to 31 March 2015, sets energy savings targets measured in terms of emission reduction that the companies have to achieve. The program is administered by Ofgem (Regulator of gas and electricity market), which also verifies the achievement of the targets, that have to be satisfied through the implementation of energy efficiency measures on the low income households. The companies cover partially or completely the costs of the measures that otherwise would not be implemented. Hence for this, it's possible to affirm that ECO is a subsidies packet in addition to Green Deal, for ensuring to all the access to energy efficiency measures, also to low income households.

To meet their obligations the companies can realize bilateral agreements with the accredited firms at Green Deal or through the creation of their personal accredited firm. Moreover, it must be specified that there are three types of binding obligations for the energetic companies:

- "Affordable Warmth" Obligation: also known as Home Heating Cost Reduction Obligation, requires that energy providers carry out interventions in order to improve the efficiency of houses with low energy performance;

- "Carbon Saving Communities" Obligation (CSCO): at least 15% of total interventions must be implemented in economically depressed zones of England, Scotland and Wales;
- "Carbon Saving Obligation" (CSO): for those cases with high complexity of intervention wherein there is provided a certain grade of wall isolation and others measures to reduce heat losses.

The electricity companies, which initially execute the investment, will be able to recover it through energy tariffs of all consumers.

The objectives for ECO are divided in relation with the different types of obligations. For the Affordable Warmth Obligation in 2013/14 the number of households identified to suppliers will be around 1 million, rising to around 1.3 million by 2014/15. Instead under the CSO are expected 20.9Mt lifetime CO_2 savings by March 2015 and around £760 million annually of investment to achieve this target and with the CSCO are expected 6,9Mt lifetime CO_2 savings by March 2015, at an estimated cost around £190 million per year (DECC, 2012).

Provisional figures, which are subject to further checks by Ofgem, show there were 303.795 measures installed under ECO up to the end of September and £288 million worth of contracts had been let through ECO brokerage up to end of October. The majority of all measures installed under ECO were for loft insulation (32 per cent of all ECO measures), boiler upgrades (27 per cent) and all solid wall insulation types (4 per cent) (DECC, 2013).

Interaction Green Deal - ECO

The interaction among Green Deal and ECO is linked to the respect or less of the Golden Rule. If it is respected, the customer will be able to face alone the costs of measures because he will find substantially each month an unchanged electricity bill than before. Instead, if the costs of measures are higher than the future economic savings, it is possible the intervention of ECO, which covers the additional costs. Of course this happens only if the subject has got the requirements necessary to access at the program. In this way, the investment is supported in part by the costumer and in part by the electricity company.

In the following diagram is summarized in detail the financing system of ECO and Green Deal :

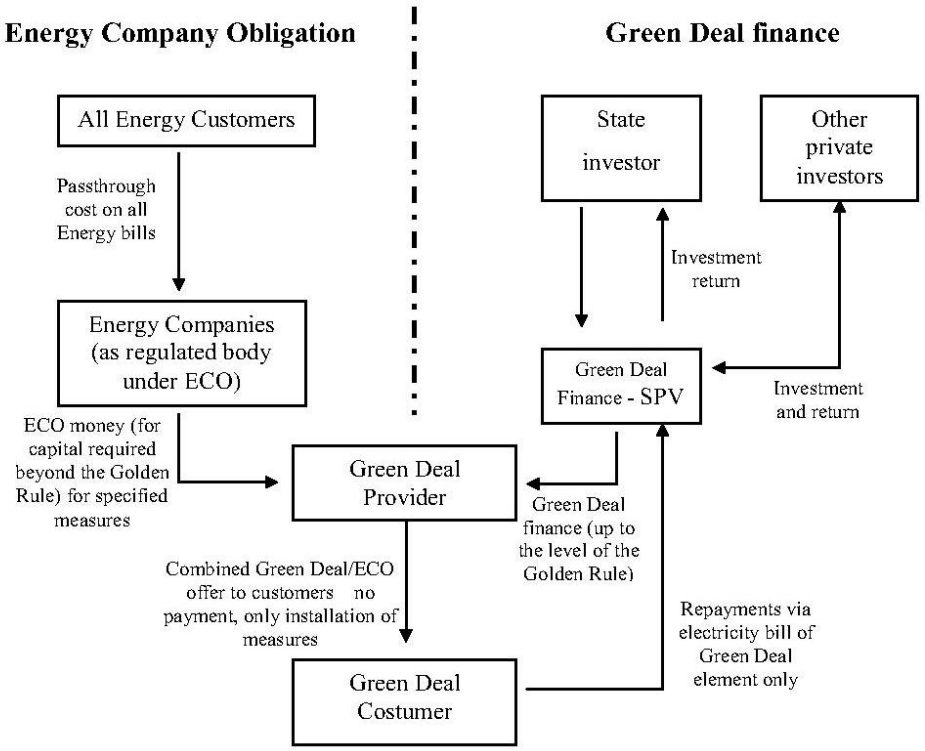

Figure 6 - Financial flows of a measure, in the case where the Green Deal is combined with the ECO obligation
Source: Decision of CE on the provision of public funds to the Special Purpose Vehicle (CE, 2013), pg. 25)

3.7 Energy efficiency obligations systems - Summary table

	Denmark	Flanders	Italy	France	Great Britain	
Type	Energy Efficiency Obligations Systems					
Name	Energiselskabemes spareindsats	Rationeel Energieverbruik	Titoli di Efficienza Energetica	Certificats d'Économiede l'Énergie	Green Deal	ECO
Start year	2006	2003	2005	2006	2013	2013
Year-end	2020	2012	2016	2016	2020	2015
Obligated Parties	electricity, gas, commercial oil, and district heating grid distributors	electricity distributors	electricity and gas distributors	electricity, gas, air conditioning and fuel traction distributors	electricity distributors	

Agencies implicated	Danish Energy Agency	VEA	GSE, GME, ENEA, AEEG	DGEC, PNCEE, ADEME, ATEE	DECC, advisors, accredited firms,	Ofgem
Actions	200 standard measures and free interventions in all the sectors, except the transport	Free (principally in residential sector)	Consumptive, technical data sheets, all the sectors + emission reduction and technological innovation	270 standard measures, specific operations and participation in programs for low-income family	Standardized measures	Residential sector
Costs	5,6 c€/kWh, including administrative and implementation costs	65 M€ of implementation costs in 2011	unitary contribution on tariff - 92,22 €/TEE	Administration: 700.000€/year, implementation costs (2006-2009): 210M€ (0,39 c€/kWh)	-	£950 million annually
Fines	-	0,10 €/KWh	flexible system	0,02 €/KWh cumac	-	-
System for recovering the costs	increase of customer tariffs	regional subsidies and electricity tariffs	unitary contribution on tariff	electricity tariff	customer tariffs (Golden Rule)	tariffs of all consumers
Outcomes	success of system and increase of targets	targets exceeded widely every year	difficulty to achieve the targets after 2008	target was exceeded by 20% (2006-2009), praises and criticisms on system (2011-2013)	-	-

4 REFLECTION ON ENERGY EFFICIENCY POLICIES – General Issues

In the previous chapter all the information and data necessary to understand the difference between the various energy efficiency policies implemented in Europe and their strengths and defects are provided. Starting from this assumption, now this work wants to concentrate more on the issues that characterize these policies.

Through an analysis on the methods of work, on results, on energy sectors interested, methods of financing and complexity of the European policies, it has been possible identify seven different issues, ranging from the absence of actions on the behavior of consumers and Free-riding Behavior up to the little consideration of transport sector, passing for high initial costs, accessory costs, equity problems and wrong analysis of the outcomes. Of course, the absence of actions on the behavior of consumers and the presence of Free-riding Behavior would be inadvisable due to the loss of effectiveness/efficiencies of the measures implemented, but also, high initial costs and accessory costs (that cause the creation of access barriers to the policies), equity problems and errors in the evaluation of the results are not to be underestimated.

In the following sections, these topics are shown and widely commented given their importance.

4.1 Absence of actions on the behavior of consumers

An important element to consider when analyzing the obligations systems of energy saving is that they are concentrated on the behavior of the energy providers, but not on the behavior of the consumers (Sàenz de Miera et al., 2013). For instance, many policies impose to providers to carry out energy efficiency measures but they do not require that then the beneficiaries have consumptions lower in line with what was assumed before the interventions. This statement introduces one of the most important issues related with the aforementioned energy efficiency policies known as the Rebound Effect. This effect indicates a situation when an improvement in energy efficiency does not bring about a proportional reduction in energy demand (Linares and Labandeira, 2010).

The lack of actions on the consumer behavior is one of the reasons that can lead to an increase of the presence of the Rebound Effect, due to the fact that consumers use more of an energy service when it becomes cheaper thanks to the efficiency improvement (Constable et al.,

2012). As long as the demand of energy is lower than that present before the efficiency improvement, policies can be considered as an instrument that leads to positive outcomes. Instead, the cases in which the demand comes to be higher than before and when the gap between the demand before and after the realization of the measures is not very wide, we are presented with a predominant Rebound Effect, and this nullifies the effectiveness of the policies. Precisely in these cases the outcomes of the energy efficiency policies can be considered unsuccessful and this failure can be attributed in part to the absence of interventions on the behavior of consumers.

4.2 Free-riding behavior

It is necessary to start from the idea that the energy efficiency policies have a cost and, as was illustrated in the previous chapter, this cost can involve the consumers that have benefited from them (Green Deal GB, Denmark) and also all the national consumers (Italy, Eco GB, France, Flanders). For this reason, it is important to maximize the efficiency of the policies, reducing hence the wasted resources (Linares and Labandeira, 2010). One phenomenon that is most prevalent in this case is the Free-Riding behavior, which occurs when agents receive incentives to realize energy efficiency measures that would be implemented also in absence of incentives. There are 3 cases that explain why this may happen (Alberini et al., 2013):

- The characteristics of energy efficiency measures are not separable from other technical or aesthetic features that would have motivated the renovation anyway.
- The agents were already convinced that the resulting efficiency improvement was worth its cost.
- The agents replace existing equipment only when it breaks beyond repair.

Different studies were done on this issue and from them it was discovered that Free-Riding behavior is a fairly widespread phenomenon. To further argue this statement, an analysis was conducted by utilities and it suggested that the share of free-riders ranges between 0 and 50% (Joskow and Marron, 1992, cited by Alberini et al., 2013). Entering more into specifics, it was estimated that 89% of the households of a group taken as sample would have purchased a high-efficiency heating system even in the absence of subsidies (Malm, 1996, cited by Alberini et al., 2013). Yet another specific example, an Italian study on the targets obtained by tax credit policy on energy efficiency renovations allowed them to observe that tax credit

has had no effect on heating system replacements, or that Free-Riding behavior must have been pervasive (Alberini et al., 2013).

In conclusion, it is possible to affirm that limiting the Free-Riding behavior allows the concentration of resources on projects that really need incentives to be made. Moreover, it helps to reduce the costs of energy efficiency policies to achieve the national targets, if the agents who do not need the incentives are convinced to implement the measures in parallel.

4.3 High initial costs

This issue does not affect the case of energy efficiency measures implemented through the obligations systems, but measures implemented in a context in which the households are incentivized to carry out energy efficiency renovations in their houses. This can be the case of Italy, where a deduction from the income taxes up to 55% is present for the renovations of residential buildings with energy efficiency criteria. The idea is to have a discount on the initial expenditure, thanks to the deduction from the income taxes and subsequently recover the money of the investment through the savings in the energy bills. The system is excellent so as it is designed, but it presents an obstacle: the high initial costs, related to the energy efficiency measures implemented. Indeed, the initial investment costs could be very high if compared with the economic availability of the households with low-medium income, causing therefore a reduction of the share of potential beneficiaries.

A solution to this problem has been found in Great Britain with the Green Deal. Its purpose is to overcome the high initial costs through the intervention of the electricity operators, which provide the money to households for the initial investment; money that afterwards is recovered through the house's electric bills. However, this system is not exempt from criticism. The fact that the debt is associated to the house and not to the owner can have a negative effect on the real estate market, for the reason that the buyers will be reluctant to buy a house with above additional burdens. Moreover, the interest of 7% on the financing provided by the Green Deal is high and it may lead to the situation in which many participants fail to meet the Golden Rule (the energetic saving must be economically greater or equal to the part of the bill intended to repay the investment) and they are therefore excluded from the program.

In conclusion, although there are these critical points, the system adopted in Great Britain can be considered a valid solution and a base from which begin for developing a system that allows to overcome the barrier introduced by the high initial costs.

4.4 Accessory costs

When analyzing the costs of energy efficiency policies, it is possible to commit the error of not considering, whether only the costs linked to the implementation of measures are taken into account. Indeed, all the contour costs needed to finance the activities that allow the proper functioning of the system would be neglected if this error was committed. These costs, which may be defined as "accessory costs", are additional costs whose elimination is not practical. Of course, they can be reduced, but this would require a modification of the structure of the systems.

In these costs are included administrative costs, which are common to all the schemes, and access costs also known in literature as transaction costs, which are present in Italy and Great Britain. These two cases are developed further in the following sections.

Administrative costs

Administrative costs are present in all the European policies of energy efficiency listed in the previous chapter and are related to the level of complexity of the scheme of each country. Of course, a greater complexity involves the need to have more government agencies (more offices and staff) for the management of system and consequently greater administrative costs. For example, recall the Italian case where an agency for the management of the system, one for the evaluation of requests of certificates, one for their issue and a market where it is possible to exchange them are all present. All of this has a cost and it is important to not forget that this cost is paid by consumers in their energy bills; therefore their obligation is not negligible. However, the quantification turns out to be difficult due to the lack of information. Normally, only the total costs of the policies are provided and not the costs for each type of expenditure (except France, 700.000 €/year for administrative costs (MEDDE (2006), cited by Sàenz de Miera et al., 2013)) and this hinders the possibility to define the proportion between the money spent for the measures and the money spent for the operation of the system, which could be a good indicator to understand whether the system is economically efficient or not.

Access costs

This is a problem that characterized the Green Deal and the Italian tax credit system. In Great Britain, the "access cost" is none other than the cost of the advisory service provided by the independent adviser. Its amount is not very high but it is enough to discourage a lot of consumers (especially the small ones), due to the fact that it is asked of them to pay for a service that could be considered as an informative step, given that only in the following one will be decided the measures that will be made and their price. Instead, in the Italian system of tax credit, this cost is related to the engineer's certification of the renovations which accompany the application for the tax credit. Unlike the Great Britain, in Italy the clients have to pay this cost only at the end of the decision-making process when they are convinced to make the renovations, hence the daunting effect of the additional cost is minimal. Unfortunately, another problem might discourage the Italian customer: the burdens due to the relationships with the public administration. For instance, Alberini et al. (2013) suspect that for most the households examined in their study, these burdens were sufficiently heavy to discourage the submission of the application, even if the households were aware of the tax credit policy.

4.5 Equity problem

The policies that finance energy efficiency measures through an increment on the tariffs of all the consumers (i.e. Italy, Eco GB, France, Flanders) could be defined as unequal. To understand the meaning of this statement one must consider the potential of saving of the medium-high income and low-income classes. The wealthy classes, thanks to their spending capacity, have high consumptions and hence a wide potential of saving, while the disadvantaged classes are characterized by a small potential for saving, linked to the low consumptions attributable to only the most essential energy needs. Therefore, the major beneficiaries of the energy efficiency measures end up being those who have the greatest chance of saving (medium-high income classes), creating what might be considered a transfer of income from low income households to medium-high income households.

In conclusion the low-income classes finance energy efficiency measures which are implemented in the houses of medium-high income classes, serving to increase the economic welfare of the latter thanks to a reduction of the amount of energy bills.

4.6 Wrong analysis of the outcomes

All the countries in EU which have introduced energy efficiency policies have experienced outcomes that, in terms of energy saving, have been positive and in some cases above the targets. Therefore, it is possible to affirm that these policies have been a success, comparable with the success obtained by the energy efficiency California policies introduced in the mid-1970s, from which many others American states have taken example for designing their energy policies. On the Californian case, given the high number of years and data that can be analyzed, many studies have been made to better understand this success. Between these studies it is interesting to quote Levinson (2013), who casts doubt on the effectiveness of the measures undertaken and in fact argues that the energy saving occurred thanks to other factors. For instance, for the consumptions in the residential sector, factors like migration of population, the climate and changes in the society characteristics (household incomes, household sizes, home sizes) have led him to conclude that the savings can be explained by long run trends unrelated to energy efficiency. In the transport sector he affirms that the savings are 100% illusory and that they can be explained by a relative decline in miles by Californians. Only the industrial and commercial sectors, in his opinion, have benefited from the energy efficiency measures.

Citing this study, however, there is no intention to assert that the savings in EU are related to other factors and not the effectiveness of the policies, but rather to invite a critical approach to the results so that during the phase of determination, all the factors which might influence the results have been taken in consideration.

4.7 Saving in the transport sector: an untapped possibility

In many European economies, the transport sector represent a very important part (about 1/3) of the final energy consumptions (Sàenz de Miera et al., 2013). Therefore, it can be considered a strategic sector (like the electricity and natural gas sectors), in which invest in order to reach the national targets. In support to this, it is possible to cite the study performed by Energy Economics Group (2009) for the European Commission, in which the total saving potentials in EU-27 level within the transport sector are quantified in 95 Mtoe in 2020 and 132 Mtoe in 2030, assuming an High Policy Intensity Scenario (which implies removing barriers to energy efficiency, a high policy effort to overcome the barriers and low discount rates for investments in energy efficiency). Despite this, the majority part of the policies that

have been implemented until now in Europe, have not focused on this area. Several allow to implement measures in the transportation sector, but only in France this sector is considered strategic on par with those of electricity and gas. Just for its importance an obligation scheme on traction fuel providers was introduced in 2009, with the goal to achieve a saving of 90 TWh within 2013. Together with this, also two standardized savings for operations on tyres and two on training were introduced in order to facilitate the providers to fulfill their obligations. Unfortunately, all this actions have not led to significant saving interventions in this sector due to the possibility for obligated parties to implement measures in other areas outside of their (Sàenz de Miera et al., 2013).

At this point one might think that the transport sector is a sector with great potential for savings but difficult to exploit. Or one might think that there are not difficulties, but that the wide dissemination and experience in the use of measures, that can be implemented in the residential and industrial sectors, have convinced many obligated distributors to invest in these last rather than in the transport sector. In fact only hypotheses can be made because firm conclusions may not be drawn due to the lack of data and experience.

5 ENERGY EFFICIENCY POLICIES IN A LIBERALIZED MARKET

While in the previous chapter the problems related to the energy efficiency policies in a monopoly/partially liberalized market have been analyzed, now this work turns its focus on what will happen when the market will be totally liberalized.

More attention has been given to energy efficiency obligations systems, but analysis illustrated in this chapter can be considered general enough as to cover other energy efficiency policies.

In the following sections problems that might arise due to the simultaneous effects of energy efficiency policies and a liberalized retail market have been hypothesized and analyzed. These can be linked to the price of electricity, the business model of retail companies, economics of scale, technical competencies, value-added services, access to the credit market, and the possibility of quick change the retail provider. However, it is correct to point out that there are no studies to support the considerations made, due to the limited number of years that have passed since the liberalization of the retail market (where this happened) or for its incomplete opening.

Before passing to the main part of this chapter, a background on electricity market liberalization is necessary in order to understand in which contexts the energy efficiency policies have worked and will work.

5.1 Background on electricity market liberalization

"Initially the electricity sectors almost everywhere on the earth were characterized by vertically integrated geographic monopolies that were either state-owned or privately-owned and subject to price and entry regulation as natural monopolies. Generation, transmission, distribution, and retail supply of electricity were integrated within individual electric utilities, which in turn had exclusive franchises to supply electricity to residential, commercial and retail consumers within a defined geographic area. This was the pattern of development for many years until several factors such as high operation costs, construction cost overruns on new facilities, high retail prices, and the development of more efficient generating technologies, led to the need to search for a new reference scheme. The primary goal of this new reference scheme was to create new institutional arrangements for the electricity sector with the purpose of providing long-term benefits to society and to ensure that an appropriate

share of these benefits were conveyed to consumers through prices that reflected the efficient economic cost of supplying electricity and service quality. All of this was discovered in a scheme characterized by the introduction of competitive wholesale markets in the generation sector, the creation of legal monopolies with the presence of basic performance in the transmission-distribution sectors and the introduction of competition between suppliers in the retail supply sector. The presence of a competitive wholesale market in the generation sector has the purpose to provide better incentives for controlling construction and operating costs of new and existing generating capacity, to encourage innovation in power supply technologies and to shift the risks of technology choice, construction cost, and operating mistakes to suppliers and away from consumers. For the transmission and distribution sectors the choice to adopt a model based on the legal monopolies with the presence of basic performance for the network firms (through the imposition of hard budget constraints) was done to allow a well-functioning of the wholesale and retail markets and for stimulating the network firms to reduce costs and improve service quality. Finally, retail competition has the purpose of allowing consumers to choose the retail energy suppliers offering the price/service quality combination that best meets their needs and provides an enhanced array of retail service products, risk management, demand management and new opportunities for service quality differentiation to better match individual consumer preferences" (Joskow, 2008).

5.2 The price of electricity and the effects on energy savings

As already illustrated in the previous section several factors such as high operation costs, construction cost overruns on new facilities, high retail prices, and the development of more efficient generating technologies, have introduced the necessity to move from a market where the electricity companies were operating in a regime of monopoly/oligopoly to a liberalized market. This change, thanks to the possibility of access at the market for new operators, introduced a certain degree of competition which led many companies operating in the field of generation to improve the efficiency of plants in order to reduce the marginal costs of production and those operating in the retail supply to reduce the operational costs; going therefore on the whole to limit as much as possible all the economic inefficiencies characteristics of a monopoly.

This containment of costs gave as a result the reduction of the price of electrical energy for the end users, a fact that can be considered positive in itself but not as much for saving energy

and for the diffusion of the energy efficiency measures in complex[1]. However, as it has just been said, the reduction in the price of electricity can be considered positive in itself and hence the effect on energy conservation and diffusion of energy efficiency measures cannot be considered as real problems in a general view. But, if we focus, instead, only on energy efficiency/energy saving and if external costs are not considered, effects due to the reduction of the price cannot be neglected. Indeed, a reduction of the price of electricity can lead on the one hand to an increase in consumption and on the other hand to a reduction of efficient energy activities in terms of economic convenience and number. Specifically, the need to reduce consumptions is not instilled in consumers if the price of electricity is too low and therefore also the willingness to adopt measures that permit it. Moreover, in the case in which anyway the consumer wants to carry out interventions of energy efficiency, the economic saving obtainable through the energy saving would not be very high due to the low cost of electricity. This would therefore not allow to amortize the investment in an acceptable number of years, thus reducing its economic convenience.

In conclusion, from what has just been said, the reduction of price of electrical energy can be considered positive in itself, but it can lead to an increase of consumption and a reduction of measures that can be still considered recommendable measures.

5.3 Business model of retail companies VS Energy efficiency activities

In liberalized markets only transmission and distribution can be seen as a natural monopoly. These two sectors are still regulated and they are not opened to competition like the sectors of generation and retail supply (as mentioned in section 5.1). Our interest is therefore concentrated on these last two sectors and in particular on the retail supply sector. Its opening to competition has an unquestionable impact on the business model of retail energy companies and on the energy efficiency activities. On the one hand there is an incentive to widen electricity sales (if it is connected with a positive margin) and this is obviously in contrast with the activities of energy efficiency, which lead to a reduction of sales. But on the other hand it provides the possibility to acquire new customers beyond the usual sales area, giving the possibility to raise their clients through the supply of value-added services.

[1] Here a elaboration is necessary: energy efficiency cannot always considered positive. Indeed, the recommended measures to implement are those in which benefits are at least equal or exceed the costs. It is important to say that some measures can be considered recommended measures, even if they are not worth the investment. Because their non-convenience is due to the presence of markets barriers or other externalities.

5.4 Economies of scale and increase in the complexity and costs of the public system of management

The idea at the base of the liberalization of the electricity retail market is to have a greater number of companies operating in order to create a competitive environment and to benefit from all the advantages that derive from it. However, an increase in companies also involves a redistribution of the consumers, with firms that will increase their number and others that will reduce it. Anyway, this is not the problem, rather it is the exploitation of the economies of scale will be more difficult. Before the liberalization, the various energy efficiency obligations systems were imposed to electric companies that operated under a monopoly and that had therefore the totality of the clients within a defined geographic area. Now, instead, those same clients are redistributed between different companies operating in a liberalized market on which the obligations are imposed. It is obvious that it is more difficult to exploit the economic savings given by large numbers[2] because a specific type of intervention of energy saving cannot be replicated on a large number of clients as they were previously under a monopoly. To better understand this statement, it is sufficient to think about interventions in the residential sector (the replacement of windows, of boilers, the insulation of the walls and roof), where purchases of large quantities of materials allows for advantageous commercial agreements with firms that produce efficient windows, efficient boilers or materials for insulation in order to obtain better prices.

Of course, a solution to this problem can be easily found, for example through commercial purchase agreements[3] among retail providers in order to buy high volumes from the various producers of windows, boilers and insulation materials. Looking ahead, these commercial agreements could become aggregations among retail providers, therefore undermining the idea at the base of the liberalization (more aggregations involve less operators and hence less competition). Luckily the reason explained above would affect little on the phenomena of aggregations, given that there are elements which have a greater influence, as a reduction of management expenditures (with the aggregation it is possible to rationalize the expenditures) and the reduction of the price of electricity (with the aggregation the companies have a higher numbers of customers and electrical energy to purchase and therefore they may directly

[2] It is important that this large number of customers are concentrated in a particular area, because if they start to be away the advantage of economies of scale will be deleted.
[3] White certificates also have a similar function.

contact the producers through OTC (over the counter) contracts, obtaining more favorable prices than from the wholesale market).

Finally, besides a reduction of the advantages offered by economies of scale, liberalization also leads to an increase of the complexity and costs of the public system of management. Indeed, more retail companies mean more interlocutors with whom to interact to fulfill the different procedures that allow the proper functioning of the system (allocation of quotas of saving, reimburse the expenditure incurred to perform the work, verification of the achievement of the objectives and assignment of fines for whomever does not respect them).

5.5 Technical competence

At the time of the electricity retail market's opening, the various vertically integrated companies that operated under a monopoly had set up commercial firms in which they had conferred staff that already worked in this sector. Besides these, firms from other sectors or newly established ones had also entered in the liberalized market, having seen in this the possibility of new business. Precisely because of the entrance of these new firms a problem of technical competence might arise in the choice of which better energy efficiency measures to implement[4]. Indeed, while the firms that derive from the vertically integrated companies have inherited this competence from the old realty, those from other sectors or newly established ones are mainly commercial firms with a reduced experience in technical area.

This problem has a negligible impact in the real market, given that the numbers of these purely commercial firms can be considered exiguous if compared with the total number of companies. Moreover, in some countries, given the small number of customers that these companies have, they are not affected by the energy efficiency obligations systems (for example: Italy).

5.6 Energy efficiency measures as value-added services

In a retail electricity market widely liberalized and where a high degree of competition is present, the providers should develop value-added services in order to differentiate from others competitors after an initial phase of price competition. This strategy exists in order to remain competitive in the market, maintaining at the same time good profit margins. Indeed, the basic idea is that competing on only the electricity price in the long term could become

[4] As it will be explained in next chapter this problem can be solved by white certificates.

economically unsustainable and for this a higher price than the competitors is maintained, offering however value-added services in exchange. Between these value-added services besides the enhanced metering and control technologies, price and consumption hedge contracts, total energy management services, and bundling of a gas, electricity, telephone services there are the energy efficiency measures. An example could be that a provider may remain competitive despite a higher price of electricity than others if, for instance, he/she provides a free consultation on the possible energy efficiency interventions to adopt, also with the possibility to realize them, obtaining in this way a twofold advantage: give a value-added service and at the same time meet its obligations.

However this strategy could prove unsuccessful. Indeed, the value-added services have a cost for the firm (administrative, staff training, management of new services), which might erode the gains obtained thanks to higher prices. This problem is present mainly in residential and small commercial sectors, where the sell volumes are small, while in industrial and large commercial sectors it is negligible, given that the cost of these value-added services has little impact on the gains obtainable from each new client (Joskow, 2000). In confirmation of this statement, the survey Retail Energy Marketer Trends 2012 (NEMA, 2012) can be taken into account. In fact, this shows that percentage of retailers that offer value-added services in the industrial and large commercial sectors is higher than that in residential sector.

5.7 Difficulty of access to credit market

The energy efficiency obligations systems, also with some variations from country to country, operate by imposing energy saving goals on providers of electricity, natural gas, and other energy sources. To achieve these goals providers can perform energy efficiency interventions directly for consumers or in some countries they can buy, through a dedicated market, quotas of savings from other providers or specialized companies (ESCO). The first solution is the most interesting to analyze in a dynamic of a liberalized energy retail market because problems of access to credit could enter into play. Indeed, even if the providers are afterwards remunerated for the made interventions, they initially have to pay with own resources. While before the liberalization, electricity companies were vertically integrated, large in size, and with an access to a more facilitated credit market, now they are smaller in size, are less structured, and due to the competition they have low gains. All of this could lead banks to provide funding with more difficulty, thus putting the capacity of retail providers to achieve their goals at risk. Moreover, the possible difficulty of access to credit might discourage the

research of innovative energy efficiency measures. Indeed, no retail company would accept the risk to invest in innovative solutions when it was already difficult to find funding for the traditional ones.

5.8 The possibility to quickly change retail providers

To open the electricity market, which until that moment had been characterized by a monopoly, rules from both the supply side and that of demand were changed. Regarding the retail market, on the supply side some rules have already been discussed in the previous sections, like the possibility of access to new operators and the obligation to set up commercial companies for the old operators, while regarding the demand side (end users) no rules have been mentioned. This is because potentially only one can have negative effects on energy efficiency obligations systems, namely the customer has the possibility to quickly change their retail provider. The problems that this introduces are related to the measurement of savings, the recovery of investments and how to set the amount of saving that retailers must fulfill. In the first case, if the customer changes after the energy efficiency interventions, the old provider will no longer have information about that customer's energy consumptions and would therefore not be able to evaluate the effectiveness of the energy efficiency measures they implemented. In the second case, instead, the problem of how the provider manages the change of supplier can arise in the countries where the recovery of the realized energy efficiency measures through an increase of customer's bill is present. Finally, in the third case, the problem is due to the fact that the savings target for each provider is awarded annually on a predetermined date, but after the objective has been decided many things can change if the market is lively enough. For example, a retail company can gain or lose one or more large industrial customers, which may alter substantially the energy sold, and thus make the target of savings, whose value had been decided based on the old sales data, wrong.

6 HOW ENERGY EFFICIENCY POLICY INSTRUMENTS WILL PERFORM IN A LIBERALIZED MARKET

The previous chapter gave an idea of the possible problems that could arise by applying energy efficiency policies in a liberalized market. As it has already been mentioned it is on systems of obligations that attention was more focused. However, the analysis can be considered general enough as to also cover other policy instruments like: technological standards, taxes, subsidies and information policies.

This chapter, instead, aims to understand how energy efficiency instruments will perform in a liberalized market, omitting the traditional problems that characterize each instrument and have already been discussed in the literature (e.g. Linares and Labandeira 2010).

In the following sections the term "recommended measures" is used multiple times. Due to this and to ensure a clear understanding of the text, this term can be defined in the following way: recommended measures to implement are those in which benefits are at least equal to or exceed the costs and also those in which their non-convenience is due to the presence of markets barriers or other externalities.

The following table summarizes the results obtained from the analysis of each energy efficiency instrument.

Energy Efficiency Policy Instruments	HOW THEY WILL PERFORM
Technological standards	- help to limit the increase in energy demand; - help to achieve certain measures, which may be interesting even if the price of electricity go down.
Taxes	- can limit the increase in energy demand - limit the variation in the number of recommended measures
Subsidies	- reduce the price of energy efficiency measures for the consumer, thus helping to be maintained almost the same number of recommended measures, despite the reduction of the price of electricity; - utilities' subsidies programs are in contrast with the business model of retail companies.
Information policies	- energy audits can help to shift the consumptions of customers in periods of low demand, with economic advantages for retailers; - energy audits can be a useful service to provide customers and these can help to compete to make retailers more competitive.

Energy Efficiency Obligations Systems	Energy efficiency measures as value-added services	Problem related with this is common to all systems.
	Business model of retail companies	All systems run into this problem.
	Technical competence	Italy, France, Denmark and Great Britain have standard energy efficiency measures, which can help. Moreover, Italy and France have tradable white certificates and this eliminates the problem.
	Increase in the complexity and costs of the public system of management and Economies of scale	Increase in the complexity and costs is present in all the systems, but the final level of complexity changes. Italian and French white certificates solve the problem related to Economies of scale.
Energy Efficiency Obligations Systems	Difficulty of access to market credits	This problem is common in all obligations systems. For the problem of investing in innovative measures, Italy found a solution with the type IN white certificates.
	The possibility to quickly change retailers	Problems of measuring savings and how to set the amount of saving that retailers must fulfill are present in every system, whereas that of recovering investments is present only in Denmark.

Source: Own elaboration

6.1 Technological standards

As mentioned in chapter 2, technological standards can be defined as minimum energy efficiency requirements for energy equipment (Linares and Labandeira, 2010). Linares and Labandeira (2010) affirm that these instruments are very popular due to the lack of transparency of the cost for the consumer, to their effectiveness regarding efficiency (although not necessarily savings), and to their easy implementation. However, they report that standards also have a negative Rebound Effect.

Neglecting for a moment the negative aspect above mentioned, their impact in a situation of a liberalized market can be considered positive. Indeed, considering the context in which we focus only on energy efficiency/saving and external costs are not considered, they can help to limit the increase in energy demand due to the reduction of the price of energy, even if the reduction of operative costs, generated from them, can lead to the presence of a rebound

effect[5], which to some extent offsets this benefit. Moreover, different studies demonstrated that standards don't lead to an increase in the price of appliances (even if standards increase the costs for consumers, albeit in a hidden way (Linares and Labandeira, 2010)). Therefore, they help to achieve certain measures, which may be interesting even if the price of electricity go down.

6.2 Taxes

The act of taxes on the price signal is considered by many economists to be the most powerful instrument for promoting energy conservation and efficiency (Linares and Labandeira 2010). Indeed, an increase in the price of energy induce technological changes which in turn allow for an increase in energy efficiency (Newell et al., 1999, cited by Linares and Labandeira 2010). However, recent research (Jossoe and Rapson, 2013) has demonstrated that the combination of taxes and information policies has provided greater benefits than the use of only taxes and also it is possible to deduce that information policies can be considered an instrument more powerful than taxes for the promotion of energy efficiency.

Before beginning to specify the advantage that taxes could provide, it is necessary to contextualize the discourse. Taxes shall not be seen as a solution in response to the reduction in the price of energy (and its effects), because the latter is not a problem. However, if we focus only on energy efficiency/saving and if external costs are not considered, taxes could help to address the problems linked with the reduction in the price of energy. First of all, an increase in energy demand would be limited and second, the number of recommended measures would not change a lot. Indeed, in a situation in which there are higher taxes on energy, the economic savings (generated by energy efficiency measures) would be greater than that present in a situation with lower taxes and this would permit the return times of investments to be more reasonable. Regarding, instead, the increase in energy demand due to the reduction of the price of energy, the mere fact that the prices are higher discourages end users to consume, thus reducing this problem.

[5] The rebound effect will probably be higher in a liberalized market, since prices are more difficult to control than in a regulated one. This is because in a regulated market the regulator can adjust the price in order to control the Rebound Effect. Instead, in a liberalized market, regulators cannot act on the price and hence he doesn't have any control on the Rebound Effect.

6.3 Subsidies

These instruments in a liberalized market introduce advantages for energy efficiency measures, but also some problems for their promotion. The first affirmation can be easily explained considering the promotion of sales of efficient appliances. They can have the form of direct payments to tax credits, but anyway they have as a result that to reduce, for the consumers, the prices of energy efficiency measures. With the use of a tool such as taxes, the reduced variation of the number of recommendable measures (the cost of which does not change) is due to an increase in energy prices. Instead, with subsidies, it is precisely the reduction of the cost of measures that allows to be maintained almost the same number of recommendable measures, despite the fact that energy prices tend to decline due to competition[6]. However, even if the problem of the number of recommendable measures is solved, the difficulty of their promotion remains. Indeed, one of the major vehicles for the promotion of energy efficiency is the utilities' subsidies programs (Linares and Labandeira, 2010). This task in a liberalized market is then transferred to retail companies, given their proximity to end users. However, they have no interest in promoting a policy that leads to a reduction in consumptions and hence to a reduction of their earnings.

Linares and Labandeira (2010) proposed to decouple revenue from sales in order to eliminate this problem. But this idea is hardly feasible in this context because it eliminates competition, since companies do not have earnings related to their ability to compete on the market, but related to parameters defined by a regulator.

6.4 Information policies

To give an assessment of how this tool could work in a liberalized market it is necessary to analyze it case by case. Labeling, for example, known by consumers as Energy Star or energy consumption labels on household appliances, does not introduce any new effect, apart from the classic one to help make the market more transparent. Much more interesting, instead, for the advantages that they could introduce, are energy audits (information on the behavior of customers). Retail companies could use energy audits to shift the consumptions of their customers in periods of low demand. This, in addition to contributing to reduce peak demand, can increase the earnings of retail companies. Indeed, energy is normally characterized by high prices in peak times and by low prices in off-peak times. Therefore, by bringing the

[6] Even here the contextualization made in the section on taxes must be taken into consideration.

major part of customer demand to off-peak times, retail companies can purchase energy from producers at the lowest prices, increasing accordingly their profit margin (supposing that there are not two-tier tariffs). Finally, energy audits can also be a useful service to give to consumers, and therefore help the retailers that provide them to compete better in a liberalized market.

6.5 Energy efficiency obligations systems

This type of instrument is affected by a lot of the problems seen in chapter 5. It must be specified, however, that not all energy efficiency obligations systems are equal and also that not all work in the same way. For these reasons, what wants to be done in this section is to illustrate what are the weaknesses and strengths of each European energy efficiency obligations systems in the context of a liberalized market.

For the problem related with *energy efficiency measures as value-added services*, there is not a dedicated section because it is common to all obligations systems and there are no comments in addition to the analysis already done in the previous chapter that can be made.

Business model of retail companies

As it is easy to understand, all the systems run into with the problem of the business model of retail companies and the reasons behind this, have already been discussed in the previous chapter. However, in support of the decision to set up obligations systems on retail companies, it is possible to affirm that the idea seems reasonable, given their proximity to end consumers. The retail companies can be the solution to address the information barriers (insufficient information), which lead to wrong decision-making. In particular, the extensive relation of retailers with consumers allows getting access to their behavior. Indeed, they have information about electricity consumption on each individual client, and sometimes they are also more informed than them.

Technical competence

Since their entry in force, obligations systems of Italy, France, Denmark and Great Britain have had the presence of standard energy efficiency measures. This choice has been made besides that for steering retailers on a certain type of interventions, also, from a technical point of view, to make the achievement of their obligations more simple. It is not possible to deny that mainly new retail companies (commercial) have benefited all of this because they

might reduce in this way a part of the technical gap that they had with retail companies derived from old vertically integrated companies. However, it not be forgotten that in addition to the standard measures, there are also interventions that can be defined as non-standard, which require high technical competencies. Moreover, the same standard measures also require minimal technical knowledge that are not always present in a purely commercial company.

The problem of technical competence of commercial companies can be quietly neglected in the obligations systems present in Italy and France, thanks to the possibility to trade white certificates (TEE or CEE). Indeed, in these two systems it is not necessary to have technical competences, but it is sufficient to simply have the economic availability for buying white certificates from other subjects (ESCO or other retail companies).

Increase in the complexity and costs of the public system of management and Economies of scale

The liberalization of the market leads to have, in the same way in all obligations systems, an increase of complexity and costs of the public system of management. The only thing that can change is the final level of complexity. Indeed, it is easily imaginable that countries like Denmark and Flanders, which have a more simple organizational structure for managing their obligations system, are affected by an increase in the number of operators, but always to a lesser extent compared to countries like Italy, France and Great Britain, that conversely have a more complex organization.

Regarding instead the economies of scale, the importance to have the possibility to exploit them changes a lot among the systems of Denmark, Flanders and Great Britain and those of Italy and France. In these last two, indeed, retail companies that do not have a large number of customers, which would allow them to exploit economies of scale, have the possibility to use white certificates. Certificates that, for example, may be sold by ESCO or other retail companies that run a large number of energy efficiency interventions in order to realize advantageous commercial agreements with companies producing efficient windows, efficient boilers and insulating materials.

Difficulty of access to market credits

This problem is common in all the obligations systems, given that retail companies are rewarded for interventions after they are made. This choice, although it may introduce

problems of access to the credit market, it is not entirely wrong because constrains of time and completion of the interventions are placed, avoiding waste of time and money. Indeed, it is in the interest of retailers to finish the work in a short time and control costs, in order to be reimbursed by the regulator as early as possible and to not have economic losses on the interventions performed.

However, all this can direct retailers to not carry out innovative interventions, but to continue with the more traditional (simpler and less risky), that at times may not be the optimal solution in terms of energy efficiencies. The Italian system, in response to this problem or to encourage innovation, introduced in 2012 white certificates (TEE) type IN. These reward the degree of technological innovation, giving the project a number of certificates greater than that theoretically should be released with the classical measures and give the possibility to choose a system that ensures a constant value of the certificate for the entire useful life of the project (the price of the TEE is no longer tied to changes in the market) (European Parliament and Council of the European Union, 2012). The Italian way, however, is not the only one that can be followed, a special guarantee fund can be set up and could act as a guarantor on loans provided by banking systems to retail providers for the realization of energy efficiency measures (innovative or not) in order to eliminate funding difficulties.

The possibility to quickly change retailers

The three problems resulting from the possibility to quickly change retailers should be analyzed separately because they do not interest all obligations systems in the same way. In fact, while the problem of measuring savings and how to set the amount of saving that retailers must fulfill are present in every scheme, that of recovering investments is present only in countries where the investment money is recovered through the customer tariffs, to which the intervention has been implemented. This is the case of Denmark, where government grants are not present and therefore retailers can recover their investment through an increase of customer's tariff.

Of course, the problem can be solved. For example the reimbursement of all costs incurred might be required, before authorizing the change of supplier. This, however, would bind the consumer too much with the retail provider. Or the customer could bring his/her debt, meaning that the consumer pays the installments of the debt with the new provider which then reimburses the cost of the intervention to the old one when changing providers.

For all other countries, instead, there is no problem given that investments are recovered through electricity tariffs from all consumers or as in Flanders, where regional subsidies are also present.

7 CONCLUSION

This thesis has examined how energy efficiency policies are performing now and how they will perform under a liberalized market. Attention has been paid mainly on energy efficiency policies adopted in Denmark, Flanders, France, Italy and Great Britain, and specifically on the instrument of energy efficiency obligations system (even if the analyses is general enough to also cover other instruments). This choice was made given their importance and centrality in the guidelines present inside European Directive 2012/27, in which, together with this instrument, others (energy or CO2 taxes, financing schemes and instruments or fiscal incentives, regulations or voluntary agreements, standards and norms for products-services-buildings-vehicles, energy labeling schemes, training-education) have been indicated to guide Member States in the achievement of objectives for 2020.

With data and information available in literature, it has been illustrated how these obligations systems work, the energy sectors they interest, their complexity, their cost, funding methods and their results. In Denmark, Flanders and France, this instrument has had considerable success and targets imposed on providers were always met and in many cases exceeded. In Italy, instead, since 2008 there has been difficulty in achieving these goals for providers, due to the decision to triple the required amount of energy to save. Finally, regarding Great Britain, a complete evaluation on its system formed by Green Deal + ECO is not present, due to the short time passed from its introduction. However, from monthly reports presented by DECC, it is possible to note that the British system is having considerable success.

Despite of the good results in terms of energy savings, some criticisms of this system have been advanced. The analysis carried out has led for example, to a criticism of the lack of actions on consumers behavior (that is one of the causes that can lead to an increased presence of the Rebound Effect), the waste of economic resources due to Free-Riding Behavior, the presence of administrative costs which affect in a certain measure on the costs of energy efficiency policies, the fact that the potential of the transport sector is not exploited, and finally equity problems. Moreover, observations have been done on the Green Deal and Italian tax-credit system for their transaction costs and the high initial costs of measures that can discourage consumers to realize them. This analysis, anyway, is not an end in itself, but it serves to underline weak points more apparent of energy efficiency policies present in Europe.

Attention has been placed also on possible effects of the liberalization of the electricity market on energy efficiency policies, and the problems that could arise have been hypothesized and analyzed. It has been noted that these are linked with the reduction of the price of electricity (if external costs are not considered), the business model of retail companies, the increase of complexity and cost of the systems of public management, economies of scale, technical competence, access to the credit market, and the ability to quickly change provider. However, it is important to remember that there are no studies to support the considerations made, due to the limited number of years that have passed since the liberalization of the retail market or for its incomplete opening.

At this point it was necessary to go deeper and therefore analyze how the different policy instruments will most likely work in a liberalized market.

<table>
<tr><th>Energy Efficiency Policy Instruments</th><th colspan="2">HOW THEY WILL PERFORM</th></tr>
<tr><td>Technological standards</td><td colspan="2">- help to limit the increase in energy demand;
- help to achieve certain measures, which may be interesting even if the price of electricity go down.</td></tr>
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<tr><td rowspan="3">Energy Efficiency Obligations Systems</td><td>Energy efficiency measures as value-added services</td><td>Problem related with this is common to all systems.</td></tr>
<tr><td>Business model of retail companies</td><td>All systems run into this problem.</td></tr>
<tr><td>Technical competence</td><td>Italy, France, Denmark and Great Britain have standard energy efficiency measures, which can help. Moreover, Italy and France have tradable white certificates and this eliminates the problem.</td></tr>
</table>

Energy Efficiency Obligations Systems	Increase in the complexity and costs of the public system of management and Economies of scale	Increase in the complexity and costs is present in all the systems, but the final level of complexity changes; Italian and French white certificates solve the problem related to Economies of scale.
	Difficulty of access to market credits	This problem is common in all obligations systems; for the problem of investing in innovative measures, Italy found a solution with the type IN white certificates.
	The possibility to quickly change retailers	Problems of measuring savings and how to set the amount of saving that retailers must fulfill are present in every system, whereas that of recovering investments is present only in Denmark.

It is necessary to remember that recommended measures are not only those whose implementation provides benefits at least equal to or that exceed the costs, but also those whose non-convenience is due to the presence of market barriers or other externalities. Moreover, that the reduction of the price of electricity is not a problem in itself but if the external costs are not considered, the effects that they introduce cannot be neglected.

It is possible to affirm, with what has been reported in the table, that in a liberalized market (ignoring the classic problems reported in literature), taxes, technical standards, and information policies work without any problems, while subsidies need changes related to utilities' subsidies programs. A separate discussion must be done instead for obligations systems: these have a certain number of problems, some of which can be solved (economies of scale, technical competence, innovative solutions, and recovery of the investment), and in two cases simply with the introduction of tradable white certificates (economies of scale and technical competence). But there are also some, for which, no evident solution has been found during this thesis.

LIST OF FIGURES

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