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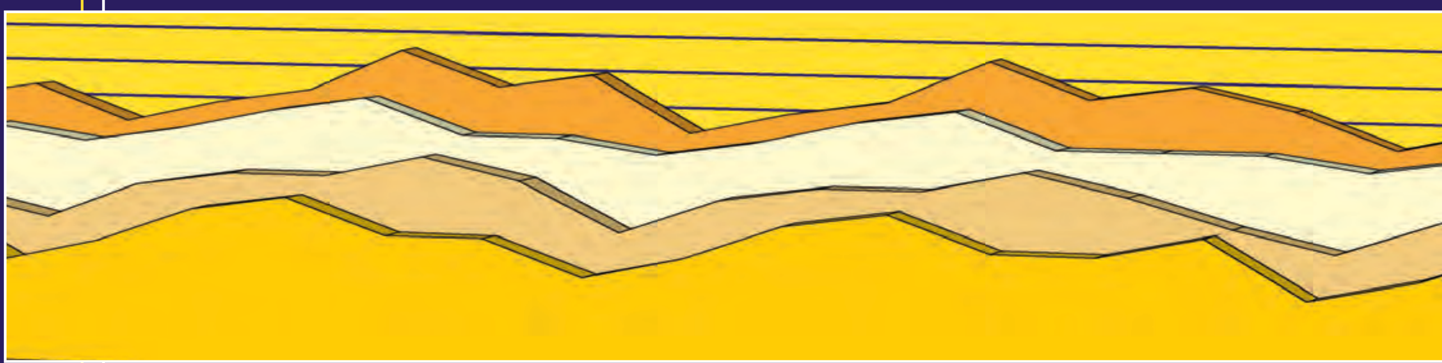
Market Trading Mechanisms for Delivering Energy Efficiency



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Foreword

The use of market mechanisms to achieve environmental objectives is growing, with the most notable example being the use of emissions trading schemes to control greenhouse gas emissions. Trading Mechanisms for Energy Efficiency, commonly referred to as White Certificates Schemes, are now in place in a few countries. This study examines these experiences with White Certificates Schemes, identifies the key design features that affect performance, evaluates effectiveness and offers advice on how developed and transition economies might proceed with such schemes. The report also considers the use of White Certificates Schemes in conjunction with Renewable Energy Trading (Green Certificates) and Emissions Trading.

The Working Group on Energy Efficiency and Related Environmental Aspects (the PEEREA Working Group) monitors the implementation of the Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects signed by 51 Member Countries and the European Communities. An important role for the working group is joint analysis and discussion of innovative policy instruments to promote energy efficiency in member countries. This publication is one of many that have been produced by the Energy Charter Secretariat (ECS) to support this role. This and other documents are available on the ECS website at www.encharter.org.

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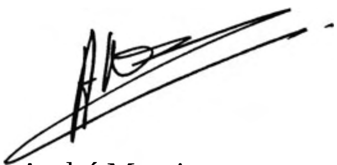
This document is released under my authority as Secretary General of the ECS.



André Mernier
Secretary General
Brussels, March 2010

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Executive Summary

Energy efficiency is a well-established option to decouple economic growth from the increase in energy consumption. Furhtermore, it can reduce greenhouse gas (GHG) emissions by cutting the amount of energy required for a particular amount of end use energy service. Several countries have set energy efficiency targets and applied numerous policy instruments at the national level, such as standards, economic instruments, market-based mechanisms, voluntary agreements, and information campaigns. At the same time, policy makers have expressed an increasing interest in promoting 'smart' energy efficiency market-based instruments focused on the energy demand side.

WhC in a nutshell

A relatively new policy instrument is the White Certificates (WhC), whose basic idea is that specific energy saving targets are set for energy suppliers or distributors who must fulfil these requirements by implementing energy efficiency measures among their clients within a specific time frame. The fulfilment of this target is acknowledged by means of (White) certificates. Energy suppliers or distributors, who overfulfil their targets, can sell their unused energy efficiency equivalents in the form of WhC to suppliers/distributors who have implemented fewer measures than according to their target. Thus far, WhC systems have been implemented in Italy, the UK and France and are currently being considered in Poland, albeit with different design characteristics and ambition levels. Furthermore, there are other countries that have implemented similar schemes to WhC, although without the certificate trading component, but merely dealing with obligations to energy suppliers or distributors for energy efficiency.

The main actors in a WhC scheme are:

- *The regulatory authority*, which plays the principal role in distributing the obligations among the participants and issuing the certificates;
- *Suppliers and the distributors of gas and electricity*, who have an obligation, set by the regulatory authority, to save a certain amount of energy within a specified period. To this end, suppliers have to promote specific energy efficiency projects to end users. Suppliers and distributors receive WhC and can trade them on the market in order to comply with the obligation; alternatively they can purchase respective amount of WhC from other suppliers or third parties;
- *Energy service companies (ESCOs)*, which are companies that offer to reduce a client's energy cost, often by taking a share of such reduced costs as repayment for installing the energy efficiency measure and financing its upgrades. They do not receive an obligation, but they are allowed to claim and sell WhC after performing energy saving actions. In the same category of these market players fall also energy efficiency providers, installers and other businesses dealing with energy efficiency;
- *"Other participants"*, which are entities that do not receive an obligation but can purchase and sell WhC, providing thus the necessary liquidity in the market. Examples for such entities are brokers and financing institutions, which facilitate the transactions and reduce the risk of the investments, while speculating on the price of WhC and receiving a commission from the transaction costs. The eligibility and the role of these entities differ among the existing WhC schemes. Their role is foreseen in the UK and French WhC scheme.

Design characteristics of WhC schemes

As a starting point, a WhC scheme in its design phase consists of the following elements upon which decisions are taken: a) Target setting (What should be the target? What is the specific timeframe?), b) Obliged parties (Which market party should undertake the obligation? Are there other eligible parties? Does the scheme enhance competition or does it lead to market concentration?), c) Counting target upgrading (Which projects are eligible for certification? Sales or end use counts for target? Are there verification requirements?), d) Compliance, transaction and administrative costs (Compliance costs? WhC costs? Transaction costs? Administrative costs? Does learning reduce such costs? Do costs reflect energy efficiency costs? Are there dangers for gold plating?), e) Eligible technologies (Are all or specific technologies allowed? Does the scheme support innovation or existing technology diffusion?), f) Institutional Setup (Which body undertakes these costs? Which body is responsible for which procedures? Are there possible conflicts between procedures?) g) Enforcement (What is the optimal level of penalty? Is the penalty relevant to sales or th level of underperformance?), h) Trading rules (Is trading prerequisite for the scheme? How can the scheme enhance trading?) i) Links to other policy instruments (Complementarities and overlaps with other instruments? Timing of instruments?).

In the following sections we demonstrate the main characteristics and an assessment on the grounds of effectiveness (target achievement) and cost-effectiveness (targets reached at minimum cost) of three such schemes in the EU.

In **Italy**, the system entered into force in January 2005 for a five year period. On the basis of the positive results achieved, the scheme was extended until the year 2012; in addition, some of its components have been updated in order to increase its effectiveness. The obligations for energy efficiency projects are attributed to distributors of electricity and gas with more than 100,000 customers and the targets are expressed in primary energy consumption. The Italian scheme aims at a range of policy objectives (for instance GHG emissions reductions, reduced dependence on energy imports, development of the market for energy efficiency products and services) and the quantitative target is set in terms of annual primary energy savings (expressed in tons of oil equivalent saved).

Energy saving projects eligible for accreditation with WhC can take place in all end use sectors, including also some energy supply ones (as for instance CHP, PV systems and others). There are three types of certificates that are issued and traded, each one with a predefined unit value that attests primary energy savings through reduction of a) electricity consumption, b) natural gas consumption or c) consumption of other fossil fuels. Cost recovery is allowed for every certificate of the distributor as long as the latter has not achieved the energy savings target. This rate should be proportional and greater than the investment required to compensate the non-compliance (estimated higher than 150-200 €/toe primary energy saved, i.e., 3.6-4.8 €/GJ).

The scheme has proven quite successful, since almost 2 million toe are saved against a target of 1.1 million toe. From these savings, 78% are from electricity, 18% from natural gas and 4% from other fuels. Furthermore, the market for ESCOs was stimulated, as 75% of savings originated from such companies. More than 60% of total savings were achieved realising saving potentials through micro-scale size and low-hanging fruit in the commercial and household sectors. Another preliminary result is that in the first three years of the scheme, consumers reduced their energy costs at a higher level than the amount of tariff contribution (six to twelve times more depending on the fuel) and the average market price of certificates.

Concerning the market part of the WhC, trading mechanisms were enhanced and approximately 2.5 mil transactions of certificates realised in the first two years of the scheme. Most of these certificates consisted of bilateral agreements between market parties, while a small amount was openly traded with an average weighted price of 61 €/toe. Based on these market prices and energy prices of end users in 2006 as benchmarks, the net financial savings for end users were 5 to 6 €cents/kWh of electricity and natural gas saved, respectively.

In **the UK**, the system of WhC was initially implemented through the Energy Efficiency Commitment (EEC) in three phases, i.e., 2002-2005 and 2005-2008 and 2008-2011. For 2002-2005, the total energy reduction target was 62 TWh of fuel-standardised carbon equivalent energy (around 16 PJ, almost 1% of consumption), which applied to all gas and electricity suppliers, possessing more than 15.000 customers. For the second period, The Energy Efficiency Commitment 2005-2008 (EEC2) required eight suppliers to meet an energy saving target of 130 TWh in domestic properties. The follow up programme of EEC1 and EEC2 is the Carbon Emissions Reduction Target (CERT) 2008 to 2011, which consists of a third three-year phase of the energy supplier obligation. The target is 185 million tons of carbon dioxide (lifetime) by 2012 (undiscounted and excluding comfort), which is an equivalent of the emissions from 700,000 homes each year. In principle, projects can be related to electricity, gas, coal, oil and liquefied petroleum gas (LPG) and they can be implemented in all households in the UK.

Three forms of trading were envisaged: a) Horizontal, between suppliers (at present they account for around 0.25% of targets), b) Inter-temporal, between compliance periods; this solution was very popular, since about 20% of EEC2 targets were met in EEC1. This banking provision led to a 28% banking from EEC1 to EEC2 and 25% from EEC2 to CERT, and c) Vertical, between suppliers and project developers: this is the most important, since suppliers have contracted out most of their measures to 3rd parties. In all these forms, there was no real certification in the form of WhC, but rather savings and obligations. Concerning the verification of energy savings, different techniques are used for the eligible technologies. For example, for CFLs, the priority group is getting 100% additionality due to the high cost of the bulb and the low income of the consumer (i.e., poorer households are unlikely to purchase CFLs outside the EEC scheme).

In the UK, the target for all suppliers was 130 TWh in 2005-08, it was surpassed by 44% and was carried over to CERT, amounting to almost 187 TWh energy saved. The total savings in the EEC2 amounted to 59 Mt CO_2 in the projects' lifetime, which can be translated to 2.1 MtCO_2. In total, over 120 million measures were installed, where appliances and lighting dominate in numbers, but insulation dominates the energy savings. Costs were 23% lower than originally expected, largely due to economies of scale and market transformation effects of the programme. The total economic benefit exceeded 3 billion € for a supplier investment of 0.9 billion €. All in all, the EEC2 can be deemed as highly cost effective, with a consumer benefit of £9 (lifetime) per £1 supplier spent, with a Net Present Value/tCO_2 of £57 (net benefit).

The WhC scheme in **France** started in July 2006 for a 3 year period and will be renewed for a second 3 year period in 2010. The overall target in final energy terms is 194 PJ (54 TWh cumac)[1] reduction over a period of 3 years, with 122 PJ (34 TWh) from electricity, 38 PJ (10.5 TWh) from gas, 5.4 PJ (1.5 TWh) from heating and the rest from other domestic fuels.

[1] Meaning the net present value of total kWh of final energy over the life of a product (or in other words cumac = Annual Energy Savings * Lifetime of energy saving actions (discounted at a rate of 4%).

The projections for the increase of the target for the second period are at least 100 TWh cumac per year and the new system will include also transport fuel. Obligations are set to suppliers of all fuels (excluding gasoline), who must either promote energy savings or purchase certificates.

The parties involved in trading of WhC are the obligation bound ones and all economic actors, who can generate energy savings and receive certificates. The law forecasts the possibility to pass the costs on to prices for regulated tariffs, taking into account other variables, such as inflation rate, social and renewable energy feed-in tariffs and evolution of transport and distribution costs.

In France, the scheme is more recent and in 2008, 28.6 TWh cumac had been achieved, representing about 53% of the total obligation of 54 TWh cumac that energy suppliers have to reach on July 2009. Early experiences from the scheme reveal that most implemented projects refer to heating and insulation in the residential sector (mainly thermal systems and to a lesser extent building shell and appliances). An important characteristic of the scheme is that it interacts at a great extent with national thermal regulations (for new and existing dwellings), an income tax credit, VAT rate reductions, and information campaigns. In general, market responses demonstrate that the cost of energy saved was low compared to consumer prices, estimated to range from 0.3 €cent/kWh cumac (average value of certificates traded in the first period) and 1 €cent/kWh cumac, which is the maximum price of certificates traded).

Other similar schemes

As mentioned above, several other schemes exist, which share lots of characteristics with WhC ones, namely those that entail an obligation for energy savings but do not incorporate a trading or certificate element. These countries are Poland, Denmark, the Netherlands and Flanders (Belgium), while several energy efficiency programmes (with or without some form of certification) exist in half of the states of the USA. Outside the EU, a well known scheme is the New South Wales Greenhouse Gas Abatement Scheme, which includes certificates. In this scheme, electricity retailers and other parties are required by legislation to meet individual mandatory targets for reducing the emission of greenhouse gases resulting from the electricity they supply or consume. To achieve the required reduction in emissions, eligible parties purchase and surrender tradable certificates called New South Wales Greenhouse Abatement Certificates. In average, certificates originating from energy efficiency actions contribute only 22.5% to the total abatement, while generation projects acquire the highest part (although the share of energy efficiency projects has grown over time). Benchmark participants comprise:

- electricity retailers;
- electricity customers taking supply directly from the Australian National Electricity Market;
- electricity generators with contracts to supply electricity directly to customers;
- certain other parties who consume large volumes of electricity in New South Wales and who elect to participate directly in the Scheme, rather than have their electricity retailer manage the emission reduction obligation in relation to the electricity they consume.

Early experiences from the New South Wales scheme demonstrated that specific measures were implemented at a large extent (namely CFLs and water efficient showerheads) as certificates could be accredited based on default abatement factors of these technologies.

Currently, the New South Wales GGAS will be extended to 2020 and beyond on a rolling 15-year basis or until an Australian national emissions trading scheme is established.

Interactions of WhC with other policy instruments

In current policy debates there are ideas of linking schemes addressing energy efficiency with renewable energy or carbon reduction targets.

Concerning the former case, a possible combination could be between WhC and TGC markets, where both renewable energy and energy efficiency and savings measures contribute to meeting a specific obligation like reduction of fossil fuel consumption. Energy savings may contribute to meeting an overall renewable energy target by reducing overall consumption. The key common characteristic of green and white certificates is that both allow for the separation of the physical flow of electricity from, respectively, the "greenness" of electricity and energy savings. In the case where no conversion of certificates is allowed and markets are separated, the only possible interaction of TGC and WhC can take place through the common eligible measures. In other words, when more common measures are being implemented due to a WhC scheme, an increase in demand of TGC will take place with a subsequent drop in prices. Similar is the case with an increase of energy efficiency measures, also eligible under TGC, which will tend to drop WhC prices. When one way fungibility is permitted, the expected effects depend mainly on the starting point of the certificate prices. More in detail, if TGC prices are higher than WhC ones, importing WhC into the TGC market is a viable solution. This will lead to an increase in TGC supply and reduce their market prices, with a parallel increase of the price of certificates in the WhC market. In this case, the exchange rate might be altered depending on the difference of the initial prices. A market where this sort of combination of energy efficiency with renewable energy targets is attempted is in the New South Wales scheme. This full fungibility option, although applied in the market, is still debated as the low emission electricity generation (via renewable energy) would have taken place regardless of the GGAS scheme, therefore additionality is not clear. This design imperfection is apparent in many schemes where TGC are combined with similar credit schemes, when allowing the credits of one scheme to fulfil the targets of the other, without setting additionality rules.

There is a growing debate on the relationship of emissions trading (ETS) with WhC schemes. In principle, integrating these schemes, where the one refers to end use electricity and the other on energy production can lead to a rather complicated scheme. The reason is that the conversion of WhC to emission allowances raises the threat of double counting: electricity savings are already accounted by the power generators within emissions trading, which produce less CO_2 emissions at their 'pipe'. The basic principle in a potentially integrated scheme is that energy savings bring a precisely measurable carbon reduction and WhC can be converted into emission allowances that can be sold on the emission market. On the practical side of integration, the major difficulty is the fact that emission trading is a cap and trade regime with ex-post measurement, while certificates schemes are baseline-and-credit ones with a large share of ex-ante measurement.

Finally, another aspect discussed is the potential integration of all three markets (emissions trading, energy efficiency and renewable energy) in one scheme. In fact, several market barriers exist to carry out energy efficiency measures and investing in RE under the ETS. To this end, integrating WhC and TGC schemes to the ETS could address these barriers and assist in achieving multiple targets. Initially, if an industrial plant reduces its electricity consumption, under the ETS that accounts for direct emissions, it does not receive any carbon reduction benefits (unless a share of electricity is generated within the plant). A WhC or TGC scheme could assist in financing the plant's more efficient energy use. In all cases, the for and counter arguments hold if the objective of the ETS is not confined to the cost effectiveness of covered sectors, but aims at broader economic and societal issues. If the case is only to maintain the integrity of a carbon market and carbon caps, then eventually other policies (not certificate based ones) are more suitable for directing energy efficiency or renewable energy actions.

General conclusions

On the whole, WhC schemes can adapt and function in several market conditions and generate energy savings, but they should not be considered as a panacea, as other complementary instruments are necessary in order to guarantee their effectiveness. WhC schemes can be a sound instrument from its basic principles, as it makes use of the market forces and can assist in overcoming market barriers towards energy efficiency, and it can be integrated with other policy instruments and allows cost-effective achievement of multiple environmental objectives. In order to render these interactions economically viable and effective, some preconditions on the designing phase of WhC schemes must be fulfilled:

- A binding long-term target must be clearly set under a WhC policy timeframe — reducing regulatory uncertainties for market actors;
- Standardised common procedures must be employed for energy savings calculations (for instance baseline setting, "deadweight" and others). Furthermore, standardised full cost accounting systems, ex-ante monitoring and verification of energy savings, streamlined procedures, and standardised trading contracts must be employed in order to reduce transaction costs. The main target in this respect is to minimise free riding behaviour, which can be achieved partly by limiting certification of WhC to projects that are not fully commercially available and highly likely to be implemented even without a support mechanism;
- A proper market must be established, thereby ensuring the participation of numerous actors (e.g., avoid oligopolistic market conditions, increase liquidity, etc.). Experience from schemes showed that the WhC market should be large and liquid, in order to avoid market power of players and eventual high certificate prices;
- In order to keep compliance costs low, market conditions should be such that the tradability of WhC is guaranteed;
- A concrete penalty should be set and publicly known before the implementation of a WhC scheme, in order to provide in advance correct market signals and let obliged parties develop their investments plans and further market strategies. This penalty for not purchasing a certificate or complying with the target should be at least higher than the expected WhC price. This means that if different countries participate, the lowest penalty must exceed the expected marginal generation costs (minus market price for electricity) within the system;
- Transparent and fair cost-recovery mechanisms and effective enforcement by the authorities are crucial;
- WhC schemes should be as technology neutral as possible, so that they can create competition among different energy efficiency technologies and avoid lock-in/out market situations. The energy efficiency target should not address only the 'low hanging fruit' that could also be diffused in the market without an extra policy. Innovative technologies can be also stimulated parallel to WhC through additional stimuli from existing instruments, however clear definition about additionality is required.

1 Introduction

Energy efficiency is a well-established option to decouple economic growth from the increase in energy consumption and thus reduce greenhouse gas (GHG) emissions by cutting the amount of energy required for a particular amount of end use energy service. Energy efficiency is considered as 'the quickest, most effective and most cost-effective manner for reducing GHG emissions (EC 2005), while it can contribute to meeting widely accepted goals of energy policy such as improved security of supply, economic efficiency and increased business competitiveness coupled with job creation and improved consumers' welfare (Bertoldi and Rezessy 2006).

Several countries, including the EU, have set energy efficiency targets and in order to achieve them, they have applied numerous policy instruments at the national level, such as standards, economic instruments, market-based mechanisms, voluntary agreements, and information campaigns. At the same time, policy makers have expressed an increasing interest in promoting 'smart' energy efficiency market-based instruments focused on the energy demand side. A relatively new policy instrument is the White Certificates (WhC), named also as Energy Efficiency Titles.

A formal definition of WhC can be found in the EU Directive on Energy End Use Efficiency and Energy Services (EC 2006): "certificates issued by independent certifying bodies confirming the energy savings claims of market actors as a consequence of energy efficiency improvement measures". The basic idea underlying this policy instrument is that specific energy saving targets are set for energy suppliers or energy distributors who must fulfill these requirements by implementing energy efficiency measures among their clients within a specific time frame. The fulfillment is acknowledged by means of (White) certificates. Energy suppliers or distributors, who overfulfil their targets, can sell their unused energy efficiency equivalents in the form of WhC to suppliers/distributors who have implemented fewer measures than according to their target. In this way, WhC ensure high flexibility and thus contribute to the implementation of measures that are more cost-effective. WhC can furthermore be traded between eligible parties; these are not only energy suppliers and energy distributors (with obligations) but also Energy Service Companies (ESCOs) (without obligations).

The purpose of the WhC as a policy instrument is twofold (Oikonomou 2004):

- As an accounting tool, which proves that the requested amount of energy savings has been realised within the time frame agreed. The owners of WhC declare their savings in energy value before or after surrendering the WhC to the appropriate authorities, depending on the design of the scheme;
- For commodity trading either bilaterally or on the WhC market (Pavan 2002), in order to provide cost effective options for existing and new participants.

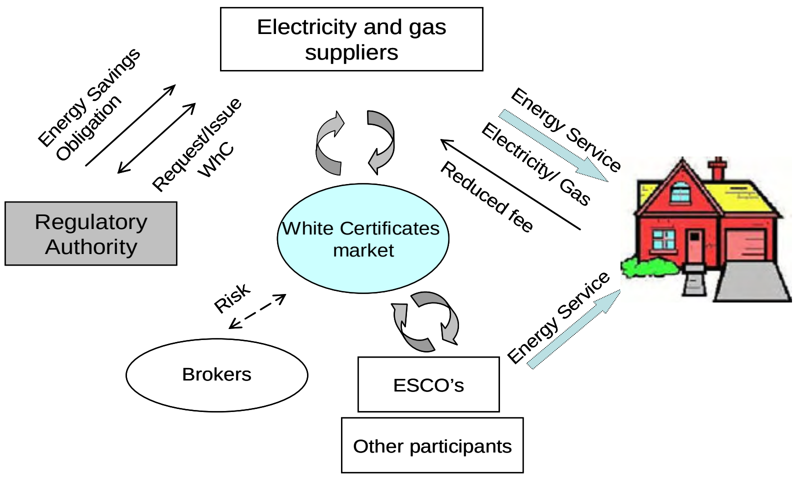
The philosophy underlying this system is to combine the guaranteed results of setting obligations (it can also be considered as a smart way of regulation) with the economic efficiency of market-based mechanisms. A WhC scheme involves certificates issued by an authority or an authorised body providing a guarantee that a certain amount of energy savings has been achieved. Each certificate is a unique and traceable commodity that carries a property right over a certain amount of additional savings and guarantees that the benefit of these savings has not been accounted for elsewhere.

Thus far, WhC systems have been implemented in the UK, Italy and France and are currently being considered in Poland, albeit with different design characteristics and ambition levels. In general, the rationale of implementing WhC schemes targets is the following:

- Improving energy efficiency and reducing energy intensity in the economy;
- Securing energy supply and to a much lesser extent fulfilling Kyoto Protocol requirements;
- Compliance with requirements to certify an attribute (energy efficiency), which is a volatile and hardly measurable entity, rather than a quantity. In fact, leaving aside the question of "trading", a WhC scheme is in itself a valid mechanism for formalising official quantification and endorsement of energy savings;
- New opportunities within an already existing and more general "environmental market", including Tradable Green Certificates (TGC) and Emission trading;
- Wide public consent/approval, due to the related *image*, connected to energy savings and environmental issues;

In a nutshell, a WhC market consists of the following participants: Regulatory Authority, Suppliers and/or distributors of gas and electricity, Energy Service Companies, End users (households, commercial and tertiary sectors) and Brokers (financial intermediaries). In Figure 1 we present a typical simulation of the WhC market.

Figure 1: White Certificate Energy Market



Source: Oikonomou et al. (2007)

The regulatory authority plays the principal role in distributing the obligations among the participants and issuing the certificates. The participants that can request and trade WhC are:

- *Suppliers and the distributors of gas and electricity*, who have an obligation, set by the regulatory authority, to save a certain amount of energy within a specified period. To this end, suppliers and distributors have to promote specific energy efficiency projects to end-consumers. Suppliers and distributors receive WhC and can trade them on the market in order to comply with the obligation, alternatively they can purchase respective amount of WhC from other suppliers or third parties;
- *Energy service companies (ESCOs)*, which are companies that offer to reduce a client's energy cost, often by taking a share of such reduced costs as repayment for installing the energy efficiency measure and financing its upgrades. They do not receive an obligation, but they are allowed to claim and sell WhC after performing energy saving actions. In the

same category of these market players fall also energy efficiency providers, installers and other businesses dealing with energy efficiency;

- *"Other participants"*, which are entities that do not receive an obligation but can purchase and sell WhC, providing thus the necessary liquidity in the market. Examples for such entities are brokers and financing institutions, which facilitate the transactions and reduce the risk of the investments, while speculating on the price of WhC and receiving a commission from the transaction costs. The eligibility and the role of these entities differ among the existing WhC schemes. These entities are included in the UK and French WhC scheme.

Depending on the design of such a scheme the relationships among the participants might differ (in theory, obligations could be also given to the end consumers, who would then be a trading party). Consumers and end users, who are the recipients of the energy efficiency measures, benefit from lower energy bills and decreasing costs of measures, as the supply of energy efficient technologies increases and prices fall. According to market theory, the cost effectiveness of the instrument as a whole is at its maximum, given that no externalities appear, when the marginal costs of energy saving projects are as low as possible. In theory, the marginal costs of energy efficiency decline with a rising number of participants and with a high number of measures, which provide greater flexibility of the WhC, and hence lower marginal abatement costs for the energy suppliers and for the entire economy.

A number of other research activities focused on white certificates in Europe, including:

- "A Comparison of Market Mechanisms for Energy Efficiency" (White and Green project co-financed under SAVE programme of the European Commission);
- "Stepwise towards effective European energy efficiency policy portfolios involving white certificates" (EuroWhiteCert project co-financed under the Intelligent Energy Europe programme of the European Commission);
- Task XIV "Market Mechanisms for White Certificates Trading" of the International Energy Agency Demand Side (IEA-DSM) Implementing Agreement.

In this report we present some key features of WhC schemes in the EU, and other countries that have implemented similar energy efficiency market based mechanisms, such as Australia (New South Wales) and the USA. The structure of this report has as follows. In section 2 we refer to the actual market experiences and results of the WhC. We provide a more detailed insight on the major players participating in national schemes, elements of funding for implementation of WhC, the institutional setting applied to render them operational and some practical results achieved thus far. Section 3 presents the current evolutions of WhC discussions in the EU level towards establishing a Pan-European scheme, alongside with experiences of countries that have favoured against adoption of WhC. Furthermore, in Section 4 we focus on major issues of implementation, in other words on ways of designing targets and obligation setting, boundaries, measurement and verification of energy savings preferred, monitoring and control mechanisms, and operational costs and funding possibilities. Sections 5 and 6 refer to an analysis of potential interactions of WhC with tradable Green Certificates and the EU Emissions Trading scheme, respectively. Concerning the former, we analyse the fundamental concepts of green certificates, with an overview of their market experience and results and ways that they can interact with WhC. For the emissions trading schemes, a short description of their principles is listed, with a particular focus on their interactions with WhC and green certificate schemes and possible advantages and pitfalls in achieving multiple energy and environmental targets. Finally, in Section 7 we conclude with the role of WhC in transition economies and institutional arrangements required.

2 Market experience and results

Italy, the UK and France have so far implemented WhC schemes in the portfolio of policy instruments to improve energy efficiency, while other countries are in the preparation phase or considering their implementation. A basic distinction between these schemes lies in the different ambition levels and participating actors.

2.1 White Certificate schemes running

2.1.1 Italy

The mechanism design started in 2001, in line with the Italian legislation about liberalisation of natural gas and power markets (1999; 2000), but was completed by two ministerial decrees (2004) and by a set of regulations defined by the Italian regulatory Authority for natural gas and electricity (AEEG 2004).

The choice of a WhC scheme in Italy is based on the following policy framework:

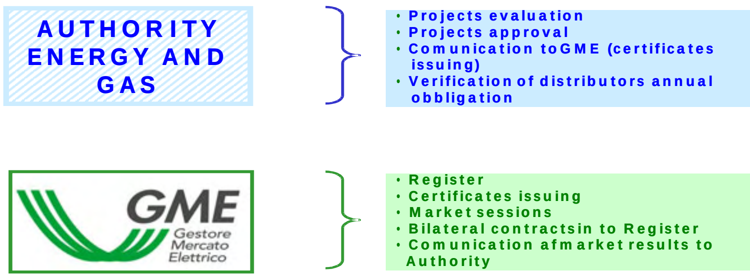
- Kyoto protocol: Italy has committed to reducing its emissions by 6.5% between 1990 and 2008-2012. About 26% of the whole emission reduction goal (24-29 $MtCO_2$) will have to be achieved through energy efficiency improvements on the demand side of the energy market;
- Two European Directives (EC 96/92/CE and 98/30/CE) on the liberalisation of the electricity and gas market. These two EU Directives were implemented into the Italian electricity and gas market by two Italian legislative acts: Legislative Decree no. 79 of 16 March 1999 (Decreto Bersani) and Legislative Decree no. 164 of 23 May 2000 (Decreto Letta) respectively. Both acts determine that concessions for the distributors' operation shall contain provisions to increase energy efficiency of end uses, according to quantitative targets to be set by Decree of the Minister of Industry jointly with the Minister of the Environment;
- Directive on energy end use efficiency and energy services COM (2006) 739.

One reason for this policy choice is possibly linked to the fact that Italy has been traditionally characterised by a relatively low per-capita energy consumption compared to other industrialised countries and this has long (and incorrectly) been interpreted as an indicator of high efficiency in energy use. On the contrary, it is primarily the result of an economic structure characterised by a relatively low share of high energy intensive industries and a significant share of the agriculture and tertiary sector, favourable climatic conditions and a relatively high fiscal pressure on energy-related activities.

The introduction of tradable WhC is the transposition to end use energy efficiency of a principle that has been applied so far to a number of other topics in a number of countries (e.g., emissions reductions, development of renewable energy sources, water rights). Its major aim is to combine the 'guaranteed results' of regulation (i.e., mandatory energy savings targets) with the economic efficiency of market-based trading mechanisms.

In 2001 after the aforementioned two legislative acts a WhC trading scheme was introduced as one of the options to meet these targets. The following three years were used by the national electricity and natural gas Regulator (AEEG) to define the technical and economic regulations governing the scheme. Revisions were also made to take into account some institutional changes (i.e., shared responsibilities between the Government and Regional administrations in the energy policy field), as well as some improvements suggested by AEEG. The system entered into force in January 2005 for a five year period. On the basis of the positive results achieved, in December 2007 the scheme was extended until the year 2012; in addition, some of its components have been updated in order to increase its effectiveness. The obligations for energy efficiency projects are attributed to distributors of electricity and gas.The government sets the national target and AEEG is responsible for designing and updating the technical and economic regulation governing the scheme (for instance, measurement and verification approaches for energy savings, cost recovery mechanism, enforcement system, trading rules), of administering it, of monitoring its outcome, and also to propose to the Government legislative changes aimed at improving its effectiveness and economic efficiency. Indeed most of the changes introduced at the end of the third year of implementation of the system have been suggested by AEEG on the basis of the quantitative and qualitative outcomes monitored via its administration (e.g., increase of the annual target for the year 2008 and 2009, new targets for the period 2009-2012, revision of the apportionment rules, simplification and strengthening of the enforcement system, measures to reduce the level of concentration on the demand-side of the market and to increase the number of actors eligible on the supply side). The existence of annual targets has facilitated the introduction of these legislative and regulatory improvements. As far as trading of certificates is concerned, the Electricity Market Operator (GME) administers the trading platform, registers the transactions and communicates the market results to AEEG. In Figure 2 we present the structure of the WhC scheme in Italy.

Figure 2: Administrative Structure of the WhC Scheme in Italy



Source: International Energy Agency (2006)

The quantitative objectives pursued by the scheme for the improvement of energy efficiency are expressed in primary energy units (PetaJoules – PJ and Tons of oil equivalent – toe) to be saved in comparison with the business as usual scenario for each year in the period 2005-2009 cumulated over this 5 years period. Table 1 presents the evolution of these targets.

Table 1: Energy and Gas Savings Targets in Italy in Primary Terms

Year	Objectives (PJ/Year)		Objectives (MTOE/Year)	
	Electricity Saving	Gas Saving	Electricity Saving	Gas Saving
2005	4.2	4.2	0.1	0.1
2006	8.4	8.4	0.2	0.2
2007	16.7	16.7	0.4	0.4
2008	33.5	29.3	0.8	0.7
2009	67	54.4	1.6	1.3
Cumulative	129.8	113	3.1	2.7

Source: Legislative Decrees, July 2004, Gestore Mercato Elettrico (5/12/2003)

The Italian scheme aims at a range of policy purposes (e.g., greenhouse gas emissions reductions, reduced dependence on energy imports, development of the market for energy efficiency products and services) and the quantitative target is set in terms of annual primary energy savings, i.e., tons of oil equivalent saved (Eyre et al. 2009). The national targets are set as specific targets for each electricity or gas distributor who serves more than 100,000 clients (as in 2001). In more detail, the following suppliers are involved (Bertoldi et al. 2010):

- Gas: 61 distributors (out of 22 distributors before 2008 with 9,630,000 customers out of total 16,000,000);
- Electricity: 14 distributors (out of 8 distributors covering almost 98% of all customers before 2008).

The obligation is adapted every year on the basis of the quantity of electricity and gas distributed to consumers, thereby taking into account the total national objective in the previous year. In 2012 the scheme is targeted to deliver 6 Mtoe energy savings, where the cumulative savings amount to 22.4 Mtoe. At least 50% of the obligation must be achieved by energy savings or energy efficiency improvement. The rest can be obtained via fuel switch (for example from electricity to gas), given that quantifiable primary energy savings are achieved (Pagliano et al. 2003). Recently, this 50% constraint has been dropped altogether in order to better stimulate the market. There are three types of certificates that are issued and traded, each one with a predefined unit value that attests primary energy savings through reduction of a) electricity consumption, b) natural gas consumption or c) consumption of other fossil fuels (Pavan 2002).

Energy saving projects eligible for accreditation with WhC can take place in all end use sectors, including also some energy supply ones (as for instance CHP, PV systems and others). A list of indicative measures that AEEG has applied is available, based on conversion rates from final to primary energy in Italy. The eligible projects contribute to the targets for up to 5 years (with an exception of the ones addressing the building envelope, such as insulation, which are taken into account for 8 years).

Obliged entities cannot recover all costs of energy saving projects via tariffs of the energy vector they distribute, since this part of the market is regulated through a price cap fixed by the authority against a licence (up to 30 year) granted to the distributors to operate within their territory in monopoly, not competitive conditions. For this reason, the Twin Decrees allow for the possibility to recover part of the costs borne by distributors for the development of projects which has not been financed via other sources. The way of recovering these costs is still being defined.

Only distributors that are subject to the energy efficiency obligation will be able to recover part of the costs borne for the development of energy saving projects via these tariff components. The rationale for this choice being that non-obliged actors who decide to develop energy savings projects, will do so because they see in this a business opportunity linked, *inter alia*, to the tradability of the energy efficiency certificates. The same is true for ESCOs (whose costs could not be recovered via rates).

The level of the tariff components that will be used to cover these costs will be set so as to reflect standard “allowed costs” related to these activities as opposed to a pass-over mechanism of actual costs borne by distributors. Such a system, based on standard rather than actual costs, is intended to introduce incentives for distributors to reduce the costs incurred to meet the obligation via energy saving projects, since not all the costs they incur will be passed on to final consumers via electricity and gas tariffs. An average standard cost per unit of primary energy saved was determined by the authority. At present, costs recovery is acknowledged to obliged parties as 100 € per redeemed certificate, that is 100 € per certified saved toe, taking into account that the cost of conserved electricity was around 0.027 €/kWh (with an electricity price of 0.166 €/kWh) and the cost of conserved gas was 0.026 €/kWh (with a gas price of 0.043 €/kWh) (Bertoldi et al. 2010).

2.1.2 The UK

Energy efficiency was identified in UK as the most cost effective way to meet energy policy goals. A great deal of analysis was undertaken during development of the Energy White Paper (2003) and the so called Energy Efficiency Action Plan (2004). Energy efficiency is at the heart of UK's climate change programme and an ambitious package of measures is being taken forward through the Energy Efficiency Action Plan.

Energy markets in the UK (mainly gas and electricity) are privatised and regulators accepted the case for household energy efficiency programmes as regulatory requirements, although the programmes were limited in scale and abolished in the gas sector when the first Director General of Gas Supply retired (Eyre et al. 2009). The Labour Government, elected in 1997, moved responsibility for determining the scale of the obligations from the regulators to Government ministers and they have been a feature of energy markets since then. The approach has the attraction of requiring the market to deliver energy efficiency improvement without public resources. Obligations on suppliers (retailers) to deliver energy efficiency for household customers were re-imposed in regulatory rounds in 1998, 2000, 2002, 2005 and 2008. Some continuity of approach has been maintained despite name changes – from the Energy Efficiency Standards of Performance (EESoP), via the Energy Efficiency Commitment (EEC) to the Carbon Emissions Reduction Target (CERT).

The system of WhC was initially implemented through the Energy Efficiency Commitment (EEC) in three phases, i.e., 2002-2005 and 2005-2008 and 2008-2011 (DETR 2000, DEFRA 2004). For 2002-2005, the total energy reduction target was 62 TWh of fuel-standardised carbon equivalent energy (around 16 PJ, almost 1% of consumption), which applied to all gas and electricity suppliers, possessing more than 15,000 customers; in total there are 11 suppliers in the UK that cover 99% of the energy market. The energy suppliers had progressively relatively tighter targets when increasing their business size and activities.[2] In this scheme, the energy distributor financed a share of the total implementation costs of these energy saving projects. This share was based on the final cost and the willingness to pay of the energy consumer. The difference is the distributor's contribution, which is named inducement cost. The inducement cost for the supplier is higher for the customers with lower income and smaller willingness to pay, which results in a higher burden for the distributor.

Households were divided in two groups. The first group is the so-called priority group, which includes 7.7 million households comprising pensioners, aged 60 or above, occupants of social housing, receptors of disability benefits, or finally, households receiving benefits with children under the age of 16, which are also the target group of the Warm Front. The latter is the UK policy measure against fuel poverty (referring to people who spend more than 10% of their income on domestic heating). This group accounts for almost 33% of total households.

[2] In order to achieve the national reduction target, each distributor's group of customers must be adjusted, according to a formula, in order to simplify the procedure of dividing up the total target between the suppliers (Oikonomou 2004).

Suppliers can implement non-structural measures, such as appliance replacement and energy efficient lightbulbs where 100% inducement cost is expected. Structural measures are mainly insulation and heating, which demand renovation of the building itself. Energy suppliers in the initial phases were obliged to implement at least 50% of their energy savings to the Priority Group. On average, suppliers cover 80% of the cost of the structural measures for the priority group. The second group covers all the other consumers. It also includes another category of consumers, mainly 'near-benefit' consumers or low-income consumers, still under fuel poverty. The average contribution level for suppliers is estimated to be just over 50% for non-structural measures and around 40% for most structural measures. In both phases of EEC1 and 2 (DEFRA 2004), the suppliers are not financed for introducing EEC measures, since they are not anymore price controlled (no tariff structure) and they can decide the amount they can charge.

The Energy Efficiency Commitment 2005-2008 (EEC2) required eight suppliers (namely British Gas, EDF Energy, npower, OpusEnergy, Powergen, Scottish Power, Scottish and Southern Energy, and Telecom Plus) to meet an energy saving target in domestic properties. Suppliers were permitted to carry forward additional savings (in excess of their target) from EEC1 into EEC2. At the end of the programme suppliers had delivered sufficient energy saving measures to meet, and exceed, the overall target. Suppliers were required to meet at least half of their obligation with consumers from the Priority Group. Again, by the end of the programme, suppliers had complied with this requirement.

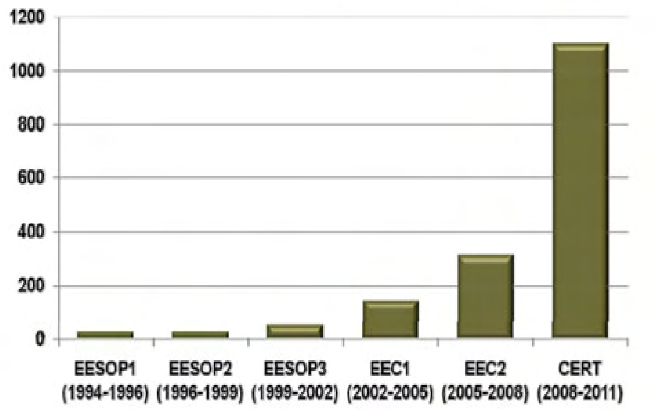
The energy savings target of EEC2 was 130 TWh in domestic households between 1 April 2005 and 31 March 2008. The overall target was set by Defra. The Office of gas and electricity markets (Ofgem) was required to administer the programme. At the end of EEC2 2005-2008 suppliers had met, and exceeded, the overall target – achieving 187 TWh of savings against the overall target of 130 TWh.

The follow up programme of EEC1 and EEC2 is the Carbon Emissions Reduction Target (CERT) 2008 to 2011, which consists of a third three-year phase of the energy supplier obligation. The Electricity and Gas (Carbon Emissions Reduction) Order 2008 and its amending order The Electricity and Gas (Carbon Emissions Reduction Amendment) Order 2009 provides the statutory basis for the CERT. The Order set out the overall carbon emissions reduction target to be collectively achieved by suppliers between 1 April 2008 and 31 March 2011. The target is 185 million tons of carbon dioxide (lifetime) by 2012 (undiscounted and excluding comfort), which is an equivalent of the emissions from 700,000 homes each year. Under CERT, gas and electricity suppliers, that have at least 50,000 domestic customers (either individually or as part of a group of companies), are required to meet a carbon obligation. This is set by Ofgem, which apportions the overall target in relation to each obligated supplier's domestic customer numbers (total expected investment of £2.8 billion). As part of this, suppliers must focus 40% of their activity on a priority group of vulnerable and low-income households. Each supplier's individual target is known as its 'carbon obligation'.

Suppliers meet their targets by setting up schemes to deliver reductions in carbon emissions, for instance through delivering loft insulation to low income households or subsidising the cost of cavity wall insulation. Ofgem have procedures in place to assess suppliers' schemes, and to oversee progress and compliance. Ofgem must be satisfied that the measures delivered through a supplier's scheme will result in an improvement in energy efficiency and therefore a reduction in carbon emissions. In principle, projects can be related to electricity, gas, coal, oil and liquefied petroleum gas (LPG) and they can be implemented in all households in the UK.

Throughout the history of the programme, the initial scale of the obligations was £25 M per year in 1994. This has risen very significantly to an estimated annual supplier investment of £305 M per year in the period 2005-2008 (Lees 2008) and rises from £844 to £1,100M annually from April 2008 (Defra 2007), with a commitment to retain at least this magnitude until 2020 (see Figure 3).

Figure 3: Annual Amount Spent from Suppliers' Obligations



Source: DEFRA (2007)

Electricity and gas regulators were responsible for the designing of the UK schemes, which rose a conflict of a common regulation due to the different approaches of regulators. More specifically, all regulators were avoiding targets that would raise energy prices, despite the cost effective character of the scheme. This problem was overcome by assigning the authority of setting targets to DEFRA (The Utilities Act 2000), while regulators are responsible for setting monitoring rules.

2.1.3 France

The background of the French energy efficiency policy framework and the drivers which fostered the French scheme involving WhC rely on the national Kyoto Protocol targets and the security of supply of energy sources. Actually, these divers led to a variety of national energy and energy efficiency policies. A French programmatic document on the matter, the "Le livre blanc sur les enérgies" considers, among the others:

- Directive on the energy performance of buildings;
- Actions to favour a better exploitation of renewable energy sources;
- Fiscal regulations;
- Mandatory energy target to be attained.

In connection to this last item, targets on energy efficiency were issued, involving a reduction of energy intensity on 2% per year until 2015 and 2.5% until 2030. More synthetically, the main drivers which underlie WhC policy instrument in France are essentially:

- Need to reach existing and important but diffuse potentials of energy savings, in particular in residential and tertiary sectors;
- Limits of traditional public instruments, which are hardly mobilised and are very often not adopted.

To apply the relevant European Directives, the French government has progressively liberalised the gas and electricity markets since 2000. The last step of this process was the opening of the domestic market to competition in July 2007, although prices remain regulated for all consumers. In the context of market liberalisation, an important law was adopted on 13 July 2005, defining a new energy political framework (Loi de programme 2005 – 781 du 13 juillet 2005). This law deals with four main items: security of supply, competitiveness, environmental protection, and public service obligations throughout France. In the area of energy efficiency, it establishes a group of policy instruments to encourage energy saving, including a white certificates scheme. WhC are currently being implemented based on the initial design suggested in the White Paper of the French Ministry of Industry (Fontaine 2003). Moreover, the Law 2005-781: "Loi de programme fixant les orientations de la politique énergétique" (Loi POPE) fixed the general principles steering the future energy policies in France, including the main rules relevant to the French WhC scheme and demanding its implementation to specific Decrees to be issued.Through the WhC scheme, the government involves energy suppliers in national energy efficiency policy, formally for the first time, by giving them energy savings obligations. In this sense, the French white certificates scheme, which started in July 2006 for a 3 year period, does not follow from former policies or plans and is totally new for all the actors involved. Furthermore, the scheme will be renewed for a second 3 years period that would begin on the 1st January 2010.

The overall target in final energy terms is 194 PJ (54 TWh cumac)[3] reduction over a period of 3 years, with 122 PJ (34 TWh) from electricity, 38 PJ (10.5 TWh) from gas, 5.4 PJ (1.5 TWh) from heating and the rest from other domestic fuels.This target in the initial learning phase of the scheme is considered quite modest because it represents roughly 1% of national energy consumption. These targets will be adjusted annually, depending on the market conditions of the suppliers and a regional factor coefficient. The projections for the increase of the target for the second period are at least 100 TWh cumac per year and the new system will include also transport fuel (Bertoldi et al. 2010).

According to the scheme principles, obligations are set to suppliers of all fuels (excluding gasoline), who must either promote energy savings or purchase certificates. The total amount of obligated suppliers is estimated around 2,500 (where ten large companies account for 85% of the obligation and the rest is distributed among a large number of small and medium size heating oil suppliers), while a broader scope for eligible parties for generating energy efficiency actions is supported (among them are also local authorities).

The total energy savings targets are shared among suppliers with annual sales beyond a fixed threshold. This threshold depends on the kind of supplied:

- in case of suppliers of electricity, natural gas, LPG and heating or cooling, the threshold proposed for the moment is 0.4 TWh in the year; this leads at present to a number of 20 obliged agents;
- in case of domestic fuel suppliers, there is no threshold: the obligation occurs "from the first litre" (according to a specific request of the professional organisation).

Energy savings can be realised in all sectors (including transport) and any economic actor can implement projects and get savings certified, as long as they are above 1 GWh cumac over

3 Meaning the net present value of total kWh of final energy over the life of a product (or in other words cumac = Annual Energy Savings * Lifetime of energy saving actions (discounted at a rate of 4%).

the lifetime of the project (naturally pooling of projects in order to achieve this threshold are allowed within the scheme). An important factor of the French WhC is the demonstration of additionality of the energy saving measures, meaning that the investment would have not taken place in the absence of WhC. To this end, in order to simplify verification procedures, a list of available pre-approved standardised measures (almost 170) is available. From this list, 80 refer to commercial buildings, 58 to residential buildings, 19 in industry and 8 in other sectors. The WhC are delivered after the programme has been carried out and after the realisation of the energy savings, where they receive the cumulated value in WhC.

In France, a similar approach has been adopted to that in the UK and Italy with the government (in this case the Ministries of Environment and Industry jointly) setting the target and the regulator implementing the detailed provisions, including the register through which limited trading occurs. More in detail, the main stakeholders participating in the WhC market in France are:

- MEEDAT (Ministry in Charge of Energy/ Direction Generale Energie Climat): Sets the obligations, attributes the Energy Savings Certificates and controls the projects;
- ATEE (Technical Association of Energy and Environment): Platform gathering economic actors involved in the energy savings market (e.g., energy suppliers, manufacturers, retailers and others), which makes proposals to the MEEDAT for standardised actions;
- ADEME (Agence de l’Environnement et de la Maîtrise de l’Energie): Serves for technical analysis, evaluation of projects and provides information on energy savings projects and procedures to public bodies and companies.

Obliged entities can recover costs of energy saving projects via tariffs of the energy vector they supply. This recovery is regulated by law for the part of market not yet liberalised. In order to have an acceptable mechanism also for the end users, the obligation level has been devised to limit the possible tariff increase due to cost recovery at 0.5% of the project cost as a maximum. Energy suppliers have developed new services to support energy efficiency projects in the residential sector, such as energy audits and low-interest loans for equipment or building renovations, and have initiated training programmes on energy savings and communication and diffusion of energy saving works’ best practises. A recent evaluation of the scheme concluded that system simplification tends to limit transaction costs and that there are trade-offs between simplification and precisely measuring energy savings.

2.2 Comparison and evaluation

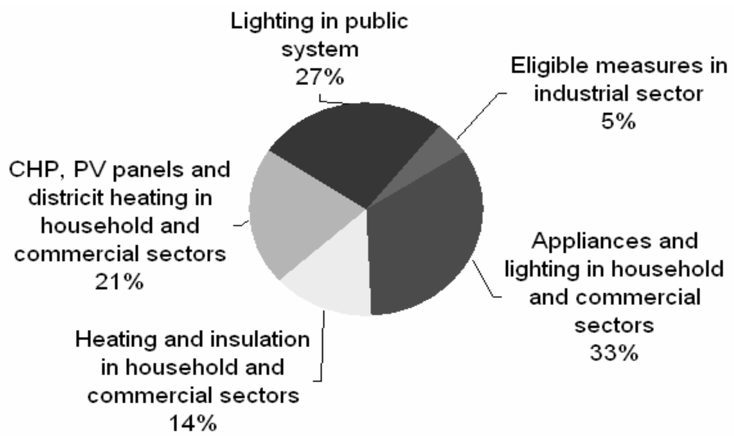
In order to provide a deeper insight and evaluation of the functioning of the WhC scheme thus far, we present a comparative analysis between the three countries. We evaluate thus the schemes on the grounds of effectiveness and cost-effectiveness (i.e., what are the actual energy savings so far and at what cost, respectively).

2.2.1 Effectiveness

The overall performance of the schemes demonstrates that targets have been reached with a relatively low effort, while in most cases they have been exceeded. A possible explanation is that targets were set below the available potential, as costs for market players during the initial phases were overestimated. Results of the schemes do not show a systematic rational exploitation of the energy savings potential along the successive steps of marginal cost potentials. All the potentials are used at the same time by obliged and eligible actors, even if there is a marked differentiation between measures (for instance CFLs were massively introduced in Italy, but not so much used in the UK and France). Below we present results for each country.

In **Italy**, the scheme has proven quite successful, since almost 2 million toe are saved against a target of 1.1 million toe. From these savings, 78% are from electricity, 18% from natural gas and 4% from other fuels. Most of these projects belonged to the list of the predefined ones, where a deemed savings calculation exists with lower transaction costs. 63% of total savings were on electricity in the domestic sector, 21% for heating in the civil sector and 7% on electricity for public lighting (Pavan 2008). Furthermore, the market for ESCOs was stimulated, as 75% of savings originated from such companies. More than 60% of total savings were achieved realising saving potentials through micro-scale size and low-hanging fruit in the commercial and household sectors. However, it was found that implemented measures were unlikely to reflect actual market behaviour. Most of these measures were implemented prior to 2005, which signifies free riding, as they are not a result of the WhC scheme. The primary interest in electricity savings (with a short payback period) can also be explained from the fact that distributors could get a 7.3 €/CFL triggering investments towards lighting. Nevertheless, this amount is reduced after legislative changes (2008) to 2.1 €/CFL. In Figure 4 we present the shares of implemented measures.

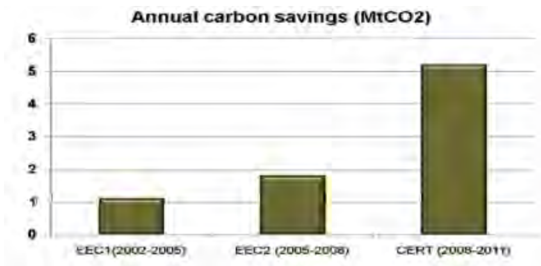
Figure 4: Measures Implemented in the Italian WhC Scheme



Source: Pavan (2008)

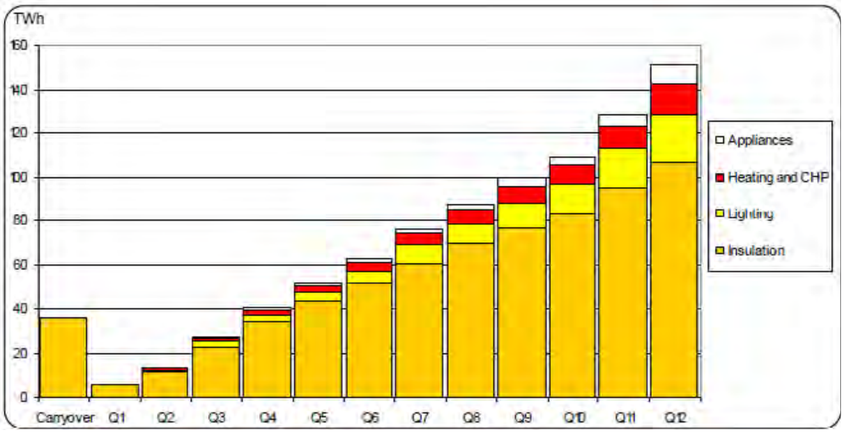
In **the UK**, the target for all suppliers of 130 TWh in 2005-08 was surpassed by 44% and will be carried over to CERT, amounting to almost 187 TWh energy saved. Of this overall activity approximately 44% was in the Priority Group. The Priority Group was targeted predominantly through the delivery of insulation measures. The range of measures delivered to the non-Priority Group is more diverse, but still dominated by insulation. The total savings in the EEC2 amounted to 59 Mt CO_2 in the projects' lifetime, which can be translated to 2.1 $MtCO_2$ (for the evolution of targets and carbon reductions see Figure 5). Nearly 60% of the energy savings achieved under EEC2 2005-2008 came from the installation of insulation measures, in particular cavity wall and loft insulation. The main reason was that the scheme deals with lifetime savings, enabling thus the implementation of measures with longer payback periods. Due to large cost-effective potentials in the household sector, these measures contributed to 56% of the total savings achieved, or nearly 38% of the savings redeemed. For each category, almost all measures were found to be mature and commercially available. For the second phase of the scheme (2005-2008), data showed very similar market trends. In total, over 120 million measures were installed, where appliances and lighting dominate in numbers, but insulation dominates the energy savings (see Figure 6).

Figure 5: CO_2 Reduction under the EEC Schemes, UK



Source: DEFRA (2007)

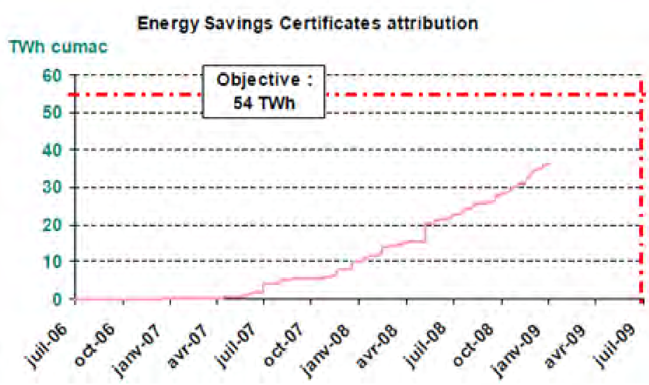
Figure 6: Energy Saving Measures under the EEC Scheme, UK



Source: DEFRA (2007)

In **France**, the scheme is more recent and in 2008, 28.6 TWh cumac had been achieved, representing about 53% of the total obligation of 54 TWh cumac that energy suppliers have to reach on July 2009. This relatively low result is due to inertia and the time needed to implement the mechanism in 2006 and 2007. Nevertheless, it is expected that a majority of energy suppliers will deliver their obligation in July 2009 and that the target of 54 TWh cumac will be reached. In July 2009, 1,099 projects were realised to 251 beneficiaries, amounting to a total of 65.2 TWh saved (see Figure 7).

Figure 7: Objective in the French WhC Scheme

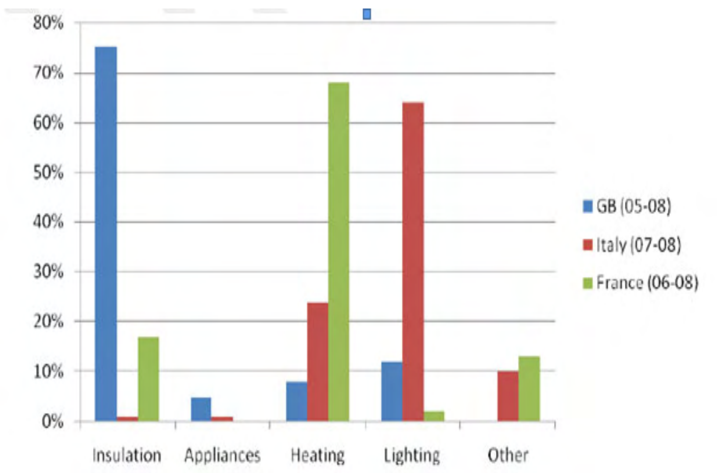


Source: Bodineau (2009)

In France, early experiences from the scheme reveal that most implemented projects refer to heating and insulation in the residential sector (mainly thermal systems and at a lesser extent building shell and appliances). An important characteristic of the scheme is that it interacts at a great extent with national thermal regulations (for new and existing dwellings), an income tax credit, VAT rate reductions, and information campaigns. Nevertheless, an initial assessment of the scheme proves that almost half of the target is achieved by the last quarter of 2008. The interaction element is revealed from the fact that most newly installed technologies under the WhC scheme are similar to the ones receiving tax credit, which leads to an uncertainty of the effectiveness of the scheme, since overall additionality of the instrument is still hard to evaluate. Most savings were carried out in suppliers' own market segment and they preferred to deal with low cost options rather than utilise the trading option.

As far as the mix of measures implemented in each country is concerned, they correspond to the standardised actions in each scheme (see Figure 8).

Figure 8: Comparison of Measures Mix between the Three European Schemes



Source: AEEG (2008), Ofgem (2008), DGEC (2009)

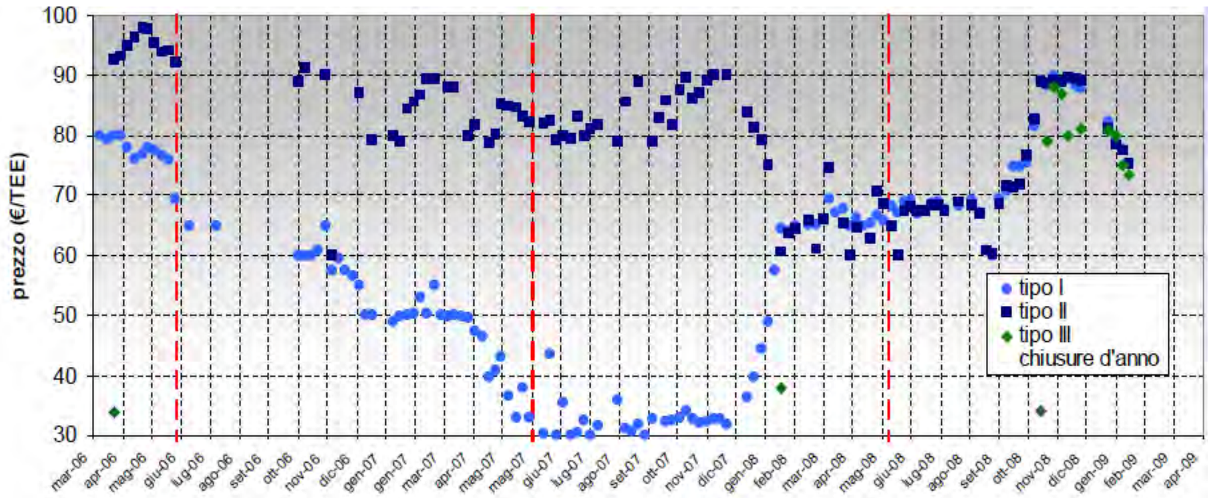
2.2.2 Cost-effectiveness

Evaluation of cost effectiveness in the WhC schemes reveals that in general in all countries they are quite cost effective. Nevertheless, information is limited because costs are very sensitive information in competing energy markets, and the flexible nature of WhC schemes implies that obliged parties could organise their actions as they want and consequently do not have to report their costs. Furthermore, Bodineau et al. (2009) states that due to the low amount of WhC traded the certificate price is not a clear indicator of the actual costs of the scheme, let alone the magnitude of bilateral exchanges (which are dominant) where no actual price is revealed in the registry. Another possible reason is that if savings are being delivered by other mechanisms, the cost effectiveness can be reduced, as discussed above for France.

In **Italy**, an analytical cost benefit analysis will take place at the end of the regulatory period. Still, some estimation on the avoided energy cost for consumers benefitting from energy saving measures and on the average market prices of certificates can be drawn. A preliminary result is that in the first three years of the scheme, consumers reduced their energy costs at a higher level than the amount of tariff contribution (six to twelve times more depending on the fuel) and the average market price of certificates (Pavan 2008, Eyre 2009).

Concerning the market part of the WhC, trading mechanisms were enhanced and approximately 2.5 mil transactions of certificates realised in the first two years of the scheme. Most of these certificates consisted of bilateral agreements between market parties, while a small amount is openly traded with an average weighted price of 61 €/toe (Alaimo 2008). More in detail, in the first year of implementation of the mechanism in Italy, certificates traded on the spot market at an average price of 77 €/ toe in the case of measure involving electricity use (type I certificates), 94 €/toe in the case of measures involving natural gas use and 33.8 €/toe for other types of measures (type III certificates). In 2006 and 2007 market prices gradually but significantly declined as a result of the over-supply of certificates with respect to the demand driven by the energy efficiency obligation: in the third year of operation (2007) prices reached an average of 45 €/toe for type I certificates, 77 €/toe for type II certificates and 22 €/toe for type III certificates. Of course, this decline in market prices was not only the result of the supply surplus; other important factors had an impact on this trend, among which: the lack of targets for the post-2009 period (that were set in December 2007, up to 2012); prevailing short-term strategies on the supply-side which, in turn, were at least in part the outcome of the characteristics of this market; possible market power on the demand-side which, again, was the result of the structure of the two reference markets; possibly, a lack of confidence in the penalty mechanism, which at that time was quite complex and possibly ineffective. As a response, regulatory changes took place, in the form of updating the target and setting mandatory registration of all transactions, which stabilised the market and increased the price of certificates to an average of 80 €/toe.[4] The course of the WhC prices in Italy is presented in Figure 9.

Figure 9: Prices of WhC in Italy



Source: Pavan (2009)

Based on these market prices and energy prices of end users in 2006 as benchmarks, the net financial savings for end users were 5 to 6 €cents/kWh of electricity and natural gas saved, respectively. An overview of the effects of certificates traded on the target during the period 2005-2008 is presented in Table 2.

[4] The main regulatory changes that took place are the update of deemed savings actions, of the unitary tariff contribution, the establishment of energy on-site audits, the introduction of minimum product and project requirements, regulations on price transparency in bilateral trading and the registration of such transactions.

Table 2: Effects of WhC Trading in Italy against the Targets

Data in ktoe	Source	2005	2006	2007	2008
Italian WhC targets (overall)	AEEG	156	312	633	2,200
WhC traded (i.e., supposed-to-be "real" savings)	AEEG	146	473	862	2,100
WhC traded vs. gross consumption	*Calculated*[a]	*0.07%*	*0.24%*	*0.44%*	*1.10%*
WhC traded vs. final uses	*Calculated*[a]	*0.10%*	*0.32%*	*0.60%*	*1.49%*

[a] *Source: Personnal communication (Daniele Russolillo, Fondazione Ambiente, Italy)*

In **the UK**, costs were 23% lower than originally expected, largely due to economies of scale and market transformation effects of the programme. The total economic benefit exceeded 3 billion € for a supplier investment of 0.9 billion €. The scheme has been accepted as highly cost effective by the relevant auditing body (NAO 2008). The costs from the scheme are estimated to be 0.6 c €/kWh for gas and 2.0 c €/kWh for electricity. When taking into account the end use energy prices in 2004, some net financial benefits were estimated to 8-8.6 €cents/kWh for electricity and 1-1.6 €cents/kWh for gas savings. In terms of specific technologies, energy savings costs are 0.8-1.4 €cents/kWh for lighting measures and 0.7-1.3 €cents/kWh for insulation (Lees 2006). These figures were lower than the estimated average savings costs of 2.5 € cents/kWh generated by the most likely alternative policy option and certainly much lower than energy prices paid by households. Furthermore, it was found that energy savings cost estimates were approximately 20% lower than those predicted by the authority (Lees 2006). Trading was not a core part of the scheme, therefore obliged parties did not participate in several transactions as compliance costs were equated during the bidding process for subcontracting insulation measures.

All in all, the EEC2 can be deemed as highly cost effective, with a consumers benefit of £9 (lifetime) per £1 supplier spent, with a Net Present Value/tCO_2 of £57 (net benefit). The total cost to suppliers amounted to £775 million on direct costs of the energy saving measures plus £140 million on the indirect costs and the total benefits to UK £15.8Bn. The total expenditure by all parties is estimated around £1.12 billion. In Table 3 we present the total direct and indirect costs calculated in millions of £ for EEC2 and their sharing between players.

Table 3: Sharing of Costs in the EEC2 (GBP mln)

	Direct Costs	Indirect Costs	Total Costs
Obliged	775	140	915 (73%)
Customers	232		232 (18%)
Other	108		108 (9%)
Total	1115 (89%)	140 (11%)	1255 (100%)

Source: Lees (2008)

In **France**, as the first period is approaching its end, there is no definite information on the cost effectiveness of the scheme, so no definitive conclusions on costs can be made. But in general, market responses demonstrate that the cost of energy saved was low compared to consumer prices. According to Bertoldi et al. (2010) the cost of energy saved is estimated to range from 0.3 €cent/kWh cumac (average value of certificates traded in the first period) and

1 €cent/kWh cumac, which is the maximum price of certificates traded. Still, these figures are under debate as the amount of certificates traded is very low; indicatively the total amount of certificates in transactions in the first period was below 4% of the national obligation. In Table 4 we present the cost sharing of the French scheme among market parties.

Table 4: Cost Sharing of the French Scheme (Euro mln)

	Direct Costs	Indirect Costs	Total Costs
Obliged	13 for dominant suppliers 57 for small fuel retailers*	50 for dominant suppliers** 30 for small fuel retailers	150 (8%)
Customers	1000		1000 (48%)
Other (tax credit mainly)	900***		900 (44%)
Total	1970 (96%)	80 (4%)	2050 (100%)

** Small fuel retailers finance around €880 per installation, while they have subsidised around 65000 installations*

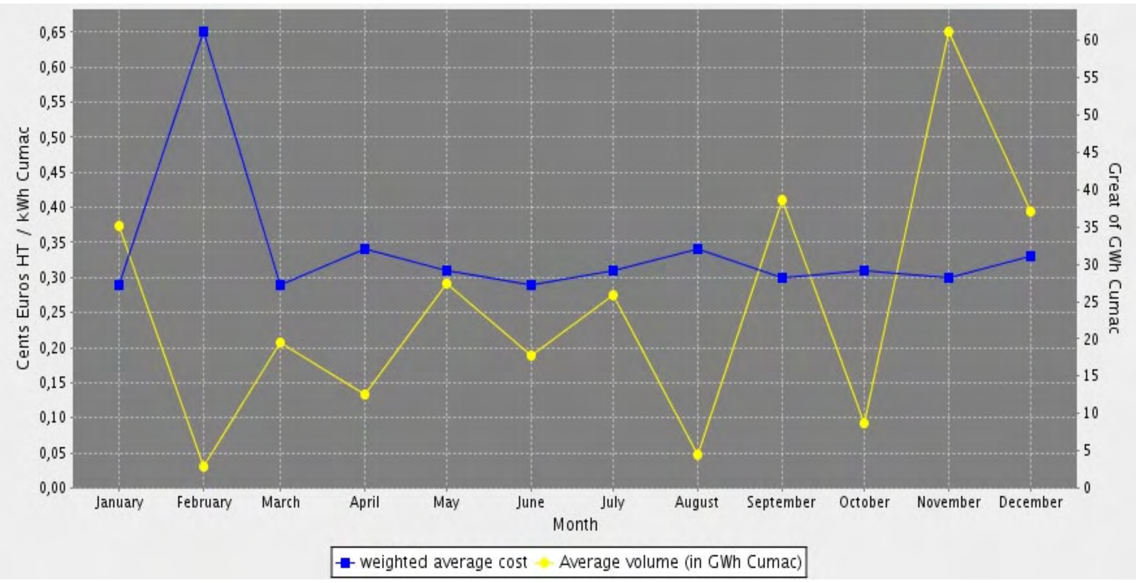
*** Rough evaluation based on information from EDF and GdFSuez which are in charge of 55% and 27% of certificates, respectively*

**** "Rule of thumb" hypothesis concerning projects, which combined tax credit and support by obliged suppliers: 20% of the total tax credits for energy efficiency and renewables per year (€950 mln in 2006, €1500 mln in 2007, €2000 mln in 2008)*

Source: Own evaluation based on ADEME information

As far as market prices of WhC are concerned, we can deduce that the market is too marginal to be representative (0.32 c€ / kWh cumac). To date, energy suppliers have not asked the regulator to increase the tariffs as a result of the scheme, which could also signify that obligations are met cost effectively. In Figure 10, we demonstrate the prices and quantities of WhC traded in the French market.

Figure 10: Prices and Quantities of the French WhC Scheme



Source: http://www.emmy.fr

Finally, in order to present the findings of WhC in comparable units in terms of savings and costs, Eyre (2009) demonstrates the actual design conditions of these three schemes (Table 5) and Bertoldi et al. (2010) some calculations on the costs in comparison with electricity and gas prices (Table 6). As shown, these schemes deliver a relatively small amount of energy savings, in comparison to the total 20-40% savings that are estimated to exist in most countries. A possible justification is that in most cases, these schemes address specific sectors (e.g., residential sector in the UK) and they are well suited to deliver low cost and standard energy efficiency measures. To this end, more ambitious energy saving targets and enlarged schemes in terms of sectoral coverage and project types can increase the overall energy savings generated.

Table 5: WhC Schemes Target and Costs

	UK	France	Italy
Annual end use savings (TWh)	3.5	1.3	4.5
Annual end use savings (%)	0.69%	0.15%	0.54-1.56%[a]
Lifetime end use savings (TWh)	53.5	18.0	52.0
Annual primary energy savings (Mtoe)	0.47	0.16	0.60
Lifetme primary energy savings (Mtoe)	5.87	2.02	6.99
Annual carbon savings (Mt CO_2)	0.7	0.2	1.5
Lifetime carbon savings (Mt CO_2)	19.6	6.1	17.8
€c/kWh gas	-0.58	-1.00	-0.26
€c/kWh electricity	-2.03	-1.00	-0.27
Carbon cost effectiveness (€/tCO_2)[b]	-53	-70	

[a] Personal communication (D. Russolillo)

[b] Negative values signify cost savings

Source: adapted from Eyre et al. (2009)

Table 6: WhC Schemes Costs Compared to Energy Prices

Country	Cost description	Costs (€/kWh)
UK (EEC 2)	Electricity saved	0.023
	Electricity price	0.1394
	Gas saved	0.007
	Gas price	0.037
Italy	Electricity saved	0.027
	Electricity price	0.166
	Gas saved	0.026
	Gas price	0.043
France	Energy based on penalty	0.02
	Energy based on certificate price	0.003
	Electricity price	0.094
	Gas price	0.044

Source: Bertoldi et al. (2010)

3 Expected market development

In this section we present findings from some countries that make use of mechanisms similar to WhC, on the DSM side, and also a couple of examples of countries that have considered WhC implementation but finally decided not in favour of them. In the last part we deal with the discussions on the EU wide WhC scheme, discussed among policymakers and the Commission.

3.1 Poland

Poland has been active in discussing possibilities of introducing a WhC scheme. In the recent National Energy Efficiency Action Plan (NEEAP), a scheme is envisaged for the period 2009-2016, in order to stimulate energy efficiency actions together with an obligation placed on suppliers of electricity, heat and gas fuels to end users. The scheme will assist in executing the national goal in respect of reducing 9% in final energy use by 2016. More in detail, it will include a detailed list of energy saving measures resulting in efficient energy generation (15%), reduction of losses in distribution of energy (15%) altogether with energy savings by end users (70%), together with an appropriate number of certificates. The size of obligatory remittance is expected to be determined by the Minister of Economy.

The administrative bodies of the WhC scheme are: i) the Ministry of Economy that determines the strategy, ii) the URE (Energy Authority) which determines the technical details, controls, imposes penalties, and has the right to issue and redeem certificates, iii) TGE SA (Power Exchange) that organises tenders, maintains the registry and follows trades on the power exchange, and iv) the White Certificates Service Office, which is responsible for benchmarking, monitoring and promoting the scheme. Entities selling electricity, heat and gas to end users will be obliged to submit their certificates to URE for redemption or for paying a substitution fee.

The proposal so far in the law is to organise tenders for energy savings and to link the right of issuing white certificates based on projects savings to success in the tendering procedure. The ambition is to link the scheme to any other support system in order to reduce the necessity of control and reporting. The market rules of the envisaged scheme are:

- Investors prepare investments and take part in a tender procedure and after winning, they can sell certificates;
- Trading companies buy the certificates (or issue them) and can redeem them in the URE (Energy Regulatory Office);
- Winning the tender means automatic issuance of WhC. Certificates are traded on the power exchange or in the off-the-counter system, where transactions are registered.

In order to reduce transaction and administration costs, a catalogue of proposed measures is available, where a measurable result can be obtained, determined as an average annual amount of 15 years. Independent of the type of action, auditing of energy savings is deemed mandatory. The minimum value of certificate to be sought in the market is 1toe. If suppliers cannot fulfil their obligation by the of the issuance year, a penalty is foreseen. Finally, based on some estimation around 0.56 billion € are considered necessary for the functioning of the scheme, which can be translated to 3% of external sales in the fuel and energy sector. The turnover of the WhC scheme will be approximately 2-3% of the retail market and the total costs should be PLN 1.7-2.5 billion. In turn the costs of the scheme between 2011 and 2020 should range from PLN 10.8-16.2 billion. Based on calculations, the planned energy savings under the WhC scheme are expected 0.5 Mtoe per year, which, assuming a certificate price of PLN 500-700/toe (or 122-172 €/toe), can save on energy bills of approximately PLN 250-350 million per year (Ministry of Economy, 2009).

3.2 Denmark

Denmark has implemented several schemes for energy efficiency improvement, including obligations to energy market players, which could resemble some characteristics of WhC schemes, although without a trading component. Typical instruments under the Danish public obligation scheme are energy audits, subsidies, information and combinations of these. Unlike in other European schemes, in Denmark the energy company must be actively involved in the project before the investment. The major compliance routes are implementing projects via daughter companies of obliged parties and contracting out. The largest part of savings under the Danish public service obligations are in industry and are realised on oil and natural gas (see Table 7).

Table 7: Danish Scheme Obligations

	Obligation first year's saving	Consumption	% of target to consumption
Electricity	1.4 PJ	122 PJ	1.1%
Natural gas	0.5 PJ	101 PJ	0.5%
District heating	0.9 PJ	103 PJ	0.9%
Oil (excl. transport)	0.15 PJ	107 PJ	0.1%
Total:	2.95 PJ	433 PJ	0.7%

Source: Togeby (2009)

In the Danish scheme, there is the obligation to realise energy efficiency combined with voluntary agreements for electricity, natural gas and oil suppliers. Furthermore, district heating companies participate, as district heating is enforced by law. Currently, the obligations are 2.95 PJ and from 2010 they will increase to 5.4 PJ.

The administrative process is rather simple, as each company maintains its documentation system of the energy savings, and only aggregated information is reported to the Danish Energy Authority (although the latter maintains the right to check individual projects). There is a standard catalogue of measures (400 registered), which mainly address households and represent 38% of the total energy savings. They include generally new windows, insulation, appliances, boilers, and better cooling of district heating.

For the period 2006-2008, all sectors have fulfilled their obligations, with some minor differences for individual district heating companies: 38 out of 171 district heating companies have reported less than 2/3 of the target for 2006-2008. There is a cost recovery envisaged in the form of a levy paid by end users equal to 0.06 €cents/kWh on average.

3.3 The Netherlands

The Netherlands has introduced several policy instruments, mainly subsidies, voluntary agreements and standards, aiming at the improvement of energy efficiency. The most important measures implemented so far are the Energy Premium Scheme, Energy Performance Standard (EPN), Energy Performance Advice (EPA), Regulating Energy Tax (REB), investment subsidies for solar water heaters, Energy Efficiency Standards for new buildings, Energy labelling of electric appliances (Joosen et al. 2004). Based on evaluation studies, the effectiveness and efficiency of these policy instruments has been under discussion, since the monitoring process has not been quite sufficient (for instance in the commercial sector targets voluntary agreements could not cover the targets). A general conclusion from studies is that a large cost effective potential for energy savings remains untapped.

The Netherlands has been considering options for introducing a domestic WhC scheme, which can overcome existing market barriers for energy efficiency improvement and provide market flexibility for the achievement of energy saving targets. An initial proposal for the adoption of a WhC scheme was provided in the Energy Report from the Ministry of Economics in the Netherlands (MinEZ 2005) revealing the positive impacts of such a scheme domestically. Taking into account that a WhC scheme is not yet in force, a proposed period for the whole baseline and credit system could be medium-long term, from 2008-2020, which could in theory also be divided into phases (an initial suggestion included a period of 3, 5 and 5 years). Actors that can be burdened with the obligation of undertaking energy saving actions, through implementing relevant projects to end users, are energy suppliers. Other market parties eligible to generate energy savings and thus obtain WhC, although without receiving an obligation, are installers of energy efficient stock (e.g., wall and roof insulation), ESCOs, Housing companies, Building corporations, Leasing companies of energy efficient measures and other participants in the housing market. Initially, the Dutch Authorities can allocate a target and distribute it among energy suppliers that have to comply with, calculated on the grounds of the volume of their energy sold. The level of the target is calculated in the range of 50-80 PJ of additional energy savings in primary energy terms (currently discussed 65 PJ).[5] This level of target can lead with more certainty to the achievement of 1.5% saving improvement as from 2012, adding up to 0.13% of extra energy savings. Adjustments of targets for each trading period will be notified in advance and will be corrected for determinant parameters (for instance gas prices, electricity prices, etc).

The functioning of a WhC scheme in the Netherlands is presented in Figure 11. The role of the governmental authorities is presented in the left side; in the centre are the market parties that implement energy saving projects, and finally on the right side are market groups that receive these measures and generate savings.

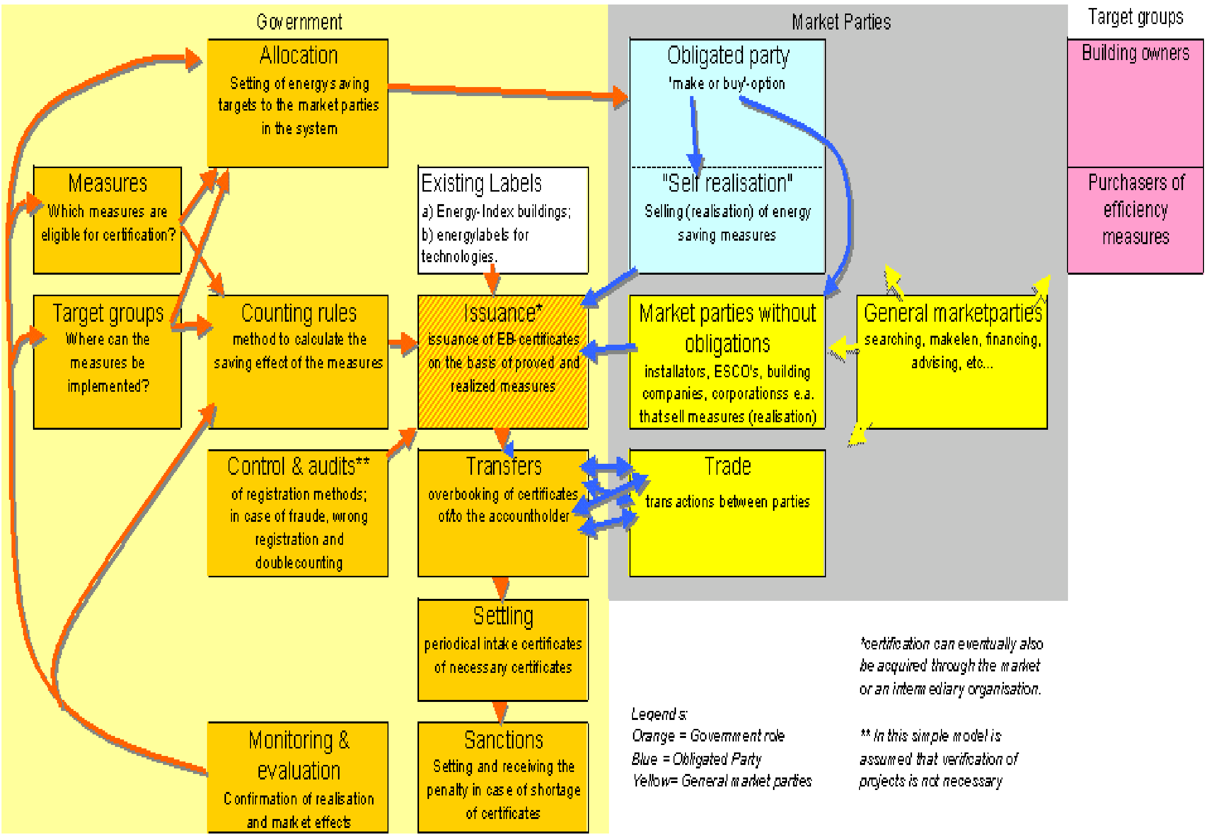
At present, design options for a White Certificate scheme in the Netherlands are being discussed and alternative policy options are also on the agenda (e.g., tenders for energy efficiency without obligations) (Blom et al. 2006). Finally, the Netherlands decided to hold this instrument as a back-up and prioritised agreements for energy efficiency improvement with energy suppliers.

The main reasons explaining the drop of WhC and its substitution with a Covenant with energy suppliers are:

- this instrument is perceived as a burden to obliged parties;
- Potentially high transaction cost may occur;
- Potential chance is for a lot of free riders, owing to the difficulties in dealing with the Business as usual – deadweight.

5 Indicatively, this target is translated to 14-22 TWh saved.

Figure 11: Market Arrangements in a Dutch WhC Scheme



Source: Schneider (2005)

3.4 Flanders

Energy efficiency obligations without certificate trading are also in place in the Flemish region of Belgium. Regional utility obligations have been introduced in 2003 and set electricity distributors: there are currently 16 electricity distributors covered by the obligation. The annual target is 0.58 TWh. Eligible actions are those considered for the residential and service sectors, and non energy intensive industry, while they can involve saving fuel from any sources.

Separate targets are set for low voltage (<1kv) (residential) and high voltage clients (>1kV). For the low voltage clients, the targets are 10.5% of electricity supplied over the 6 years from 2003 to 2008 and for high voltage users (>1kV) 1% per annum for each over the same period. The reason for the higher than 1% per annum target for the low voltage users is because of the Flemish Parliament's decision to provide free vouchers for the head of every family in 2004 and 2005 which can be exchanged via the electricity distributor for either an energy saving CFL or a low flow shower head or an energy meter. In 2006 and 2007, it is planned that the other members of the family will receive a voucher for an energy efficient light bulb.

The obligations envisage that on a yearly basis grid operators must submit a plan to the Department of Natural Resources and Energy with energy efficiency actions, where concrete measures, such as financial support and information campaigns, alongside with a proposal for calculation of energy savings must be stated (Labanca 2006). The department then evaluates the proposed savings calculation method, and requires from grid operators to submit in the end of the year an evaluation report about the implementation of measures during the previous year. In case of non-compliance a penalty is being set at a level of 1 €cent/kWh. The main difference of the Flemish scheme with the other WhC ones is that it excludes the trading component in terms of certificates or obligations.

3.5 New South Wales, Australia

An energy efficiency certificates trading scheme is being implemented since 2003 in New South Wales, Australia. These certificates are part of a larger Greenhouse Gas Abatement Scheme (GGAS) introduced by the State, where electricity retailers and other parties are required by legislation to meet individual mandatory targets for reducing the emission of greenhouse gases resulting from the electricity they supply or consume. To achieve the required reduction in emissions, eligible parties purchase and surrender tradable certificates called New South Wales Greenhouse Abatement Certificates (NGACs). Each NGAC is freely tradable and represents one tonne of carbon dioxide equivalent that would otherwise have been released into the atmosphere in generating electricity.

NGACs can be created in several ways, one of which is by undertaking 'demand side abatement' which includes energy efficiency projects (mainly projects that modify existing equipment, replace existing installations with less electricity intensive ones, install new efficient installations, reduce electricity consumption where there is no negative effect on production, switch fuels, on-site electricity generation that replaces supply from the national market) (Crossley 2008). In average, NGACs originating from energy efficiency actions contribute only 22.5% to the total abatement, while generation projects acquire the highest part. During the progress of the scheme, the number of NGACs from energy efficiency actions grew by eight times predominantly in the residential sector. This scheme is combined also with a Mandatory Renewable Energy Target, a Commonwealth Greenhouse Gas Abatement Programme and a national carbon sequestration rule.

The New South Wales Government has set a state-wide benchmark of reducing greenhouse gas emissions to 7.27 tons of carbon dioxide equivalent per capita by 2007. This is five% below the per capita emissions in the Kyoto Protocol baseline year of 1989/90. To ensure continual progress towards this end target, progressively tighter targets have been set year-on-year, commencing with a target of 8.65 tons per capita in 2003 and leading to the final benchmark level of 7.27 tons per capita in 2007, which will then be maintained until at least 2012. Each benchmark participant then has to reduce the average emissions of greenhouse gases from the electricity they supply or consume to the pre-set individual benchmark level.

Benchmark participants comprise:

- electricity retailers;
- electricity customers taking supply directly from the Australian National Electricity Market;
- electricity generators with contracts to supply electricity directly to customers;
- certain other parties who consume large volumes of electricity in New South Wales and who elect to participate directly in the Scheme, rather than have their electricity retailer manage the emission reduction obligation in relation to the electricity they consume.

Initially, the government introduced a requirement to retailers for reductions of GHG emissions from their electricity production. In the start up period, there were no abatement actions in place, mainly because a mechanism for sanctions had not been defined. As a response, penalty modifications took place. If a benchmark participant does not reduce the average emissions of greenhouse gases from electricity they supply or consume to their pre-set individual benchmark level, they pay a penalty of AUD12.00 per tonne of carbon dioxide equivalent above their benchmark, and as from 2010 an extra AUD1.00 will be added to the penalty for four years (IPART 2007).

In the scheme, eligible actions must be additional against a business as usual scenario. In other words, abatement additionality is defined to be where projected have reduced emissions sicne the start of GGAS compared to the situation otherwise. Two forms of additionality are envisaged: a) BaU additionality, in terms of investments that would not have occurred in GGAS sectors without the scheme and b) policy additionality, where the abatement was not invoked by another supporting policy targeting at reducing GHG emissions.

The main reasons for the trading of NGACs relies on the scarce ability and background of electricity suppliers, simply being market retailers, to actually carry out energy efficiency or any other low emission generation. On these circumstances, this NGAC trading scheme gave them the chance to substantially fulfil their obligation, while subcontracting to third parties those activities hardly related to their core business.

Early experiences from the New South Wales scheme demonstrated that specific measures were implemented at a large extent (namely CFLs and water efficient showerheads) as certificates could be accredited based on default abatement factors of these technologies. This ended up to selling such appliances at discounts or free of charge, which resulted in more than half of these technologies not to be finally installed. This led to a reform in the scheme, where a discount factor for sales and giveaways was halved (from 0.9 to 0.4) and this balanced the market. Furthermore, pooling of small projects was enacted, in order to overcome transaction and administration costs of small scale investments.

Currently, the New South Wales GGAS will be extended to 2020 and beyond on a rolling 15-year basis or until an Australian national emissions trading scheme is established (estimated around 2010). Nevertheless, this eventual policy change led to a market uncertainty, which on its own triggered market parties to supply more NGACs and collapse their price (from 12 to 6 AUD), leading firms to lose their commercial viability. To this end, the New South Wales government is considering options for transition in the enlarged national scheme (Passey et al. 2008).

3.6 USA

In the USA the concept of utility energy efficiency schemes with some form of obligation exists since the early 1970s. Since the end of 1990s the number of state utility energy efficiency programmes increased progressively and by 2007 half of the sates in the USA had such schemes in place. All relevant policies setting energy savings targets were named Energy Efficiency Resource Standards (EERS), while the ones specifically including a form of certification (comparable to WhC) were attributed as White Tag schemes. Currently, there are 19 energy efficiency resource standards at state level, pointing at differences in terms of delivery mechanisms such as obligations on distribution utilities, obligations borne by a state agency, performance contracts with third parties, bidding into regional capacity markets and ‘energy efficiency utility’ as designed in Vermont. There is an existing proposal for introducing a national energy efficiency resource standard, summarising the major expected impacts in terms of peak demand savings, CO_2 emissions savings, jobs created and monetary savings.

In Table 8 we present a list of the existing EERS schemes in some USA states.

Table 8: Energy Efficiency Programmes in the USA

Name	Period	White Tags/ EERS	Obligation
California	2003-2013	EERS	30 TWh of electricity savings with financial rewards
Connecticut	2007-2010	EERS/White Tags	Energy efficiency with green certificates (and RE obligation)
Hawaii	2004-2020	EERS	20% of electricity from RE and energy efficiency
Illinois	2007-2015	EERS	Energy efficiency
Minnesota	2007-2021	EERS	Energy efficiency
North Carolina	2007-2021	EERS	Energy efficiency
New Jersey	2007-2020	EERS/White tags	Energy efficiency (trading allowed)
Nevada	2005-2021	EERS	20% of electricity by 2015 from RE and energy efficiency and 25% by 2020
New York	2007-2015	EERS	15% energy savings of total forecast sales
Pennsylvania	2004-2020	White Tags	Energy efficiency with green certificates (and RE obligation)
Texas	2000-2007	EERS	Energy efficiency by 20% (consideration for updating to 50%
Virginia	2007-2022	EERS	Energy efficiency
Vermont	2000-2007	EERS	Energy efficiency
Washington	2006-2025	EERS	Energy efficiency (trading allowed)

Source: adapted from Waide and Buchner (2008)

In all USA schemes, the importance of delivering energy efficiency is recognised, but the relative importance given to value for money for rate payers, the contribution to energy security objectives and the reduction of GHG emissions is more oriented towards the first two targets. In contrast to the EU schemes, most EERS and White Tags are implemented by regulatory authorities and public utility commissions, as the latter focus more security of energy supply and economic efficiency of energy production (Waide and Buchner 2008).

Finally, there are ideas on integrating energy efficiency programmes under a GHG cap-and-trade for efficiency. In this case, 100% of initial credits are allocated to customer trustees (e.g., energy efficiency programmes) and generators are required to purchase allowances, recycling much of the revenue back into low carbon measures, including energy efficiency. One way could be to allocate a sizeable pool of carbon allowances to states or wires companies to promote end use energy efficiency.

3.7 EU-Wide Scheme

An earlier debate in the field of market based mechanisms in the EU concerned the introduction of an EU wide WhC scheme, originating from national WhC schemes of member states. This innovative concept of WhC is supported in the European Directive on End Use energy efficiency (2006): “the Commission considers this to be a possible next step in a few years time and may then come forward with a proposal based on the experiences in some Member States currently developing and implementing such certification schemes". Given that there is no such scheme so far, or relevant discussion whatsoever, we present in this section insight from available literature in the topic (Mundaca 2008).

In such a scheme, the EU could set mandatory energy saving targets and apportion them nationally and in absolute terms according to the market share of obliged parties. Modelling results demonstrate that an EU wide WhC scheme appears to be cost effective and effective, where life cycle energy savings costs range from -2 to 8 €cents/kWh with significant potentials for improvements in the end use sectors (around 1,500 TWh in cumulative energy savings in 2020). Moreover, a societal cost-effective potential (taking into account externalities) potential above 30% is observed and in environmental terms, GHG emission reductions amount to 200 Mt CO_2-eq by 2010.

Still, the introduction of an EU wide WhC scheme demands special attention, as existing schemes in the EU are entirely different in terms of their design characteristics and impossible to integrate at present. For instance, harmonisation of M&V procedures alongside with the obliged entities and verification of energy savings are quite different in national schemes. Other main differences are that on the one hand there is a booming market of certificates and ESCOs on the supply side in Italy, and on the other hand limited or no trade and no major role for third parties in France and the UK. Possible alternatives for a target setting in the EU scheme could be either national targets and European integration of certificate markets or a common European target along with integration of certificate markets. In the case of national targets, these would have to be equally ambitious and this point of view gains more ground on the political agenda. Furthermore, if the main aim of harmonisation and establishing an EU-wide scheme is increased market liquidity on the supply side of certificate markets, then actual schemes do not seem to guarantee that. The reason is that a strong supply side of the market exists in Italy with ESCOs and transactions, but little trade and few eligible parties take place in France and the UK. Based on evaluation studies, arguments supporting the introduction of an EU wide WhC scheme are (Rezessy and Bertoldi 2009):

- Changing mindsets and business models among energy suppliers in Europe, which are increasingly operating on a cross-border basis, and assisting product differentiation in the energy markets;
- A generic European scheme should be built gradually, leaving savings targets at national level while harmonising the way of certifying savings;
- Trying an EU-wide white certificate scheme on a voluntary basis first, keeping it open for countries to join;
- Establishing a regional white certificate scheme to test ideas and principles.

In contrast, arguments against such a scheme are:

- Equity issues of implementing savings projects abroad (cross-subsidisation);
- Lack of a commodity associated with white certificates;
- Inherent technical difficulties in harmonising measurement and verification;
- Differences across Member States in terms of levels of energy taxation and experience with demand-side management;
- Cross-border energy markets are not yet mature, so even multinational companies under a supplier obligation may not be able to benefit from an EU-wide scheme, at least initially;

- The legal framework in some countries prevents investment in heat markets, which would undermine the benefits of a European scheme in its heat part;
- Focussing on the European dimension should not reverse the priority list of first and foremost saving energy and, only subsequently, trading.

4 Major issues for implementation

In order to design a WhC scheme, policymakers can draw lessons from the experiences and design characteristics of existing schemes in the EU and other countries. As a starting point, a WhC scheme in its design phase consists of the following elements upon which decisions are taken (International Energy Agency 2006): a) Target setting, b) Obliged parties, c) Counting target upgrading, d) Compliance, transaction and administrative costs, e) Eligible technologies, f) Institutional Setup g) Enforcement, h) Trading rules i) Links to other policy instruments. The questions that need to be answered from policymakers during this phase are presented in Table 9.

Table 9: Issues in WhC Setting

Characteristics	Questions raised
Target setting	What should be the target? What is the specific timeframe?
Obliged parties	Which market party should undertake the obligation? Are there other eligible parties? Does the scheme enhance competition or does it lead to market concentration?
Counting rules	Which projects are eligible for certification? Sales or end use counts for target? Are there verification requirements?
Costs	Compliance costs? WhC costs? Transaction costs? Administrative costs? Does learning reduce such costs? Do costs reflect energy efficiency costs? Are there dangers for gold plating?
Eligible technologies	Are all or specific technologies allowed? Does the scheme support innovation or advantages existing technology diffusion?
Institutional setup	Which body undertakes these costs? Which body is responsible for which procedures? Are there possible conflicts between procedures?
Trading rules	Is trading prerequisite for the scheme? How can the scheme enhance trading?
Enforcement	What is the optimal level of penalty? Is the penalty relevant to sales or not covered target?
Links to other instruments	Complementarities and overlaps with other instruments? Timing of instruments?

Source: Oikonomou and Mundaca (2008)

These questions are approached differently in countries with WhC schemes. Although the nature of any tradable certificate scheme is common (i.e., equalise compliance marginal costs among responsible parties), one can easily notice that there is no specific or standard design of these schemes. Below we present some basic concepts of a market structure and what options exist in a WhC market (Bertoldi and Rezessy 2008).

4.1 Design characteristics in general

In this section we demonstrate the main design characteristics of WhC schemes that must be taken into account during the initial design and consultation phase. In general, design modalities of such schemes reflect national policy priorities.

4.1.1 Creating market demand

In principle, tradable certificates represent a meaningful option only if there is interest in buying/selling them. To this end, there are two options to create demand: by obligation or by voluntary demand (in the form of incentives).

Size of the target

Initially, the size of the target should be defined and an analysis is required to feed-in such a decision. Target setting refers to the level of obligation, expressed in TWh or ton of oil equivalent (toe) saved. The reference point and year for setting the target is crucial – the target can be defined, e.g., in terms of technoeconomic potential, of actual or predicted energy use. Another aspect of this characteristic is the timeframe upon which obligated parties must fulfil the target. The policy goal under which a WhC scheme is introduced has direct implications for setting the unit of the target. In other words, if a WhC scheme builds on the policy goal of improved security of supply, the target will probably be defined in primary energy savings, while if the aim is reliability of electricity supply the target will be set in final energy.

Obliged parties

A second step is to define the market entities that receive the energy savings obligation how the overall target should be apportioned to individual actors. The alternatives are upstream and downstream systems. In principle, such market entities are:

- Energy (electricity, heat) producers;
- Energy (electricity, heat, gas) distributors;
- Suppliers of energy and fuel;
- Energy retailers/suppliers;
- Consumers/end-users.

So far, mainly energy suppliers and distributors have received obligations in such schemes. The arguments for involving energy suppliers in energy savings are numerous, notably the fact that they are closer to the end users. On the other side, distributors are more stable and, depending on network tariff regulation, also less under pressure to increase sales.

Other market entities that can generate energy savings and get accredited with WhC for their actions, with the only difference that they do not face any obligation, can be:

- Not obliged agents (e.g., Distributors or suppliers below the threshold);
- Energy service companies (ESCOs);
- With or without a minimum requirement on turnover, experiences;
- Accredited or not though presence in an official register;
- Consumers/end-users;

- All without discrimination or only the large ones;
- Market intermediaries (e.g., brokers);
- Any economic actor (with or without threshold).

In principle the individual targets can be expressed as a sales percentage or as an absolute value, i.e., independently of the commercial choices of suppliers. Other allocation criteria are number of served customers (reflecting also the market share), absolute value of distributed energy and annual turnover. There is no blueprint for such target allocations, as they depend on the national market context. Based on studies, nevertheless, it appears to be more acceptable to set targets as a percentage of the energy that distributors or suppliers sell rather than in absolute terms and should be contingent upon the evolution of market share.

Technologies

At a further step, policymakers must decide what projects and/or technologies are eligible to receive certificates under a WhC scheme. Eligible technologies are the choices of specific technologies and packages of measures allowed and recognised as appropriate for counting against the target. In practice there are two options: leaving the scheme completely open to any technology, form of energy, or end use sector or limiting the scheme with respect to technologies (for instance establishing a list of eligible project types), end use sectors, or energies (only grid-bound ones). Other parameters that must be taken into consideration as criteria are the size of the projects and the economic sectors that they can be implemented.

Advantages of an open scheme: With regard to project eligibility, the economic textbook argument is not to give preferential treatment to any technology, form of energy or end use sector and to instead focus on primary or final energy that is causing the environmental or social harm. A preferential treatment could lead to higher costs of compliance than if the market forces were left to determine the least-cost path to the environmental or social objective. Many project types should be allowed in order for trading to bring benefits that are sufficient to offset the associated administrative and institutional costs; in contrast, limiting the scope to certain technologies will increase the risk of price uncertainties and fluctuations. Limiting the scope of a scheme in terms of participating sectors and actors can potentially reduce administrative costs, but has the drawback of marginal cost of energy efficiency measures increasing with time as lower cost options (“low-hanging fruit”) are used up.

Disadvantages of an open scheme: As research on emission trading shows, the positive effect of leaving it completely to market forces to decide on measures taken is only valid where the benefits yielded by each unit of compliance/action are the same in whatever end use sector or location it is achieved. Because cost minimisation is an inherent feature of markets, a completely open scheme is likely to focus compliance on large-scale projects. This may leave out certain sectors usually pointed at as especially problematic from an energy efficiency point of view, such as residential and in general buildings (where transaction costs are higher and payback periods longer). Any possible negative consequences of allowing obliged parties to undertake measures outside their own energy carrier should be carefully considered for possible interferences with competition law. For example, if an electricity supplier engages in energy saving projects outside its own client base and outside its own energy carrier (for instance gas), then a gas supplier, in whose client area the incursion takes place, could claim that the considered energy carrier is more prone to energy saving and hence the scheme has introduced an unfair disadvantage and consequently the alleged loser may insist that the state pays compensation for stranded cost.

4.1.2 WhC market trading

Trading rules refer to a framework upon which trading of WhC can take place and include arrangements for managing supply and demand of certificates, and design characteristics of certificates. Enforcement deals with sanctions and penalties that suppliers must pay in case they cannot comply with their obligations.

Certificates and trade

Certificates are commodities that entail a property right over a certain amount of energy savings. Their main characteristic in a properly established market is that they are unique and tradable. Some basic rules that need to be determined in advance in order to guarantee the creation of a functioning market are:

- Participants to the market;
- Lifetime of certificates;
- Frequency of transactions;
- Safety rules during electronic transactions;
- Banking (chance to keep and to use in the future years the certificates possibly gained in addition to the targets the targets);
- Borrowing (issuing of an amount of White Certificates prior to the implementation of the project they refer to);
- Grandfathering (mechanism typical of Emission trading where certificates are issued also relying on “merits” gained in the past in fulfilling the targets).

A minimum project size may be applied for certification of savings in order to reduce transaction costs and encourage pooling of projects. A long certificate lifetime and banking increase the elasticity and flexibility of demand in the long term. Parties that may be allowed to receive and sell certificates include obliged actors, exempt actors, ESCOs, consumers, market intermediaries, nongovernmental organisations, and even manufacturers of appliances.

Penalties

In order to ensure that the economic risks of the whole WhC scheme will be affordable for market players and that the required targets will be achieved, a price ceiling for compliance is often advocated. This can take the form either by setting a buyout price or a predefined penalty. This penalty can be proportional to the non-covered energy savings or to the sales of market players. Alternatively, if compliance rules are not strict, a grace period can be provided.

4.1.3 Processes to support the scheme

A concrete institutional setup is the pillar of supporting a WhC scheme. Institutional setup consists of the choice of entities that undertake setting up, administration, verification, registration, and reporting requirements of a WhC scheme. Two issues deserve special attention for their fundamental role in institutional infrastructure of WhC schemes: baseline setting to measure the impact of projects and choice of verification system.

Baselines and additionality

To determine the energy savings resulting from an energy efficiency activity, the eventual energy consumption has to be compared to a baseline (reference situation) without additional saving efforts. Additionality refers to certification of genuine and durable increases in the level of energy efficiency beyond what would have occurred in the absence of the energy efficiency intervention, for instance, only due to technical and market development trends and policies in place. Core criteria for determining additionality can be based on:

- Increase of turnover for obliged entities;
- Innovation;
- Present market structure;
- Average performance of components (e.g., insulations);
- Existing standards and regulations;
- Monitoring mechanisms;
- Duration of energy savings;
- Rebound effects, i.e., unexpected grater consumes deriving from chances of increased comfort (e.g., turning up the heating) produced by some energy saving projects (e.g., cavity wall insulation) without additional fuel costs for the residential use.

Measurement, verification, and certification

Energy savings can be determined by estimating energy consumption or metering consumption before and comparing it to the consumption after the implementation of one or more energy efficiency improvement measures and adjusting for external factors.

Three types of methods are available for the evaluation of the energy savings connected to a project:

- *Default method (no on-field measurement)*

  It is based on standard evaluation procedures with no on field measurements and it gives "ex-ante" the energy savings per physical unit (e.g., per substituted lamp, per kW of installed motor power, etc) of equipment. This approach will be used for projects for which expected savings are reasonably well understood and direct measurement would therefore be not cost effective. The approach is typical for "mass" projects where reliable averages can be determined. For every type of project, a simple equation is provided together with standard values for each of the parameters included in the equation itself. In this default method, gross savings were to be converted into net savings through simple multiplication by a default factor which takes into account for free-riding effects and, depending on the type of project been considered, by a second default factor which takes into account the impacts of different delivery mechanisms (direct installation, sale without installation, discount bonus, etc.).

- *Analytic method (some on-field measurement)*

  This method can be considered as an "open" default method, where savings are assessed after on-site metering of few relevant parameters. This method is justified for peculiar projects having relatively large unit size (cogeneration, VSD pumping systems, etc.), that is those projects whose energy saving impact is quite well understood but varies depending on a limited number of identifiable parameters of usage (e.g., number of hours of usage). Also in this case, standard evaluation procedures are going to be established, based on an algorithm where the value of some parameters is fixer whereas direct measurement is required of the parameters of usage which are likely to vary significantly case by case.

- *Metered baseline method*

  According to this method, savings are based on the difference between the measured energy consumption 'before' and 'after' the implementation. Baselines may be normalised and adjusted to other process variable (actual versus reference exploitation of equipment, thermal load of buildings, climatic conditions). This approach will be open only for projects, where their performance depends on variables and parameters that change from case to case and is therefore less predictable. Energy savings are inferred through the measurement of energy use.

The metering approach is a more accurate guarantee of energy saved but often difficult to identify actual saving (e.g., there is only one meter in households for the entire consumption). It could be better suggested for large installations, but it could carry with high monitoring costs for small projects. Alternatively, sample surveys can be used to calibrate savings attributed to projects using standard factors. Experience so far demonstrates that there is a strong preference towards deemed saving approach and standardised methods, as transaction costs can be lowered for obliged parties and project developers (Mundaca 2007).

Furthermore, monitoring and verification methods affect the process of certification of savings, as they can be issued ex-post (expressing the actual energy savings realised over time) or ex-ante (expressing an estimate of the energy to be saved under specific projects).

Ex-post: increases validation and verification costs, and if certificates are issued after the project, then market liquidity is jeopardised.

Ex-ante: Deemed savings approach, less costs, and when under-compliance takes place, then supplier must match that with buying certificates.

Discount factors

Affects the life time of savings and influences the actual target. For instance, lowering the discount rate in calculations the same energy savings target renders the target easier to fulfill, and favours measures with longer life cycle.

4.1.4 Cost recovery

Cost recovery is a process whereby an energy distributor is able to recover, through rates, the costs of implementing either DSM programmes or any other type of energy saving action beyond the consumers' meter. Cost recovery via regulated tariffs can only be applicable where electricity and gas markets are not fully liberalised and/or where the obligation is imposed on grid companies. Since cost recovery is linked to regulated tariffs, it is not applicable in fully liberalised markets whereby the obliged parties are energy suppliers who can pass the additional cost of compliance to the final user (as is the case of the UK). While cost recovery aims to compensate suppliers for the investments in end use energy efficiency measures, there are also larger economic effects of overall energy demand reduction caused by the application of a scheme with energy saving obligations: these are related to possible price reduction for energy purchased at the wholesale markets by suppliers, due to among other deferred and avoided investment in electricity generation plants and network upgrades.

Certification

Certificates can be issued either *ex-post* and thus they represent the energy saved over a certain period of time, or they can be issued *ex-ante* and thus represent the *estimation* of the energy to be saved over a certain period of time. With regard to *ex-post certification* there are different options: the saved energy resulting from an energy efficiency measure could be measured at *the end of a predetermined period* (e.g., after 1 year) or *over the lifetime of the project* (which has to be accurately assessed). The energy efficiency certificate can be equal to the energy saved over the period or the lifetime of the project, or could be issued when a certain amount of energy savings has been achieved (e.g., 1 MWh). The latter option will make the system more comparable to a TGC scheme – the certificate will have a unique time of issue attached to it, will indicate the period over which and the location where energy has been saved, and by whom it has been saved (initial owner of the certificate) – but will increase validation efforts and verification costs. Alternatively, for projects that can be monitored through a standard savings approach, certificates can be granted *in advance* of the actual energy savings delivery to mitigate liquidity constraints of project implementers and allow them to finance new projects. If with such ex-ante attribution of savings underperformance is detected at the end of the lifetime of the measure, the underperforming project owner should be asked to cover the shortage with certificates purchased on the spot market.

The above general principles may be implemented in several different ways. The variety of schemes which can be devised (and which were actually devised, as it will be shown in this report) depends on how to specifically implement in practice the options which underlie these principles and on how to combine them into a national mechanism. In the following sections we demonstrate in brief how these design characteristics are selected in the running WhC schemes.

4.2 Design characteristics of existing WhC schemes

4.2.1 Italy

Creating market demand

The obliged parties in the Italian WhC scheme are electricity and gas grid distributors, with more than 50,000 customers and the targets are expressed in primary energy consumption. The overall target can be attained by electricity, gas and other fuel savings.

The targets do not refer to specific end use sectors and/or type of projects. Consequently, the kind of the eligible projects is open to allow for compliance with target in the widest way. An open list of eligible technologies was set up by the Regulatory Authority, which is also responsible for designing, implementing and quantifying the savings of these projects. Supply-side projects are not considered eligible to meet the obligation.[6]

In Italy, the attribution of mandates to distributors rather than to suppliers was aimed at overcoming market power difficulties with supplier's oligopoly and to help develop energy service activities in a market framework supposed to incite to efficiency. In fact vertical trading dominated in the market relations.

[6] This exclusion is specifically mentioned in the decrees. However, a bit contradictorily, eligible projects attached to the two decrees include small photovoltaic plants (< 20 kW).

WhC market trading

Three types of certificates are forecast, characterised by different degrees of fungibility between each other:

- type 1: they attest the achievement of primary energy savings through reductions of electricity consumption;
- type 2: they attest the achievement of primary energy savings through reductions of natural gas consumption;
- type 3: they attest the achievement of primary energy savings through reductions in the consumption of other fossil fuels (fuel switching).

Being lifetime of each certificate set at 5/8 years, banking of certificates is allowed whereas borrowing[7] is not. Banking will allow distributors some additional flexibility in meeting the obligation. No limits were planned for the bankable amounts of WhC. The parties involved in WhC trading are essentially the operators to whom the certificates will be awarded: all electricity and gas Distributors, companies controlled by Distributors and ESCOs. Besides these institutional parties, participation of financial intermediates, and voluntary buyers is expected as well.

The certificates are to be assumed as the only valid document which entitles the obliged operators to assess compliance with their energy savings targets. WhC may be negotiated both via bilateral contracts and in the marketplace organised by the Electricity Market Operator, with trading rules (concerning the periodicity/frequency of trading, safety rules for buyers and sellers, etc.) jointly defined with AEEG.

In Italy trading is a central element of the scheme, both in regulatory terms and with respect to the quantitative outcomes. A platform for spot market trading has been organised and specific rules and procedures defined by AEEG in order to guarantee market liquidity, transparency and security of market deals (Pavan 2007). Trading does not have to be authorised in advance. From mid-2008 both quantities and prices of bilateral deals (i.e., of over the counter-OTC trades) have to be registered.

Processes to support the scheme

The three methods of evaluating energy savings mentioned above are eligible in the Italian scheme (deemed savings, analytic method and metered baseline method). Baselines adopted in the evaluations procedures in default and analytic methods are built on:

- average consumption of installed stocks according to existing mandatory standards (this criterion holds for energy savings projects in buildings (heating, insulation, etc.); for example, the baseline for the insulation to an old building is estimated as the average of the insulation effects, according to the age of the building; the measure will tend to rise the performance of this building to the performance required by the present regulation;
- average of sales, which allows for evaluation of “average” consumes of the “average” equipment existing on the market; this criterion holds for energy savings projects based on substitution with high efficiency boilers or high efficiency electric appliances; this criterion is dependent on the market share and on the present technological development[8]

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[7] That is, issuing of an amount of White Certificates prior to the implementation of the project they refer to.

[8] To this purpose, a continuous and remarkable drift of the market towards *class A* efficiency is under way in Italy, owing mainly to the a definite position of the equipment sellers in this sense.

and need of periodic updating of baseline is then required to keep significance to the whole evaluation process.

Cost recovery

Cost recovery is allowed for every certificate of the distributor as long as the latter has not achieved the energy savings target. This rate should be proportional and greater than the investment required to compensate the non-compliance (estimated higher than 150-200 €/toe primary energy saved, i.e., 3.6-4.8 €/GJ). Prior to 2008 cost recovery was allowed only for electricity and gas savings but currently all types of energy savings except transport fuels are eligible for cost recovery. There is no clear financial penalty set, as AEEG is not in favour of setting a buyout price that could determine the final price of certificates (Eyre et al. 2009). Still, one year grace period is assigned for distributors that met at least 60% of their annual target.

4.2.2 The UK

Creating market demand

The UK scheme runs (under CERT currently) from 2002-2011 and sets the obligation on electricity and gas suppliers, with more than 15,000 customers. There was a progressive increase of the target from 62 to 130 fuel standardised TWh. This narrow scope of obliged suppliers, households as sole target group and standardised actions (37) are selected in order to limit the administrative costs.

The enlargement of the scheme covering more sectors and market actors was not adopted, although it could in theory be more socially efficient, as according to the British Regulators they cannot lead to social benefits high enough to compensate administrative and transaction costs (Eyre et al. 2009).

WhC market trading

The legislation under EEC1 and 2 allowed for trading of either energy efficiency obligations or the delivery of that obligation between suppliers, while under CERT this provision is dropped. There is no transparent market in savings, although it is believed that there have been bilateral trades between suppliers, as well as sales of insulation measures to suppliers from the managing agent for Government funded programmes. The responsibility for registering schemes rests with the energy regulator, who will only consider applications by licensed suppliers, which effectively precludes the development of speculative activity by third parties.

Three forms of trading were envisaged:

- Horizontal, between suppliers; at present, they accounted for around 0.25% of the targets;
- Inter-temporal, between compliance periods; this solution was very popular, since about 20% of EEC2 targets were met in EEC1. This banking provision led to a 28% banking from EEC1 to EEC2 and 25% from EEC2 to CERT;
- Vertical, between suppliers and project developers: this is the most important, since suppliers have contracted out most of their measures to 3rd parties.

Horizontal trading was undermined as it was allowed to take place only when suppliers' own targets were met, and also because the scope limitation (residential sector) often led to contracting with similar entities for energy saving actions, rendering thus the horizontal trading difficult.

Processes to support the scheme

Ofgem maintains a spreadsheet of measures carried out by each supplier, recording the points they have earned. These are added up and counted against their target. If trading is carried out, this can be of measures undertaken or of part of their obligation. Concerning the verification of energy savings, different techniques are used for the eligible technologies. For example, for CFLs, the priority group is getting 100% additionality due to the high cost of the bulb and the low income of the consumer (i.e., poorer households are unlikely to purchase CFLs outside the EEC scheme). For social sector measures, the supplier needs to receive a letter from the landlord who self-certifies not to be free-rider, i.e., that he would not have carried out the energy efficiency measures outside the EEC.

To this end, specific measures are identified that deem energy savings. Among others, EPBD requirements can be also used as a baseline or terms of reference against which energy savings can be evaluated. Table 10 presents the measures suggested on the basis of the target and expected annual savings, alongside with the relative burden of households on the cost of each measure (for EEC 1 and EEC 2).

New eligible measures (as shown in Table 10), or higher ambition level between the two phases of the EEC, reveal the enhanced efficiency of the scheme. Furthermore, the cost sharing fulfils the criterion of equity, since for the most expensive measures (i.e., fuel switching) the burden of the priority group is rather limited, while for cheaper options (CFLs) the burden is equally shared.

Cost recovery

The Utilities Act sets the maximum penalty Ofgem can give at 10% of the supplier's turnover. It should be remarked that this is a maximum, possible, not "universal" value for the penalty, i.e., this value is expected to affect only very serious faults. Another provision is that any penalty should exceed the cost of delivery. No compensation is given, but there is no constraint on how much suppliers charge customers.

4.2.3 France

Creating market demand

In France, obligations are set for energy suppliers delivering electricity, gas, domestic fuel, cooling and heating for stationary applications. Obliged parties receive targets based on their physical sale quantities in the residential and commercial sectors. Annual adjustments of the individual obligations take into account the market variations.

The scheme has a wider scope and it is flexible towards eligibility of actors and projects, which can cover almost all end use sectors. Still the large number of obliged parties undermines that energy markets in these countries are concentrated and major players are limited in number.

WhC market trading

The parties involved in trading of WhC are the obligation bound ones and all economic actors, which can generate energy savings and receive certificates. In terms of process, after the realisation of savings, WhC are issued and in the end of the period returned by the obligated parties to the delivering Body (DRIRE), where clearance of these titles takes place. Certificates are valid for three compliance periods (9 years in total) with a provision of banking them for each subsequent period.

Table 10: EEC 2002-2005 and 2005-2008 Illustrative Measures in the UK

Projects	Total installations from EEC (M)	Lifetime in years	Primary Energy Savings per year (GJ/unit/yr) basis of target		Total EEC target-fuel standardised and lifetime discounted (PJ) basis of target		Annual net primary energy savings (PJ/year)	Total cost per measure (€)	Consumer contribution to measure (%)	
			2002-2005	2005-2008	2002-2005	2005-2008	2005-2008	2005-2008	Priority group	Other groups
Cavity wall insulation private	1.00	40	18.86	18.54	66.24	155.52	23.33	462	0	28.2
Cavity wall insulation social	0.70	40	-	18.00	-	105.84	-	455	33.4	35.8
Loft insulation private	0.70	30	6.62	9.76	10.44	49.68	7.14	380	0	28.4
Loft insulation social	1.42	30	-	6.73	-	20.52	-	383	32.9	35.3
Loft insulation DIY	0.46	30	-	12.02	-	39.96	2.43	194	25.8	27.4
Glazing E to C rated	4.50	20	-	0.11	-	2.52	0.38	15	13.6	27.3
Boiler end-of-life replacement with condensing boiler, A/B rated boilers	0.20	15	9.22	11.16	16.56	9.36	2.60	283	11.7	29.3
B to A rated boilers	1.00	15	-	4.14	-	16.92	4.36	73	0	0
Fuel switching	0.06	15	-	28.48	-	18.36	2.34	2637	6.7	44.4
Heating controls – upgrade with boiler replacement	0.50	15	-	2.45	-	4.32	1.26	120	10	29.1
Heating controls – extra	0.09	15	-	6.77	-	2.88	0.80	196	10.2	29.5
Fridge saver – type schemes	0.10	10-12	0.4	0.5	0.72	0.72	0.29	176	17	0
Appliance replacement – higher efficiency models	0.60	10	0.4	-	1.44	-	-	-	-	-
Appliance cold	0.88	12	-	0.22	-	2.52	1.08	29	0	0
Appliance wet	1.17	12	-	0.07	-	0.72	0.29	15	0	0
Appliance set top box	0.50	8	-	0.04	-	0.36	0.01	2	0	0
CFLs – extra bulbs	17.60	14	0.11	-	12.60	-	-	-	-	-
CFLs – new bulbs	12.60	8	0.25	-	-	-	-	-	-	-
CFLs – retail	9.75	16	-	0.04	-	7.20	0.94	5	47.7	47.7
CFLs – direct	32.64	16	-	0.04	-	24.48	5.15	6	0	34.1
Hot water tank insulation – new	0.17	20	8.32	-	15.48	-	-	-	-	-
Hot water tank insulation – top-up	0.46	10	1.62	1.62	-	2.52	0.36	19	10.5	26.2
Draught-proofing	0.31	20	-	2.66	5.04	4.68	0.72	139	10	28.7
Total:					**130**	**469**	**53**			

Notes: The databases used for the UK originate from the documentation accompanying the Energy Efficiency Commitment (DEFRA 2004) and the costs are converted to € under the rate £/€=1.47. One important assumption is that the 2005-2008 EEC is discounted at 3.5%, as decided by HM Treasury in January 2003 in order to reflect prevailing circumstances rather than 6% as in 2002-2005. This differentiation favours the measures with longer life cycle (i.e., cavity wall insulation) (DEFRA 2004)

Source: DETR (2000, pp 25-27), DETR (2004), Carsten R. (pers.comm.)

An official national marketplace were not planned and predominantly bi-lateral exchanges take place. If necessary, actions to encourage the market of WhC will be launched by entrusted Bodies (as the Minister of Industry) to foster complete fulfillment of the obligations; to this purpose and to favour this process, a list of potential sellers of certificates will be set up and published by the Administrating Bodies (Minister of industry – Board responsible of the national certificates registry). Currently, a free trade market between WhC buyers and sellers is available on the register EMMY (www.emmy.fr). As of beginning 2009, registered trading accounted for less than 4% of total amount of certificates, as suppliers tend to implement projects on their own with contracting activities to other entities.

Processes to support the scheme

The approach for the evaluation of the impact of a project in terms of energy savings is developed through two steps.

First step: definition of elementary Energy Efficiency actions involving products or widely exploited services. At present, 71 savings actions were preliminarily pointed out. Standardised methodologies are being set up for saving calculation. These methodologies are based on fast and straightforward user-friendly procedures without complex details. Lump evaluation of energy savings are established for each action, expressed in kWh of final energy, cumulated and present-worthed over the life of the product. These procedures are the results of "technical"/objective evaluations of savings, then processed and weighted in suitable ways to keep into account:

- the specific type of equipment or goods;
- the process used to save energy (e.g., switching to renewable sources, etc.);
- the state of the market of the processes;
- a possible state of grid congestion in particular geographical areas, which could be relieved by recovery of energy efficiency at a local scale.

In other words, "smart" weighting criteria may be devised to particularly encourage or discourage some specific actions and the resulting so tuned bouquet of procedures can then be used as a tool to favour focused energy policies.

Second step: definition of typical pre-fixed combinations of the elementary actions of the first tep, aimed at fostering energy efficiency (mainly in the civil sector). Energy savings actions must be additional with respect to the ordinary activity of the implementer, i.e., they are performed only as a consequence of the present obligation on the mandatory targets and beyond a plain "business as usual" logic. Criteria for additionality depend on the obliged/non-obliged features of the actor performing the energy saving project:

a) Obliged implementer: any eligible action aimed at energy savings is considered additional;

b) Eligible (but non-obliged) implementers: an eligible action is also additional if it does not increase the turnover of the implementer.

Finally, more selective criteria are expected to be set up for obliged agents when the energy efficiency project is relevant to own equipment or building; at present, this definition is in progress, though it will include very probably two classes of actions:

- Actions connected to standardised evaluation methodologies;
- Action characterised by a long payback time.

Cost recovery

The law forecasts the possibility to pass the costs on to prices for regulated tariffs, taking into account other variables, such as inflation rate, social and renewable energy feed-in tariffs and evolution of transport and distribution costs. Furthermore, a ceiling price for certificates is calculated based on the penalty. The penalty, although not explicitly defined, is estimated to cover at least the same price of the purchase of a certificate, around 2 c€/kWh final energy cumac, i.e., 5.6 €/GJ.

In Table 11 we present a summary of the main differences in the design parameters of the existing WhC schemes in the EU.

5 Interactions with green certificate schemes

A main target in the EU climate policy beyond the framework of Kyoto Protocol and the security of energy supply is the promotion of Renewable Energy (RE). The EU Directive on Renewable Energy Electricity (1997) aims at increasing electricity produced from RE sources in the EU to 22.1% by 2010 (from 15.2% in 2001), thus helping EU to reach RE target of 12% of the overall energy consumption by 2010. Recently, a binding target of 20% of RE participation in the overall energy mix has been set by the currently voted Directive on the promotion of the use of energy from renewable sources (2009). This target is also supplemented by a minimum target for biofuels of 10%. These directives provide direct support for innovative mechanisms that could assist also in the liberalisation of energy markets, which represents another target of the EU.

Many Member States have in place mechanisms for the support of electricity generation from energy sources that have environmental and other benefits (‘green electricity’), but which are not commercially viable without special policy intervention. Such mechanisms include feed-in tariffs or guaranteed prices, tax-exemptions, credit guarantees, tendering systems, and research and development programmes. The last decade, a number of countries have added TGC schemes as one of these support mechanisms. TGC have become an increasingly common instrument for RE targets in OECD countries (Australia, Belgium, UK, the Netherlands, Sweden) with different design characteristics and specific targets. A green certificate can be defined as:

‘An official record proving that a specified amount of green electricity has been generated. Green certificates represent the environmental value of renewable energy production. The certificates can be traded separately from the energy produced.’ (Haas 2001)

5.1 Overview of TGC market

A Green Certificate actually represents the “greenness” of a unit of RE production. This divides the unit in two parts: the physical electricity and its associated “greenness”, which can be traded in two different markets, the conventional physical electricity markets and a market for certificates. Primary targets addressed by TGC schemes are the reduction of oil dependence, Kyoto Protocol commitments (reduction of GHG emissions), security of energy supply, and diversification of RE sources. The hierarchy of these targets can vary at some extent on national energy market characteristics and incumbent industrial structures.

Table 11: Characteristics of WhC Schemes

	UK (CERT)	France	Italy
Obliged parties	Electricity and gas suppliers	Electricity, gas, heat and fuel suppliers	Electricity and gas distributors
Compliance period	(2005-2008) 2008-2012	2006-2009, 2009-2010	2005-2012 (Annual)
Policy objectives	185 $MtCO_2$, 40% from priority group (annually 3.5)	54.7 TWh (197 PJ) lifetime discounted cumulated final energy savings over 3 years (annually 1.3)	50% from electricity/gas savings (until 2008), 22.4 Mtoe (260 TWh), (annually 4.5)
Threshold	≥50,000 domestic customers	≥0.4 TWh/year sales	>50,000 customers None (residential, fuel suppliers)
Reference	Number of domestic customers	Electricity/Gas distributed	Number of domestic customers
Eligible sectors and technologies	• Households • Pre-approved list of measures	• All end use sectors • No pre-approval yet	All end-use sectors (building, industry and transport, but not measures on sites covered by EU ETS) Pre-approved measures but not fully decided
Project evaluation	Annual reports by Ofgem to Government. Following Ofgem's final report on EEC 2002-2005, Government will consider its impact, including carbon abatement	For standard measures *ex ante* evaluation based on data on technologies and sales of equipment Correction after the realisation of savings (receipt of certificates)	• Deemed-savings approach • Engineering savings approach • Direct measurement approach
Additionality	Suppliers must demonstrate that projects are additional (deadweight removed from targets)	Additionality must be demonstrated by suppliers • obliged: any eligible action is additional • Non-obliged: turnover must not be increased or they install very innovative products	• Dealt with baseline definition • Other adjustments foreseen but not yet implemented
Certificates	• Savings (between obligated parties)	WhC	• WhC for electricity • WhC for gas • WhC for other fossil fuels
Trading parties	Responsible electricity and gas suppliers	Responsible suppliers, eligible owners (i.e., building owners), other bodies (manufacturers, traders)	All electricity and gas distributors and ESCOs
Penalty	Calculated as a 10% of the supplier's turnover	At least the same price of the purchase of a certificate, estimated around 2 c€/kWh final energy cumac, i.e., 5.6 €/GJ	Proportional and greater than the investment required to compensate the non-compliance (estimated higher than 150-200 €/toe primary energy saved, i.e., 3.6-4.8 €/GJ)
Issuance of certificates	Not provided (no certificates)	DRIRE (Regional Directorate of industry, research and environment, Ile de France)	AEEG (Italian Regulatory Authority of Electricity and Gas)
Measurement and verification	OFGEM assesses and approves measures DEFRA develops a 'Target Setting model' for ex-ante determining energy savings	ADEME and ATEE set methodologies for calculating savings French High Council of Energy validates savings	AEEG
Monitoring and control	OFGEM developed administrative monitoring procedures and registers energy savings	Ministry of Industry verifies implementation of energy savings	AEEG executes sample controls

Source: adapted from Bertoldi et al. (2010)

A key characteristic differentiating TGC schemes from other support mechanisms thus is that the desired outcome (certain forms of electricity generation) is separated from the product market. Eligible electricity generation thereby produces two distinct products of value: i) electricity, which is sold as usual in the normal electricity market; and ii) green certificates, which are traded in an entirely separate market.

A system of TGC belongs mainly to the category of *regulatory instruments*, which aids public authorities to reach a specific goal of RE production by putting in practice advantages of the market, and as *an accounting system* that certifies RE production. A basic distinction is made between the *mandatory* or *voluntary* character of demand for TGC. They can be considered as a regulatory instrument for long-term wider use of RE only if demand is set and mandatory.

Depending on the level on which obligations are placed there are different kinds of Green Certificate schemes (Schaeffer et al. 2000):

- **Quota model**. This scheme imposes the obligation to purchase green electricity on distribution companies, which have to present the required amount of green certificates within a certain period. When a distribution company buys electricity from a producer, one part (quota) of the purchase consists of green electricity, which is accompanied by the transfer of TGCs. The distribution company can, however, embark on trading TGC in a parallel certificate market. The TGC price is passed on to the electricity consumers as a general price increase;
- **Green Pricing**. Under this model, the utilities' demand for RE stems either from a voluntary target or from direct obligation set by the government. The difference with the quota model lies in the fact that the green fixed price is transferred only to those consumers who have agreed to buy renewable electricity, paying thus a higher price. The basic difference of this system with the quota model is while the obligation is set to the distributors and they can still trade TGC, they can sell their green electricity only to specific consumers that have committed themselves to buying RE electricity at a higher price;
- **Renewable Electricity Obligation**. The RE obligation is imposed on electricity consumers (companies or households) who have to prove that they have fulfilled this obligation at the end of a specified period by presenting the amount of certificates they have bought. The amount of certificates they have bought serves as a proof and furthermore, the consumers have the possibility to trade these certificates.

The national TGC systems could be distinguished according to some special characteristics. These could be summarised as:

- The national target set for RE deployment;
- National legal framework and implementation of the EU Directive on the promotion of renewable energy sources in the internal electricity market in accordance with the national laws and measures;
- Choice of technologies eligible for certification. Although there is a list of standard technologies that can be included, some countries may try to promote some specific technologies excluding others. This standard list consists of biomass (including waste and landfill gas), hydro power plants, wind parks, photovoltaics, geothermal use, heat pumps and other (solar thermal power, tidal power, ocean currents, wave power, hot dry rock, ocean thermal energy). The most debated technologies are energy recovery from waste and hydropower;
- Mechanisms used to stabilise the national TGC market. This refers to the difference of validity-time; banking and borrowing rules; existence and amount of penalty; establishment of minimum and maximum TGC prices.

Mechanisms to stimulate the consumer demand and to reduce the investment risk for the new producers of RE, as they were analysed in the previous section. However, in all cases, the institutional set up required is more or less the same. The requirements for a TGC are:

1. Issuing certificates;
2. Verification of the issuing process;
3. Monitoring and control;
4. Registration of certificates and trade;
5. Exchange market;
6. Accounting of the certificates;
7. Withdrawing of certification from circulation.

An overview of the existing TGC schemes in the EU is presented in Table 12.

Table 12: Overview of TGC Schemes

Country (scheme)	Date of introduction	Administrator	Target	Obligation (demand driver)	Average price of TGC	Inter-temporal flexibility	Price mechanism	Plant eligibility	International trading	Notes
Belgium (Flanders)	2002	Regulator (VREG)	Rising to 6% in 2010	Suppliers (quota)	€85 in 2003, €108 since 04/2004	5 years' banking	Price ceiling	Excl. some hydro and all fossil fuels	Regional trading, may be extended to international	-
Belgium (Wallonia)	2003	Regulator (CWAPE)	Rising to 8% in 2010	Suppliers (quota)	€85 in 2003	5 years' banking	Price floor and ceiling	Incl. efficient CHP	Regional trading, may be extended to international	Certificate metric is CO_2 equivalents
Italy	2002	Transmission System Operator (GRTN)	Currently 2%	Generators (quota)	€99 in 2003 €97 in 2004	Banking allowed	No price restrictions	Excl. fossil fuels; only facilities built after 04/1999; eligibility lasts 8 years	Allowed for import of certificates	-
The Netherlands (certificates)	2000	Transmission System Operator (TenneT)	N/A	Consumers, voluntary (tax exemption)	€55 in 2000 but falling thereafter	N/A	Limits effectively set by tax incentive	All renewables, detailed 'calibration' of eligibility	Allowed for import of electricity	Ended in 2005 because of difficulties in establishing market
The Netherlands (groen label)	1998	Industry association (EnergieNed)	1,700 GWh over five years	Generators, based on past generation (voluntary quotas)	€20 in 2000	N/A	No price restrictions	All renewables, including large hydro	Allowed for import of electricity	Ended in 2001 partly because no new voluntary agreement was made
Sweden	2003	Regulator (STEM)	10 TWh annual production (defined as relative quota of 17%) in 2010	Consumers (quota)	€25 in 2005	Unlimited banking	Price floor and ceiling being gradually phased out	Incl. only non-fossil fuel energy; some hydropower sites ineligible	Compatible with RECS, no international trading	Not yet permanent; review in 2005
United Kingdom	2002	Regulator (Ofgem)	Rising to 10.4% in 2011	Suppliers (quota)	€40 in 2004-2005	Max 25% of obligation from banked certificates	Price ceiling close to anticipated market price; 'smearback'	Excl. large hydro and some biomass co-firing	No international trading	Scheduled to be in place until 2027. Allows levy exemption certificates

Source: Plumb and Zamfir (2005)

Implementation lessons

The same institutional body can simultaneously carry out some of these functions, while the remaining functions must be carried out by specialised bodies. An obvious conclusion from TGC schemes is that a binding target has to be set from authorities in order to trigger the correspondent demand for increased energy efficiency (in the case of WhC), otherwise free riding behaviour from market parties or lack of incentives for implementing energy efficiency measures can prevail. Furthermore, this target must include a clear timeframe of the policy instrument (a typical example is Sweden). This provides the due certainty to market players about the political and stable market conditions in order to proceed with investments with a longer payback period and set necessary business strategies to cope with new policy demands. Another aspect is that these targets must enhance the market liberalisation process, otherwise reconsolidation tendencies and market dominance by few players will prevail.

In general, ensuring a proper market requires that target groups consist of numerous actors with different market power, in order to avoid the risk of market dominance of very few players (i.e., oligopolistic market conditions). From the Swedish TGC experience, it is worth noticing that obliged parties should be operationally close to sources that allow them to meet their target. As mentioned before, some electricity suppliers acted mostly as intermediaries between electricity generators and end users in the beginning of the scheme. This created conditions for rent-seeking behaviour on behalf of suppliers, which increased the compliance costs for end users unnecessarily.

Experiences from TGC schemes revealed that a quota with a certificate market can be cost-effective for numerous reasons, without necessarily depending on the certificate market as such. Furthermore, monitoring and verification costs are quite low, since they involve meter reading and auditing, therefore energy suppliers can incorporate them in their normal activities. From a transaction cost perspective, if an instrument parallel to investment risk raises such costs, supplier's profits must be higher than the cost of the equipment for an investment to be financially attractive. In this way, certificates (if linked to the bidding system with a tight cost cap) are quite unfavourable to the realisation of plants because of insufficient payments or high volatility, as opposed to the case of feed-in tariffs for the case of RE. Rent-seeking behaviour on behalf of electricity suppliers ended up with end users being overcharged (marginally compared to the overall electricity costs, though).Based on TGC experiences, when many administrative bodies undertake several procedures in the scheme, this can lead to a malfunctioning and subsequently increase in administrative costs.

Trading rules are crucial and determinant in certificate schemes. TGC experiences reveal that where trading rules were easy and not complicated, trading activity was present, which led to lowering of costs.[9] Trading rules should specify ways of dealing with both bilateral and open certificate exchanges. Tradability of certificates depends also on the compliance/redemption period, lifetime of certificates, banking and borrowing rules. Most certificate trading takes place on an annual basis, while their lifetime differs. In general, more frequent compliance periods, due to their market activity effects, and longer lifetimes of certificates, due to more price stabilisation, could be preferable options.

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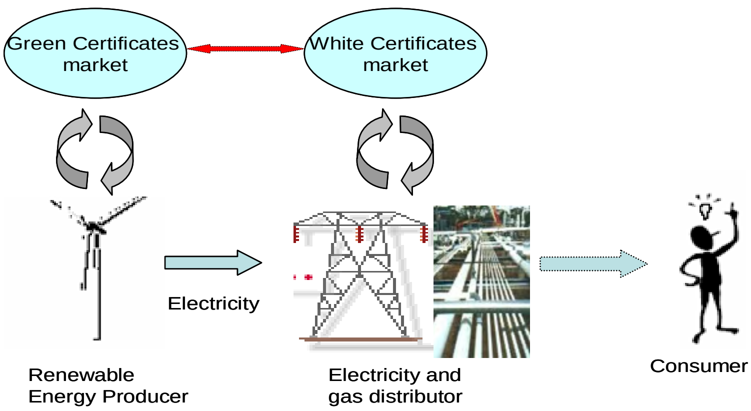
[9] Still on the voluntary markets, trading of TGC was quite small, and on the international market was mainly due to financial incentives (so marketing reasons could not guarantee trading) (Voogt et al. 2006).

Supply of certificates is achieved when producers of RE sell the units to the grid and acquire TGC. Demand for certificates is induced by transferring the national target for RE to either consumers or to distribution companies. The obligation can be set to any points of the electricity supply chain, from production to consumption. The most known obligation schemes apply to production, distribution and consumption, where the latter are preferable to other schemes, as it is argued that they are more consistent with market liberalisation principles (Schaeffer et al., 2000).

5.2 Combination of TGC with WhC

It is possible to combine domestic TGC and WhC in a single common scheme, where both RES and energy efficiency and savings measures contribute to meeting a specific obligation like reduction of fossil fuel consumption. Energy savings may contribute to meeting an overall RES target by reducing overall consumption. On the other hand, there are also significant differences. TGC is targeted at electricity generation exclusively whilst WhC might be targeted at any final energy consumption including heating oil, natural gas or even transport fuels. Also both have the objective of stimulating the market, although they deal with different markets, i.e., renewable energy and energy efficiency. The key common characteristic of green and white certificates is that both allow for the separation of the physical flow of electricity from, respectively, the "greenness" of electricity and energy savings. The same rationale in principle holds for integrating renewable heat and end use energy efficiency. From a cost effectiveness perspective, integration of supply and demand options should result in the lowest cost for society. A potential integrated scheme of WhC with TGC is presented in Figure 12.

Figure 12: Market of an Integrated TGC/WhC



Source: Oikonomou (2004)

An alternative design of a potential hybrid scheme of WhC and TGC can function on the basis of aiming at the electricity sector, with concrete RE supply and energy efficiency actions. With this kind of TGC design, the target setting of a WhC obviously influences the TGC target, even if the WhC does not refer to electricity markets.

If the target is expressed in relative terms to energy supply, the introduction of WhC could reduce the absolute targets of TGC targets. Market entities addressed by the TGC/WhC obligations in this sense can be the same, i.e., energy suppliers. Nevertheless, so far TGC RE obligations are assigned mainly to electricity production and supply, while WhC have a broader scope including savings on natural gas and oil for domestic use.

In principle, technologies addressed by both schemes are different in accordance with the RE and energy efficiency targets, but still some technologies that are not covered by the EU Directive on RE (2001) could include some specific advantages that enable them to be eligible in both schemes. In Italy, such an effort has been attempted in a legislative level with the two decrees (2001) that establish the WhC as a scheme for energy savings through the electricity and gas suppliers (including the development of decentralised renewable energy sources) (Pagliano et al, 2003). The WhC in this case include, apart from energy efficiency projects in end consumers, part of RE projects that are not covered by TGC. The latter consist of RE technologies that produce mainly heat, like solar heaters for sanitary hot water production and utilisation of geothermal heat, RE electricity production that is below the threshold of the TGC (below 20kW peak power, i.e., photovoltaics are mentioned explicitly), and RE electricity that is not fed into the grid but is self consumed (Farinelli, 2004).

A possible case of combining these instruments is through the biomass cogeneration plants that can produce both electricity and heat.[10] The electricity production generates TGC, while the heat production could be used against the energy efficiency obligation issuing thus WhC. As an integrated scheme, a possible solution could be the 1 way conversion and trading. After the implementation of sufficient energy efficient projects to the end users, the energy suppliers (or in this specific case, the biomass CHP plants) could initially achieve to fulfill their obligations and furthermore convert the surplus WhC, if any, to TGC in order to cover their RE obligations.

The projects will be chosen as long as the marginal cost they entail is not higher than the price of the WhC in the market and the next tradeoff for the suppliers will consist of the price of the TGC in the market (so that they can convert the WhC) or the expected price of the WhC in the following commitment period (so they can bank the certificates). An important barrier to this optimising procedure could be the financing differentiation. RE producers in a TGC scheme, at least in most of the already existing schemes in the EU receive support (direct or with fixed guaranteed prices), while in the case of WhC, energy suppliers have or to pass on the extra costs of the projects, possibly including their revenue loss from not supplying the market up to their marginally profitable point, in order to cover their self financing, or to request third party financing at a high interest rate in order to minimise the risk.[11] However, since the accepted financial cost of RE generation nowadays is higher than the small-scale energy efficient projects, the latter are considered in a relative more attractive position as recipients of reduced risk financing.[12]

A combined TGC/WhC scheme could allow some degree of interchangeability of the two different certificates, where three cases can be distinguished: i) Complete market separation, ii) one way fungibility, meaning TGC can be exchanged to WhC or vice versa, iii) two ways fungibility, where both commodities can be exchanged in a common market.

In the case where no conversion of certificates is allowed and markets are separated, the only possible interaction of TGC and WhC can take place is on through the common eligible

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[10] In principle, this integrated scheme could play a leading role in achieving the EU target of doubling the share of electricity production from combined heat and power up to 18% by 2010. This target aims parallel at reducing 65 mil tones of CO_2 (Huld and Bertoldi, 2003).

[11] These options of financing are being dealt with in the design of the WhC schemes in the EU countries, however in the UK the cost of undertaking such energy efficiency projects is subsidised, as analysed in the White Certificates chapter. In Italy, the cost recovered from the suppliers for every kWh will range from 3.3-4.4 €cent/kWh and will be examined every 5 years from the implementation of the measure (Pagliano et al, 2003).

[12] See, http://www.rerum.org/PDFS/Green%20Certificates_FINAL.pdf, ALTENER.

measures. In other words, when more common measures are being implemented due to a WhC scheme, an increase in demand of TGC will take place with a subsequence drop in prices. Similar is the case with an increase of energy efficiency measures, also eligible under TGC, which will tend to drop WhC prices. When one way fungibility is permitted, the expected effects depend mainly on the starting point of the certificate prices. More in detail, if TGC prices are higher than WhC ones, importing WhC into the TGC market is a viable solution. This will lead to an increase in TGC supply and reduce their market prices, with a parallel increase of the price of certificates in the WhC market. In this case, the exchange rate might be altered depending on the difference of the initial prices. Depending on the elasticity of supply of TGC and WhC and on the differences between equilibrium prices, the gains on the TGC market may be outweighed by the higher costs on the WhC market. Such conversions can also be time-restricted, i.e., conversion of a certificate for a certain measure is only allowed once or only allowed at certain points of time. In the final case where both commodities can be converted, similar conditions hold as in the previous case. The main difference is that when there is no simultaneous functioning of both schemes, one commodity can serve to cover the shortage of the other commodity's market, which results in equilibrium and potential avoidance of price peaks.

A market where this sort of combination of energy efficiency with RE targets is attempted is in the New South Wales scheme, as analysed in an earlier section of this report. Parallel to the GGAS market, a Mandatory Renewable Energy Target scheme is designed to stimulate the use of RE. To this end, TGC, in the forms of RECs (Renewable Energy Certificates), corresponding to 1 MWh of RE electricity produced can be used to comply with the scheme's targets. RECs originating from RE electricity sold in New South Wales can be used by GGAS participants in order to achieve their targets. The conversion takes place with a multiplication of the RECs with the pool coefficient (see Passey et al. 2008) and provides an equivalent amount of NGACs. This full fungibility option, although applied in the market, is still debated as the low emission electricity generation (via RE) would have taken place regardless of the GGAS scheme, therefore additionality is not clear. In practice, for the period 2003-2005, 13.6% of NGACs originated from RECs, hence the outcome of the GGAS scheme cannot be clear. This design imperfection is apparent in many schemes where TGC are combined with similar credit schemes, when allowing the credits of one scheme to fulfil the targets of the other, without setting additionality rules (Passey et al. 2008).

6 Interactions with emissions trading schemes

Parallel to the International Greenhouse Gas Emission Trading Scheme implemented under the Kyoto Protocol, several countries initiated or are planning to initate their own domestic carbon trading schemes. One of the most known schemes is the European Union Greenhouse Gas Emission Trading System (EU ETS), which commenced operation in January 2005. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003.The EU ETS is the cornerstone of the EU's strategy for fighting climate change. It was launched on 2005 and as of 2008 it applies to the 27 EU Member States (including Norway, Iceland and Liechtenstein). For the second trading period EU ETS emissions have been capped at around 6.5% below 2005 levels to help ensure that the EU as a whole, and Member States individually, deliver on their Kyoto commitments and the 20% GHG reduction targets by 2020. The agreed design changes will apply as of the third trading period, i.e., January 2013. It currently covers over 10,000 installations in the energy and industrial sectors which are collectively responsible for close to half of the EU's emissions of CO_2 and 40% of its total greenhouse gas emissions.

6.1 General characteristics of the EU ETS

The EU ETS covers several installations above certain capacity thresholds. These namely are power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants and factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. As for GHG, it currently only covers carbon dioxide emissions, with the exception of the Netherlands, which has opted in emissions from nitrous oxide. The aviation sector will be included in the scheme as from 2012. As from 2013, the scope of the ETS will be extended to also include other sectors and GHG. CO_2 emissions from petrochemicals, ammonia and aluminium will be included, as will N2O emissions from the production of nitric, adipic and glyocalic acid production and perfluorocarbons from the aluminium sector.

The EU ETS is a cap-and-trade programme, where a fixed amount of emissions allowances are allocated to the installations falling under the scheme. Member States decide on the targets for individual sectors or installations through their National Allocation Plans, which have to meet specific criteria. Installations must achieve their individual target by reducing their own emissions on site, alternatively they can purchase emissions reductions (allowances) from other participants or pay a fixed penalty for non compliance.
There are alternative ways of allocating the allowances to the installations in a cap-and-trade system, depending on the criteria selected:

- Grandfathering: the allowances are distributed free of charge to the installations;
- Auctioning: the allowances are distributed at a price, which is often formulated after bidding offers;
- Updating or Performance Standard Rates: The allowances are distributed according to the receiver's efficiency (for instance energy efficiency). The EU ETS does not allow updating in allocation of allowances during a trading phase, but it can take place across phases.

Member states allocated initially emissions allowances among their covered sectors with at least 95% of the allowances allocated for free (or grandfathered) to existing installations for the period 2005-2007, and at least 90% for the period 2008-2012, but with reasonable provisions to allow for new entrants. Taking into account their ability to pass on the increased cost of emission allowances, full auctioning is the rule from 2013 onwards for electricity generators. However, Member States who fulfil certain conditions relating to their interconnectivity or their share of fossil fuels in electricity production and GDP per capita in relation to the EU-27 average, have the option to temporarily deviate from this rule with respect to existing power plants. In other sectors, allocations for free will be phased out progressively from 2013, with Member States agreeing to start at 20% auctioning in 2013, increasing to 70% auctioning in 2020 with a view to reaching 100% in 2027. However, an exception will be made for installations in sectors that are found to be exposed to a significant risk of 'carbon leakage'.

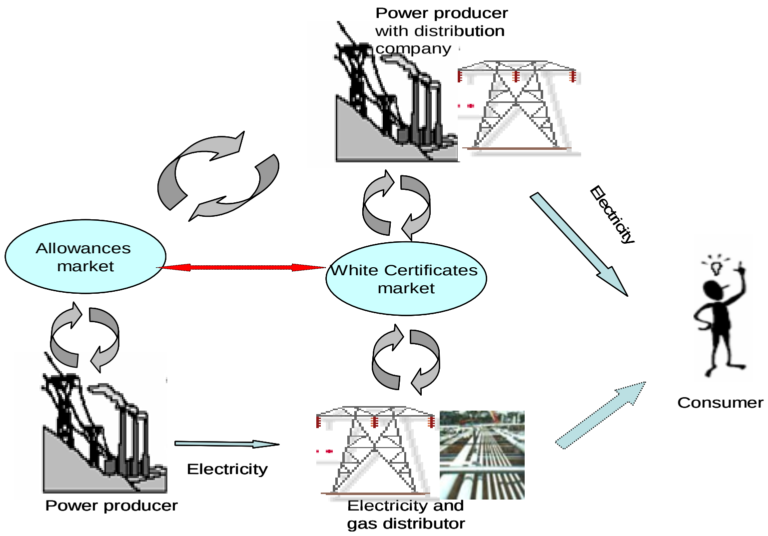
As a result of the scheme, a price increase of the electricity sold in the market, due to higher costs carried over to end users, stimulates the increase of the production, as the marginal profits increase. In contrast, an increase in the price of allowances will result negatively on the energy produced from fossil fuels, since the production of one extra MWh will increase the cost of the power company of buying an extra allowance at a higher price. The level of the increase of the end price is dependent on the elasticity of demand for allowances, the carbon intensity of the energy production and the existence of regulatory tariffs (or the possibility to carry over all costs to end use) (Sorrell 2003).

6.2 Integration of WhC with the EU ETS

There is a growing debate on the relationship of the emissions trading with other market based mechanisms, including WhC schemes. Integrating these schemes, where the one refers to end use electricity and the other on energy production can be a very complicated task, since the conversion WhC to emission allowances puts the threat of double counting: electricity savings are already accounted by the power generators within emissions trading, which produce less CO_2 emissions at their 'pipe'. This complication to integrating end use energy efficiency within emission trading does not hold for non-electricity end use savings in the sectors outside the ETS.

The basic principle in a potentially integrated scheme (see Figure 13) is that energy savings bring a precisely measurable carbon reduction and WhC can be converted into emission allowances that can be sold on the emission market. Allowing certain types of activities in the end use sectors as eligible for the emissions reductions of energy efficiency projects can potentially create a voluntary market for WhC.

Figure 13: Integrated ETS with WhC Schemes



Source: Oikonomou (2004)

Under the current individual schemes, the non-energy suppliers are not encouraged to carrying out energy efficiency projects to end consumers. In a potential integration of the two schemes, generators could have an incentive to invest in energy efficiency services for consumers in order to reduce electricity and gas demand. This decrease, translated in CO_2 emissions will assist them to meet their cap. This option could be strengthened if a specific mechanism within the ETS would be established, that would allow energy producers to acquire allowances from individual energy efficiency projects. An important issue in the design of a hybrid scheme is that emissions reductions achieved by the WhC schemes are relative to the number of consumers of electricity and gas sold, while in the EU ETS the emissions reductions are absolute as determined by the cap (Sorrell et al. 2009).

Furthermore, as the electricity supply companies are often directly linked in ownership terms with power generators or possess their own electricity generation capacity, they can participate in both schemes simultaneously. Middtun and Summerton (1998) distinguished this relation in three categories: Vertically integrated networks, networks integrated by ownership ties and contractually integrated networks. Still, the number of the participants in such a hybrid scheme would be expected to be limited, since the small-scale end users of primary energy, like gas and electricity, that are included in the WhC schemes, do not fall under the ETS. In this case, a basic question is if and how these two certificate markets could interact.

The energy supplier that does not fall into the ETS scheme will be affected solely by the price of energy in the market and the price of the WhC in order to determine the quantity supplied. The analysis of the price effects of the price changes is twofold, since the impacts on the quantity of electricity and gas supplied and on the quantity of the energy saved by energy efficiency projects differ. A rise in the price of WhC will trigger the realisation of energy efficiency projects, since they generate WhC and they can increase the profitability for the market participants. The energy efficiency projects, representing energy savings, must be harmonised with the obligations set to the suppliers, which reflect a quota on the energy they are supplying in the market. The suppliers will hence choose an optimal efficient point, where the allocation of the quantity of energy saved and the quantity supplied will maximise their profits. The same effects can be expected for the price of the energy. Changes in the price of energy in the market will result in direct effects in the behaviour of the energy suppliers. A rise in the energy price leads to a relative increase in the quantity supplied and depending on the opportunity cost of purchasing WhC or paying sanctions, they can possibly decide to disregard their quota. In contrast, an increase in the price of allowances will result negatively in the energy produced, since the production of one extra MW will increase the cost of the power company of buying an extra allowance at a higher price.

An important requirement for the functioning of such as scheme is the harmonisation of the commodities traded, in terms of converting WhC into allowances based on a common conversion factor. This conversion can take place only if a common baseline is introduced, which can be based on the avoidance of produced electricity. The additionality principle entails that baselines could include some variations, depending on the time, location and type of technology being replaced by the energy efficiency investment. This baseline can be determined on the same principles of the JI and CDM procedures. However, a potential obstacle that might arise is the double crediting of the emission reductions. When an energy efficiency project is realised in end use sectors, emissions reductions will be reduced, hence extra allowances are available, whereas they are also credited as the efficiency value of the project. The cost recovery of the investment will consist of two indirect ways, through the rise of the electricity price that consumers will pay and through the emission reduction value of the WhC. This double crediting could eventually lead to a reduction of the overall abatement that could have been achieved if both measures were functioning with separate objectives.

On the practical side of integration, the major difficulty is the fact that emission trading is a cap and trade regime with ex-post measurement, while certificate schemes are baseline-and-credit ones with a large share of ex-ante measurement. Furthermore an integrated WhC/ETS scheme requires robust tracking and data management across markets, which can increase administrative costs. For instance, the accounting for the carbon savings reflected in both instruments through a conversion rate for both certificates is a critical issue, since a fixed rate might not reflect the true CO_2 reduction if it is not updated in the course of time and following the new energy efficient technologies. Nevertheless, if monitoring and verification procedures are standardised and clear rules for the conversion of certificates are established, a hybrid scheme could entail a significantly low cost, thus improving the overall cost efficiency of the system in achieving the desired objectives.

There are three possible options of integrating these two schemes:

- one-way fungibility;
- two-way fungibility;
- set-aside quotas.

One way fungibility

In this case energy suppliers under WhC obligations can trade them into the ETS and convert them into allowances if these certificates originate from an overcompliance of the energy savings target, but not vice versa. This process can guarantee that the required energy savings target is met and further incentives for exceeding the target are provided. The effectiveness of this interaction will depend on the relative marginal cost of the household energy efficient measures in order to accomplish the efficiency target and the price of the allowances in the market. If banking of WhC is allowed, then suppliers can opt for banking their surplus WhC and convert them to allowances in the next period, if the expected price of the latter is higher, financing thus their extra investments.

Two ways fungibility

In this case energy suppliers that overcomply with their energy savings target can convert WhC into ETS allowances, but they can also convert allowances to WhC, under specific conditions, to meet their energy savings targets. This renders both commodities competitive in the market and their price difference will determine suppliers or producers' preferences towards trade. A possible drawback of this case is that there is no guarantee that energy savings are met.

A volatility of prices of the two certificates that determines the direction of trade, could be provoked by the stringency of the targets to be achieved for the future period. A more stringent CO_2 target for instance, will drive many installations that cannot reduce their emissions to increase their demand for allowances. This, under a relatively stable supply of allowances, will result in the rise of the price of the allowances but in the meantime decrease in the price of the WhC, as their supply in the market will increase.

In both cases examined above, one practical issue under debate is the accounting of the carbon savings reflected in both instruments. This stems from the definition of a conversion rate for both certificates, since a fixed rate might not reflect the *true* CO_2 reduction if it is not updated in the course of time and following the new energy efficient technologies. The amount of the certificates converted to one form or another will be influenced also by the banking regulations accompanying each instrument. Two-ways fungibility may compromise the environmental soundness of certificate systems, since all WhC projects have a carbon component/value, but not all carbon projects have an energy component/value. This could even result in undermining the overall effectiveness of both schemes.

Set aside quotas

This way enables the one way fungibility approach (converting WhC into ETS allowances), but a certain share of allowances are kept set aside by administrator and dedicated to certified CO_2 emission reductions from end use energy efficiency and renewable energy. Set aside quotas ensure that a certain number of WhC enter the ETS market, reducing hence their price volatility and the risk of a price collapse of allowances. In order to avoid double-counting and a strong bias towards investments in energy intensive industry, only end use energy efficiency measures not undertaken in EU ETS sectors could be converted into CO_2 emission reductions. In this way the risk of double counting a same measure would be avoided and the realisation of energy savings measures in end use sectors. Furthermore, it will not compromise the environmental integrity of the emission cap because renewable and energy savings projects have a carbon component. A precondition in this case is the compatibility of WhC and ETS allowances. The conversion of a WhC into an EU ETS allowance should be completed on the grounds of the evaluation of CO_2 emissions abated, as determined from the MWh saved from energy efficiency measures.

6.3 Integration of WhC with the EU ETS and TGC

According to the EU Directive establishing the ETS (EC 2003), domestic projects that reduce GHG emissions should be allowed to issue emissions allowances provided they comply with conditions required to safeguard the functioning of the ETS. This envisioned flexibility of the scheme could provide some space for the integration of certificate mechanisms addressing energy efficiency or RE deployment within the ETS. To this end, discussions have taken place on accepting at a certain extent GHG reductions from TGC or WhC schemes within the ETS. Linking between the EU ETS for instance and other tradable GHG currencies established under the Kyoto Protocol has attracted much attention and has been embodied in the Article 25 of the Emissions Trading Directive and in the Linking Directive.

In fact, several market barriers investments in energy efficiency measures and in RE under the ETS. To this end, integrating WhC and TGC schemes to the ETS could address these barriers and assist in achieving multiple targets. As an example, if an industrial plant reduces its electricity consumption, under the ETS that accounts for direct emissions, it does not receive any carbon reduction benefits (unless a share of electricity is generated within the plant). A WhC or TGC scheme could assist in financing the plant's more efficient energy use. Other market barriers that could be overcome by using WhC or TGC schemes in the ETS are those of misplaced incentives. More in detail, the ETS covering only direct emissions provides negative incentives to new industrial CHP plants participating in the scheme, and can encourage the extension of lifetime of existing or older boilers. In other words, an industrial plant can increase its on site emissions under ETS by replacing a boiler with CHP, but the economic incentive is not there, unless the electricity price renders this investment competitive (i.e., price increases due to ETS scheme).

Furthermore, both WhC and TGC schemes reduce CO_2 from electricity generation, where the former reduce electricity demand under the same output, while the latter reduce emissions from displacing conventional fuel electricity by RE generation. When both schemes are integrated, they can trigger investments towards energy producers, which can trade-off other (often cheaper) abatement measures or purchase emissions allowances. Irrespective of that, the overall direct emissions of their plants remain unchanged, so there is a risk that only an increase in the ETS could take place. This risk can be avoided by setting a high TGC or WhC target and when applied in an international (or EU) level (as most of them so far are national schemes and do not have an impact on the overall EU ETS).

In order to render such a scheme operational, two possible ways are discussed in policy debates: through an integrated target (quota) of energy efficiency and RE deployment, or integrating certificate markets of TGC and WhC. In the case of an integrated quota, there is a risk that most investments will be driven towards 'low hanging fruit', which in this case are zero cost energy saving actions, while RE technologies might be locked out. Furthermore, a common quota from a demand (energy efficiency) and supply (RE) side, which both target at reducing the dependence on fossil fuels, are criticised, as they carry with different sets of costs, benefits, timing, and regulatory issues and therefore they could be kept as parallel mechanisms. The counterargument of that is that RE and end use energy efficiency are the two building blocks of such a comprehensive strategy to cover the entire energy chain: from production to obtaining useful service from the energy delivered at the point of final consumption.

In all cases, the for and counter arguments hold if the objective of the ETS is not confined to the cost effectiveness of covered sectors, but aims at broader economic and societal issues. If the case is only to maintain the integrity of a carbon market and carbon caps, then eventually other policies (not certificate based ones) are more suitable for directing energy efficiency or RE actions. However if a GHG cap-and-trade regime is taken from a broader societal perspective, then an intervention to bring more energy efficiency measures and RE sources may be desirable even if such an intervention increases the overall costs of compliance.

7 Drawbacks and advantages of implementing White Certificates

With the gradual opening of European electricity and gas markets to competition, new policy tools are needed to promote energy efficiency in end use that are compatible with market conditions. Apart from complying with this requirement and often being more acceptable than, for instance, taxation, market-oriented schemes are likely to change mindsets. Harnessing market forces to deliver energy savings may thus focus the attention of businesses on the economic benefits of demand-side energy efficiency and energy services and hence stimulate both investments and the ESCO industry.

The concept of WhC is debated among policy cycles and there are many options in favour and against it. One of the strongest arguments supporting WhC is that under competitive market forces they minimise the energy efficiency costs to society. Nevertheless, market trends demonstrate that a fully competitive market in the electricity supply industry in the EU at least is not the case so far. There is a trend in reconsolidation in the energy market, while in the last decade several mergers of EU suppliers have taken place, let alone the introduction of incumbent EU 15 electricity companies to the central-eastern EU markets. This can lead to higher administrative costs for such schemes reducing substantially their effectiveness.[13] Still, the scheme's trading component leads to an equalisation of marginal costs of compliance with the energy efficiency target, while it creates financial incentives to stimulate innovation. Below we present some main arguments for and against WhC presented in each country where this scheme is being implemented and some general ideas on their potential role in transition economies.

7.1 Italy

The Italian WhC scheme has gained support from stakeholders, as it has proved to combine command and control measures (energy saving mandatory target) with certificate trading and elements of tariff regulation (as distributors can recover some of their costs via electricity and gas tariffs). Furthermore, from a theoretical view, the scheme is politically accepted as it establishes a negotiated target between an objective entity (an amount of energy efficiency titles) and a more volatile entity, such as the energy savings themselves. This is essential in the market phase, when an obliged actor needs to demonstrate quantitative compliance with his own savings targets.

The main opposition against the implementation of the scheme is due to its complexity of setting rules and applying it in the market. This is also enforced by the fact that standardised assumptions employed for the validation of energy savings can result under- or over-compensating certification evaluations. Finally, another risk is connected to the conventional

[13] A detailed economic analysis on the effects of WhC with other instruments in oligopoly energy markets can be found in Oikonomou et al. 2010.

savings persistence of 5 years assumed for most measures, which is likely to penalise the implementation of measures with longer lifetimes and capture only the ‘low hanging fruit’.

7.2 The UK

The EEC was identified in the UK as the most cost effective way to meet energy policy goals. It was consistent with the great interest of reducing energy intensity and for policies suitable to cope with climate changes. Moreover, energy efficiency obligations are also more straightforward for companies, which do not have energy efficiency in their core business.

Still many considerations during the functioning of the scheme (EEC1 and EEC2) led to the identification of several risks and finally to its redesign. One of the biggest risks is probably the uncertainty of the cost evaluations. Expected costs, expected impact on prices and expected energy savings can be worked out with a variety of methods; still, all these items will have to be monitored and potentially all the instruments have to be adjusted if a need for tuning arises.

Another risk in the UK scheme is connected to the possible inability of manufacturers to keep pace with the needs driven by the fast target increase required in the scheme. This can induce potential monopolistic behaviour of suppliers of energy saving equipment and eventually risks on price.

A third problem is connected to an insufficient amount of publicity. A scheme like EEC must be supported with a consumer-awareness campaign; otherwise the scheme potentially will not attain the expected goals. The Energy Saving Trust actually devoted funding to this specific purpose in EEC. A last possible demographic reason for risks in EEC can be envisaged in the disproportion of the measures that have to be installed in the so-called “priority groups” and the actual customers portfolio of the suppliers.

7.3 France

A WhC scheme was selected in **France** for its lower public budget burden than other policy instruments. Furthermore, it triggers diffusion of existing and innovative technologies and links obliged parties with the energy efficiency market. In addition, energy efficiency stimulation increases the environmental awareness and resolves economic problems originating from the inefficient use of energy. Other envisaged benefits of the scheme are that it allows the introduction and financing of new technological measures and that the scheme is fully adapted to energy market liberalisation. Debated issues still in France are the eligibility of actors and technologies, transaction costs and whether a WhC is a system on its own or mainly a market.

7.4 Role in transition economies

Taking all the advantages and disadvantages of WhC schemes into consideration, an issue that could be addressed is whether they are suitable for transition economies. Within the framework of the Kyoto Protocol and its flexible mechanisms, there could be established a possible link between WhC and CDM or JI projects, depending on the status of the host country. More specifically, given the growing interest towards JI and CDM projects, only 18% of JI projects (out of 193) and 15% of CDM projects (out of 4,532) currently in the pipeline are in energy efficiency (Romani 2009). An introduction of WhC schemes in transition economies could render such projects financially viable and attract further investments in order to untap these countries’ energy saving potential. The necessary precondition of course is that a link is established between national energy efficiency policies and the Kyoto Protocol mechanisms. Based on a study conducted for the Netherlands and Bulgaria (Oikonomou and van der Gaast 2009), where a WhC scheme was combined with JI credits from the built environment, it was shown that it can be complementary and enhance energy efficiency improvement in a national and international level. Alternative options could be the linking of WhC with existing Green Investment Schemes, which are already functioning in Central and Eastern Europe.

Nevertheless, as demonstrated in the earlier sections of this report, the overall outcome of a WhC scheme will depend exclusively on its design characteristics. In other words, a complex scheme requiring several administrative procedures will tend to increase such costs and render energy efficiency actions as inefficient. Given the policy environment in several transition economies, where administrative burdens can still be significant, a WhC scheme should be designed in such a way that it requires the minimum effort from implementing and monitoring bodies.

In terms of objectives, a hybrid scheme can facilitate electricity and gas suppliers to achieve their obligations through implementing cost-effective energy efficiency projects in another country. Furthermore, it can contribute to security of energy supply in the host countries for the JI projects and provide incentives for long term spillovers, given that free riders and rebound effects are dealt with.

In terms of cost-effectiveness, WhC can achieve both reduction of GHG emissions and energy efficiency improvement at a relatively lower cost due to flexible options provided to energy suppliers. The range of costs will be determined by transaction and administrative costs, which can increase if policymakers opt in for a complicated design. Effects on innovation and diffusion of new energy efficient technologies can be positive through basically supplier's and ESCOs' efforts to increase market shares under a WhC scheme.

In general, effects of such schemes on innovation are rather difficult to estimate since (local and foreign) market demand, competitiveness between technologies, existing energy saving potential, and transaction costs will determine the overall situation. A WhC/JI scheme in the aforementioned study can have positive effects such as employment and an increase in environmental awareness. Finally, such a scheme can be rather promising in terms of market effects given the market oriented character of both policy instruments, since it can be compatible with energy market liberalisation and increase competitiveness of specific "cleaner" technologies.

These results will depend mainly on the level of preparation and readiness of transition economies, which host JI or other energy efficiency mechanisms. As the WhC scheme requires obligations to energy suppliers and the creation of a market for a new commodity (i.e., WhC), countries implementing currently simpler and more basic energy efficiency policies can at this stage gather information on the effects of WhC schemes in other countries. A consistent knowledge of the transition country's energy market and the responsiveness of market players towards energy efficiency is required, therefore experiences from existing policies should be transferred and translated into policy knowledge for an effective design of a WhC scheme (see for instance Poland that as a transition economy experimented with several market based mechanisms and is a pioneer in Central and Eastern Europe on WhC). Alternatively, obligations towards energy efficiency could be sufficient, as trading in a scheme that is limited in scope can increase administration costs and may not justify the efficiency gains of trading for obliged parties and society. Furthermore, another characteristic of transition economies is often the rising energy prices, where the energy market initiated its liberalisation, which could be seen as an obstacle and an opportunity for the implementation of such schemes. An elaborate scheme with obligations on energy suppliers could result in further increase of energy prices, as a way of carrying over the costs from energy efficiency projects (without being able to finance them through WhC trading in an immature market), which could lead to political opposition towards the scheme. In contrast, increasing energy prices could trigger the correct signal towards energy saving and open possibilities for cost effective projects, given the enormous untapped potential for energy efficiency in the transition economies.

On the whole, WhC schemes can adapt and function in several market conditions and generate energy savings, but they should not be considered as a panacea, as other complementary instruments are deemed necessary in order to guarantee their effectiveness. WhC schemes can be a sound instrument from its basic principles, as it makes use of market forces and can assist in overcoming market barriers towards energy efficiency, and we expect that it can be integrated with other policy instruments and allow cost-effective achievement of multiple environmental objectives. In order to render these interactions economically viable and effective, some preconditions on the design phase of WhC schemes must be fulfilled:

- A binding long-term target must be clearly set under a WhC policytimeframe – reducing regulatory uncertainties for market actors;
- Standardised common procedures must be employed for energy savings calculations (for instance baseline setting, "deadweight" and others). Furthermore, standardised full cost accounting systems, ex-ante monitoring and verification of energy savings, streamlined procedures, and standardised trading contracts must be employed in order to reduce transaction costs. The main target in this respect is to minimise free riding behaviour, which can be achieved partly by limiting certification of WhC to projects that are not fully commercially available and highly likely to be implemented even without a support mechanism;
- A proper market must be established, thereby ensuring the participation of numerous actors (e.g., avoid oligopolistic market conditions, increase liquidity, etc.). Experience from schemes shows that the WhC market should be large and liquid, in order to avoid market power of players and eventual high certificate prices;
- In order to keep compliance costs low, market conditions should be such that the tradability of WhC is guaranteed;
- A concrete penalty should be set and publicly known before the implementation of a WhC scheme, in order to provide in advance correct market signals and let obliged parties develop their investment plans and further market strategies. This penalty for not purchasing a certificate or complying with the target should be at least higher than the expected WhC price. This means that if different countries participate the lowest penalty must exceed the expected marginal generation costs (minus market price for electricity) within the system;
- Transparent and fair cost-recovery mechanisms and effective enforcement by the authorities are crucial;
- WhC schemes should be as technology neutral as possible, so that they can create competition among different energy efficiency technologies and avoid lock-in/out market situations. The energy efficiency target should not address only the 'low hanging fruit' that could also be diffused in the market without an extra policy. Innovative technologies can also be stimulated parallel to WhC through additional stimuli from existing instruments, however clear definition about additionality is required.

Abbreviations

AEEG: Italian regulatory authority for gas and electricity
BAU: Business as usual
CERT: UK Carbon Emissions Reduction Target
CFL: Compact Fluorescent Lamp
CHP: Combined Heat and Power
CO_2: Carbon Dioxide
CO_2eq: Carbon Dioxide equivalent
EEC: Energy Efficiency Commitment
EDF: Électricité de France
ESCOs: Energy Service Companies
ETS: Emissions Trading Scheme
EU: European Union
EU ETS: EU Emissions Trading Scheme
GGAS: Australian Greenhouse Gas Abatement Scheme
GHG: Greenhouse Gas
IEA: International Energy Agency
IPCC: Intergovernmental Panel on Climate Change
KWh: KiloWatthour
M&V: Measuring and Verification
Mtoe: Million Tons of oil equivalent
MWh: Megawatt hour
NGAC: New South Wales Greenhouse Abatement Certificates
OECD: Organisation for Economic Cooperation and Development
OFGEM: Office of Gas and Electricity markets
PI: Policy Interactions
PJ: PetaJoule
PV: Photovoltaic
R&D: Research and Development
RE: Renewable Energy
SO_2: Sulphur Dioxide
TGC: Tradable Green Certificates
Toe: Tonne of Oil Equivalent
UNFCCC: United Nations Framework on Climate Change Convention
WhC: White Certificates

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