Assessment of White Certificate Schemes and their Energy Saving Evaluation Methods

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Abstract

Recently a number of countries have introduced market-based instruments to foster energy efficiency improvements. Some of these schemes are based on quantified energy savings obligations imposed on energy distributors or suppliers, coupled with a certification of the energy savings (via white certificates), and a possibility to trade certificates. The paper presents an up-to-date review of white certificate schemes in Europe, and analyses results achieved so far. It discusses design and operational features that are key to achieve the overall saving targets. Delineation of the scheme in terms of eligible projects, technologies and obliged parties, institutional structure and processes to support the scheme are among the issues discussed. Energy saving evaluation methods are central to the present discussion.

Introduction

Energy efficiency is a sound part of the environmental and climate change agenda and contributes to meeting the goals of improved security of energy supply, economic efficiency and increased business competitiveness coupled with job creation and improved consumers' welfare. The Green Paper on Energy Efficiency states that by 2020 the European Union (EU) could save at least 20 % of its energy consumption in a cost-effective manner (European Commission 2005) and lists a number of options to achieve this. The Directive on Energy End-Use Efficiency and Energy Services aims at fostering cost effective improvement of energy end use efficiency and at transforming and promoting the market for energy services.

The other main direction in EU energy policy is the restructuring of electricity and gas markets. A new Directive was adopted in June 2003 on market liberalization (2003/54/EC) and all customers will be able to choose their supplier by 1 July 2007 at the latest. The effects of liberalization on energy efficiency are versatile: falling prices give rise to short term approaches from suppliers focused on maximizing turnover and may make suppliers hostile to action beyond the consumer's meter. At the same time improved efficiency at the demand side may be fostered by suppliers trying to retain consumers and attract new ones by offering energy services as 'added value' to the offer of an otherwise homogenous commodity such as electricity.

A key policy challenge is to establish long-term synergies between the energy sector liberalization and end-use energy efficiency. A possible market-based policy portfolio oriented towards end-use energy efficiency could comprise **energy-savings quota** (obligations) for some categories of energy market operators (distributors, suppliers, consumers, etc.) coupled with a trading system for energy-efficiency measures resulting in energy savings. The savings would be verified by the regulator (or the national authority charged with this role) and **certified by means of the so-called "white" certificates** (certificates for energy savings). In addition, in some national implementations also other subjects without the obligation can certify the energy savings from eligible projects implemented and sell the white certificates, thus generating an additional stream of revenue for themselves, increasing the certificate market liquidity and allowing the operators under obligation to reach their obligations at lower cost. In this way tradable white certificates allow greater flexibility and the implementation of the most cost effective measures, thus

potentially minimizing the overall costs of compliance for obliged parties (perfect markets assumed). A comprehensive discussion on the cost-effectiveness and environmental effectiveness of this policy instrument, compared to other energy efficiency policy instruments is available in Bertoldi & Rezessy (2006).

In principle a tradable certificate for energy savings (TCES) portfolio involves five key elements (Bertoldi & Rezessy 2006, Bertoldi et al. 2005b, Langniss & Praetorius 2003, Pavan 2002, 2003): (a) the creation and framing of the demand; (b) the tradable instrument (certificate) and the rules for trading; (c) institutional infrastructure to support the scheme and the market (measurement and verification, evaluation methods and rules for issuing certificates, a data management and certificate tracking system and a registry); (d) a cost recovery mechanism in some cases; and (e) sanctions in case of non compliance.

A white certificate is both *an accounting tool*, which proves that a certain amount of energy has been saved in a specific place and time, and a *tradable commodity*, which belongs initially to the subject that has induced the savings (implemented a project) or owns the rights to these savings, and then can be traded according to the market rules, always keeping one owner at the time. As for renewable electricity certificates (aka green certificates), the value of the white certificate is different from the value of the saved energy.

This new policy instrument, based on the quota principle, whereby governments set targets (obligations) and leave the market operators choose how to achieve them, is dependent upon the existence of a sound monitoring and evaluation mechanism, because any saving carried out under the scheme needs to be monitored and certified, thus allowing an easy assessment of the overall policy instrument.

In the sections to follow we provide an overview of the elements of schemes that involve energy savings targets and a possibility to trade certified energy savings or savings obligations. We look at the different arrangements of these in the three existing schemes in Europe. While these schemes are conceptually similar, the implementation shows some marked differences.

Tradable Certificates for Energy Savings: Review of European Experiences

Variations of this policy mix have been introduced in Italy, Great Britain, and since January 2006, also in France. In the Flemish region of Belgium there are savings obligations imposed on electricity distributors without certificate trading option. The first scheme in the world with a white certificate trading element has been introduced in New South Wales (Australia); it is however a GHG trading system that has an end-use energy efficiency element. A white certificate scheme has been under discussion in The Netherlands for a while, however the final discussions between the possible subject under obligation and the government are still on going. It is expected that the white certificate scheme will be finalized and adopted in 2007. Other European countries, such as Denmark, have expressed interest in introducing white certificates schemes. The European Directive on energy end-use efficiency and energy services (EU 2006) defines "white certificates" as follows: "certificates issued by independent certifying bodies confirming the energy savings claims of market actors as a consequence of energy efficiency improvement measures". The same Directive confirms the interest for this policy instrument stating that "the Commission shall examine whether it is appropriate to come forward with a proposal for a directive to further develop the market approach in energy efficiency improvement by means of white certificates."

The **Italian** scheme became operational in January 2005 (Pavan 2002, 2004, 2005)[1]. Here energy savings targets are combined with tradable certificates for energy savings issued to electricity and gas distributors and energy service companies (ESCOs), as well as with a cost recovery mechanism via electricity and gas tariffs or dedicated funds in some circumstances. The targets are expressed in primary

[1] The original plan was to start the scheme in 2002, however strong opposition by the distributors coupled with the complexity in setting all the verification methods resulted in a considerable delay

energy consumption (tones of oil equivalent, i.e. toe) and imposed on electricity and gas grid distribution companies with more than 100,000 customers as of the end of 2001. For the time being targets are set on an annual basis for the period 2005-2009. Targets for the post-2009 period are to be fixed by the Government by the end of 2007. Current targets are just for savings achieved each year and do not include expected savings in the future. In the fifth year of the current phase approximately 3 Mtoe of primary energy savings/year are projected to be realized, of which 1.6 Mtoe/year by electricity distributors and 1.3 Mtoe/year by natural gas distributors (about 1.5% of gross inland consumption in Italy). On the whole, the mechanism is planned to deliver energy savings equivalent to 5.8 Mtoe (243 PJ) in the five year target period.

In **Great Britain**, the Energy Efficiency Commitment (EEC) runs in 3-year cycles from 2002 to 2011. The EEC-1 program required that all gas and electricity suppliers with 15,000 or more residential customers deliver a certain quantity of 'fuel standardized energy benefits' by assisting residential customers to take energy-efficiency measures in their homes. The overall savings target was 62 fuel standardized TWh[2] and the total delivered savings reached 86.8 TWh (Mansero 2005). In EEC-2 (2005-2008) the threshold for obligation has been increased to 50,000 domestic customers. The target has been increased to 130 TWh. Due to carrying over of savings from EEC-1, already in 2005 more than a quarter of this target has been achieved. Certificate trading is not a feature of the scheme in Great Britain. In July 2006, the Government initiated a consultation to solicit early views on EEC3 (for the period 2008-11), and to inform its thinking for a statutory consultation scheduled for spring 2007.

In the **French** system obligations are set for energy suppliers delivering electricity, gas, domestic fuel (not for transport), cooling and heating for stationary applications. A threshold for the imposition of a savings target is set at 0.4 TWh/year (or 5,000 liters in case of domestic fuel). Obliged actors have received targets in proportion to their market sales in the residential and commercial sectors. The obligation covers the period 2006-2008. Annual adjustments of the individual obligations are made to take into account variations in the market. The system excludes plants under the EU ETS Directive and fuel substitution between fossil fuels, as well as energy savings resulting from measures implemented to comply with current legislation. The total target for the first three years is 54 TWh (in final energy, i.e. 197 PJ) cumulated over the life of the energy efficiency actions with a 4 % discount rate. The expected cost of action is below 20 Euro/MWh (Baudry & Monjon 2005).

Table 1 summarizes the basic features of the three major European white certificate systems in place. The following section provides an expanded discussion on the operational design features.

[2] Energy savings are discounted over the lifetime of the measure and then standardized according to the carbon content of the fuel saved. These coefficients are set as: coal (0.56), electricity (0.80), gas (0.35), LPG (0.43) and oil (0.46)

Table 1. Features of existing white certificate systems in Europe

	UK (EEC 2, 2005-2008)	Italy	France
Unit of target	TWh fuel weighted energy benefits	toe, annual	TWh lifetime discounted
Duration of current phase	2005-2008	2005-2009	2006-2008
Sectoral coverage for eligible projects	Residential consumers only	All consumers	All consumers (no measures for plants covered by the ETS)
Restrictions on compliance	50 % from 'priority group' (low income consumers on social benefits).	50 % from reduction in own energy sector (electricity and gas).	
Obliged parties	Electricity and gas suppliers above 50,000 residential customers served (15,000 in EEC 10)	Electricity and gas distributors above 100,000 customers served	Electricity, gas, LPG, heat, cold and heating fuel suppliers with energy sales of 0.4 TWh/year or greater
Trading	No certificates; Obligations can be traded; Savings can be traded after own obligation met; No spot market; One-way trade in national emission trading scheme;	Certificate trade; Spot market sessions; OTC trading;	Certificate trade, only bilateral exchange
Institutional structure	Energy regulator OFGEM	Energy regulator AEEG + electricity market operator GME	Ministry of Industry + French Agency for Energy Management (ADEME)
Penalty	No specific guidance on how penalty would be calculated; Penalty can be as high as 10 % of the supplier's turnover.	Fixed by the Regulator taking into account, *inter alia*, the actual possibility to meet the target (i.e. number of certificates issued as compared to the annual target), the magnitude of the non-compliance, the state of affairs of the non-compliant party.	0.02 Euro/kWh

White Certificate Schemes: Project Eligibility and Implementation Details

The following sections provide the definitions and initial experiences with the following parameters in use by existing European white certificate schemes: (a) eligible projects allowed; (b) institutional infrastructure and processes to support the scheme; (c) energy savings evaluation methods; and (d) trading rules and tools to stabilize the market. A comprehensive discussion of these and other design and operational features is available in Bertoldi & Rezessy 2006.

Eligible projects. In *Italy*, projects in all end-use sectors are eligible. At least half of the target set for each single year should be achieved by reduction of the supplied energy sector, *i.e.* electricity and gas uses (a.k.a.

the "50 % constraint") (Pavan 2002). The remaining share can be achieved via primary energy savings in all the other end-use sectors. There is an illustrative list of eligible projects. Energy savings projects contribute to the achievement of targets for up to 5 years (with only some exceptions). Only savings that are achieved over and above spontaneous market trends and legislative requirements count against the targets (additionality criterion).

Energy savings accredited by the Regulator in 2005 (Autorita 2006) come from co-generation and district heating (21%); building electricity consumption, appliances and lighting (33%); energy efficiency improvements in heating systems and building insulation in the households and the commercial sector (14%), and public lighting (27%). The remaining share comes from reductions of industrial energy consumption (5%). On the basis of energy savings accredited so far it can be said that both the overall target for the electricity distribution sector and the total target for the natural gas sector have already been achieved[3], with a *surplus* of certificates to be banked for the following years. The largest part of these savings comes from early actions: in the first operational year of the scheme (2005) the Regulator had to certify many projects implemented since the original starting date of the scheme (2002). Therefore many more 'new' projects will be needed in order to guarantee the achievement of the targets for future years.

In *Great Britain* only activities concerning domestic users are eligible. At least 50% of the energy savings must be targeted at customers that receive income related benefits or tax credits (i.e.,. priority group)as this condition contributes to the governmental objective of fuel poverty eradication. Projects can be related to electricity, gas, coal, oil and LPG. Suppliers can achieve improvements in relation to any domestic consumers in the UK. A non-exclusive list of measures is included within the illustrative mix for EEC 2005-2008. Measures that are related to the reduction of energy sectors other than the one supplied by the obliged party are allowed. Experience from EEC-1 in Great Britain shows that a significant share (56 %) of the 86.8 TWh of savings delivered in the period 2002-2005 came from building insulation (wall and loft). CFLs accounted for 24% of the savings achieved, followed by appliances (11 %) and heating measures, mainly condensing boilers (9 %; Mansero 2005, Lees 2006). In table 2 the list of the measures undertaken under EEC-1, seventeen measures accounted for 98.7% of the energy savings (Lees 2006). CFLs accounted for the largest number of projects undertaken (almost 40 million measures related to CFL installation in EEC-1), followed by almost 6 million refrigerators, freezers and washing appliances (Lees 2005). All suppliers, but two – who went into administrative receivership – achieved their targets; six suppliers exceeded their targets in EEC-1 and carried over their additional savings to EEC-2. Suppliers can receive a 50% uplift on the savings of energy efficiency measures that are promoted through energy service activities. This uplift is limited to 10% of the overall activity.

Table 2. Energy Efficiency Measures Accredited under EEC-1 (source Lees 2006)

Cavity wall insulation	**Condensing boilers**
Loft insulation	**Heating controls (electric and fossil fuels)**
DIY loft insulation	**Thermostatic radiator valves**
Draft stripping	**New central heating**
Hot water tank insulation	**Upgrading electric or coal fired heating systems**
External wall cladding	**to gas central heating**
Insulation of pipes and valves	Ground source heat pumps
Radiator panels (including DIY)	Combined heat and power
Refrigerators	Replacement of district heating boilers with energy
Fridge Freezers	efficient ones

[3] Note that for the gas sector the distributors under obligation cover only 60% of the total number of customers and accordingly the initial target of 100,000 toe for the first year has become an actual target of 58,000 toe.

Freezers **Washing machines** **Dishwashers** Jug kettles	Kiltox heat fans **Compact fluorescent lamps** **Luminaires designed to only take CFLs**

Apart from plants under the EU European Emission Trading Scheme (ETS) Directive, fuel substitution between fossil fuels and savings resulting just from measures implemented only to conform to current legislation, no other restrictions on compliance are foreseen in the *French* scheme. Any economic actor can implement projects and get savings certified, as long as savings are above 3 GWh over the lifetime of a project, although it is possible to pool savings from similar actions to reach the threshold. Actions must be additional relative to their usual activity. All energies (including fuel) and all the sectors (including transportation and excluding installations covered by the ETS) are eligible. Certification of projects implemented by organizations, which do not have a savings obligation is allowed but only after considering the impact of the project on their business turnover. If an impact on business turnover is identified, then certification of savings is allowed only for innovative products and services. An innovative product in this context means that its efficiency is at least 20 % higher compared to standard equipment and its market share is below 5 %.

Institutional infrastructure and processes to support the scheme. A sound institutional structure is needed for a white certificate system to function, including administrative bodies to manage the system as well as processes such as verification, certification and market operation, transaction registry, detection and penalization of non-compliance.

Under the EEC in *Great Britain* the regulator OFGEM manages project evaluation and approval, verifies savings and manages the data. In *Italy* the regulator AEEG implements the scheme; the marketplace is organized and managed by the electricity market operator GME according to rules and criteria approved by AEEG. GME issues and registers certificates upon specific request by AEEG, organizes spot market sessions, and registers bilateral, over-the-counter contracts according to rules set by AEEG (Pavan 2002). In *France* certificates are issued by the Ministry of Industry, while the French Agency for Environment and Energy Management and the ATEE are in charge of the definition of standardized projects and their evaluation methods. The certificate register has been recently (February 2007) delegated to LOCASYSTEM International. This company will be in charge of maintaining the list of certificates issued by the administrative authorities and publishing a "certificate average market price" in case of trading operations.

Energy saving verification

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 such as occupancy levels, level of production etc. Certificates can therefore be issued either *ex-post* and thus they represent the energy saved over a specified period of time, or they can be issued *ex-ante* and thus represent an *estimate* of the energy to be saved over a specified 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 latter option will make the system more comparable to a green certificate system where the certificate has a unique time of issue attached to it, indicates the period over which and the location where energy has been saved, and by whom it has been saved (initial owner of the certificate). However, ex-post certification will probably increase validation efforts and verification costs. Alternatively, for projects that can be evaluated through a standard savings approach, certificates can be granted *in advance* (*ex ante)* of the actual energy savings

delivery. This will mitigate liquidity constraints of project implementers and allow them to finance new projects. If 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[4].

Depending on the design of the scheme the role of the regulator may or may not include the issue of certificates and verification of savings. For instance, third parties may be licensed to evaluate and approve projects, verify savings and issue certificates. The role of the regulator would then be to accredit third parties and audit their performance. It is not so crucial which body issues the certificates provided that these are based on verified data, which can come from the energy regulator (as is the case in Italy) or from a certified verifier.

Baseline definition and the additionality criterion are two issues of particular importance for the proper evaluation of actual energy savings realized. 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 due to technical and market development trends and other policies in place[5].

In *Great Britain*, the Department for Environment, Food and Rural Affairs (DEFRA) requires suppliers to demonstrate additionality. Concerns have been raised that energy suppliers can claim the total energy savings that flow from a partnership project towards their EEC target regardless of the actual financial contribution made by the supplier.

In *Italy*, as already mentioned, savings have to go over and above spontaneous market trends and/or legislative requirements (Pavan 2004, 2005). For stipulated savings and savings involving engineering calculations (see explanation below) the additionality criterion is embedded in the choice of the baseline/reference technology within the deemed savings calculation and the engineering evaluation algorithm respectively. For projects not covered by deemed savings or engineering methods, project developers have to demonstrate additionality within their methodological proposal, that has to be approved by the Regulator before it can actually be applied. The accepted technological baseline is the average technology sold at the national level to produce the same level of energy service (unless more stringent legislative requirements exist).

The *Italian* scheme uses three **valuation (measurement and verification, M&V) approaches**. (1) A deemed savings approach with default factors for free ridership, delivery mechanism and persistence, and that does not require onsite measurements. (2) An engineering approach, with some onsite measurement. (3) A third approach based on monitoring plans whereby energy savings are quantified via a comparison of measured or calculated consumptions before and after the project, taking into account changed framework conditions (e.g. climatic conditions, occupancy levels, production levels). In the latter case, all monitoring

[4] One should note however that this suggestion is rather difficult to implement in practice for two major reasons. First, it requires the monitoring and evaluation of the actual energy performance of the project in order to allow the comparison between the lifetime energy savings accredited in advance and the real savings. Second, most of the energy saving measures have quite long lifetimes, therefore the comparison between real savings and accredited savings could only be made many years in the future (and many years after the first compliance checks).

[5] In practice projects tend to have a mix of public and private benefits, but the cost of disaggregating these benefits and precisely accounting for the exact share of no-regret measures in a larger action may be prohibitively high. One way of overcoming this problem would be to place an objectively defined discount factor on investments, which accounts for these private benefits. Minimum efficiency requirements or current sale weighted average efficiency levels, electricity price and the effects of the EU ETS and other policies in place (such as taxation or standards) should also be accounted for in the baseline to ensure genuine additional savings from the policy instrument "white certificates".

plans must be submitted for pre-approval to the regulatory authority AEEG and must conform with pre-determined criteria (e.g. sample size, criteria to choose the measurement technology, etc. See Pavan 2004, 2005). Most of the projects submitted to date are of the deemed saving and engineering methods. There is ex-post verification and certification of actual energy savings achieved on a yearly basis[6] (Oikonomou et al. 2004 and references herein). In 2005 for 70% of the certified saving the deemed saving approach was used, the engineering approach was used for about 20%, while the monitoring approach was[7] used only for 10% of the certified savings.

In *Great Britain* the savings of a project are calculated and set when a project is submitted based on a standardized estimate taking into consideration the technology used, weighted for fuel type and discounted over the lifetime of the measure. There is limited ex-post verification of the energy savings carried out by the Government. Although this work would not affect the way energy savings are accredited in the current scheme, the monitoring work affects the energy savings accredited in future schemes. The UK Government has published the illustrative list of the energy, cost and carbon savings of the standard, well-established measures for the Energy Efficiency Commitment 2008-11 (EEC3). This list gives the final energy and carbon savings for EEC-3, including the scores that will be attributed to these standard measures under EEC3 and which will be used in the EEC3 Illustrative Mix.

In *France* a list of standardized actions with the saving evaluation method has been published in June 2006. The standard actions currently introduced include 31 in the residential sector, 22 in the commercial sector, 3 in the industrial sector, and 3 in the transport sector.

In Great Britain a discount factor of 3.5 % over the lifetime of the measure is applied, while in France the discount factor is 4 %. In the British and French schemes the discount factor refers to realizing the annual savings for different measures with different life spans[8]. In Great Britain saving estimates take into account the likely proportion of the investment to be taken up by improved comfort (take back due to comfort factors which is an adjustment to the calculation of carbon benefits), as well as dead-weight factors to account for the effect of investments that would be made anyway (free ridership).

Certificate delineation, trading rules and tools to stabilize the market. The certificate is an instrument that provides a guarantee that savings have been achieved. Each certificate should be unique, traceable, and at any one time have a single owner. Certificates need to be a well-defined 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. Property rights must be clear and legally secured as it is unlikely that trades will occur if either party is unsure of ownership (Jaccard & Mao 2002).

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[6] E.g. in the case of CHP the plant operator has to prove that the plant has run a certain number of hours, etc.

[7] From a theoretical point of view the monitoring approach allows more flexibility (thus stimulating technological development) and more accuracy in reflecting the actual savings, it also gives a more active role to the implementer in the saving project by monitoring consumption. However, it requires more expertise and it is more expensive than standard saving methods.

[8] An example of the energy savings cumulated over the life time and discounted (kWh cumac) for an energy efficient refrigerator (belonging to the European energy efficiency class A+) follows. The annual mean consumption of the standard refrigerator that is replaced is 221 kWh/year. The new refrigerator in A+ class has an annual consumption of 155 kWh/year. Per unit there is an annual energy saving of 66 kWh/year. The agreed lifetime of the measure is 10 years, resulting in 660 kWh savings per refrigerator over the lifetime. Multiplying the per unit lifetime savings with the 4% discount factor result in 557 kWh cumac per refrigerator. It is interesting to note that in the current Italian scheme the standard savings associated with a CFL in the residential sector are 66 kWh/year, in France 230 kWh cumac, resulting in about 32 kWh per year (measure life 7.5 year), and in Great Brittan in EEC-2 33.5 kWh per year with a life of 14 years, resulting in discounted lifetime electricity savings of 405 kWh, and fuel-standardized lifetime discounted energy savings, including the heat replacement effect of 208 kWh.

Minimum project size may be applied for certification of savings in order to reduce transaction costs and encourage pooling of projects (Pavan 2002). The size of a certificate also has important implications for the number of parties that can offer certificates for sale (unless other restrictions apply). In *Italy* certificates are expressed in primary energy saved and the unit is 1 toe. In *France* certification is allowed only above a threshold of 3 GWh of savings over the lifetime of a project (Baudry & Monjon 2005). In France the value of the certificate is based on the final energy saved, the unit is kWh Cumac (i.e. cumulated over the life time and discounted). The certificates are delivered after the programmes are implemented but before energy savings are realized.

The validity and any associated inter-temporal flexibility embodied by banking and borrowing rules, the rules for ownership transfer, the *length of the compliance period* and expectations of market actors about policy stability and continuity will all influence the market for white certificates. A long certificate lifetime and banking increase the elasticity and flexibility of demand in the long term. To mitigate the uncertainties about the achievement of the quantified policy target within the pre-specified timeframe, banking for obliged parties may be allowed only once they achieve their own targets. As already mentioned, in Italy certificates are valid for up to five years, with a few exceptions (Pavan 2002). In Great Britain suppliers can carry over to EEC-2 all their excess savings from measures implemented under EEC; this refers to measures rather than savings. In France it has been proposed that the certificates' validity be at least 10 years. Borrowing is discouraged because it makes the attainment of a target uncertain and is against the ex-post logic of the white certificate scheme as applied in Italy.

For instance, rules defining **trading parties** are also important for market liquidity. Provided that administrative and monitoring costs are not disproportionate, as many parties should be allowed in the scheme as possible, since this enhances the prospects of diversity in marginal abatement costs and lowers the risks of excessive market power (Pavan 2003). Parties that may be allowed to receive and sell certificates include obliged actors, exempt actors, ESCOs, consumers, market intermediaries, NGOs, even manufacturers of appliances. A key benefit of allowing many parties in the scheme is that new entrants may have the incentive to innovate and deliver energy efficiency solutions, which have a lower marginal cost.

In *Italy* certificates are issued by the electricity market operator upon request of the regulator AEEG to all distributors and their controlled companies and to energy service providers and ESCOs. Certificates are tradable via bilateral contracts or on a spot market organized and administered according to rules set out jointly by AEEG and the electricity market operator. There are three types of certificates and thus three markets– for electricity savings, for gas savings and for savings of other energy carriers. This differentiation is required in order to allow the enforcement of the '50% constraint'. The three types of certificates are only partially fungible. The first market sessions have been held in March 2006. For the time being, the volume of trade is lower than expected and the largest share of trading is occurring over the counter.

In *France* any economic actor can undertake savings actions and get certificates as long as the savings are at least 3 GWh over the lifetime of a measure. Certificates are delivered after the programs are carried out but before the realization of energy savings (Baudry & Monjon 2005). In *Great Britain* there are no certificates in the strict sense of the word. The scheme covers obliged parties and no other party can receive verified savings that can be used to demonstrate compliance with the savings target. Suppliers may trade among themselves either energy savings from approved measures *or* obligations, with written agreement from the regulator. In Great Brittan there has been little interest in trading to date because energy savings can only be traded once the supplier's own energy saving target has been achieved. Three possible trading situation are identified in the Great Brittan scheme: (a) Horizontal – i.e. between suppliers: there has been hardly any trade of this type; (b) Inter-temporal – i.e. banking between compliance periods, which is very popular (20% of the EEC2 target was achieved in EEC1), and (c) Vertical – i.e. between suppliers and project developers, this is the most important, since suppliers have contracted out most of their measures to third parties.

Suppliers are also allowed to trade excess energy savings into the national emission trading scheme as carbon savings. However the linking of carbon savings to the national emission trading scheme was never formalized. Suppliers have been allowed to carry savings over from EEC-1 to EEC-2 and this is what all suppliers who exceeded their target have chosen to do.

In France there is no formal market organized by the national administration, therefore there are only over-the-counter trades between obliged subjects, and between project implementers and obliged subjects. The national administration is considering creating and publishing a list of f sellers.

Evaluation of the existing tradable certificates for energy savings schemes.

Experience to date allows the evaluation of only the Italian and the British schemes. In *France* the scheme was launched in July 2006 and many projects are now under development. About 10 projects have been accepted by the public authority in charge of the scheme, for an amount of some 210 GWh cumac. This amount is equivalent to 0.5 % of the total obligation (54 TWh cumac for 3 years) (Angioletti 2007).

In *Italy* a first report on the results of the period from January 2005 to May 2006 was published in October 2006. For year 2005 the Italian target amounted to 97,854 toe for 11 electricity distributors and for the 58,057 toe for the 23 gas distributors. All distributors under obligation (excelpt 3, 1 electricity and 2 gas distributors) have reached their targets including the 50% target (Autorita 2006). Between January 2005 to end of May 2006 savings of 286,837 toe have been certified (i.e. 184% more than the yearly target!), with 214,244 toe (75%) in electricity savings, and 62,826 toe (22%) in gas savings, and only 9,767 toe (3%) in savings in other fuels. It is also important to notice that the gas and electricity distributors under the obligations received about 33% of the total certificates delivered (with 24% going to gas distributors), while ESCOs received about 65% of the delivered certificates (Autorita 2006). This may be an indication that many projects were implemented in the non-residential sectors, where ESCOs are usually more active. As previously noted, in Italy certificates have been issued to projects implemented since 2001. In fact, projects started before 2005 accounted for about 60% of the total certificates delivered in 2005. However, their impact in future years will decrease as the lifetime of the early measures will come to an end. As previously noted, about 90% of the certificates have been submitted with simplified evaluation methodologies (deemed saving or engineering models), where standard report documents have been developed by the authority. This confirms that project implementers prefer these reporting mechanisms as they reduce the overall monitoring costs, and simplify the certification procedure. In Italy the first market session for certificates was started in March 2006. Gas savings certificates, which were more in demand, commanded a higher price, as shown in Table 3. Note, the spot market accounted for 17 % of trading activity.

Table 3 Summary of Italian White Tag Transactions January 2005 – May 2006

	Type I (certificates from electricity savings)	**Type II (certificates from gas savings)**	**Type III (certificates from savings in other energies)**
Total number of certificates exchanged (at the exchange)	15024	10086	76
Minimum price	€ 69.00	€ 90.00	€ 32.00
Maximum price	€ 84.00	€ 98.00	€ 36.00
Medium price	€ 77.04	€ 94.00	€ 33.84
Total number of certificates bilaterally exchanged	104498	15713	170
Price (bilaterally exchanged)	N/A	N/A	N/A

(Source Autorita)

Type III certificates are less in demand as there is no cost recovery (fixed at 100 Euro per toe saved). Bilaterally exchanged certificates for which the price is not known, represented 83% of the total volume. The Italian authority indicates that most of the projects have short pay back time, and also short saving life times. Among the benefits the Italian authority is claiming is that the certificates scheme has contributed to the development of the ESCO industry in Italy. To date, no data is available regarding technological development and permanent market transformation achieved.

In *Great Brittan*, in EEC-1 all the suppliers met their targets, and delivered efficiency 20% more cost-effective than anticipated (Lees 2006). More recent results for EEC-2 for the period April 2005 to December 2006 show that all major suppliers will meet their target (85% already achieved), with 86% of the saving coming from insulation, 5% from heating improvements, 2% from appliances and 7% from lighting (still the most popular measure with 34 million projects). Lees (2006) estimates that 2 out of 5 households have directly benefited from EEC. Lees estimate the cost of saving a MWh of electricity as 20 Euro/MWh (with the average residential electricity cost of 100 Euro/MWh), while for gas the cost of saving a MWh is 7 Euro/MWh (with the average residential electricity cost being 25 Euro/MWh). The cost of EEC-1 (there is no tariff cost recovery mechanism as in Italy, every supplier is free to charge the real cost to its customer base) was about 5 Euro per customer per fuel, and in EEC 2 it is estimated to be about 11 Euro, with ongoing annual financial benefits to householders by 2010 from EEC-1 of about 10 Billion Euros. The Great Brittan experience shows that it is very difficult to attract ESCOs in the residential sector, even with the bonus provided. Other conclusions for Great Brittan are: the rising targets and the long time frame (EEC-1, EEC-2) have reduced the cost of energy efficiency measures (CFLs, condensing boilers, home insulation, etc.), and helped the long term and stable market transformation. The EEC has also created the condition for further regulatory intervention such as a ban of non-condensing boilers and a future ban of incandescent lighting.

Summary and conclusions

This paper has described the concept, the main elements and the overarching principles and issues related to the establishment and practical functioning of a system with tradable certificates for energy savings. It has provided an up-to-date review of white certificate schemes in Europe, discussing some key design and operational features, such as projects, and eligibility of implementers and technologies, and pointed out key issues such as the additionality criterion, baseline setting, and measurement and verification. Particular attention has been paid to measurement and verification which is a key element of the certificate schemes. It has also illustrated the early results of the schemes in Italy and Great Britain. As previously noted, the two schemes are rather different with respects to eligible projects and trading rules, and cost recovery mechanisms. At this stage both schemes have been successful and cost effective. At this early stage of the Italian (and very early for the French) scheme it is not possible to arrive at any conclusions on the optimal setup concerning the subject under obligation (suppliers or distributors), the sector covered (this is also linked to other policies such as eradication of fuel poverty or increased competitiveness of the commercial/industrial sectors), or trading rules (no trading, bilateral transactions or exchange). More experience will soon be gained through the new French scheme, and the possible introduction of white certificate schemes in the Netherlands or other European countries.

References

Autorità per l'energia elettrica e il gas 2006 "Primo Rapporto annuale sul meccanismo dei titoli di efficienza energetica Situazione al 31 maggio 2006" (in Italian)

Angioletti, R. 2007 Private communication.

Baudry, P. and S. Monjon 2005. "The French Energy Law and white certificates system." Presentation at RECS open seminar, Copenhagen, 25 September 2005.

Bertoldi, P., S. Rezessy and M. J. Bürer 2005a. "Will emission trading promote end-use energy efficiency and renewable energy projects?" In *Proceedings of the 2005 Summer study on efficiency in industry of the American Council for Energy Efficient Economy*, Washington: American Council for Energy Efficient Economy.

Bertoldi, P., S. Rezessy, O. Langniss and M. Voogt 2005b. "White, green & brown certificates: how to make the most of them?" In *Proceedings of the 2005 Summer study of the European Council for Energy Efficient Economy*, Stockholm: European Council for Energy Efficient Economy.

Bertoldi, P. and S. Rezessy 2006. *Tradable certificates for energy efficiency (white certificates): theory and practice*. Ispra: Institute for Environment and Sustainability, DG Joint Research Centre, European Commission.

European Commission 2005. "Green Paper on Energy Efficiency. Doing more with less. COM(2005) 265 final of 22 June 2005". Brussels, European Commission,

Jaccard, M. and Y. Mao 2002. "Making Markets Work Better". In *Energy for sustainable development. A policy agenda*. New York: UNDP.

Langniss, O. and B. Praetorius 2003. "How much market do market-based instruments create? An analysis for the case of "white" certificates". In *Proceedings of the 2003 European Council for Energy Efficient Economy summer study*, Stockholm: European Council for Energy Efficient Economy.

Lees, E. 2005. "How increased activity on energy efficiency lowers the cost of energy efficiency". Presentation at RECS Seminar, Copenhagen, 25 September 2005.

Lees, E. 2006. "Evaluation of the Energy Efficiency Commitment 2002-05". Report for UK DEFRA

Mansero, S. 2005. "Energy efficiency commitment. An example from the UK". Presentation at RECS Open seminar, Copenhagen, 25 September 2005.

Ministère de L'économie, des Finances et de L'industrie 2006 "Arrêté du 19 juin 2006 définissant les opérations standardisées d'économies d'énergie". In French

Oikonomou, V., M. Patel, L. Mundaca, T. Johansson and U. Farinelli 2004. *A quallitatiive analysis of white, green certificates and EU CO2 allowances. Phase II of the White and Green project*. Utrecht: Utrecht University, Copernicus Institute.

Pavan, M. 2002. "What's up in Italy? Market liberalization, tariff regulation and incentives to promote energy efficiency in end-use sectors." In *Proceedings of the 2002 American Council for Energy Efficient Economy summer study*, Washington: American Council for Energy Efficient Economy.

Pavan, M. 2003. "Expectation from Italy: suggestions to focus the project proposal". In *Workshop on organising a task on white certificates under the IEA-DSM Implementing agreement*, Milan: CESI.

Pavan, M. 2004. "The Italian White Certificates System: Measurement and Verification Protocols." In *EU and ECEEE expert seminar on Measurement and Verification*, Brussels.

Pavan, M. 2005. "Italian Energy Efficiency Obligation and White Certificates: Measurement and Evaluation". In *European Parliament Workshop on Measurement and Verification*, Brussels.

Rezessy, S., P. Bertoldi, M. Pavan 2006 "Assessment of White Certificate Schemes and Their Integration into the Carbon Markets" In *Proceedings of the 2006 American Council for Energy Efficient Economy summer study*, Washington: American Council for Energy Efficient Economy.