Assessment of White Certificate Schemes in Europe

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ABSTRACT

A number of European 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 certification of the energy savings (via white certificates or white tags), and a possibility to trade certificates. The paper provides a review of white certificate schemes in Europe, and analysis of the results achieved so far. The paper discusses major design and operational features of white certificate portfolios, such as eligible projects, technologies and obligated parties, institutional structure and processes to support the schemes. The paper shows that while these schemes are conceptually similar, the implementation shows some marked differences.

Introduction

A portfolio with tradable certificates for energy savings (referred to as a white certificate system) includes an energy-savings quota for some category of energy market operators, such as energy distributors, suppliers, or even consumers, coupled with a trading system for energy-efficiency measures resulting in energy savings. The savings are verified by an independent party and certified by means of white certificates. The portfolio involves five key elements: (a) Creation and framing of the demand, usually by imposing an energy saving obligation on some category of market actors; (b) Tradable instrument (certificate) and rules for trading; (c) Technical processes to support the scheme and the market (e.g. measurement and verification; (d) Cost recovery mechanism in some cases, and (e) Enforcement mechanisms and sanctions.

In Europe similar policy portfolios have been introduced in Italy, Great Britain and France. In the Flemish region of Belgium there are electricity savings obligations imposed on electricity distributors. Other European countries, such as Denmark, the Netherlands and most recently Poland, have expressed interest in introducing white certificates schemes[1].

The paper introduces the fundamental design concepts of a white certificate policy portfolio and brings concrete examples about the design choices of schemes in Europe. The paper is organized as follows. Following the introduction, Section 2 discusses the establishment of demand for white certificates, looking at the saving obligation, obligated parties and eligible projects and bringing examples from the three existing schemes in Europe. Section 3 presents the tradable commodity (white certificates) looking at delineation of certificates, penalties and certificates reserves, and bringing examples from the existing European schemes. Section 4 introduces the core processes needed to support a white certificate scheme. Section 5 concludes with a few general observations about design issues and some country-specific explanations on what has worked in different national contexts. These could facilitate the development of such schemes in the future. It needs to be emphasized that the track record of white certificate schemes has been too short to point at pre-requisites of successful programs. Existing programs show marked design differences that make comparison of results difficult.

[1] Poland intends to introduce a white certificate scheme in 2009.

Creating Demand: Energy Saving Obligations

There are two options to create demand for tradable certificates for energy savings: by imposing an obligation on some category of energy market operators or by introducing some kind of incentive in order to foster voluntary demand. All existing schemes rely on mandatory energy saving targets imposed on energy distributors or suppliers.

Size and Unit of the Obligation

Usually the size of the total energy saving obligation is linked to a national target defined by the government and introduced in legislation. On a practical level the reference point and year for setting the target are crucial. The target can be defined e.g. in terms of economic savings potential in the sector(s) covered by the scheme or of actual or predicted consumption. The obligation can be expressed in primary or final energy, or in carbon emission reductions. The definition of compliance period (temporal content of the target) and possibly rate of increase are important from the point of view of providing security for investors.

Obligated Parties

A second step is to define who the obligated actors should be and how the overall target should be apportioned to individual actors. Obligated parties are the ones that surrender white certificates at the end of the compliance period to prove they have met their saving obligations. An important issue is to have a significantly large share of energy consumption covered by the obligation, while retaining a manageable number of obligated parties by possibly excluding very small market actors for whom the saving obligation may pose a big burden. Target apportionment among obliged parties can be based on market share or number of consumers (linear or increasing for larger obliged parties).

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 (Oikonomou, Rietbergen and Patel 2007). In a comparison of the distributional effects from alternative apportionment rules Quiron finds that setting energy saving targets as a percentage of the energy that distributors or suppliers sell and contingent upon the evolution of market shares is more acceptable than setting absolute targets (Quirion 2005). In the latter case under assumptions of perfect competition and no public intervention in the energy market, energy suppliers' profit decreases since suppliers cannot pass the cost of certificate generation on to consumers.

Eligible Projects: Technologies, Actors, Energy Carriers, Customer Base

Next, the regulator should define the types of projects and/or technologies eligible under the scheme. The regulator can decide to leaving the scheme completely open to any technology, form of energy or end-use sector, or to limit it with respect to technologies (e.g. establishing a list of eligible project types), end-use sectors or energies (e.g. only grid-bound ones). The economic textbook argument is to not limit eligibility because this 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. In addition, theoretically the wider the scope in terms of types of projects/investment choices and the fewer limitations in terms of compliance routes, the more diverse marginal costs of compliance become and the greater the benefits of trading in terms of lowering the overall cost of compliance.

There are some practical arguments against a comprehensive scheme that is completely open in terms of technologies and sectors. A purely operational consideration against extensive scope is that inclusion of all project types and all sectors may result in difficult and expensive validation and monitoring of savings and a huge amount of work for regulators to design monitoring and verification methodologies. Because cost minimization is an inherent feature of markets, a completely open scheme is likely to focus compliance on large-scale projects, where savings are easy to monitor and economies of scale and straightforward monitoring are likely to bring a reduction in transaction costs of certification. Such a trend however may leave out certain hard-to-reach sectors, such as residential buildings.

Defining the Energy Saving Obligation, Target Apportionment and Project Eligibility: Examples from Practice

Defining the obligation. In Italy the energy saving targets are expressed in primary energy (toe), imposed on electricity and gas grid distribution companies with more than 100,000 customers as of the end of 2001 and set on an annual basis for the period 2005-2009[2]. 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. This is 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 (Pavan 2002; Pavan 2004; Pavan 2005).

The Energy Efficiency Commitment (EEC) in Great Britain runs in 3-year cycles from 2002 to 2011. The EEC-1 program (2002-2005) 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[3] and the total delivered savings reached 86.8 TWh. In EEC-2 (2005-2008) the threshold for being subject to an energy saving obligation was increased to 50,000 domestic customers and the target was fixed at 130 TWh. Due to carrying over of savings from EEC-1, already in 2005 more than a quarter of this target was achieved. There was a roughly double increase in target between EEC-1 and EEC-2; however due to changes in the way the savings have been calculated (discount factors), it is difficult to put a precise figure on the increase. The third phase of EEC, which will run from April 2008 till March 2011 has been re-named Carbon Emission Reduction Target (CERT).

In the French system saving obligations are set for energy suppliers delivering electricity, gas, domestic fuel (not for transport), cooling and heating for stationary applications for the period 2006-2008. 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). Obligated actors have received targets based on their physical sale quantities in the residential and commercial sectors (75 %) and price (25 %) that is an estimate of the reference price for the three years before 2006. Annual adjustments of the

[2] 50,000 customers threshold after 2009.

[3] 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)

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. 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.

Energy efficiency obligations without certificate trading are also in place in the Flemish region of Belgium, whereby regional utility obligations have been imposed on 16 electricity distributors. The annual target is 0.58 TWh and eligible actions refer to residential and non energy intensive industry and service and can involve saving fuel from any sources. Separate targets are set for low voltage and high voltage clients: 10.5% of electricity supplied over the 6 years from 2003 to 2008 in the case of low voltage clients and 1% per annum for high voltage users (Collys 2005). The Flemish obligation has no trading option of any type (certificates or – as is the case of the EEC – obligations).

Target apportionment. In Italy each year national targets are apportioned among distributors on the basis of the quantity of electricity and gas distributed to final customers compared to the national total in year t-2, linear to the market share. 10 electricity distributors, covering 96 % of the electricity market, and 20 natural gas distributors, covering 60 % of the gas market, are subject to targets. Italgas accounts for 34 % of the gas target; there are about 500 distributors without targets (due to small size). For electricity the amount of non-covered distributors' share in final consumption is about 2 %; Enel Distribuzione has the largest market share (almost 88 % of final consumption) and consequently the largest share of the target. Overall 22 % of the total obligation in Italy has not been distributed, which corresponds to the volume of small suppliers. In Great Britain target apportionment is based on number of domestic customers; in EEC-1 the obligation was tighter for companies with increasing size, but this feature of the system was removed in EEC-2. In the French system the distribution of obligations is based on market shares of energy sales turnover in the residential and tertiary sectors; EdF accounts for approximately 50 % of the obligation and GdF for 25 %. The apportionment of the total annual target is done on annual basis to take into account new market players.

Eligible projects. Energy efficiency projects in all end-use sectors are eligible for certification in Italy, along with some supply options (such as CHP and solar). At least half of the target should be achieved by reduction of the supplied energy sector (a.k.a. the "50 % constraint") (Pavan 2002). The remaining share can be achieved via primary energy savings in all other energy sources. 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). Energy savings accredited by the regulator AEEG until June 2007 come from electricity savings in buildings (55%), heat demand in buildings (16 %), street lighting (12%), generation and distribution (11%) and industrial energy consumption (6 %) (AEEG 2007). The largest part of certified 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). The effect of such early measures undermines the effectiveness of the scheme; it is expected to significantly decrease in the coming years. As of mid-2007 there were 919 registered ESCOs in Italy that could receive white certificates: it was observed that only 15 % of these have demanded verification and certification of savings from projects. On the other hand almost three fourths of all certificates issued went to ESCOs and 12 % went to non-obliged distributors (AEEG 2007).

In Great Britain only energy saving 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 (so-called 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 Great Britain. Suppliers can receive 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.

Apart from plants under the EU European Emission Trading Scheme (ETS) Directive and fuel substitution between fossil fuels, 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 saving obligation is allowed but only after considering the impact of the project on business turnover. If an impact on business turnover is identified, then certification of savings is allowed only for innovative products and services[4].

White Certificates – The Tradable Commodity

It is important distinguish between certification of energy savings and trading of white certificates. Trading is not a precondition for certification: a certificate is an instrument that provides a guarantee that savings have been achieved due to a specific measure and can be used as an accounting tool to verify compliance with energy saving targets or with other obligations, or to qualify for e.g. state support (subsidies) or preferential taxation.

Certificate delineation. A white certificate is an instrument 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.

The size and lifetime of a certificate have important implications for the number of parties that can offer certificates for sale (unless other restrictions apply). A long certificate lifetime and possibility to bank certificates for future use increase the elasticity and flexibility of demand in the long term. Minimum project size may be applied for certification of savings in order to reduce transaction costs and encourage pooling of projects (Pavan 2002); on the other hand only allowing large amounts of savings to be certified may discourage some project developers from having their project results certified, unless it is possible to pool savings from different projects for the sake of certification. To mitigate the uncertainties about the achievement of the quantified policy target within the pre-specified timeframe, banking of certificates for future use may be allowed once obligated parties achieve their present targets. The validity and any associated inter-temporal flexibility of certificates (rules governing banking and borrowing), the rules for ownership transfer, the length of the compliance period and

[4] 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 %.

expectations of market actors about policy stability and continuity will all influence the market for white certificates.

Italian certificates are denominated in primary energy (1 toe) and are valid for 5 years. Unlike in France and Great Britain, where compliance is demonstrated at the end of a multi-annual period, in Italy the obliged parties have to demonstrate compliance annually. Depending on the measurement and verification approach adopted (see explanation of approaches later), the following thresholds apply on projects that can be certified: for "default approach" 25 toe/year, independent from the type of project proposer; for "engineering approach" certificates 100 toe/year for obliged actors and 50 toe/year for non-obliged actors; and for energy monitoring plan 200 toe/year for obliged actors and 100 toe/year for non-obliged actors[5].

In France certification is allowed above a threshold of 3 GWh of savings over the lifetime of a project (Baudry and Monjon 2005); smaller projects can be grouped together to reach the threshold for applying for certification, i.e. the threshold is per application for certification and not per project. In France the value of the certificate is based on final energy saved, expressed in kWh cumulated over the life time and discounted (so-called kWh cumac). The certificates are delivered after the programs are implemented but before energy savings are realized.

Rules for certificate trading. Rules defining trading parties are important for market liquidity. Provided that administrative and monitoring costs are not disproportionate, as many parties should be allowed to trade in the scheme as possible, since this enhances the prospects of diversity in marginal abatement costs and lowers the risk of excessive market power. 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, to energy service providers and ESCOs. Certificates are tradable via bilateral contracts or – since March 2006 – on a spot market organized and administered by 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. For the time being, the volume of trade is lower than expected and the largest share of trading is occurring over the counter with 76 % of certificates traded under bilateral contracts (Grattieri 2007).

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. There is no formal market organized by the national administration, therefore there are only OTC trades between obligated entities, and between project implementers and obligated entities. There is a registry with information on white certificates (www.emmy.fr).

Certificate trading is not a feature of the scheme in Great Britain and no formal certification of attained savings takes place. The scheme covers obligated parties and no other party can receive verified savings that can be used to demonstrate compliance with the savings target. While trade of obligations and of measures is allowed, little actual trading occurred so far (Capozza, Devine, Enge *et al.* 2006). The lack of formal certification, the fact that most suppliers use the same contractors to undertake the work and the fact that suppliers can only trade once they meet their own energy saving targets explain limited trading in EEC-1 and EEC-2.

[5] We are indebted for this comment to Nicola Labanca.

Mitigating certificate price volatility. Pre-defined non-compliance penalties, minimum or maximum buy-out prices and certificate reserves attained by the regulator are tools to mitigate price volatilities. Recycling the revenue collected from penalties to obligated parties that exceed their obligations enforces the effect of a penalty by increasing the opportunity costs of non-compliance.

In Italy the sanctions for non-compliance have to be "proportional and in any case greater than investments needed to compensate the non-compliance" (Pavan 2002). There are two types of non-compliance: with the 50 % constraint for action concerning an actor's own energy vector, and with the general obligation. The proposal is that the unit value of each of the two penalties equals the bigger value between a level to be defined at the end of the consultation process and the average market price of the certificates in the previous year, multiplied by a factor greater than one. Failure to meet the whole obligation in one year has to be recovered in the following two years: thus the monetary penalty does not cancel the obligation (Grattieri 2007). In Great Britain the regulator OFGEM has the power to consider whether it is appropriate to set a penalty for non-compliance. However, there is no specific guidance on how this penalty would be calculated other than the indication that suppliers that do not meet their individual target may face a penalty fee that can be up to 10% of supplier's turnover. In the French system a penalty of 0.02 Euro/kWh non-compliance is envisaged. In Flanders the non-compliance penalty is 0.1 Euro/kWh and the fine cannot be passed in the tariffs.

Processes to Support the Scheme

Baseline setting to measure the impact of projects and choice of verification system, discounting of savings from measures and cost recovery deserve special attention for their fundamental role in TWC schemes.

Baseline setting. To determine the energy savings resulting from an energy efficiency activity, the eventual energy consumption has to be compared to a baseline without additional saving efforts. The choice of the reference scenario – in terms of reference consumption and conditions – raises some challenges related to determining the relevant system boundary, minimizing the risk of producing leakage, the practicality and cost-effectiveness of a baseline methodology, and treating no-regret measures in the baseline determination.

Additionality. 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. In Great Britain, the Department for Environment, Food and Rural Affairs (DEFRA) requires suppliers to demonstrate additionality in each of the schemes they carry out. In Italy savings have to go over and above spontaneous market trends and/or legislative requirements (Pavan 2004; Pavan 2005). For projects that are based on the deemed savings and engineering verification approach (see explanation in the next section) there is a case-by-case additionality check performed by the regulator.

Verification approaches. Energy savings can be determined by estimating energy consumption or by 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. Possible verification approaches are metering or standard savings (also referred to as deemed savings). The former implies metering real energy consumption and calculating savings (e.g. with climate or weather corrections) based on consumption before and after the energy-efficiency improvement is carried out. The latter implies standard formulas for energy-efficiency measures (e.g. a given number of CFLs installed in the residential sector is equivalent to a given quantity of kWh saved). There can be various combinations of the above, such as sampling of metering. In principle the metering approach is a more accurate guarantee of energy saved than the deemed savings (which cannot verify details such as location and operating hours of installed CFLs), but in practice it can be difficult to identify the actual saving (e.g. in households there is only one meter for all electricity usage: impact of increase in number of appliances, fluctuations with changing household numbers, lifestyle, weather etc.). It may result in high monitoring costs for projects of smaller size.

The Italian TWC scheme uses three verification approaches: a deemed savings approach with default factors for free riding, delivery mechanism and persistence; an engineering approach; and 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). All monitoring 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; Pavan 2005). There are 22 approved evaluation procedures. 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. 70% of the certified saving in 2005 were based on deemed savings, 20% were based on the engineering approach and only 10% were based on monitoring.

In Great Britain the savings of a project are calculated and set 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 in order to inform the design of standardized estimates in future periods.

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.

Finally, in the Flemish region of Belgium, grid operators submit to the Department of Natural Resources and Energy of the Ministry of Flanders plans for actions to be implemented in the following year. These plans also include proposals for the calculation of energy savings.

Discount factors. In the British and French schemes there are discount factors for accounting the annual savings of different measures with different life spans. The role of the discount factors can be seen as accounting for the ‘deterioration’ of a measure over its lifetime. In France the discount factor is 4 %. In Great Britain the discount rate has been decreased from 6 % in EEC-1 to 3.5 % in EEC-2 and eliminated altogether in the CERT. Changing the discount rate ‘increases’ savings coming from projects thus decreasing the size of the target: the same goal with a lower discount factor is a lower and easier-to-reach goal in practice: for the case of Great Britain from 62 TWh to 81 TWh fuel standardized lifetime-discounted savings. In the case of Great Britain, the reduction of discount rates has favored the measures with longer life cycle.

Cost recovery. Cost recovery is a process whereby an energy distributor is able to recover, through rates, the costs of implementing any type of energy saving action beyond the consumers' meter. Under the assumption of perfect competition all customers will bear the same specific burden of the costs incurred for savings project implementation by energy suppliers. In practice suppliers may shift the burden to less competitive market segments.

In Italy cost recovery of 100 Euro is allowed for each type I and type II certificate (electricity and gas savings resp.) delivered by the distributor as long as the distributor total saving target for the year under consideration has not been achieved. Cost recovery is also allowed when the intervention concerns measures on the customer base of another distributor or measures that save energy on an energy carrier different from the one of the distributor. The cost recovery is net of any contribution from other sources and is administered by a fraction of electricity and gas network tariffs going to a fund disbursed by the regulator in such a way that each obliged actor can receive 3 Eurocent/kWh saved. The existence of cost recovery has largely biased actions towards savings in electricity and gas, undermining primary saving projects (where no cost recovery applies). As of the end of 2007, the regulator considers reducing the 100 Euro/toe cost recovery and differentiating it for electricity and gas; proposed levels are 46 Euro/toe for electricity and 80 Euro/toe for gas (Grattieri 2007). The impact of cost recovery in the case of electricity (rate adders) has been estimated at 0.6 Euro/year for an average family (Grattieri 2007). The French scheme stipulates rises in prices and tariffs to be limited to a maximum of 0.5 %. In Flanders the savings obligation is incorporated in the electricity tariffs as a public service obligation.

Summary and Conclusions: What has (not) Worked?

This paper has described the concept, the main elements and the overarching design issues related to the establishment and practical functioning of a system with tradable certificates for energy savings. It has illustrated the functionalities of the concept by giving examples with key design and operational features of existing schemes in Europe. Even if these national implementations are conceptually similar, the exact design of their major elements brings some marked implementation differences. Table 1 summarizes the key design features of the ongoing phases of the schemes in Italy, France and Great Britain. Taking into account the early stage of developments and the limited track record of TWC schemes, it is difficult to point at optimal design choices. The success of a TWC scheme inevitably depends on national policy contexts and priorities.

Table 1. Major Design Features of White Certificate Systems in Europe

	Great Britain (EEC 2, 2005-2008)	Italy	France
Unit of target	TWh fuel weighted energy benefits	toe, annual	TWh lifetime discounted
Current phase	2005-2008	2005-2009	2006-2008
Sectoral coverage for eligible projects	Residential consumers only	All consumers	All consumers
Restrictions on compliance	50 % from 'priority group'	50 % from reduction in own energy sector	
Obliged parties	Electricity and gas suppliers above 50,000 residential customers	Electricity and gas distributors above 100,000 customers	Electricity, gas, LPG, heat, cold and heating fuel suppliers above 0.4 TWh/year sales
Certification	No certification; 3.5 % discount factor in EEC-2; No cost recovery.	1 toe; No discount factor; 100 Euro/toe.	Min. 3 GWh certification threshold; 4 % discount factor; No cost recovery.
Trading	No certificates. Obligations can be traded;	Certificate trade; Spot market sessions; OTC trading;	Certificate trade, only OTC trading
Penalty	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, the magnitude of the non-compliance, the state of affairs of the non-compliant party.	0.02 Euro/kWh

Nevertheless, a set of early general observations and some country specific conclusions can be extracted based on the discussion provided in this paper.

First of all, similarly to the US-style demand-side management (DSM) systems and the Danish electricity saving obligation, the three schemes reviewed in this paper are in reality dominated by subsidy measures, i.e. obliged parties subsidize savings measures partially or entirely. Financial incentives for end-users are especially important in the residential sector. Compared to traditional DSM, whereby utilities are obliged to spend a certain amount of money on energy saving programs and there is no 'guarantee' on amounts to be saved, TWC systems in principle work in the direction of both assuring savings are delivered and making incentives for implementing cost-effective projects (see Bertoldi and Rezessy 2006).

Second, the three reviewed schemes are dominated by measures with standardized saving factors. A scheme limited in terms of scope is more likely to use this valuation method because there is only a limited number of saving options available, which are carried out in large numbers. This is the case in Great Britain, where all savings are calculated based on standardized estimates adjusted for free riders and other factors.

Third, the schemes all have some supply options included. In some cases options are allowed that are 'in-between' supply and end-use options, namely micro cogeneration and solar heaters that replace end-use technologies.

In terms of country specific design conclusions, while **the Italian scheme** is delivering savings, it has inherent issues to resolve in terms of very low targets in the first two years compared with the potential, also related to the fact that almost two thirds of the savings realized during the first year of system implementation were due to saving measures implemented before 2005. For example the 2007 target was 633,382 toe (79 % of the nominal objective of 800,000), while as of June 2007, savings amounting to 240 % the 2006 target have been certified (AEEG 2007) . Five times more electricity savings have been certified than gas savings: this is also related to the different price for the two types certificates. As a consequence there was a strong drop in the price of electricity certificates. While early measures should decrease in the next years, they significantly lower the systems effectiveness to deliver savings. Furthermore, 22 % of the total obligation has not been distributed (suppliers below the threshold) and at the same time there is a large (monopolistic) obliged subject in the electricity target. In addition, cost recovery of 100 Euro/toe goes beyond the real cost of some saving projects: windfall profits for distributors undermine the cost efficiency of the instrument. There is insufficient information among end-users about the Italian TWC and the existing energy saving opportunities. Finally, most of the trading activity is bilateral over-the-counter, which allows no transparency and can potentially lead to price volatility. On the positive side: ESCOs have received 72 % of all certificates issued, which shows that the scheme supports ESCO operation; another 12 % of all certificates were attributed to non obligated distributors (AEEG 2007).

In practice EEC has been a 'tendering' system, whereby suppliers tendered to energy efficiency industry (e.g. manufacturers and installers) projects to deliver them savings. 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. CFLs accounted for 24% of the savings achieved, followed by appliances (11 %) and heating measures, mainly condensing boilers (9 %). 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. Energy suppliers in EEC-1 have delivered more cost effectively than the Defra illustrative mix. The cost of saving a delivered unit of electricity or gas was 1.3p/kWh and 0.5p/kWh respectively – much less than the electricity and gas prices to consumers (Lees 2006).

While the EEC has been successful, this is not a real white certificate scheme as there is no market for certificates. Part of its success has possibly also been due to the limited coverage of the scheme (residential sector only), which makes design and operation easier[6]. At this early stage of the Italian (and very early for the French) scheme it is difficult to give 'prescriptions' about the optimal setup concerning the subjects under obligation, 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). Nevertheless it should be emphasized that a liquid market – both in terms of demand and supply – would ensure realization of the economic benefits attributed to market-based instruments. The lifetime of measures, the redemption period, banking and borrowing of certificates, the definition of parties that can acquire certificates and the design of non-compliance penalties all have an impact on market liquidity and stability. More experience will soon be gained through the newly started French scheme, and the possible introduction of white certificate schemes in other European countries.

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[6] According to the National Energy Efficiency Action plan of the UK under the Energy Service Directive, the scheme is to be extended in scope.

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