Energy Supplier Obligations and White Certificate Schemes: Comparative Analysis of Results in the European Union

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ABSTRACT

This paper discusses the most recent results of the energy saving obligations implemented by Member States of the European Union, analysing dominant end-use sectors and measures, as well as estimated costs. The paper examines the implications of different designs on the outcomes of national schemes and draws conclusions about the design and operation of supplier and utility obligations and tradable certificate schemes.

In the European Union (EU) supplier obligations to save energy and white certificate schemes have delivered larger savings than originally expected with obliged companies exceeding targets and, in some cases, at cost below what policy makers have anticipated. Supplier obligations have fostered the uptake of standardised energy efficiency actions often targeting smaller energy users (residential sector), lowering the transaction costs and contributing to market transformation. The role of certificate trading is more ambiguous. Trading can bring benefits where the target is set sufficiently high with respect to the energy saving potential in the sectors covered. Theoretically trading may be better suited for broader systems with comprehensive coverage, but even in smaller schemes trading may reduce the transaction costs of compliance for obliged actors without sufficient expertise on end-use energy efficiency. Yet, trading increases the administrative cost ratio of energy saving obligations.

Introduction

Among the many policy instruments introduced in the EU to support energy efficiency, the United Kingdom (UK), Italy, France, Denmark and the Flemish region of Belgium have introduced obligations on some categories of energy market operators (in particular electricity and gas distributors or suppliers) to deliver a certain amount of energy savings[1]. Energy saving obligations imposed on energy companies – referred to as utility or supplier obligations, or energy efficiency resource standards – include energy saving targets. These targets – usually imposed on energy distributors or suppliers above certain size – can be defined in absolute terms (e.g. kWh or tonnes of oil equivalent, toe) – or can be formulated as percentage of annual sales. Within a saving target imposed on electricity or gas supply individual company's targets can be based on energy market shares, or for simplicity in the residential sector, in terms of customer numbers[2].

[1] Other European countries, such as the Netherlands and most recently Poland, Bulgaria and Romania, have expressed interest in introducing white certificates schemes. As of 2009 almost half of the states in the USA have some kind of energy efficiency or energy savings obligations, either as a stand-alone target (referred to as energy efficiency resource standards, EERSs) or as part of renewable energy obligations (referred to as renewable portfolio standards, RPSs).

[2] In the US obligations have been expressed as a percentage of demand, peak demand, load growth or retail sales.

The introduction of certification of project-based savings and the possibility to trade certificates (referred to as white certificates) is an additional policy option related to the implementation of energy saving obligations. The savings related to the implementation of energy efficiency projects are verified by an independent party (either ex-ante or ex-post) and certified by means of white certificates. In the EU, Italy and France are the only countries where the policy portfolio includes energy savings obligations in combination with fully tradable white certificates. Trading can take different forms and formal certification of savings is not necessarily a precondition for trading. Thus apart from trading of certified energy savings, policy practitioners may allow trading of eligible measures without formal certification of savings, or trading of obligations. For example, in the UK certified energy savings can be traded between obliged parties without formal certificates and obliged parties may purchase certified savings or projects from third parties.

In complying with the obligation, a number of market actors and administrative bodies are directly involved. These include companies under the obligation (energy distributors or suppliers), energy efficiency businesses (such as energy service companies - ESCOs, energy efficiency providers, installers, eligible bodies and companies under the obligation) and energy users on whose premises projects are implemented. A system administrator oversees compliance with the target, a certifying body authorises the validity of energy savings and a registering body tracks certified actions. A system of energy saving obligations and white certificates has the following core elements:

- Establishing energy saving obligation on some category of market actors;
- Technical processes to support the scheme and the market (e.g. measurement and verification) backed by a reputable body authorising that the claimed energy savings are valid;
- Tradable instrument (certificate) and rules for trading;
- Cost recovery mechanism in some cases, and
- Enforcement mechanisms and sanctions.

The fundamental design concepts of an energy saving obligation policy portfolio, the technical processes to support the scheme, and the tradable commodity (white certificates) have been described extensively in literature (see, for example, Bertoldi and Rezessy 2006 and 2008, Bertoldi et al 2010, Capozza et al 2006, Eyre et al 2009, Lees 2007, Mundaca 2008, Oikonomou and Patel 2004). The present paper evaluates the results to date of the major supplier obligations in the EU, analysing dominant end-use sectors and measures and pointing to the implications of different designs on the outcomes of national schemes in order to draw lessons about the design and operation of supplier and utility obligations and tradable certificate schemes.

Results of the Current European Schemes

Table 1 presents the key design features of the ongoing phases of the schemes in Italy, France, Denmark, Flanders and the UK. This section discusses the results of the national energy saving obligations in the EU in terms of target distribution and compliance, dominant end-use sectors and measures, and cost estimates as of August 2009.

Table 1 Cost Estimates in Comparison with Electricity and Gas Prices

	UK	*Italy*	*France*	*Denmark*	*Flemish region (Belgium)*
Current target	Carbon: 185 $MtCO_2$ lifetime in 2012	Primary energy: at least 22.4 million tones of oil equivalent (Mtoe) (~260 TWh) to be saved between 2005 and 2012 of which 6 Mtoe (~ 70 TWh) to be saved in 2012 only.	Final energy: 54 TWh lifetime discounted	Final energy: 2.95 PJ (~0.82 TWh) annual (as of 2010: 5.4 PJ/y =1.5 TWh/y)	Primary energy: 0.58 TWh for 2008 (annual)
Current phase	2008-2012	2005-2012 (annual targets)	Mid-2006 to mid-2009 (no new target set yet)	2006-2013 (annual targets)	2003 – (annual targets)
Annual end-use energy savings (TWh)[a]	3.5 [b]	4.5 [c]	1.3 [d]		
Sectoral coverage for eligible projects	Residential consumers only	All consumers	All except ETS	All except transport	Residential and non energy intensive industry and service
Restrictions on compliance	40 % from 'priority group' (50% in EEC)	50 % from reduction in own energy sector (applied until January 2008)			
Obliged parties	Electricity and gas suppliers above 50,000 residential customers	Electricity and gas distributors above 50,000 customers	Suppliers of electricity, natural gas, heat, cold and above 0.4 TWh/year sales, LPG above 0.1 TWh yearly sales and all heating fuel suppliers.	Electricity, gas and heat distributors	Electricity distributors Separate targets for residential and non-residential (2008 on)
Eligible parties for savings accreditation	Gas and electricity suppliers only can achieve accredited savings	ESCOs, energy efficiency installers, private and public enterprises with an energy manager, non obliged gas and electricity distributors	Any economic actor but restriction on non obligated parties	Obliged distributors and daughter companies	Electricity distributors only

	UK	*Italy*	*France*	*Denmark*	*Flemish region (Belgium)*
Certification size; discount factor; explicit cost recovery	N/A certification; No discount factor in CERT; No explicit cost recovery.	1 toe; No discount factor; 100 Euro/toe cost recovery until 2008. As of 2009 cost recovery depends on energy sale price variation.	Min. 1 GWh certification application threshold; 4 % discount factor except for 1st year.; No effective cost recovery [e].	N/A First-year savings only count Cost recovery	N/A First-year savings only Cost recovery determined based on annual action plans for compliance
Trading	Energy savings can be traded only between obligated parties;	Certificate trade; Spot market sessions; OTC trading;	Certificate trade, only OTC trading	No trading, no certificates	No trading
Penalty	Penalty can be as high as 10 % of the supplier's turnover but takes into account the size of the underperforma nce.	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 cumac	Penalty exists, not fixed.	0.01 Euro/kWh

Source: Bertoldi et al 2010

[a] Source of the entire row: Eyre et al (2009)

[b] Based on evaluation of 2005-2008

[c] Based on 2005-2007 certified savings

[d] Estimates for annual average in July 2006 to July 2009 based on targets

[e] The law allows that certificate costs be put in electricity and natural gas tariff, but they are not.

Target Distribution and Compliance

Over compliance with targets has been a feature of all the major energy saving obligations in the EU.

In the period 1 June 2007-1 June 2008, the Italian regulator certified approximately 904,000 toe of energy savings. However, due to the existence of certificates issued in 2005 and 2006 and not yet redeemed, as of 1 June 2008 there were almost 1.34 million certificates in circulation, equal to 210% of the 2007 target (AEEG 2008). Energy efficient measures implemented in the period 2001-2004 account for 13% of the total amount of white certificates issued so far and of the total savings generated in the period 2005-2007 by all energy efficiency measures implemented. In 2007 only the tradable white certificates issued and available for demonstrating compliance over the ensuing 5 years amounted to 143% of the 2007 target distributed[3].

[3] The total is taken to be 633 382 toe – the actual amount apportioned in 2007, which is 79% of the total target. The shortfall is due to the share of small distributors, which were not under the obligation until 2008.

In the UK suppliers exceeded their EEC-2 targets by 44% delivering 184 fuel standardized TWh (lifetime discounted savings excluding comfort) and the French suppliers exceeded their targets by more than 20% delivering 65.2 TWh cumac by the end of the first compliance period on the 30th of June 2009.

The three schemes have targeted different energy sources and carrier: the Italian scheme, for example, has been dominated by electricity savings, driven by the focus on primary energy and short measure lifetimes. The combination of these two factors has discouraged e.g. thermal envelope measures in buildings delivering savings in gas or other primary energy sources.

In the period 2005-2007 in Italy 61% of the target distributed was targeting electricity distributors, while 78% of the savings actually came from electricity. Over 2001-2007 almost 21 million CFLs were delivered to comply with the obligations for the period 2005-2007. Prior to the legislative changes of 2008 distributors could get 7.3 Euro/CFL (3.65 Euro/CFL distributed as a free token), which also explains the interest in lighting measures[4]. After legislative changes of 2008 distributors receive at most 2.1 Euro/CFL[5].

In the UK electricity savings accounted for 27% of all delivered energy savings to meet the EEC-2 target[6]. In contrast in Denmark, natural gas accounts for a larger amount of savings than initially indicated in target apportionment. This is likely to be due to the pre-dominance of interventions in the industrial sector in Denmark[7].

Dominant End-Use Sectors and Measures

Among the schemes that target more than one end-use sector, the Italian and French schemes have delivered the largest amount of energy savings in the residential sector, while the Danish obligation has focused efforts on trade and industrial sectors (see Table 2). The availability of deemed savings measurement methods associated with various projects implemented in the residential sector has focused the efforts of obligated parties towards these. The Danish experience may also reflect the continuance of the historical energy efficiency activities of the distributors with trade and industrial sectors.

In terms of measures, the 10 most common measures undertaken in Italy, France and the UK differ considerably. Although CFLs and appliances dominated in terms of number of measures in EEC-2 (2005-2008) in the UK, in terms of energy saving 75% were achieved with insulation measures, 8% with heating measures, 5% appliances and 12% with CFL and lighting measures (Lees 2008). The heavy emphasis on insulation is driven by working with lifetime savings, which incentivises the use of long lifetime measures.

[4] Calculated with cost recovery of 100 Euro/toe, annual savings and lifetimes for CFLs as in force prior to the 2008 legislative changes.

[5] Calculated with 2009 value of cost recovery of 88.92 Euro/toe, annual savings and lifetimes for CFLs in force as of 2009. The marked decrease in the costs recovered from CFL distribution is due to both the lower cost recovery rate and the new deemed estimates for CFL savings that apply as of 2009 (i.e. 0.024 tep/CLF for CLF with nominal power below 15 Watt and E14 lamp fitting instead of 0.073 tep/CFL that were assumed to be averagely saved for each CFL of any nominal power and any lamp fitting distributed before 2009).

[6] In terms of the energy savings in fuel standardised units, 41% of the total savings to meet the EEC-2 target came from electricity; this is reduced from the corresponding figure in EEC-1 of 54% due to increasing dominance of insulation measures in EEC-2 which mainly save gas.

[7] Data on savings breakdown by fuel type are not available for France and almost impossible to estimate because the two main actions - boilers and insulation – have no fuel specification and are not fuel specific.

Energy savings accredited by the Italian regulator AEEG in the first 3.5 years of operation of the Italian scheme come primarily from electricity savings in buildings mostly lighting) and thermal demand in buildings (AEEG 2008).

Table 2 Savings Delivered by End-Use Sector

	Residential buildings (electricity and thermal)	Commercial buildings (electricity and thermal)	Industry	Transport	Other
Italy 2005-2007	59% electrical use in buildings 21% thermal uses in buildings		6%	0	14% (public lighting and supply options)
France 2006-2009	86.7%	4.3 %	7.4 %	0.4 %	1.3% (district heating)
UK 2005-2008	100%	NA	NA	NA	NA
Denmark	42%	50% trade and industry 8% public sector		NA	NA

Source: Bertoldi et al 2010

Almost two thirds of the certificates issued by the end of the first compliance period in France concern actions in residential heating. The dominant measures – efficient boilers, heat pumps, insulation and windows – are eligible for tax credits too. Energy suppliers have directed their programs to take advantage of this support.

In Flanders the most common actions include super-insulated glazing, condensing and high-efficiency boilers, roof insulation in existing buildings, thermostatic valves and solar water heaters. In addition to the actions the distribution system operators are free to choose, they are also obliged to carry out two energy scans (simple audits) for every 100 household connections in 2007-2009.

Cost Estimates

Table 2 puts the cost estimates of the three largest schemes (UK, France and Italy) in the context of electricity and gas prices in the residential sector of each country in 2008. As can be seen in all cases the electricity and gas cost estimates are lower than electricity and gas residential prices by a factor of 2 to 6.

In terms of cost of compliance to obliged companies,in the UK over the three years of EEC-2 energy suppliers' expenditure to comply with the obligation amounted to 775 million GBP (909.8 million Euro[8]) on direct costs of the energy efficiency measures plus 140 million GBP (164.4 million Euro) for the indirect costs[9]. The total expenditure by all parties on energy efficiency measures (i.e. excluding the energy supplier indirect costs) was 1.12 billion GBP (1.315 billion Euro)[10]. The direct costs incurred by the regulator Ofgem in the UK in

8 The exchange rate used is 1 GBP = 1.174 Euro (as of 15 June 2009)

9 Indirect costs cover all administration for obliged parties, such as monitoring, reporting, planning, etc., as well as marketing costs.

10 The difference between the 1.12 billion GBP (British Pounds) and the 775 million GBP is the costs towards the implementation of the measures from households, local authorities, housing associations, manufacturers, charities,

administering the three years of EEC-1 were 1 million GBP (1.174 million Euro). The cost for all parties of saving a delivered unit of electricity or gas (sometimes called the national cost effectiveness) under EEC-2 was approx. 0.7 Eurocent/kWh in the case of gas and 2.35 Eurocent/kWh for electricity (Lees 2008).

Based on market prices for white certificates Eyre et al (2009) indicate cost of conserved energy for obliged parties in Italy of 0.26 Eurocent/kWh (gas) and 0.27 Eurocent/kWh (electricity).

As of the end of the first compliance period of the French scheme (July 2009), no data on the cost of conserved energy was available. The only reliable information is that the cost is between 0.3 Eurocent/kWh cumac, which is the average value of the certificates traded during the first period, and 1 Eurocent/kWh cumac, which is the maximum price of certificates traded in 2008[11].

Table 2. Cost Estimates in Comparison with Electricity and Gas Prices

	electricity cost of conserved energy (Euro/kWh)	electricity price (Euro/kWh without taxes)	gas cost of conserved energy (Euro/kWh)	gas price (Euro/kWh without taxes)
UK	**0.023 (EEC-2)**	0.1394 (in 2008)	**0.007 (**EEC-2)	0.037 (in 2008)
France	**0.02 - 0.003**[12]	0.094 (in 2008)	**0.02 - 0.003**	0.044 (in 2008)
Italy	**0.027** (certificate prices 2006-2007)	0.166 (in 2007)	**0.026**	0.043 (in 2008)

Source: For residential gas and electricity prices Eurostat (2009)

Note: Prices refer to electricity and gas prices charged to final consumers. Eurostat defines electricity prices for household consumers as follows: Average national price in Euro per kWh without taxes applicable for the first semester of each year for medium size household consumers (Consumption Band Dc with annual consumption between 2500 and 5000 kWh). Natural gas prices for household consumers are as average national price in Euro per GJ without taxes applicable for the first semester of each year for medium size household consumers (Consumption Band D2 with annual consumption between 20 and 200 GJ). A conversion factor of 1 GJ = 278 kWh has been applied.

The total budget for meeting the 2008 obligation in Flanders has been estimated at approximately 48 million Euro[13.] This estimate includes premiums in the residential and non-residential sectors, as well as overheads and communication. A simple calculation of dividing this budget by total savings achieved in 2008 shows cost of conserved energy in the range of 0.027 Euro/kWh. This is a very low cost, given the fact that only first year savings count in the Flemish scheme and the fairly higher cost measures implemented (see previous section).

The cost estimates in different national schemes are *not directly comparable* due to the profoundly different design and coverage of the schemes: for instance in Italy the estimates are

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etc. Note that for appliance and heating measures, this is the differential cost between the energy efficient solution and the energy inefficient alternative e.g. for condensing boilers it is the difference between the cost of an ordinary boiler and the condensing boiler and NOT the total cost of the condensing boiler.

[11] Yet, these numbers should be interpreted with caution because of the very low volumes of trading and the low number of transactions: the total amount of certificates traded during the first period was below 4% of the national obligation.

[12] Cost of conserved energy upper bound based on the non-compliance penalty (Euro/kWh cumac) and lower bound based on the average price of certificates traded by the end of first period (Euro/kWh cumac) 2006-2009

[13] Personal communication with Ann Collys, August 2009.

based on certificate prices on the spot market, which are heavily influenced by cost recovery, while in France the cost estimates refer to cumulative and discounted savings.

Discussion

The design of supplier obligations and white certificate schemes across the EU varies considerably and their performance is heavily influenced by initial policy, market and institutional conditions and policy traditions in each national context. Under all supplier obligation and white certificate schemes in the EU obliged parties have achieved and exceeded their energy saving targets. The choice of primary or final energy influences the balance between savings of gas and electricity: for example in Italy, where obligations are in primary energy, most savings have occurred in electricity. Long lifetimes for certain project types (e.g. building insulation) and accounting for cumulative savings tends to influence the compliance choices towards such projects.

Whether certification of energy savings and certificate trading add value to supplier obligation depends on at least two major factors. Trading could make energy saving obligations a preferable option with respect to other policy instruments for energy saving (e.g. energy taxes) only when the energy saving target established is sufficiently high with respect to the existing saving potential in the sector(s) covered by the scheme[14]. In theory, the more ambitious the saving target gets, and the more variation there is in energy saving unit-costs and end-use energy prices, the greater scope there is for a tradable white certificate scheme to outperform other energy policy instruments (Perrels 2008)[15]. Design modalities, such as parties eligible to trade, affect the role of trading.

Trading appears beneficial in a system with a wide scope in terms of sectoral coverage and project types where non-obliged parties are allowed to trade. This is the case of Italy where trading is an important element. In contrast, despite the rather wide scope of the French scheme suppliers have chosen to do projects themselves or via partnerships, positioning themselves in the energy services market and promoting their own brand. In France economic actors that are not eligible to certify savings, but wish to do so, can participate in the certificate market by signing agreements with energy suppliers[16]. The role of trading in a scheme that is limited in scope (e.g. residential sector only as in the UK) is more ambiguous: the additional administration cost of establishing and operating a trading regime may not justify the cost efficiency gains of trading for obliged parties and society. Since in the UK most suppliers work with a number of contractors and retailers, the implementation costs are similar. However, there are considerable variations between energy suppliers in the mix of energy saving measures they employ to meet their targets and the insulation installers complain that the current way of fulfilling requirements does not permit the more efficient local area blitz approach. i.e. delivery and marketing cost savings arising from working in a coordinated fashion in a specified local area. It is not clear

[14] An analysis of the existing energy saving potentials in Finland, Hungary, the Netherlands and the UK claimed that the saving target for a possible tradable white certificate scheme in these countries would need to be at least about 60% of their estimated saving potentials in order to be reasonably sure that positive white certificate prices might occur (Perrels 2008).

[15] Note that the conclusions of Perrels (Perrels 2008) are based on modeling assuming rational behavior, which is not necessarily valid in the markets under consideration. We are grateful for this remark to an anonymous reviewer.

[16] These actors may include non-obliged ESCOs and/or equipment manufacturers. Note that in France most energy service providers and ESCOs are also energy suppliers and hence have energy saving obligations.

whether there would be significant added value from certificate trading in the UK, but this issue is under review for energy supplier obligations post 2012.

The policy additionality of supplier obligation and white certificate schemes is not always clear. For example, in France obliged parties rely on local contractors. Existing generous tax credits add to the financing of most of the interventions[17]. In France residential tariffs are regulated and there is no cost recovery: hence obliged parties are not passing on the costs in any standard way. Similarly, in Italy tax deductions play an important role for residential projects and it is not clear which policy is the driver for some project types implemented under the scheme: the rebate given by obliged parties as part of their progress on targets or tax deductions available for certain energy efficiency measures.

In the UK and Italy obliged parties tend to subsidize the energy efficiency intervention, especially in the case of low-cost measures (e.g. CFLs). In the UK for measures targeted at low income families, the energy suppliers usually pay nearly all the costs except in the case of measures in social housing where obliged parties partially fund social housing providers. For appliances and boilers the subsidy only covers the differential cost between the energy efficient and energy inefficient solution to influence householder purchasing decisions.

The three major schemes function in a similar manner in the residential sector where projects are small and project transaction costs high: obliged parties initiate and partially subsidize the measures. In the residential sector the financial contribution to the end users is much smaller and not transparent; the end-user cannot obtain certificates and may not even be aware of ownership titles that he is assigning.

Experience in Italy points that in the tertiary and industrial sectors the end users get the monetary benefit of certificates, including certificate price estimates in their calculations of projects' internal rate of return or net present value.

The heavy reliance on deemed saving evaluation method in most supplier obligation schemes reflects the greatly reduced transaction costs associated with applying these which is particularly appropriate for measures with relatively low unitary energy savings e.g. in the residential sector. Nevertheless, especially in the case of the massive giveaways of CFLs in Italy and the UK, the extent to which the CFLs are actually used remains unclear and hence the actual amount of savings achieved in reality[18].

In the UK the supplier obligation has been introduced with the intention of, among other, changing business models in energy supply. It has been observed that the major household energy suppliers have developed their own program, used to some extent as a marketing tool (Eyre et al 2009). In the UK and France obliged parties are moving in the direction of positioning themselves as energy efficiency providers vis-à-vis their clients. Obliged companies in the UK have formed partnerships with energy efficiency industries, bringing new activities to their portfolios without significantly modifying their core business of selling energy. For example, suppliers in the UK use their brand on the delivery of products via contractors. In France, the

[17] Example of French tax credit in 2009: for a low temperature boiler no tax credit, for a condensing boiler 25 % (or 40 % if replacing a very old installation - before 1977) and if installed in the first two years following the acquisition of the building, efficient heat pumps 40 % (if COP $\geq$ 3.3), thermal solar 50%. The tax credits only apply to the costs of the equipment and not on the costs of the manpower.

[18] Recently the UK has announced that in the light of the large number of CFLs given free to customers by unsolicited mail deliveries from energy suppliers, that when evaluating the energy and carbon savings from this for Government purposes, they will reduce the saving values considerably. It will not affect the energy savings accredited to the energy suppliers but they will no longer be able to use this promotion route from 1 January 2010.

majority of obliged parties have developed within their own groups new services in the household energy market, such as advice, individual audits, financial instruments like low-interest rate loans and upfront subsidies. These build on partnerships with retailers, installers, manufacturers and banks and have also helped to transform the business of household installers towards more energy efficient solutions. (Eyre et al 2009).

In Italy obliged companies do not have a direct contact with final energy users and obligations have been mostly delivered by third parties, such as ESCOs. This does not hold for massive hand-outs of CFLs, which are directly mailed or sold by retailers under the brand of the distributor that subsidizes them. In the medium term this cooperation may expand the scope of commonly implemented projects to the tertiary and industrial sectors once 'low-hanging fruits' are exhausted or implementation rules strengthened.

Conclusions

Similar to the US-style demand-side management (DSM) systems, the major energy saving obligations and white certificate systems in the EU are dominated by subsidy measures. Financial incentives for end-users are especially important in the residential sector. Compared to the early DSM programs, 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, supplier obligation 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).

With the exception of the Danish obligation, European schemes are dominated by measures with standardized saving factors, particularly in the residential sector. A scheme limited in terms of scope and energy sectors covered is more likely to use this valuation method because similar measures are used in the sectors with large end use customer numbers (e.g. residential, small businesses), which greatly reduces the transaction costs.

Supplier obligations and white certificate schemes are well-suited to deliver low-cost and standard energy efficiency measures. Nevertheless, as shown in the UK, they can be designed to channel efforts towards measures with higher upfront investment needs (e.g. by issuing more certificates for longer lifetime project types that actually yield more savings or by giving longer validity to certificates).

All the schemes have some supply options included, but for none of these have supply options – such as cogeneration – been dominant[19]. In some cases options are allowed that are 'in-between' supply and end-use options, namely micro cogeneration and solar water heaters that replace end-use technologies.

Finally, supplier obligations may result in a 'tendering' system like in UK where suppliers tendered to the energy efficiency industry (e.g. manufacturers and installers) for projects to deliver them savings. Part of the success of supplier obligations may also possibly depend on the limited coverage of the scheme which makes design and operation easier, as happening with the UK scheme where only energy saving measures in the residential sector are eligible.

[19] In the EU a number of countries support cogeneration via investment support and CHP electricity feed-in tariffs. The procedure for calculating energy savings from cogeneration under the Italian scheme has been disputed in the court.

Based on the results of European schemes provided in the previous sections, the following lessons can be drawn about the design and operation of supplier and utility obligations and tradable certificate schemes.

- Supplier obligations engage energy market actors into energy efficiency without necessarily changing their business models from selling energy into selling energy services at least in the short term;
- Providing administrative and monitoring costs are not disproportionate in opening up the generation of white certificates to any party (not just obligated energy companies), then this approach should theoretically ensure diverging marginal costs and lower risks of market power and speculative behavior. Allowing third parties to certify project savings is an opportunity to develop an energy services activity rather than to constrain the obliged parties to evolve toward such activities;
- Obliged parties expect to recover the costs of compliance with the obligation in some way (cost recovery as in Italy or passing through in end-user prices as in the UK);
- Defining standard measurement and verification methodologies reduce the transaction costs for obliged parties and project developers and thus directs the market towards types of projects or sectors, where such standard methodologies (‘deemed savings’) are available. Thus, the co-existence of default values for unitary energy savings and of more detailed measurement and verification methodologies results in a bias towards measures that introduce energy efficiency technologies with default values for unitary energy savings. This is even more so whereby default saving values are set 'generously' high;
- Banking of certificates or savings, long validity of certificates and long compliance periods mitigate price risks for obliged and eligible parties, but may discourage trading and thus reduce liquidity in the current compliance period. Minimum buy-out prices of certificates and penalties may act to establish a ceiling and a floor price;
- Administrative costs of all policy instruments are a function of the simplicity of the system and the ease of obtaining reliable information necessary for its design and enforcement. The relatively low burden for the British authority results from a single eligible sector, rather limited number of obliged parties, ex-ante measurement and verification approach, as well as lack of third party trading provisions;
- Trading is expected to deliver cost efficiency gains when energy saving targets are set sufficiently high with respect to the existing economic saving potential in the sectors covered by obligations;
- An efficiently working tradable certificate market requires transparency i.e. that all players know the price of certificates in the market, the possibilities for the purchase and sale of certificates and possess information on the types and costs of energy saving technologies and processes in the market.

The major national supplier obligations and white certificate schemes in Europe have very different design modalities and very different experiences in terms of trading: there is a flourishing certificate market and many energy service providers and ESCOs on the supply side of the market in Italy, little trade and no major role for energy service companies in the schemes in France and the UK, and no trading allowed in the Flemish region. These differences, along with the strong local benefits of energy saving measures, present the major difficulty relating to the establishment of a European-wide white certificate market.

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