White, green & brown certificates: How to make the most of them?

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Abstract
Recently a number of market-based instruments (MBIs) have been introduced to achieve sustainable energy policy goals. The most prominent MBIs are tradable permits and certificates introduced to attain CO_2 or other pollutant emission reductions, to promote market-driven penetration of renewable energy sources (green certificates), and, more recently, to foster energy efficiency improvements (white certificates). These policy instruments often target parts of the same sectors (e.g. power generation). The paper identifies design and operational features that the MBIs in the energy sector share and analyses how these features have been implemented in existing schemes, especially in those with relatively longer track record. Creation of demand, organisation of markets and institutional requirements are among the issues discussed. Possible ways to integrate or link different schemes are investigated in order to achieve the maximum environmental benefit as well as a high degree of economic efficiency, including practical suggestions for a potential integration of white and green certificates and a possible further integration with CO_2 emission trading; the idea of a set-aside quota of emission allowances for efficiency and renewable projects is elaborated and discussed. The advantages and challenges of a uniform trading mechanism such as CO_2 trading are outlined vis-à-vis having several sectoral trading mechanisms which may be integrated to a certain degree.

Introduction
Market-based instruments (MBIs) are public policies which make use of market mechanisms with transferable property rights to distribute the burden from a policy. In the energy sector MBIs have been introduced to promote electricity from renewable energy sources (RES) and cut harmful emissions (e.g. SO_2, CO_2, NO_x). One of the strongest arguments in favor of market-based instruments is that theoretically they minimize the costs to society for reaching a certain target at a certain time: they equalize the marginal costs spent on complying with a target (static efficiency) and create incentives to innovate and improve performance (dynamic efficiency) (Egenhofer 2002). The key elements of MBIs are the creation of demand, the tradable property right, and institutional infrastructure and processes to support it. We structure our discussion on common features of MBIs in the energy sector along these lines, adding the perspective of cost recovery.

Renewable quota obligations coupled with tradable green certificate (TGCs) schemes have been implemented in the last decade in a number of EU Member States (see explanations later). There has been experience with emission trading (SO_2 trading under the Clean Air Act in the United States, NO_x trading) and the European Emissions Trading Scheme (ETS) is now taking off the ground. A possible market-based policy to promote energy efficiency in end use could comprise energy-savings quota for some category of operators (distributors, suppliers, large consumers, etc.) coupled with a trading system for energy savings. This is now starting in Italy; the UK has been operating a similar scheme for some years now and France is developing one.

The present paper points at transferable design and implementation experiences from MBIs already in place in the energy sector that are relevant to tradable certificates for energy savings (TCES) and analyses possible ways to integrate market-based schemes in the energy sector. The paper has the following structure. First, we identify those design and operational features that the TCES system has in common with respectively the ETS and the green certificate system and analyse how these features have been implemented in existing schemes, especially in those with relatively longer track record. Second, we analyse possible ways to integrate different schemes and discuss a uniform trading mechanism versus several sectoral trading mechanisms which may be integrated to a certain degree.

Market-based instruments in the energy sector of European countries: lessons learned for the design of white certificate schemes

THE EU EMISSION TRADING SCHEME

The European Climate Change Program report identified the introduction of an EU emissions trading scheme as an important policy area. The EU adopted a Directive (2003/87/EC) introducing a scheme for greenhouse gas emission (GHG) allowance trading within the Community. Emissions trading (ET) in some sectors has started in 2005; the first three-year trading period is limited only to CO_2. The scheme is supposed to cover about 46% of the EU-15's total CO_2 emissions in 2010 and involve about 10 000 installations that fall under the activities in Annex I: practically all energy intensive sectors (apart from the Chemical sector)[1]. Emission reductions from joint implementation (JI) or clean development mechanism (CDM) projects can be used by the companies to fulfil their emission reduction targets. The details are regulated in a Directive (2004/101/EC), which entered into force in November 2004. Starting from 2005 firms will have direct access through CDM to credits from countries without targets; from 2006 JI credits will be available for countries with targets. It is also agreed that companies have the possibility to pool their emissions allocations until 2012, which means that e.g. industrial branches can try to find a common solution.

For tradable permit systems a direct and an indirect emissions approach is possible. The direct (upstream) approach is based on the physical source ('the pipe'), whereby the actual emitters are obliged to purchase sufficient emission permits[2]. The cost of the permits will be accounted for in the price of the products emitters sell: products with high carbon content will become more expensive and buyers will respond by consuming less or switching to an alternative with less price rise (which presumably, but *not certainly*, is also less carbon intensive). Hence, **this approach only indirectly gives some incentive to energy savings** as a means to consume less carbon intensive product without loosing the desired service level. However, price differences between product alternatives are not only caused by carbon intensity. While it can be argued that the carbon content will be internalized in the electricity price and this will create a sufficient price signal to be passed through to consumers, even this short-term impact of the EU ETS on electricity prices will be contingent upon a plethora of factors. The method of allowance allocation, the allowance price, the extent to which additional costs are passed on to consumers rather than to e.g. shareholders, the carbon intensity of the electricity generation system as a whole, and the elasticities that operate on behavior (in relation to price, substitution, and income), are among these factors (Sorrell 2003). In addition the demand side of the energy sector is rarely as responsive to price incentives as economic theory predicts. These would probably make negligible the effect on energy efficiency of a possible price increase driven by the EU ETS.

Conversely, the indirect (downstream) approach is based on the idea that the final users, who are causing the whole production chain, should see more precisely what the carbon intensity is, and **get allotted emission quota** based on a baseline.

The EU ETS follows the direct system, among other things because of the monitoring and inspection complications inherent to the indirect scheme, especially at an international scale. This makes the guidance of energy efficiency for companies inside the ETS only indirect; for instance, an industrial user with an emission cap under EU ETS cannot get any credit for improving the electricity efficiency of end-use at his site(s). In addition, sectors outside the ETS are influenced by the initial division of reduction tasks between trading and non-trading sectors: if Member States wish to favour the export-oriented companies inside the EU ETS, they end up with having to demand more efforts from other sectors in order to fulfill the overall target.

TRADABLE GREEN CERTIFICATE SCHEMES FOR ELECTRICITY FROM RENEWABLE SOURCE IN EUROPE

In October 2001 the so-called renewable electricity Directive (2001/77/EC) was adopted, aiming to increase the share of green electricity from 14 to 22% of gross electricity consumption by 2010[3]. It establishes non-mandatory national targets[4] for the portion of electricity consumption to be met by RES.

TGC schemes work as follows: a quantified obligation (RPS, quota) is imposed on one category of electricity system "operators" (generators, producers, distributors, retailers, or consumers) to cover a certain percentage of electricity from RES. On a settlement date, the operators must submit

1. Each installation gets emissions allowances for the whole period. For the first period (2005-2007) installations are free of charge (grandfathering), for the second phase (2008-2012) up to 10% can be auctioned. The Member States have allocated the emissions to the concerned installations by means of a national allocation plan (NAP) and according to defined criteria. If installations do not meet their obligations they have to pay a penalty of 40 Euro per ton CO_2 for the period 2005-2007, for the next periods it will be 100 Euro per ton CO_2.
2. What 'sufficient' exactly constitutes depends on the kind of quota allocation and trading system chosen.
3. This overall target was specified for the EU-15. With the Accession of ten additional Member States in May 2004 the overall target was set at 21%.
4. The Directive mentions that no later than October 2005 the European Commission will monitor the progress of individual Member States toward their national objective and will, if necessary, propose mandatory targets for member states that do not reach their goals. The current public debate seems not to focus on setting mandatory targets nor on harmonisation of support mechanisms, but rather on taking away further market barriers that hamper actual realisation of the indicative targets.

the required number of certificates to show compliance. Certificates can be obtained in one of the following ways: (a) operators can own their own RE generation, and each defined amount of energy produced by these would represent a certificate; (b) operators can purchase electricity and associated certificates from eligible RES-E generators, or (c) operators can purchase certificates without purchasing the actual power from a generator or trader or via a broker. Under perfect market conditions supply-side competition leads to minimal generation costs for RES, if there is surplus RE generation beyond the demand for certificates.

Renewable quota obligations coupled with TGCs have been established in a number of EU member states, including Italy, Belgium, Sweden and the UK[5]. In the Netherlands the certificate system was not linked to an obligation, but to various tax exemption and production support (see elaboration below). Austria has formally used a TGS system for a short period of time, linked to its obligation on small-scale hydro production. However, the system was never fully operational and was quickly abolished by new feed-in tariff. Poland has introduced a quota system since 2001 and is still planning to introduce a full TGC system; details for the TGC system have still not been set and the lack of penalty for non-compliance led to many distributors failing to meet their targets; hence no driver existed for trading targets and/or certificates. Denmark for many years planned the introduction of a TGC system but never actually implemented it.

To date experiences are mixed, both resulting from the specific design of the TGC systems and from the initial market conditions. The Dutch market was the first market where certificates were actually used. Initially the system (then called the Green Label) was intended to register the compliance of Dutch utilities with the voluntary target setting and allow for trade among this group. Later the system was called a certificate system and linked to a combination of tax exemption and production support (a pass through of part of tax revenues to RES-E producers). The certificates were again used for registration matters, but also by the tax authorities to arrange payments on tax exemptions and production support[6]. During part of this period the certificates could also be imported. From July 2004 until January 2005 the certificate system has been linked to a combination of tax exemption and feed-in tariff. As of January 2005 the system is only linked to a feed-in tariff.

The Italian system is designed in such a way that the system operator, GRTN, covers the shortfall of certificates. The certificates again serve as a means to register target compliance. Italian certificates are only issued for new production. In Sweden the market was designed with moderate targets, aiming to create a long market at least in the first years of the system. Because of strong market control by a small number of parties, the market failed to comply with the targets set so far, but large amounts of Elcerts are in store. The design of the UK market puts large credit risks on investors and plant developers, resulting in large problems to acquire long-term financing or purchase power contracts. Parties handing in Renewable Obligation Certificates (ROCS) are entitled to share in the recycling of the revenue fund that is filled with buy-out payments (i.e. payments from parties not meeting targets).

Inherently to the design of the system prices paid for certificates on the different markets also largely vary. Where in Italy the price is still almost artificially set by GRTN at approx. 83 Euro/MWh, the price on the UK market is fully established by the definition of the buy-out price (30 pounds or approx 43 Euro/MWh) and the investment decisions of market parties, resulting in ROCs prices of approx. 69 Euro/MWh. In Sweden prices in the first years have been around 240 SEK or 43 Euro/MWh, but as the market was short it was no real surprise that prices fluctuated around the penalty price.[7] The Dutch market has seen large price fluctuations resulting from the continuous changes in the connected policies: from an initial 50 Euro/MWh to below 10 Euro/MWh at the end of 2003. Prices for imported biomass fluctuated between 2 and 10 Euro/MWh. Due to the fact that certificates expire after one year, oversupplies at some time resulted in very low market prices.

Without technology bands specified, TGC systems mainly trigger establishing production from the cheapest resource available. In Italy mainly electricity from municipal solid waste and from upgrading of hydro power account for meeting the targets, while in the UK nearly half of the ROCS were issued for landfill gas. In both countries wind power (onshore in Italy, offshore in the UK) is expected to deliver most of the certificates in the coming years. In Sweden approximately 75% of the certificates were issued for biomass, of which again approx. 75% for bio-CHP (mainly in the paper and pulp industry). In the Netherlands a large amount of certificates (approx two-thirds) was imported in the period until end 2004. The certificates issued for Dutch power mainly originated from biomass electricity (52%) and wind power (44%).

In addition to these government-based TGC systems, the RECS[8] facilitated trade in TGCs used mainly for voluntary demand. So far over 55 TWh of certificates have been issued within the RECS of which over 20 TWh has been redeemed. Out of the total number of certificates issued nearly 60% was issued for electricity from hydro power and more than 35% for biomass from forest residues. So far most of the certificates were issued in Finland, Norway, Sweden, Austria, Spain and Slovakia. Nearly a quarter of all certificates used were consumed in the Dutch market, where they could profit from the former support system. Austria imports a good deal of RECS certificates, strongly supported by the

5. While we acknowledge that the new systems in Texas (USA) and Australia seem to be successful, we focus on European systems
6. The main aim of Dutch support for renewables was to support domestic demand for green power. This indeed happened: the number of green power customers increased to nearly 3 million (out of 7 million households).
7. In the Swedish Elcert system much more certificates were issued than used, resulting in a large amount of Elcerts in store. The price level of 240 SEK is in fact a tax adjusted sanction fee of 175 SEK per MWh. Elcerts do not expire and can thus be banked for an indefinite period.
8. The Renewable Energy Certificate System is an organisation that was established in March 1999, aiming to prove that a high quality system of tradable green certificates can operate in the European market. Its two main objectives were and are to facilitate actual trade in TGCs as well as establishing harmonization between national systems. To ensure the latter, the RECS developed and adopted a set of rules on the establishment of systems (issuing certificates, trade regulations and rules for redemption). More information: www.recs.org.

fact that RECS certificates in this country have been fully compatible with the system of GoO.

TRADABLE CERTIFICATE SCHEMES FOR ENERGY SAVINGS

A tradable certificate for energy savings (TCES) portfolio involves four key elements (Pavan 2002 and 2003, Bertoldi and Huld 2004, Bertoldi and Rezessy 2004, Langniss and Praetorius 2004): (a) the creation and framing of the demand, (b) the tradable property right and the rules for trading, (c) the cost recovery mechanism[9], and (d) Institutional infrastructure and processes (such as measurement and verification) to support the scheme.

Variations of this policy mix have been recently introduced in Italy and the UK; in France a similar scheme is under preparation. In Italy energy-savings targets for electricity and gas distributors in terms of savings in primary energy consumption are combined with tradable energy saving certificates issued to distributors and ESCOs, as well as with elements of tariff regulation (cost recovery mechanism via electricity and gas tariffs and multiple driver tariff schemes to avoid profit losses) or dedicated funds. At least half of the target set for each single year has to be achieved via a reduction of electricity and gas end-uses (referred to as the "50% constraint" to which each distributor is subject). The remaining share can be achieved via primary energy savings in other sectors.

In the UK, the Energy Efficiency Commitment 1 (EEC) program required that all electricity and gas suppliers with 15 000 or more domestic customers must encourage or assist those customers to take energy-efficiency measures in their homes: suppliers must achieve at least half of their energy savings in households on income-related benefits and tax credits. In EEC 2 suppliers with at least 50 000 domestic customers (including affiliated licenses) are eligible for an obligation; the reason to increase was in part to limit the effect of EEC on new entrants. Energy benefits estimations take into account the rebound effect – the likely proportion of the investment to be taken up by improved comfort – by adjusting the benefits to 'comfort factors'; in addition deadweight factors are considered to account for the effect of investments that would be made anyway (Sorrell 2003).

BROWN, GREEN, WHITE CERTIFICATES: ARE THEY REALLY ALIKE?

Renewables and energy efficiency are the two major pillars of a sustainable energy path. Below we point at transferable experiences related to the design and implementation of MBIs for the promotion of renewables and energy efficiency.

Creation and framing of the market and relevant policy aspects

There are two options to create demand for tradable certificates: by obligation or by some kind of incentive (e.g. tax exemptions). Imposing obligations provides for certain outcome, but at the same time opens a whole new array of design complexities: the **size** of the target and the reference point to measure it, the **temporal** content of the obligation and who the obliged actors should be, how the overall target is **apportioned**, what projects and/or technologies are **eligible** under the scheme.

Green certificates: The RE quota obligation can be placed on one of the following: producers and importers (as in Italy, where it is a percentage of net electricity sales), distributors or suppliers (as in the UK, Poland and Flanders region), or consumers (as in Sweden where individual households and companies have an obligation[10]). In RE quota systems the choice of an obliged party determines the reference point to calculate the target and the apportionment method (e.g. based on kWh generated, distributed or consumed). Setting the RE target should be informed by technical and economic studies on potentials; it is influenced by international commitments, and the obliged parties.

The definition of long compliance period and possibly rate increase the security for investors. Most European systems cover at least the period till 2010 and have an embedded pre-defined rate of increase of the size of their targets: in Sweden the obligation increases from 6.4% of electricity consumption in 2003 to 16.9% in 2010, in the UK the obligation is expected to reach 15.4% of power supplied in 2015/16[11]; in the Flemish region of Belgium the growth is by a factor of 1.09 between 2005 and 2009. The Italian quota is based on the amount of conventional sources produced or imported in the previous year; since the RES-E share is constant till 2010 while electricity generation will likely grow, the actual penetration of RES is expected to decrease (Lorenzoni 2003).

RPS/TGC systems often excludes certain types of technologies or plants: in Flanders electricity from non-organic waste incineration is not certified, in Italy pumped hydro and in the UK hydro above 10 MW are excluded; in Italy existing plants are ineligible for certification and new plants receive certificates only for the first 8 years. There is a possibility to distinguish between technology bands so that certificate prices of "cheaper" renewables are lower[12].

White certificates: With regard to TCES the size of the target should be defined and the reference point should be chosen (e.g. as a share of actual or predicted consumption (Pavan 2003). Unlike ET and TGC trading, where the unit of the target is clear, the policy goal under which a TCES is

9. The rationale for providing cost recovery for end-use energy efficiency is that end-use energy efficiency represents a public good, which markets cannot be expected to provide. Similarly transmission lines represent a public good and there is charge applied for their maintenance. It should be pointed out that while M&V is a key tool to prove the value and results of energy savings, cost recovery is the instrument through which compensation is given to distributors for the activities undertaken so that the ultimately the final user – at whose premises the measures are implemented – will pay for them.

10. Electricity intensive industrial consumers are excluded from the obligation. The obliged parties are allowed to manage the obligation themselves by paying an annual registration fee; alternatively the distribution companies will manage the obligation for a number of consumers and pass the TGC cost as a separate item on their electricity bill.

11. The current design of the scheme includes a continued obligation until 2026/27 with a flat rate of 15.4%. A major review of the scheme is planned for the year 2005/06 in which an important element is a proposed future increased target setting until 2027.

12. This was planned in the Czech Republic. Technology bands indirectly exist in the UK system where the use of ROCs from biomass co-firing is limited (to a share of 25% and for a limited number of years) and also indirectly exist in Sweden where wind power will still receive a so-called miljo bonus for a number of years. As the Dutch certificates (now GoO) are linked to technology dependent feed-in tariffs an implicit system of technology bands also exists in this market.

fit has direct implications for setting the unit of target. If a TCES scheme builds on the policy aim of improved security of supply, the target will be defined in primary energy savings; if the aim is reliability of electricity supply the target will be set in kWh saved (Pavan 2003). Other possibilities include CO_2 reduction and local pollution reduction. It seems less appropriate to establish a TCES scheme based on a CO_2 reduction target because CO_2 is already covered in other schemes[13]. Furthermore, CO_2 reduction is not the only benefit of end-use energy efficiency and thus other important benefits of end-use energy efficiency will not be captured. Local pollution is not an obvious candidate either. In our opinion TCES scheme fits best under policy goals related to improved security of supply and improved reliability of electricity supply.

The Italian scheme has a target expressed in primary energy (toe), while the UK system has a target in TWh of fuel weighted energy benefits. The obliged parties under the Italian scheme have to demonstrate compliance annually in the period 2004-2008. In the UK the compliance period for the EEC1 was 2002-2005; EEC 2 runs in the period 2005-2008. There has been a roughly double increase in target between EEC1 and EEC2.

In terms of obliged parties in the end-use energy efficiency discourse an upstream system cannot aim "higher" in the energy chain than transmission and distribution; a downstream system that targets users (such as large industrial users, commercial facilities, and even households[14]) may have prohibitively high costs of control and transaction costs. Target apportionment is conceptually different from permit allocation in ET because energy efficiency implies a positive externality. In Italy obliged actors are electricity and gas distributors with more than 100 000 customers as of 2001, while in the UK the obliged parties are electricity distributors and suppliers with more than 50 000 domestic customers. In Italy each year national targets are apportioned among distributors that serve more than 100 000 customers on the basis of the quantity of electricity and gas distributed to final customers compared to the national total in the previous year, while in the UK target apportionment is based on number of domestic customers. The apportionment in Italy is linear to the market share; in the UK the obligation becomes tighter for companies with increasing size. 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 2004). Quirion ((2004), cited in Oikonomou 2004) presents the implications of alternative distribution rules.

In terms of projects and/or technology eligibility, three major issues emerge in the white certificates discussion:

- should the scope of projects be limited (e.g. to certain technology or minimum project size) and/or subject to pre-approval,
- should more projects be streamlined towards certain groups of consumers,
- should certain activities receive additional credit (similar to technology bands in TGC), while other be restricted (like technology exclusion in TGC).

In theory 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. Therefore many project types should be allowed for trading to bring benefits that are sufficient to offset the associated administrative and institutional costs. Limiting the scope to certain technologies will increase the risk of price uncertainties and fluctuations. However, as an extensive scope may result in difficult and expensive validation and monitoring, minimum project sizes can be applied to reduce transaction costs. In Italy activities in all end-use sectors are eligible and there is an illustrative list of eligible projects. However, at least half of the target set for each single year should be achieved by reduction of electricity and gas uses (a.k.a. the "50% constraint") (Pavan 2002). In the UK only activities concerning domestic users are eligible and there is a minimum required percentage of action in the priority group; suppliers can receive a 50%-uplift on the energy efficiency measures that are promoted through energy service activity[15].

Cost recovery

In liberalised markets the extra costs from an MBI effects pricing like a tax. Energy suppliers or other obliged parties are free to distribute the burden to the final customer in any way. In theory with perfect competition all customers will bear the same specific burden; in practice suppliers will shift the burden preferable to less competitive market segments.

Green certificates: TGCs in principle are cost-neutral to obliged parties as all additional costs of production are borne by consumers. The certificate provides payment to the supplier of a benefit that the society gained and that would otherwise be undersupplied.

White certificates: The cost recovery mechanism in a TCES scheme has similar effect: it is aimed to recover part of the extra costs for obliged companies. In Italy cost recovery is allowed only for interventions with the own energy vector[16]; the maximum cost share to be contributed to suppliers is specified ex-ante and – in order to discourage high cost-low impact projects – is not framed as a full pass-through, but as standard average lump sum (maximum allowed costs). There is a maximum allowed cost per unit of energy saved, which equals the cost to the consumer multiplied by a factor that takes into consideration the benefits not accounted in the market price, or a percentage of the maximum reference value, in order to have these added to the private avoided cost. This mechanism caps the price and

13. While the Energy Efficiency Commitment in the UK is part of the carbon reduction strategy, the scheme itself is expressed in MWh of energy benefits.
14. In order to keep transactions costs low downstream systems tend to limit their coverage to the major industrial sectors with additional instruments such as taxation and regulation being applied in the other sectors (Egenhofer 2002).
15. This uplift, however, is limited to 10% of the overall activity. Of the six major suppliers with an EEC target three have submitted schemes that would take them over the 10% threshold if take up is as forecast. The first order impact of enhancement is a **reduction in overall carbon impact** of policy instrument, which is clearly undesirable (DTI 2003).
16. It is also allowed when the intervention concerns customers of another distributor

ensures that the cost of saving from a project is not higher than buying unit of energy (Oikonomou 2004). In the UK, the cost recovery, referred to as "inducement cost", is dependent upon whether action is taken in the priority or in the non-priority group and whether the project involves structural or non-structural measures (Oikonomou 2004).

Certificates, trading rules and tools to stabilize the certificate market

It is important to separate the rules for the issue of the certificates from the rules of the trading of the certificates.

Certificate delineation

Certificates need to be a well-defined commodity that carries the property right over a certain amount of savings and guarantees that the benefit of these savings has not been accounted for elsewhere. Property rights[17] must be clear and legally secured as it is unlikely that trades will occur if either party is unsure of ownership (Jaccard and Mao 2002). It is essential that each certificate is unique, traceable, and at any time has a single owner.

For TGC certificate delineation is straightforward: each kWh of electricity can be metered. For TCES one of the overarching questions is whether it is improved efficiency or savings that are the objective of the policy action. Savings can be achieved through investments in energy efficiency projects (which may not always result in savings), through behavioral changes, or through change in both exogenous and endogenous conditions (i.e. outside and inside temperature, production levels, occupancy levels). Whether to certify **genuine** and **durable** energy efficiency (additionality) or energy savings in general is a central issue. Hence, an important aspect is whether to include in the certificate measures, which do not include energy efficiency improvements but behavioural changes[18].

Trading rules

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. Trading systems may allow for *banking or borrowing*. Banking, as well as certificates with long periods of validity, increase elasticity and flexibility of demand in the long term. On the other hand banking may bring uncertainties about the achievement of the quantified policy target within the pre-specified timeframe. The latter threat holds even more strongly about borrowing; hence borrowing is discouraged in practice and hence omitted from the present discussion. In Sweden the Elcerts can be banked without limits; in the UK ROCS may be banked for one year and a company may use banked ROCS for up to 25% of its target. In the Italian TCES scheme banking is possible: certificates are valid for five years, but there is limit on the share of certificates banked calculated proportionally to each supplier's target . In the UK Defra have proposed that suppliers will be able to carry over all their excess activity installed under EEC to EEC2; this refers to measures rather than savings.

Defining which parties are allowed to acquire certificates has profound implications 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 energy saving costs and lowers the risks of excessive market power. Parties that may be allowed to sell certificates include obliged actors, exempt actors, ESCOs, consumers, market intermediaries, and NGOs. As research on emissions trading shows, this proposition is only valid where the benefits yielded by each unit of compliance/action – i.e. toe saved – are the same disregarding where it is achieved. If this is not the case – for instance in cases where multiple policy objectives are addressed through the scheme, then activities may "migrate" to lower cost areas/sectors, where actions yield less benefits (Boemare and Quirion 2002).

In the Italian TCES obliged parties are allowed to trade among themselves; ESCOs may sell certificates too. In the UK suppliers may trade among themselves either energy savings from approved measures or obligations, with written agreement from the regulator. At present there has been little interest in trading in the UK. This reflects two developments: that energy savings can only be traded once the supplier energy saving target has been achieved and that the suppliers have been expecting the EEC2 details. Suppliers are allowed to trade excess energy savings into the national emissions trading scheme as carbon savings; the trading is one-way only (Costyn 2002).

Tools to mitigate price volatilities

The objective of the regulator is to reduce the price risk of high costs to society by setting a price ceiling (a buy-out price or a pre-defined penalty); conversely, for third parties price risks are mitigated by allowing banking and/or borrowing and establishing long compliance periods (Pavan 2003).

In TGC mechanisms to mitigate price volatility include non-compliance *penalties*, pre-defined minimum or maximum buy-out prices (e.g. in Italy, the UK) and *certificate reserves* attained by the regulator also mitigate price volatility (Italy where GRTN can sell "uncovered" TGCs at a fixed price (Nielsen and Jeppesen 2003)). Recycling the revenue collected from penalties to overcomplying parties enforces the effect of penalty by increasing the opportunity costs of non-compliance. Pice mitigating instruments may compromise the achievement of targets.

17. According to Faure and Skogh (2003) effective property rights have to fulfill the following criteria: (1) the owner must be able to enjoy the benefits and influence the costs generated by the resource and the owner's effort; (2) it must be possible to enforce rights and duties privately and/or publicly; and (3) the owner needs to be able to contract with other parties involved. However, as Jaccard and Mao (2002) note, the idea of assigning property rights can be applied in a less ambitious manner, which is the case of tradable emission permits. They refer to "market-based regulation" to illustrate the process of establishing targets, allocating rights to emit and allowing trade to achieve the target as efficiently as possible (2002, p. 68).

18. For example, the user may decide to switch off equipment, decrease the set point (heating/cooling) or decrease the size of equipment (e.g. refrigerator). This however may conflict with structural or temporal changes forced on the participants by other unforeseen circumstances. The scheme may adjust ex-post the certificates for climatic condition, e.g. a very hot summer or a cold winter, and/or production levels. However this may lead to increased risk for obliged parties and/or investors because they will not know the exact amount of certified savings.

In the Italian TCES two types of non-compliance are distinguished: with the 50% constraint for action among own vector, and with the general obligation; consequently the regulator AEEG has proposed two different types of sanctions (Pavan 2002). The proposal is that the unit value of each of the two penalties equals the maximum 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. The idea behind this is not to create a potentially distortive reference price for certificates; in practice this means that there is no ceiling of the unit cost of certificates that will act as a cap of the overall cost of reaching the target (Pavan 2002). This sophisticated penalty mechanism resembles the Swedish TGC scheme, where non-compliant consumers are subject to a fine of 150% of the average volume of weighted TGC price over the previous year (Oikonomou 2004). In the EEC in the UK for non-compliance the regulator OFGEM has the power to consider whether it is appropriate to set a penalty. However, there is no specific guidance on how this penalty would be calculated.

Institutional infrastructure

A sound institutional structure is needed to support a complex MBI: administrative bodies to manage the system as well as processes such as verification and certification, ability to detect non-compliance and authority to sanction it.

The institutional setup pf white and green certificate schemes are very similar; hence common institutional arrangements can be used. In the case of TGCs the institutional setup requirements include bodies to issue certificates, monitor and control, register of certificates and trade, and manage an exchange. Stakeholders involved are public authorities (e.g. approve, monitor and register plants, decide on sanctions), system operators (maintain the accounts of a certificate database, allocate TGCs), private bodies (e.g. independent bodies) (Oikonomou 2004).

In the UK the Office for Electricity and Gas Markets (OFGEM) manages EEC project evaluation and approval, certificates issuing, verification; the electricity market operator organizes the registry and updates it for all transactions and communicates results to the Regulator. OFGEM also administers the Renewable Obligation by accrediting generating stations, issuing ROCs, recording the transfer of ROCs and assessing compliance.

In Italy the regulator Authority for Electricity and Gas (AEEG) implements the scheme. The marketplace will be organized and managed by the electricity market operator GME (Gestore Mercato Elettrico). GME will register and issue certificates, organize market sessions, and also register bilateral OTC contracts. GME has been created by the transmission system operator GRTN, which is responsible for controlling RE production, releasing TGCs, redeeming TGC, etc. operations on the green certificate market.

BROWN, GREEN, WHITE CERTIFICATES: WHERE DO THEY DIFFER?

Due to the presence of a variety of barriers related to policy, regulatory, behavioural issues and market failures, energy efficiency and RES both need policy support. The principal difference between them is in the general perception about their cost efficiency and the degree to which they are 'visible'.

Measurement and verification

The basic principle for white certificates is that a certain amount of energy is saved compared to a reference scenario. This is the major difference with the TGC scheme where effective electricity production can be metered without any reference, even if only additional generation capacity is allowed in the scheme for a limited amount of time. This definition of a reference situation holds important parallels to the use of project-based carbon credits, where the applicant of credits has to prove that his project reduces emissions beyond a baseline situation and where a full-fledged system is set in place for specification and acceptance of baseline methodologies.

If the electricity savings cannot be metered, a certain estimation of the energy saving for specific measure must be carried out: e.g. the savings resulting from the replacement of a refrigerator with one in class A+ are calculated on the difference with to the installed average or the sales average (we have already a first approximation). The saved energy resulting from an energy efficiency measure could be measured at the end of a predetermined period or over the lifetime of the project (which has to be accurately assessed). The certificate can be equal to the energy saved over the period or the lifetime of the project, or could be issued when a certain amount of energy savings has been achieved (e.g. 1 MWh). The latter option will make the system simpler and more comparable to a TGC scheme: the certificate will have a unique time of issue attached to it, will indicate the period over which and the location where energy has been saved, and by whom it has been saved (initial owner of the certificate). However it may increase verification costs.

One of the frequently used protocols to verify energy savings is the International Performance Measurement and Verification Protocol (IPMVP) (www.ipmvp.org). IPMVP provides an overview of current best practice techniques available for verifying results of energy efficiency projects in commercial and industrial facilities. Energy conservation measures covered in the protocol include fuel saving measures, water efficiency measures, load shifting and energy reductions through installation or retrofit of equipment, and/or modification of operating procedures. In 2001, a revised addition of the IPMVP was issued. Possible verification approaches are:

- *The Metering Approach* – metering real electricity consumption and calculating savings (could be with climate or whether corrections) based on consumption before and after the energy-efficiency improvement is carried out, or
- *The Standard Savings Formula Approach* – using standard formulas for energy-efficiency measures (e.g., a given number of CFLs installed is the residential sector is equivalent to a given number of kWh saved; the formula can be adjusted to reflect if the CFL are installed or if there is an incentives to buy them for end-users).

Although the metering approach would be a more accurate guarantee of energy saved than the standard factors approach (the latter cannot verify details such as location and operating hours of installed CFLs), it may result in high measurement costs. One solution would be to use the metering approach and to take into account the conditions prevailing in the facility, which would affect the energy efficiency project. Before being granted a certificate, operators could be required to describe the measures they are implementing and provide metered data before and after the implementation, as well as any "standard" information and conditions (weather, activity, etc.) needed to evaluate the measures (e.g. their load profile).

For different project types the Italian TCES scheme offers the choice of the following three valuation approaches: (a) a deemed savings approach with default factors for free riding, delivery mechanism and persistence; (b) an engineering approach; (c) a third approach based on monitoring plans[19] whereby energy savings are inferred through the measurement of energy use (Malaman and Pavan 2002). There is ex-post verification and certification of actual energy savings achieved on a yearly basis (Oikonomou 2004 and references herein).

In the UK the savings of a project are calculated and set when a project is submitted based on *standardized estimate* taking into consideration the technology used, weighted for fuel type and discounted over the lifetime of the measure. However, it is not clear what happens in case of underperformance. There is 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 reason for this is that adjustments to the way energy savings are calculated for target setting purposes and accreditation would have *implications for the costs for suppliers and consequently consumers*. However, this work could have implications for the way energy savings are accredited in future.

Demand creation

A key difference between ETS on the one hand and white and green certificates on the other is that the former is a capped system where rights (e.g. permits or allowances) are traded under the cap, while the latter two are not capped and the certificates traded actually represent something already realised (i.e. savings or electricity generated). The ETS the supply is limited, while with the other two systems demand needs to be created and delineated.

Baseline

The process of establishing the reference situation, of monitoring and determining the realised energy savings involves a number of methodological issues. To determine the energy savings resulting from an energy efficiency activity, the eventual energy consumption has to be compared to a reference situation (*baseline* or *business as usual*) without additional saving efforts. What exactly is the baseline, which reference technology should be accepted, which time frame applied, what are the relevant boundaries for a project, and how to minimise leakage effects?

First, the reference use of energy is, by definition, *counterfactual* and thus imposes considerable uncertainty to the determination of investment additionality. The calculation of the baseline scenario has to take into account likely changes in relevant regulation and laws, the trend in autonomous efficiency improvements and changes of other basic variables such as the development of markets for products of the project (Michaelowa and Fages 1999)[20]. Second, the relevant *system boundary* has to be determined and will vary, depending on the respective measure: end-use efficiency measures could have an impact on the related upstream levels and should ideally be considered. This, however, is not practical because it would impose prohibitively high information or transaction cost (Gustavsson et al. 2000). Third, there is a risk of producing *leakage* (Parkinson et al. 2001): when the system boundary is set too narrow, energy savings may be overstated. Take for example a total demand of generation capacity of about 100 MW. When the system boundary is drawn around a generation plant with a capacity of 100 MW replaced by an efficient cogeneration plant with a capacity of 50 MW, half of the demand will be covered by generators outside the system boundaries, regardless their respective efficiency properties. A number of indirect effects may be disregarded, such as an autonomous reduction in demand. A fourth and crucial issue (and criterion) is the practicality and cost-effectiveness of a baseline methodology. Both establishing a relevant baseline and monitoring energy savings implies cost to the project developer and also to the government or regulator. The cost of monitoring and evaluation has been estimated to amount to about 5-10% of the project budget, which depends on many factors and assumptions (Vine and Sathaye 2000). Relative transaction costs are even higher in the case of small-scale energy saving technologies and of private households (DIW 2003). Even worse, as it is in the case of DSM programmes, indirect behavioural and positive spill-over effects are difficult to be calculated and distinguish from an autonomous development without the measure (Gustavsson et al. 2000). Both factors encourage investors to overstate the actual savings with the aim to receive and sell more certificates. It also stimulates the appearance of free riders. Fifth, the issue emerges how to treat no-regret measures in the baseline determination. No regret means that no additional costs are implied, as the investment is entirely covered by the related energy savings. However, these investments did not take place without the EE programme. The additionality criterion hence needs a careful definition in order not to inhibit such investments.

The above (and further) issues have been addressed for the case of Kyoto Protocol's flexible mechanisms in a large body of literature (e.g. Viloette et al. 2000 for baselines in the case of energy efficiency). Therein, a number of meth-

19. The 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.).

20. A study conducted for eastern European countries estimates the range of counterfactual uncertainty for the case of greenhouse gas emission reductions, related to the underlying assumptions used for the respective baseline calculation, to be as high as ±55% for cogeneration projects and ±35% for demand side projects (Parkinson et al. 2001).

ods have been suggested and may mostly be applied to the case of energy efficiency certificates.

Commoditization of public goods

While both white and green certificates embody a positive externality, in the case of RES the public good is much more "visible" but often perceived as too expensive. Conversely, in the case of energy savings the externality issue is unclear and hence the question is pending which is the public good that is commoditized through the certificate.

CONCLUSIONS

In this section the common elements that green and white certificate schemes share have been reviewed; we have discussed the creation of demand, certificate delineation, certificate trading rules and how these are framed in existing TGC and TCES schemes, what are the common solutions in the two schemes, and what is the reasoning behind certain choices. We also outline the conceptual differences between the two schemes, namely measurement and verification, demand creation, baseline setting, and commoditization of public goods.

Interactions and integration

WHITE AND GREEN CERTIFICATES

It is possible to combine domestic TGC and TCES in a single common scheme, where both RES and end-use energy efficiency measures contribute to meeting a specific obligation. Energy savings may contribute to meeting an overall RES target by reducing the overall consumption. In effect Directive 2001/77/EC on the promotion of RES-E encourages such integration by establishing the RES-E target as a **share of final consumption**. The key common characteristic of green and white certificates is that both allow for the separation of the physical flow of electricity from, respectively, the "greenness" of electricity and the energy savings. The same rationale holds for integrating renewable heat and end-use energy efficiency[21]. From cost efficiency perspective, integration of supply and demand options should result in the lowest cost for society. Conversely applying different instruments to different parts of the sector increases the risk of undertaking high-cost measures at one part, while ignoring lower cost options in the other. Purely operational matters, like registries, can be managed in an integrated way. Double counting can be avoided by using a database and again in the principle of redemption.

In Italy there is scope for integration of RES in the TCES: solar heaters and small photovoltaic installations are eligible for white certificates, but are not certified in the TGC scheme at present. The Australian TGC scheme certifies solar water heaters based on the electricity consumption they displace. Integration is not a technical issue, but a matter of policy choice. Nevertheless, integration must be approached with caution since energy efficiency certificate trading is more challenging than TGC trading especially in terms of M&V. Double counting challenges emerge in relation with project types that have multiple values: e.g. how to treat a project, such as CHP on biomass that may receive emission allowances, and may turn out to be eligible for both green and white certificates.

EMISSION TRADING, WHITE AND GREEN CERTIFICATES

Both end-use energy efficiency and renewable energy projects result in CO_2 emission reductions, and these can be calculated. The carbon value from end-use energy efficiency and RES could be calculated and included in the certificate (even in a more sophisticated way than national or EU averages)[22]. The carbon value of energy efficiency and renewable energy projects varies in accordance with factors such as the local electricity mix and the time of the day when energy is saved. Calculating the exact value of the carbon displaced is a technically solvable issue: in the NO_x set-asides in the United States there are software programs that calculate the real time power generation displaced by savings taking into account factors such as time of the day and exact generation mix. Table 1 shows the interaction options. The total value of certificates (both white and green) may be viewed as constituted of two items: an energy benefit and a carbon benefit. The energy value is limited to a certain country or region and hence purely domestic and unsuitable for trade-in an international carbon scheme; conversely the benefits from carbon mitigation are global, i.e. internationally valid (Oikonomou (2004) points out this about TGC)[23].

In our view there are two ways in which white and green certificates may interact with carbon credits represented by Option 2 "One-way fungibility" (with two possible roots) and Option 3 "Two-way fungibility" in Table 1. Two-way (full) fungibility among the three schemes may compromise the environmental soundness especially of green certificate systems: while RES-E and end-use energy efficiency have a carbon component/value, not all carbon projects have an energy component/value (e.g. reducing CO_2 without reducing the primary energy consumption)[24]. For this reason we focus mostly on the possibilities of one-way fungibility; its two interaction roots (2A and 2B) differ in whether both values are simultaneously utilized or whether just one of them is utilized.

In case of one-way fungibility where the energy and carbon values of a project are distinguished (Option 2A) white and green certificates can be traded in the ETS. In the ETS the value of end-use energy efficiency and renewable energy projects is limited strictly to the value of carbon displaced

21. Currently there are no green heat certification schemes. Therefore TGC and TCES schemes are asymmetric in the sense that the former at present apply to renewable electricity only, whereas the latter in principle can be applied to all fuels, energy carriers and sectors (although it may be decided to limit white certificate schemes to electricity and gas only, as is in Italy).

22. Note that here we refer to energy efficiency and RE projects that are not covered by ET, i.e. not undertaken by operators under CO_2 cap.

23. The difficulty here, as pointed by Sorrell (2003), is that with EU ETS in place the CO_2 value of renewables and energy efficiency has been partly reflected in the allowances 'freed up' by displaced fossil fuel emissions.

24. An industrial plant which reduces production volumes is likely to generate less carbon emissions, which however cannot be considered a project eligible for white certificates. There is a risk of double counting if two-way fungibility is allowed even only for carbon projects with clear energy benefit: if a power generator builds a new wind mill, then it reduces carbon emissions, but at the same time is eligible for TGC.

by the projects; the energy benefit then goes to certification in a domestic scheme: TCES or TGC. In the ETS end-use energy efficiency and renewable energy projects will thus compete against other carbon saving options. Not many credits from renewable projects are expected to enter the ETS because:

- Renewables may have higher marginal abatement costs than other carbon mitigation options,
- So far the allowance prices in EU ETS are anticipated to be low, and
- In general MBIs are indifferent towards the direction of technological change.

On the other hand, end-use energy efficiency is a low-cost carbon mitigation option. However, there is the risk that not many end-use energy efficiency projects will enter the ETS because

- End-use energy efficiency is 'invisible': e.g. businesses may not recognize it as an energy source, business opportunity and a way to improve competitiveness and comfort;
- Power generators obliged under the EU ETS are more likely to take measures at the supply side where their area of expertise is. In this sense an indicative gradation of their preferences would be to first improve the efficiency of plants (rehabilitation and/or fuel switch), then to install renewable generation capacity, and only last to look beyond the consumer's meter.

Certainly, there may be one-way fungibility without distinguishing between carbon and energy value, but then only the energy or the carbon benefit will be utilized (depending on the relative prices across markets) and hence the other benefits of energy efficiency and renewables will be ignored (Option 2B).

In the EEC in the UK energy savings are adjusted to the carbon content of the fuel and there is a one-way trading of surplus savings from overcompliance to the UK emission trading. This already constitutes integration with carbon policies.

Since energy efficiency investments are highly cost effective, integrating energy efficiency in EU ETS will bring the benefits of improved static efficiency of the latter; conversely excluding energy efficiency will increase the overall compliance costs because more expensive options will be taken up to attain the target[25]. While the core of tradable emission permit systems is lowest marginal compliance costs, these schemes are neutral towards the direction of technological change[26]. Hence some other support mechanisms for technology innovation are needed: in the case of renewable energy integrating renewable energy projects in EU ETS will improve the dynamic efficiency of the latter (Sorrell 2003 and references herein)[27]. In addition, integrating end-use energy efficiency in emission trading improves the environmental soundness of the latter: if white certificates and emission trading are not integrated, then the benefit of reduced emissions due to lower e.g. electricity consumption remains within the ETS obliged parties (power generation sector), which would receive credit for an effort that they have not been involved in.

One-way fungibility may therefore encourage overcompliance with energy efficiency and renewable targets. A possible advantage of such a combined scheme is that once one of the two values is redeemed (the energy or the carbon) the certificate would be declared non-valid, *i.e.* this would avoid double counting.

Conversely, a possible consequence of imposing energy saving quotas without linking the schemes and letting carbon credits and white certificates compete for energy efficiency projects may be that the cheapest options on the demand side are "stolen" and go to white certification; this may limit the scope of CO_2 abatement options and increase the price of tradable carbon allowances[28]. In addition, the creation of parallel markets may impose higher transaction costs and/or sub-optimal market sizes.

Integrating a market for TCES with ET or with a market for TGC has the potential to establish one homogenous good, increase compliance options, boost liquidity of the car-

Table 1. Interaction options.

OPTION 1. No interaction: only energy value for energy efficiency and RES projects not converted in CO_2 and not covered by emission trading	
OPTION 2. One way fungibility: Separate carbon and energy values for energy efficiency and RES projects not converted in CO_2 and not covered by emission trading	
2A. If both are utilised: Carbon benefit → ETS Energy benefit → TGC/TCES	2B. If either one or the other: Carbon → ETS, but no TGC/TCES Energy → TGC/TCES, but no carbon (= option 1 above)
OPTION 3. Two-way fungibility: feasible only for carbon projects have an energy value*	

* However risk of double counting: if a power generator builds a new wind mill, then the power generator gets reduced emissions, but at the same time is eligible for TGC.

25. We assume that power generators will not invest in end-use energy saving programs to fulfil their carbon caps.
26. Emission trading will only evoke innovations when these bring extra rent to the obliged parties.
27. Sorrell (2003) also draws attention to the following point: if the carbon benefits of renewables and energy efficiency are largely accounted for when establishing the EU ETS allocation, then retaining TGCs and TCES should be justified on the ground of policy objectives other than efficiency and overcoming market barriers other than carbon externalities. Some argue that renewables and energy efficiency are already more attractive with EU ETS in place as they do not carry the opportunity costs of CO_2 emission allowances.
28. This will depend on the prices across (certificates and allowance) markets. Market mechanisms may correct such a 'migration'.

bon market and bring market stability, and stimulate energy efficiency and renewable projects and the development of ESCOs[29]. The ability to do domestic projects that generate allowances will therefore act as a "safety valve" for buyers in an ETS scheme by not limiting source of allowances to only those with surplus under their allocations (Langniss and Praetorius 2004), but also e.g. end-use electricity efficiency improvements in installations that fall under EU ETS. Last, but not least, for the end-use efficiency projects it is also important to notice that the saved energy has a much greater financial value than the carbon credit. Currently only the Clean Development Mechanism (CDM) integrates energy efficiency projects; with the linking of JI and CDM credits to EU ETS, energy efficiency generated project credits will enter the EU ETS.

A few practical concerns have been pointed at as barriers to the promotion of end-use energy efficiency and RES under the EU ETS[30]. Integrating white and green certificates in the carbon market will address these barriers. First, as the EU ETS covers direct emissions only, it does not account for reduced industrial electricity consumption and therefore if an industrial user reduces its on-site electricity consumption, he cannot receive carbon benefit for this. Second, this may give negative incentive for electricity end-use options (motors/drives, lighting). Third, there may be a shift from thermal to electricity. Finally, wrong signals may go to industrial CHP, which have higher absolute emissions for installation because allocation of allowances is not based on useful heat and/or power output.

Double counting can be avoided if white and green certificates (project credits) are submitted to the governmental body of the respective country that will have to subsequently exchange it for allowances: the converted project credits are equal to the same amount of emission allowances redeemed to keep the emission cap untouched. This is already happening with the CDM. However, linking requires robust tracking and data management across markets and will increase the administrative complexity.

Conclusion

The present paper explored the common features and transferable experiences of MBIs in the energy sector, in particular white and green certificates. Clearly many aspects related to the design of these tools are similar and involve analogous processes; we focussed on creation and framing of demand, certificate delineation, trading rules and market stabilisation tools, outlining the major choices to be made in these areas and ways in which they have been approached in some existing European TGC and TCES schemes. The policy space is getting crowded with a plethora of MBIs that aim at bringing sustainability in the energy sector. Interactions between them inevitably occur. For reasons such as enhanced static and dynamic efficiency of the EU ETS, as well as improved liquidity and stability of the ET, we argue that green

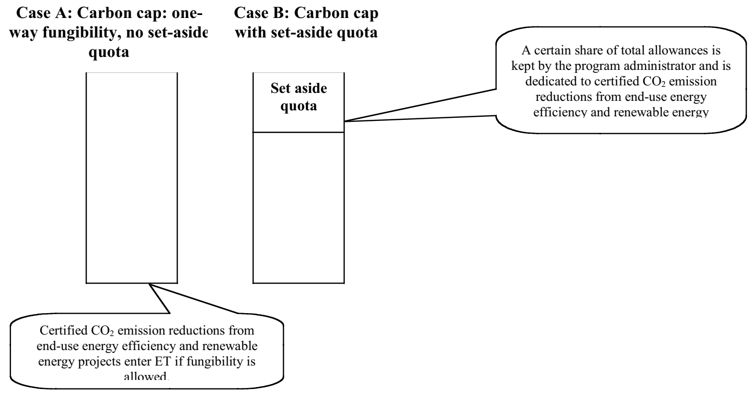

Figure 1. *Integrating energy efficiency and renewable energy projects in carbon trading: one-way fungibility versus set-aside quota.*

and white certificates should be integrated in the EU ETS. Finally, we discuss the advantages of a set-aside quota as a specific tool to integrate project-based green and white certificates in the EU ETS and make an overview of possible challenges that energy efficiency and renewables may face on their way to the carbon market and in particular these related to the establishment of a set-aside quota. We conclude that integration is not a technical issue, but a matter of policy choice.

Since there is a limited track record with RPS/TGC schemes in Europe and elsewhere, the EU ETS has only started and the first real TCES scheme are just taking off the ground in Italy, it still remains to be seen whether these policy instruments will perform as expected, at what cost this will be achieved and whether they can co-exist, and complement each other to pave the road to a sustainable energy future. The jury is still out…

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29. This is not possible in the EU ETS, which allocates the emission allowance only to some industrial sector and to power producers. However, when an end-user reduces its electricity consumption, CO_2 emissions of the power producer is reduced. The end-use certificate scheme could be used to transfer part of the benefits that the power producers receive by lowering its CO_2 emission to the actor who has actually saved energy.

30. We recognize that there is a profound difference between emission trading as defined in UNFCCC and the EU ETS and the latter is much more limited. Here we describe the practical concerns related to EU ETS.

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