Mission possible: bringing end-use energy efficiency to the European Emissions Trading Scheme

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Abstract
There is no dispute that end-use energy efficiency is the quickest and most cost efficient solution to reducing CO_2 emissions. The European Emissions Trading Scheme (EU ETS), a cornerstone of the EU climate change policy, in its present design has limited impact on certain types of end-use energy efficiency measures, as well as on renewable energy sources. Although promotion of energy efficiency is not the objective of the EU ETS, its extension to less energy intensive sectors, and the inclusion of end-use efficiency projects, could foster energy savings. The paper looks at those features of the current EU ETS that may have unintended or limited effects on additional efforts in end-use energy efficiency and explores the design adaptations in EU ETS that would remedy potential flaws. In particular new allocation methods and the equivalence between carbon allowances and credits are discussed. The paper proposes solutions how to include end-use energy efficiency (and new small scale renewable energy generation) in the EU ETS, through both a direct integration of energy efficiency carbon credits in the EU ETS, or through set-aside allowances for efficiency. The paper explores practical solutions for carbon ownership and correct carbon accounting and examines factors that influence the exchange among white certificate and carbon markets. While the primary scope of the ETS is to reduce emissions in a cost effective manner, depending on its design the EU ETS could also foster energy efficiency, thus bringing additional and cheaper options to the carbon market.

Introduction
The Emissions Trading Scheme of the European Union (EU ETS) was launched in January 2005. The EU ETS involves about 12 000 installations from energy-intensive industry and combustion installations, covering about 40 % of the EU's total CO_2 emissions in 2010. Each installation is allocated emissions allowances for the full trading period. These allocations are described in the national allocation plan (NAP) of each country in which each EU government specifies the total amount of allowances to be allocated and how these allowances would be allocated to the installations. Therewith an emission cap (quota) is specified for each individual plant. If installations exceed their quotas they have to pay a penalty of 40 and 100 Euro per ton CO_2 respectively for the first and second trading period. For comparison, carbon prices have fluctuated between 8 and 30 Euro/ton CO_2 in 2005-2006 (EurActiv 2007) and have dropped to below 1 Euro/ton CO_2 in February 2007. Emission reductions from joint implementation (JI) or clean development mechanism (CDM) projects can be used by the companies to fulfill their emission reduction targets.[1]

The paper looks at those features of the current EU ETS that may have unintended negative effects on additional efforts in end-use energy efficiency and explores the design adaptations and solutions as to how to include end-use energy efficiency in the EU ETS. This is done through a direct integration of energy efficiency carbon credits in the EU ETS, or through set aside allowances for efficiency. Section 1 looks both at general and

1. The details are regulated in a Directive (2004/101/EC), which entered into force in November 2004. Starting from 2005 firms have direct access through CDM to credits from countries without targets; from 2006 JI credits are available from countries with targets.

at specific limitations of the EU ETS that influence the uptake of end-use energy efficiency projects. Sections 2 and 3 explore possible design adaptation and practical solutions for bringing end-use energy efficiency under the EU ETS. Integrating white certificate schemes - e.g. schemes that involve an energy saving target imposed on a certain category of market actors in the energy sector and tradable certificates for energy savings – is one way to bring end-use energy efficiency projects to the carbon markets. For this reason section 4 examines factors that influence the exchange among white certificate and carbon markets. Section 5 concludes. Different aspects of white certificate systems are well documented a growing body of literature (see for example (NERA Economic Consulting 2005; Bertoldi and Rezessy 2006; Lees 2006) and also the reports of the EuroWhiteCert project[2]).

Caveats of the EU ETS with respect to energy efficiency

A number of reasons exist why the EU ETS may be insufficient to stimulate end-use energy efficiency. While the primary scope of the EU ETS is to reduce emissions in a cost effective manner, depending on its design ETS could also foster end-use energy efficiency, thus bringing additional and cheaper options to the carbon market. In this section we discuss the following issues:

- The upstream approach chosen for the EU ETS only provides an indirect incentive to energy savings.
- Lenient emission caps have resulted in an excess supply of allowances and therewith low carbon prices. This has not had any significant impact on investment decisions and has not promoted more fuel switching or more emission abatement in the industrial sector.
- The chosen bases for allocation have not resulted in a large incentive to energy efficiency measures.
- Disproportional smaller efforts are required from EU ETS industries in some countries, again not providing sufficient stimulation to emission abatement, including energy efficiency.
- Energy efficiency is often not recognized as a business opportunity because of deviation from core business expertise, due to the smaller size of high-cost measures and associated larger transaction costs.

UPSTREAM APPROACH

For emission trading schemes 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 allowances[3]. Conversely, the indirect (downstream) approach is based on the idea that the final users, who are causing the whole production chain, get a more clear insight on the carbon intensity related to their consumption and get allotted an emission quota based on a baseline.

The EU ETS follows the upstream approach, among others because of the monitoring and inspection complications inherent to the downstream scheme, especially at an international scale. In an upstream system the cost of the allowances will, to a certain extend, be accounted for in the product price: 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. For example, 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), which may give a wrong incentive to electricity end-use options (motors/drives, lighting) and may result in a shift from thermal energy to electricity. 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 size of the impact, which in the current first phase of the EU ETS refers primarily to the degree of increase of electricity prices, depends on the stringency of emission caps, the methods and criteria used for allocation, allocations to newcomers and closures of installations and information about future allocation (Schleich and Betz 2005). The criteria used for the electricity sector – both for existing installations and for new entrants – are particularly relevant, since they may have a direct impact on electricity prices. Along with the stringency of caps and the method of allowance allocation, other important factors that influence the degree to which customers will re-orient their consumption to less carbon intensive products include 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) (Sorrell 2003).

In addition the demand side of the energy sector is rarely as responsive to price incentives as economic theory predicts.

LENIENT EMISSION CAPS

Fundamental to the functioning of the EU ETS, is a meaningful price for carbon on the market. This requires scarcity in supply and thus *emissions caps* set at a level significantly below business-as-usual developments. In Phase I most national emission caps were set in a loose way. Official data published by the European Commission on 15 May 2006 showed a group of 21 EU countries were left with 44.1 Mt extra CO_2 allowances in 2005 (EurActiv 2007). The fact that verified emissions for 2005 were lower than allocated amounts in Phase I shows that indeed caps for Phase I were weak and the surplus is mostly due to over allocation, not to serious emission mitigation effort.

With regard to Phase II, with some exceptions, the caps proposed by Member States in their notified NAPs are above independent estimates of BAU emission projections. Total proposed caps in 20 out of the 27 countries are 53 Mt CO_2/year

2. See www.eurowhitecert.org

3. What 'sufficient' exactly constitutes depends on the kind of quota allocation and trading system chosen.

higher than independent calculations of BAU emissions. This corresponds to 2.5 % of the total emissions within the EU ETS (Rathmann, Reece et al. 2006)[4]. When comparing proposed caps to indicative maximum caps[5] the sum of proposed caps are 23 Mt/year higher than the indicative maximum cap for these countries (Rathmann, Reece et al. 2006). This suggests that the proposed Phase II caps would not require substantial emission abatement effort by EU ETS participants and thus no shortage of allowances can be expected if the Commission accepts Member States' proposals. In its first two sets of Decisions on the Phase II NAPs the Commission responded by requiring an average cap cut of 7 %, which would push the market again to an overall shortage. Some Member States however are contesting the Decisions, so the resulting market shortage is still unclear[6].

The lenient emission allocation and therewith the low carbon price have not had any significant impact on investment decisions and has not promoted more fuel switching or more emission abatement in the industrial sector.

ALLOCATION METHODS AND CRITERIA

Most Member States have used extensively grandfathering as the main allocation option for existing installations. Furthermore grandfathering was not based on real "historic" emissions but on *projections* of emissions for the three-year trading period of 2005-2007 (assumed future emissions) calculated from previous periods; this gave big polluters an incentive to exaggerate projections. The way the permits were distributed was also not transparent and the actual emissions were not verified independently (WWF 2006). In Phase I more than 90 % of CO_2 allowances were given away to businesses free-of-charge and very little use was made from the possibility to auction up to 5 % of allowances. Distributing allowances for free has raised concerns of possible windfall profits from selling permits, especially in the power sector[7]. Auctioning a larger part of allowances can provide a stronger impetus to using more efficient technologies.

Technological (benchmarking) considerations were taken into account in very few cases, mainly in the allocation of allowances to new entrants and in some instances in a manner that is subsidizing coal generation. For instance, in Germany new entrants in the power sector will be allocated allowances based on fuel-specific benchmarks ranging from 365 to 750 g CO_2/kWh, with coal installations being given twice as much allowances as gas installations for equivalent production amounts (WWF 2006). Distributing emission allowances to new entrants for free based on methodologies representing more or less the BAU are likely to discourage the wider introduction of low-carbon fuels like cleaner natural gas. Some allocation options, discussed later in the paper, may provide greater incentive to energy efficiency measures, both on the supply and on the demand side.

LIMITED SECTORAL COVERAGE IN PHASE I

In Phase I buildings and transport – sectors, which after the power generation and energy-intensive industries represent the largest share of CO_2 emissions – are not covered. Nevertheless, sectors outside the ETS are influenced by the initial division of reduction tasks between trading and non-trading sectors: if Member States wish to favor the export-oriented companies inside the EU ETS, they end up with having to demand fewer efforts from these companies and more efforts from other sectors in order to fulfill the overall target. Phase II NAPs suggest that European EU ETS industries will not contribute sufficiently to achieving the overall Kyoto target. For instance, it was shown that the emission caps in the notified Phase II NAPs of Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain are less strict than would be required if the ETS sectors were to make an *equal* contribution to meeting country Kyoto target as other sectors of the economy (Rathmann, Reece et al. 2006). This indicates that disproportionate effort is expected from smaller industries, residential sector and transport.

FURTHER ISSUES

Despite the fact that end-use energy efficiency is a low-cost carbon saving option, direct 'competition' of end-use energy efficiency projects against other carbon saving options in the EU ETS might result in the additional deployment of a limited number of end-use energy efficiency projects. This is because businesses may not recognize energy efficiency as an energy source, as a business opportunity and as a way to improve competitiveness and comfort, as well as due to smaller size of highly cost efficient energy saving measures and associated larger transaction costs. Furthermore power generators obliged under the EU ETS are more likely to take measures on the supply side where their area of expertise is (Bertoldi and Rezessy 2006). Nevertheless, if emission caps are progressively tighter and the allowance price increases, even small-scale measures are likely to become attractive.

Already current evidence shows that under the Clean Development Mechanism (CDM), supply side projects and methane emission reductions are the preferred option for investors. Most energy efficiency-related projects will generate only a small stream of carbon credits and consequently fall under the small project stream of the CDM. Even though this stream is designed for easier flow through the CDM project cycle, one study shows that energy efficiency projects are under-represented relative to their estimated potential, which suggests the existence of factors and flaws, such as high administrative costs or other barriers that are not fully reflected in analyses of the achievable potential for these projects (Wang, Byrne et al. 2003). On the other hand, projects that involve non-CO_2 gases, such as methane, are over-represented[8] because the higher global

4. There are huge differences between official national BAU emission projections in NAPs and independent estimates of BAU emissions for 9 out of the 20 countries investigated by Ecofys official national emission projections are more than 10 % higher than the independent projection estimates. Comparing proposed caps to official BAU projections provided in the NAPs suggests a shortage of 153 Mt Co2/year in Phase II, which corresponds to 7 % of the total emissions within the EU ETS (Rathmann, Reece et al. 2006).

5. This is defined as the multiplication of historic EU ETS sector emissions, projected national GDP growth and CO2 intensity improvement.

6. According to information available as of mid-January 2007.

7. Several studies have illustrated that there is significant pass-through of EU ETS allowance prices to the wholesale electricity prices in many EU countries. The degree of pass-through also depends on the functioning of the electricity market.

8. See: http://cdm.unfccc.int/Projects/registered.html (for the limited list of CDM projects that are registered as of May 4th, 2005.

warming potential values of non-CO_2 projects improve their project economics (Haites 2004). Nevertheless, several efforts are underway around the world to improve the CDM, including policies and strategies to promote investment in small-scale CDM energy projects and assistance for key participants in the process of developing, financing and implementing small-scale CDM project activities.

In summary unless emission caps are set more ambitiously causing the price of carbon to rise, and the flaws outlined above are addressed, the EU ETS in its present design is unlikely to contribute to emission reductions set by other policies, even less so investments in renewable energy or end-use energy efficiency projects. On the one hand prices are not expected to increase sufficiently to foster takeoff of renewable energy projects. On the other hand solely price increases cannot be relied on to foster end-use energy efficiency project deployment. If support for renewable energy and end-use energy efficiency is not provided today, knowledge may be lost, carbon-intensive demand patterns and technology may lock-in, and low-carbon infrastructure will be much more difficult to implement widely and quickly at a later stage.

Design adaptations

It should be emphasized at this point that the upstream approach as applied in the EU ETS appears to be the only practical approach to account for emissions – a downstream approach would pose enormous accounting problems due to the numerous end-users that would be covered. The trade-off is between the genuine implementation of the polluter pays principle – according to which every time a buyer buys a product s/he would need to pay for its lifecycle emissions – and manageability of a cap-and-trade system in practice. Depending on its design the EU ETS could also foster energy efficiency, thus bringing additional and cheaper options to the carbon market. This section looks at a few general adaptations that may improve the chances of end-use energy efficiency projects, as well as at specific conditions that can allow carbon credits based on end-use energy efficiency to the emission market. These include:

- Extending the sectoral coverage of the EU ETS (even without bringing all downstream sectors under the emission cap);
- Allocation methods and use of auctioning to foster end-use energy efficiency projects in the EU ETS;
- Equivalence between emission allowances and project credits from renewable energy and end-use energy efficiency projects.

EXTENSION OF THE EU ETS SECTORAL COVERAGE

Over-allocation of permits to the power sector and large industry players makes direct policies in downstream sectors even more critical. Depending on the extent that allowances may be over-allocated, the obliged parties under the cap-and-trade system might be required to make relatively little effort towards contributing to a national target, compared to uncovered sectors. This would result in downstream sectors (residential and tertiary sectors, transport that are not easily or efficiently covered by emissions trading) paying disproportionately for reductions to ensure that a given emission reduction target is attained (Bertoldi, Rezessy et al. 2005).

One way to bring buildings to the carbon markets without putting them under a formal emission reduction cap – which may be politically challenging – is by allowing white certificates generated in these sectors to be converted into carbon credits. For the time being this issue has not been formally discussed; as of early 2007 the policy discussion is about including aviation in the EU ETS.

AUCTIONING EXCESS ALLOCATIONS AND NEW ALLOCATION METHODS

With regard to allocation ensuring that emission caps for Phase II represent a significant departure from BAU is a key issue. Existing excess allocations can be auctioned to push the market prices up. The High Level Group on Competition, Energy and the Environment recommends a more harmonized allocation across the EU to reduce competitive distortions (High Level Group 2006). Such competitive distortions may exist between companies passing through CO_2 allowance prices into electricity prices (and thus generating windfall profits since these allowances were acquired for free) and companies situated in countries that have made extended use of auctioning.

A further possibility is to auction credits generated from the conversion of carbon credits generated from end-use energy efficiency projects (white certificates) into carbon credits. Projects that deploy additional energy savings and green electricity result in CO_2 emission reductions: the precise calculation of the exact amount of carbon displaced is a technically solvable issue though no doubt it brings additional complexity in a trading system. 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 (Shiller, Kumar et al. 2004).

The allowance allocation methods applied can favor RES or end-use energy efficiency technologies to a certain extent. An alternative to relying on historical emissions is to assign a certain number of allowances for each unit of actual heat input or to electricity production ("output") going forward ("earn as you burn" or "forward looking"). An input-based allocation gives allowances to sources based on emissions per unit of boiler heat input (measured in Btu). An output-based allocation provides greater incentives to reduce emissions through plant operational efficiency. Alternative allocation schemes such as these should also be used for new entrants (Bertoldi, Rezessy et al. 2005). Other ways to allocate emission allowances to favor end-use energy efficiency and renewable energy supply include assigning allowances for an *avoided emission value* for each unit of green electric power produced or based on consumption avoided or introducing *set-aside quotas*, as discussed later in the paper.

EQUIVALENCE BETWEEN ALLOWANCES AND CREDITS

Energy savings can technically be converted into carbon savings without a burdensome procedure, and could in principle be treated in a way similar to CERs resulting from CDMs[9]. The

9. For CDM it is possible to have end-use energy efficiency projects (e.g. a CFLs project in China), and this could enter the EU ETS through the linking Directive.

concern of double counting with regard to electricity savings and savings related to district heating (DH) that have an indirect impact on DH installations under the EU ETS deserves special attention. Electricity saving measures or measures that reduce heating consumption on premises heated by DH installations above 20 MW undertaken within the EU cannot be converted in a straightforward manner into CO_2 credits and imported into the carbon market because this would result in the same amount of CO_2 accounted for twice. The same electricity or energy savings has also reduced the emissions of the power generator or the DH installation, respectively. For this reason currently the Linking Directive in principle forbids project credits from JI when they lead directly or indirectly to emission reductions in installations covered by the EU ETS. In the case of electricity savings, in theory double counting can be avoided if the indirect impact of savings can be *traced back* to the power generator that benefits from emission reductions due to a particular electricity saving project, for example. Consequently it is a corresponding amount of emission allowances would need to be *withdrawn* from the account of this power generator. However such re-adjustments along the way may be impossible to implement. A practical solution of this inherent difficulty to retreat allowances would be the existence of *reserve margin* for implementing projects that generate carbon credits: this can be done via a set-aside quota (see next section).

Different and much less complicated is the case of savings in natural gas or heating oil on *non-EU ETS premises*. A residential or tertiary building insulation project (in a building heated by a gas or oil boiler) can bring genuine and additional to EU ETS carbon reduction that are otherwise not covered by the EU ETS and that can be accounted for via a white certificate and converted into a carbon (project) credit, which could be used in the EU ETS. Such non-electricity savings undertaken in sectors outside the EU ETS ones represent genuinely additional emission reductions to the EU ETS that are easily accountable.

Equivalence between emission allowances and emission project credits (such as white and green certificates) would make it possible to credit the party that has actually undertaken measures that have directly resulted in carbon savings. Under the EU ETS as it stands at present power generators will receive the carbon credit from somebody else's efforts on saving electricity beyond the meter.

The next section presents a few practical solutions related to allowing the conversion of carbon credits generated from end-use energy efficiency projects into emission allowances; establishing a *reserve margin* for implementing projects that generate carbon credits is one of these solutions.

Practical solutions for integration of white certificates into the carbon regime

The principal arguments for and against integration of white and green certificates into the emission market are discussed elsewhere (Bertoldi and Rezessy 2006). This section therefore does not discuss the general desirability of integration, but outlines approaches to put integration into practice. The benefits of an energy saving project may be viewed as composed of two separate values: energy and carbon. The energy value is limited to a certain country or region and hence purely domestic and unsuitable for trade in an international carbon scheme[10]; conversely the benefits from carbon mitigation are global, i.e. internationally valid[11].

We believe there are the following major routes to establishing links between certificate and carbon allowance markets:

- direct integration by making tradable commodities one or two-way fungible, and
- set-aside quotas for energy efficiency and renewable projects.

Below we demonstrate that while direct integration establishes links between the markets, it does not really integrate them. In contrast set-aside quotas allow real integration of project credits (white and green certificates) into carbon markets.

ONE- AND TWO-WAY FUNGIBILITY

Here we have a situation with three types of targets (an emission cap, an energy saving target and a green electricity target) and three types of tradable commodities (emission allowances, white certificates and green certificates, respectively). One-way fungibility refers to a situation whereby green and white certificates may be used to comply with emission caps. White and green certificates are allowed to enter the carbon markets, but in contrast emission allowances cannot be used to meet green electricity or energy saving targets. Separate carbon and energy values are assigned to energy savings and renewable energy projects that are not covered by emissions trading.

In contrast, two-way (full) fungibility implies that white and green certificates can be used to show compliance with the emission target and also emission allowances can be used to show compliance with green electricity or savings targets. However, two-way fungibility may compromise the environmental soundness of green electricity and of energy saving targets: while green electricity and end-use energy efficiency always have a carbon component, not all carbon projects have an energy component and thus leakage into green electricity or energy saving systems can take place.

With regard to the overall carbon cap in principle two scenarios are possible: keeping the initial carbon cap intact after allowing project-based green or white certificates to enter the carbon market, or allowing the cap to be exceeded under certain conditions. In the former case (case A in Figure 1) an equal number of carbon allowances will need to be withdrawn from the allocation of any obliged party under the EU ETS, in relation to whose emissions energy savings - and therefore carbon reductions - have taken place. As already indicated, this is likely to introduce some extra complexity in the system and to be politically unacceptable. Another possibility is to allow the EU ETS installations to exceed their individual caps with an amount of emissions, which can be precisely offset with project-based energy saving credits generated by sectors outside the EU ETS (case B in Figure 1). Because energy savings have a precisely measurable carbon content, this will have no implica-

10. With integrated energy systems security of supply is an increasingly international issue. It is however generally accepted that most of the benefits of energy savings are local.

11. Oikonomou (Oikonomou, Patel et al. 2004) points this out about TGC. The difficulty here, as noted by Sorrell (Sorrell 2003), is that with EU ETS in place the CO2 value of renewables and energy efficiency has been partly reflected in the allowances 'freed up' by displaced fossil fuel emissions.

tions in terms of environmental soundness as long as the surplus emissions can be covered by white and green certificates denominated in carbon.

SET-ASIDE QUOTAS

One-way fungibility in effect it keeps the three markets – the emission allowance market, the green certificate market and the white certificate market – separate. There will probably be profound influences across markets, but no real linkage. An alternative can be to seek integration of energy savings- and renewable energy-based project credits (i.e. green and white certificates) with emissions trading via a dedicated link. A possible approach to integration via a dedicated link is through a set-aside quota in the emissions trading scheme.

A *set-aside* is a pool of allowances that are kept by the program administrator in charge of emission trading and used to reward energy savings and renewable energy projects; this will influence the market towards more such projects. Energy efficiency or renewables set-aside quotas have been developed and introduced by 6 states in the NO_x Allowance Trading Program in the USA (Shiller, Kumar et al. 2004). Set-aside quotas could avoid possible problems arising from additional allowances generated by energy savings and renewable energy projects, as these are reserved ex-ante and therefore there is no need for ex-post adjustments of allowance numbers. Set-asides described here are of *offset type* that allows participants outside of formal emissions markets to participate by allowing certain types of activities to be recognized for the emissions reductions these projects provide. Energy efficiency and renewable energy facilities generate emissions offsets that firms under the EU ETS can purchase to meet their targets.

In effect a set-aside can function in different ways. One arrangement would be to impose on each entity under the EU ETS a total emission cap (like at present) and deduct a fraction of this allowance cap 'reserving' it for emission reductions coming from energy efficiency and green electricity project credits (dedicated set-aside within a cap) (case A on Figure 1). Energy efficiency and green electricity projects would be converted into emission allowances that can be sold on the carbon market. Two options are possible: the dedicated set-aside can be optional or mandatory. Under an optional set-aside parties with emissions caps will have the possibility to create or purchase these 'special' allowances generated from end-use energy efficiency and green energy projects if they wish to fully utilize their initial emission cap. A variation of this arrangement is to mandate the exact share of the set-aside quota, thus creating a portfolio standard in the emissions trading scheme and making end-use energy efficiency and renewable electricity generate 'tagged' emission allowances (see Figure 2). Under such arrangement the program administrator reserves a certain share of allowances that are dedicated only to verified and certified CO_2 reductions from end-use energy efficiency and renewable energy projects (white and green certificates).

Another option in calibrating a set-aside is to allow obliged parties to exceed their emission caps provided that they submit sufficient green and/or white certificates to cover these surplus emissions (graphically this overlaps with case B on Figure 1). Therefore the program administrator may sell allowances generated via energy efficiency and renewable energy projects to carbon emitters who need to buy allowances. This option will not compromise the environmental integrity of the emission cap because renewable and energy savings projects have a carbon component.

Project-based carbon credits at the carbon market: factors and impacts of exchange

As discussed in the previous section white certificates can potentially correspond to project-based carbon credits from end-use energy efficiency measures. In this section white certificates are discussed as part of a larger policy portfolio that includes a mandatory energy saving targets and individual company obligations. This section looks at the following issues:

- White certificates (end-use energy efficiency project credits) in a common European system or separate national systems;

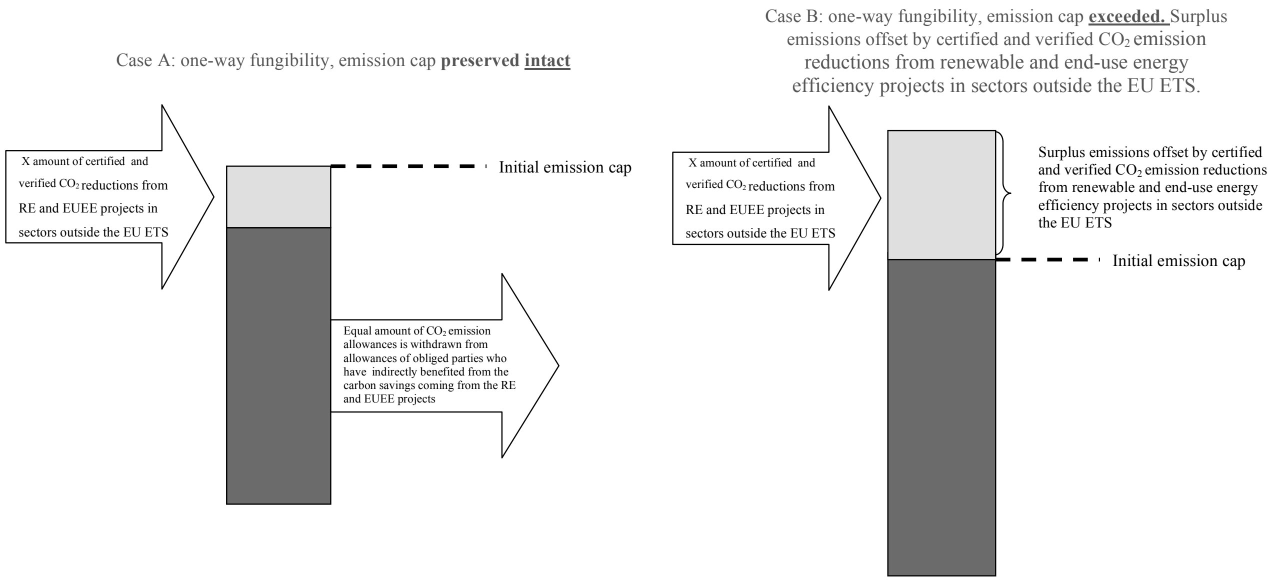

Figure 1. One-way fungibility (flexible use of allowances from end-use energy efficiency and/or renewable energy projects within an emission cap)

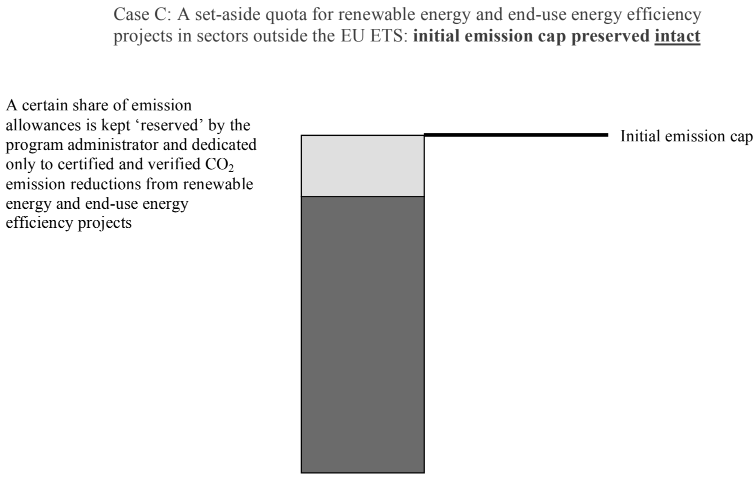

Figure 2. Dedicated set-aside quotas for allowances generated from end-use energy efficiency and renewable energy projects within an emission cap

- Generic factors influencing the exchange among white certificate and carbon markets;
- Impacts of exchange on white certificate systems.

It needs to be emphasized at this point that the existence of a saving target is not a pre-condition for introducing project-based credits from end-use energy efficiency projects (white certificates) into the EU ETS. Certified project credits from end-use energy efficiency can be integrated into the ETS on the basis of voluntary white certificates. A mechanism can be established to certify energy savings in some sectors and convert these in CO_2 allowances and bring them in the CO_2 market through a set-aside, for example. Thus, voluntary white certificates can be created to purely respond to the needs of the carbon market. This section however looks at the particular case of integration of white certificate schemes that incorporate an energy saving target (national or European) into the EU ETS because of the growing interest of policymakers in introducing MBIs to foster energy savings and energy efficiency.

END-USE ENERGY EFFICIENCY PROJECT CREDITS (WHITE CERTIFICATES): THE EUROPEAN DIMENSION

Two scenarios are discussed here. First, white certificates generated within entirely separate national schemes can subsequently enter the EU ETS. Second, a European tradable white certificate scheme may evolve along the following organizational models (Table 1 summarizes the characteristics of these models):

- National targets, integration of certificate markets across Europe in a European TWC market (*EUCertMarket* case),
- Integration of both energy saving targets and certificate markets into a common EU regime (*EUScheme* case),
- Common European target with national certificate markets (*EUTarg* case, unlikely).

In the EUCertMarket case separate national systems with national targets set independently at national level are linked via a common European market. Progress on national targets can be monitored by introducing a guarantee of origin on certificates. The EUTarg and the EUScheme cases are in effect 'bubble' arrangements, whereby a total EU-level saving target is apportioned at company level. In the former case companies are allowed to undertake measures and/or trade certificates to meet their obligation only domestically (in their country of operation); in the latter case scheme obliged companies are allowed to implement measures and get certificates across Europe. In order entities with energy saving obligations to get their individual quantitative targets the European target will need to be apportioned, which can be done for instance on the basis of obliged parties' market share[12].

The essence of a Europe-wide white certificate system is that problems in fulfilling energy saving targets (either individual company-level or national) can be handled by importing white certificates generated elsewhere, while surplus of certificates can be exported to obliged parties with shortages. Under a set of standard assumptions about perfect markets obliged parties reach their individual targets for energy savings in the most cost-efficient way. A few remarks should be made at this point. First, it may be inherently difficult to find a common objective for either setting a mandatory European energy saving target or even for integrating the national markets for white certificates (the latter will require complete harmonization related to common sectoral and measure coverage, measurement and verification, etc.). Second, even if common objectives, sectoral and measure coverage are agreed upon across Europe, the establishment of comparative project baselines for energy saving projects will be very difficult due to different national technological standards across Europe (where no European legislation applies). While for the purpose of baseline creation standard values can be established for certain standard technologies, this does not resolve the problem of penalizing countries with high efficiency of installed stock and/or high efficiency requirements. Third, the interactions of white certificates with existing national policy instruments for the promotion of energy efficiency (for instance, subsidies) become very complicated in a

12. Similar to the logic of burden sharing in the EU ETS. In the EEC in Great Britain two scheme participants have operated joint energy saving programmes, effectively creating a " bubble" arrangement for compliance activity (NERA Economic Consulting 2006).

Table 1. Framing the European dimension

	Targets	Certificate trading	Comments
Purely national white certificate scheme	National	National	Not discussed
European white certificate market (***EUCertMarket***)	National	European	Obliged parties can undertake energy saving measures across Europe, certificates can be traded across Europe
European saving target (***EUTarg***)	European, apportioned to company level	National	Domestic action to meet a European target. Rather unlikely setting.
European white certificate scheme (***EUScheme***)	European, apportioned to company level	European	Obliged parties can undertake energy saving measures across Europe, certificates can be traded across Europe

European white certificate system with high probability of price distortions at the certificate market or cumbersome national monitoring to ensure that projects receiving white certificates do not benefit from other support. Even if properly monitored this nevertheless leaves the problem of impact of different energy prices, including energy taxation, with a potentially strong implication on certificate market prices. Finally, the degree of desirability of Europe-wide integration of white certificates depends on the point of view taken, namely whether analysis is done strictly from cost efficiency point of view for obliged parties, or from a wider societal perspective. A European white certificate system introduces distributional issues: some countries will benefit others will loose local benefits.

GENERIC FACTORS INFLUENCING THE EXCHANGE AMONG WHITE CERTIFICATE AND CARBON MARKETS

In the most generic case of one-way fungibility (see definition above), whereby white certificates can be converted into emission credits and no restrictions or special treatment apply as to the use of white certificates on the carbon market, the amount of white certificates that enters the carbon market will be influenced by a number of factors. These include:

- The stringency of the emission cap and the allocation criteria in the EU ETS (see Table 2 and explanatory notes after);
- The stringency of the energy saving target (see Table 2 and explanatory notes after);
- Possible trade restrictions: trade surplus white certificates as emission credits only once energy saving target is met (either national or individual company' energy saving target);
- Availability of energy saving options (slope of the marginal energy saving cost curve[13]) in terms of unit cost of emission savings coming from energy saving projects, the volume of such emission savings and the speed with which they can be generated vis-à-vis availability of other mitigation options available (unit cost, volume and speed of realization). Competitive position of energy saving options vis-à-vis other emission mitigation options available: either at national level or across Europe;
- Transaction costs associated with trading[14], the degree of easiness to convert white certificates to allowances without complex administrative procedures;
- Emissions factor for conversion: apart from being inaccurate[15], a fixed European emissions factor will penalize savings entering the carbon market from countries where carbon intensity is higher than the factor and put an unfair premium on energy saving in low carbon intensity economies. Thus depending on the emission coefficient used for calculating the emission credit attributable to white certificates, barriers to white certificate trade may be created. If domestic marginal possibilities for emission reductions are cheaper than the emission credit value, then the emission value of the certificate may be a barrier to white certificate trade on the carbon market (see Morthorst (Morthorst 2003) for discussion of this issue in the context of green certificates);
- Influence of exogenous factors: weather and changes in business activity for instance will influence the demand for white certificates at the carbon market (just as these exogenous factors influence the price evolution on the carbon market);
- Where a fixed non-compliance penalty on energy saving obligation exists, its size will influence the willingness to trade white certificates at the carbon markets: if carbon prices are sufficiently high, obliged parties may prefer to pay non-compliance on their saving target and trade their projects on the carbon markets;
- The length of the compliance periods of a European white certificate system and the EU ETS: if a white certificate scheme is with a shorter compliance period than the EU ETS phase, then probably less white certificates will enter the EU ETS market. A scheme with periodic assessments will generate more trading than one whereby the compliance is checked once at the end of the scheme (NERA Economic Consulting 2006). This observation is related to the length of the compliance period and not to this of white certificates;

13. A steep the marginal cost curve implies that compliance costs increases very rapidly with a more stringent cap

14. The size of the transaction costs depends among other on the size and liquidity of the market. Where markets are sufficiently large, some transaction costs can be mitigated by introducing clearing house mechanisms, by having intermediaries or standard terms of agreement (NERA Economic Consulting 2006).

15. It should be noted that the carbon value of energy savings varies in accordance with factors such as the local electricity/energy mix and the time of the day when energy is saved.

Table 2. Stringency of targets

Stringency of European emission cap and saving target	Anticipated impacts	Anticipated effect on certificate price	Anticipated effect on allowance price
Stringent emission cap + stringent saving target	Shortage of emission allowances, demand for certificates. Demand for certificates depends on unit cost of emission mitigation of energy saving projects and other factors (see bullet list above) Depending on the prices on the markets, there may be an increase of cost of compliance with the saving target if allowance price increases and the lowest cost savings are sold at the carbon market.	High certificate price.	High allowance price, but lower in the presence of a TWC as some emission reduction is paid for via the white certificates.
Stringent emission cap + lenient saving target	Shortage of emission allowances, demand for certificates. Demand for certificates depends on unit cost of emission mitigation of energy saving projects and other factors (see bullet list above)	Low certificate price	High allowance price, but lower in the presence of a TWC as some emission reduction is paid for via the white certificates.
Lenient emission cap + stringent saving target	Surplus of emission allowances, no demand for certificates In an extreme case where the energy saving target were sufficiently stringent, it alone will bring aggregate emissions below the cap, reducing the price of CO_2 allowances to zero.	High certificate price	Low allowance price
Lenient emission cap + lenient saving target	Surplus of emission allowances, no demand for certificates	Low certificate price	Low allowance price

- The possibility to bank certificates and allowances (intertemporal trade): a primary purpose of banking is to ensure safety against increase in cost of compliance in the future. How much the cost of achieving emission reduction from energy savings is likely to increase in the future depends on the interplay of a few factors. The major factors are the real or perceived degree of stringency of both the emission cap and the saving target in the current and also in subsequent phases of the schemes, the speed with which savings and emission reductions can be realized, the expectation that certain types of measures will be 'exhausted'. A possibility for parties under the EU ETS to bank allowances for the next compliance periods may increase the demand for white certificates, if the two markets are linked: however almost all Member States have banned banking from the first to the second compliance periods[16];
- High auction share and treatment of new entrants in the EU ETS: demand for white certificate-based allowances may be higher if both incumbent and new installations are required to purchase allowances on the market. At present all Member States have a new entrant reserves from which new installations get allowances free of charge[17];
- The size of a set-aside quota will act as an upper limit for the demand for white certificates at the carbon market. The size of the set-aside quota in relation to the stringency of individual saving targets and the availability of energy saving options will motivate the supply of white certificates at the carbon market. Whether a set-aside is mandatory or not has an impact on the demand for white certificates too: a sizeable and mandatory set-aside or a very stringent emission cap may lead to increased costs of compliance with the energy saving target.

Table 2 presents the anticipated impact of the stringency of emission caps and energy saving targets on the demand for project-based carbon credits (white certificates) and on the prices of certificates and allowances. The assumption is that energy saving targets are coupled with tradable white certificates, which are one-way fungible into the carbon market.

Whereby both the emission cap and the energy saving target are stringent and there is a possibility for white certificates to enter one-way the carbon market, a shortage of emission allowances would boost the demand for certificates. In this case the actual demand for certificates will depends on unit cost of emission mitigation of energy saving projects and other factors (see bullet list above). Depending on the prices on the markets, there may be an increase of cost of compliance with the saving target if allowance price increases and the lowest cost savings are sold at the carbon market. In any case the price of certificates will be higher than if no integration is allowed due to the additional demand for white certificates coming from the carbon market. Allowance prices will be lower in the presence of a white certificates as some emission reduction is paid for via the white certificates.

Whereby a stringent emission cap and a lenient energy saving target are present and there is a possibility for white certificates to enter one-way the carbon market, shortage of emission allowances would boost the demand for certificates. Demand for certificates will depends on unit cost of emission mitigation of energy saving projects and other factors (see bullet list above). The certificate price would be low due to the lenient saving target, but will be influenced by the stringency of the

16. France and Poland allowed for limited banking where the individual limit is related to emissions reductions from actual investments. Not long ago France took out its banking provision.

17. Only Sweden requires some operators of new installations – new power plants in the electricity sector, but not CHP – to purchase allowances on the market (Schleich and Betz 2005)

emission cap. Allowance prices will be lower in the presence of white certificate schemes as some emission reduction is paid for via the white certificates.

Whereby a lenient emission cap and a stringent energy saving target are present and there is a possibility for white certificates to enter one-way the carbon market, there will be a surplus of emission allowances and thus no demand for white certificates from the carbon market. In an extreme case where the energy saving target were sufficiently stringent, it alone will bring aggregate emissions below the cap, reducing the price of CO_2 allowances to zero. Finally, whereby both the emission cap and the energy saving target are lenient, there will be a surplus for emission allowances and thus no demand for white certificates from the carbon market. The prices of both certificates and allowances will be low.

PROJECT-BASED CARBON CREDITS AND THE CARBON MARKETS: IMPACTS OF EXCHANGE

Whereby national tradable white certificate schemes with separate national targets are linked via a European certificate market and integrated into the carbon market, the following impacts can be expected.

Impact of national set-asides for energy efficiency in the EU ETS

- A larger set-aside would allow more energy savings from a given country: the size of a set-aside indicates the commitment of a country to steer its EU ETS parties towards energy efficiency;
- Set-aside quotas increase the competition for white certificates across markets (white certificate market and EU ETS): the size of the set-aside quotas would have implications on the price of white certificates. In addition the possibility for EU ETS parties to access white certificates may cause "cherry picking" with the cheapest energy saving options going to the carbon markets. This depends on the prices across markets. This in turn will boost the compliance cost for obliged parties under an energy saving target;
- Where white certificates and EU ETS are linked, national set-aside quotas ensure that no ex-post adjustment of national greenhouse gas targets is needed to reflect the entrance of new additional emission reductions associated with white certificates. In the absence of set-asides if a country imports white certificates, it should in principle be allowed to increase its greenhouse gas emissions relative to its national target corresponding to the amount of emissions attached to the volume of imported white certificates. At the same time the exporter of white certificates will have to lower its emissions relative to its national target.

Impacts of trading rules

If international trade of white certificates is allowed *only after* a national energy saving target is met, then a protected share is 'craved' for national energy savings schemes to absorb lowest cost 'local' measures in a country. These may be measures with significant local benefits (e.g. social impact). What part of measures with significant local benefits will be implemented locally in this case will depend on the way a saving target is set (incl. priority actions or other specific mandates)[18]. Such a restriction however will add additional complexity to a European white certificate scheme, even more so in case of ex-post verification and attribution of savings on annual basis: a company under saving obligation may then have to wait a whole year (the end of the annual compliance) before it can get a permission to trade in the EU ETS. In addition the provision of first meeting own targets before trading in the European markets will not contribute to meeting general national saving obligations – in a country one obliged party may exceed its target and thus be allowed to trade in the European markets, while another party may fail to reach its target, with a combined result of national-level quantitative target not met.

Final remarks

While the primary purpose of the EU ETS is to reduce emissions in a cost effective manner, depending on its design the EU ETS could also foster end-use energy efficiency, thus bringing additional and cheaper options to the carbon market. The paper explores design adaptations in EU ETS that would remedy potential design flaws that have unintended or limited effects on additional efforts in end-use energy efficiency. These include extending the sectoral coverage of the EU ETS even without bringing all downstream sectors under the emission cap, using allocation methods and use of auctioning to foster end-use energy efficiency projects in the EU ETS and establishing equivalence between emission allowances and project credits from renewable energy and end-use energy efficiency projects. The paper shows that it is possible to integrate carbon credits from end-use energy efficiency projects into the EU ETS and the most practical way for doing this is via a set-aside quota. While in principle certified project credits from end-use energy efficiency can be integrated in the EU ETS on the basis of voluntary white certificates, the paper examines the particular case of integration of white certificate schemes that incorporate an energy saving target (national or European) into the EU ETS. The paper looks at the factors that determine the presence of project credits (white certificates) at the emission markets and impacts of integration in both European white certificate scheme and national schemes. The most important among the determinants are the stringency of emission caps and energy saving targets, the competitive position of energy saving options vis-à-vis other emission mitigation options available, transaction costs, possible trade restrictions, conversion factor applied, auction share and treatment of new entrants, and existence and size of a set-aside quota. To avoid double counting concerns only non-electricity end-use savings from sectors outside the EU ETS are considered for integration.

Taking into account the early stage of developments and experiences with the EU ETS, as well as with tradable white certificates (project credits for energy savings), the additional complexity of integrating carbon credits from energy saving projects into the EU ETS may outweigh the benefits. More work is needed to systematically explore the costs and benefits of integration in a comparative context. An interesting possi-

18. Possibilities of keeping domestic a certain share of compliance include putting a limit on the amount of non-domestic compliance or – if specific policy objectives are pursued, e.g. social ones – establishing different categories of certificates.

bility thus can be the voluntary trade at the EU ETS market of emission credits coming from energy saving projects.

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