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Implementing CDM Limits in the EU ETS: A Law and Economics Approach[*]

Corrected Version January 2011[•]

Alexander Vasa[+]

Abstract

The EU allows installations, subject to Emissions Trading, to use a limited volume of certified emissions reductions (CERs) generated through the Clean Development Mechanism (CDM) to cover their greenhouse gas emission. For the year 2008, the CER limits, which are differentiated by EU Member State potentially created substantial arbitrage rents, due to the CER-EUA spread in the range of 250 million Euro. This paper discusses different options for the allocation of this rent. The paper finds that according to economic theory making the right to use CERs tradable or the regulator pre-committing to buying CERs at the level of the limit reduces the inefficiencies connected to the current regulation. Auctioning these CER usage rights furthermore shifts the rents created through the CER-EUA spread to the state. The improved design and implementation of CDM limits justifies an intervention of the EU policy maker to correct previously competition distorting choices.

Keywords: Clean Development Mechanism, EU Emissions Trading Scheme, Climate Policy Frameworks

JEL Classifications: K23, K32, Q48, Q54

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[•] This version has undergone substantial changes thanks to numerous comments. At least one erratum in the previous July 2010 version is important to mention: the reference to "Alexeew, J., Bergset, L., Meyer, K., Petersen, J., Schneider, L., & Unger, C. (2010). An analysis of the relationship between the additionality of CDM projects and their contribution to sustainable development. *International Environmental Agreements: Politics, Law and Economics*" was meant to refer to "Seres, S., Haites, E., & Murphy, K. (2009). Analysis of technology transfer in CDM projects: An update. *Energy Policy*, 37(11), 4919-4926."

Introduction

The EU has agreed to cut its greenhouse gas emissions by 20% by the year 2020 relative to 1990 emissions (European Council, 2008). The EU distinguishes its efforts between the emissions trading sector (ETS) and sectors not covered through the ETS. The ETS covers approximately 12,000 installations EU-wide identified in Annex I of EU ETS Directive 2003/87/EC. These installations comprise combustion installations and energy-intensive manufacturing activities. In the period 2008-2012, installations get allocated EU allowances (EUAs) for free (grandfathering). In addition, each installation can use, subject to a country specific limit, certified emissions reductions (CERs) generated through the Clean Development Mechanism (CDM) to cover its emissions.[1] Thus, if an installation has emissions of 100 emission units, it can use as many EUAs it wants, but only a limited amount of CERs to cover these 100 units. This limit is currently expressed as a percentage of freely allocated EUAs to the respective installation and is differentiated between EU Member States, with limits ranging from 0% to 22%, in Estonia and Germany, respectively.[2] Thus, installations in Germany can use more CERs than installations from the same sector in Estonia.

The limit, among other factors, translates to a price spread between EUAs and CERs, which leads to a rent for installations in countries which opted to allocate a generous CDM limit to their manufacturing industry and combustion installations. CDM limits are differentiated between EU member states to cater to the different levels of emission reduction ambitions, the progress made when the limits were established and the ability of the Member State to reduce emissions. However, the rents created can potentially be substantial and in 2008 the EUA-CER arbitrage rents reached about 250 million Euro.

The current rule potentially leads to a distortion of the market, when emitters that compete in the same market are treated differently in different EU member states. From a law & economics perspective, an interference in the market is only warranted,

[1] Flues (2010) assesses the political economy of CER limits and finds that CER import limits increase with the sector's emissions; whereas government valuation of lobby contributions and voter's budgets decrease with the voter's valuation of consumption over environmental integrity and abatement costs.

[2] The limit on the use of CERs is imposed to fulfil the supplementarity condition of the Kyoto Protocol. The supplementarity condition is a normative concept that states that CERs should only be used to achieve only part of the overall mitigation effort (UNFCCC, 1997: Article 12). It aims at making sure that significant abatement occurs in the EU, while emitters can profit in a limited way from the cost-reducing nature of cheaper CDM credits. The EU implemented the supplementarity condition under Linking directive 2004/101/EC. Woerdman (2004) explains that the EU committed to supplementarity partially due to equity concerns.

if a) the market cannot solve the issue by itself, and b) if the interference substantially improves the situation.[3]

Specifically, this article analyzes the decision parameters for an implementation of the CDM limit and the efficiency gains expected. The gap in the literature on this issue is surprising since, as in the discussion about the free allocation of allowances, large rents conferred to emitters have opened the gates to rent-seeking behaviour (Hepburn et al., 2006). Zhang (2001) and Tol (2009) confirm that rents are created by CDM usage limits. Tol (2009; p.4330) draws attention to the literature gap regarding the allocation of the usage limit to emitters in non-ETS sectors.[4]

This article is an attempt to fill the gap in the literature on the interaction of offset mechanisms with emissions trading schemes. The paper analyzes potential options in the implementation of limits to the CDM, on the compliance side. This paper extends the analysis of Gorecki, Lyons & Tol (2009) to the EU ETS sector, and focuses on the rules in Phase II to illustrate current challenges. The paper attempts to answer the following questions for the CDM limit allocation for the period 2008-2012:

1) What are the effects of a CDM limit?
2) Which alternative options exist to implement CDM limits?
3) How has the CDM been used in the EU ETS?

The paper assesses three options, 1) the status quo, 2) establishment and allocation of CDM usage rights, and 3) the pre-commitment option, for the allocation of this rent. In the status quo, the right to use CERs is allocated for free, proportional to the allocation of allowances. Alternatively it can be allocated proportional to the verified emissions of an installation. Trading of the right to use CERs is not allowed under these options. Secondly, the right to use CDM credits can be established as property rights and be auctioned or freely allocated (grandfathered) and then be traded between EU ETS participants. A third option is for the EU to sell allowances of the same amount of the aggregate CDM limit granted, and then subsequently buy the amount in the CDM market.

The paper finds that making the right to use CERs tradable or the regulator pre-committing to buying CERs at the level of the limit reduces the inefficiencies connected

[3] One could argue that the supplementarity criterion, the limit on the use of CERs, is the cause for the inefficiencies. However, the supplementarity condition has been aimed at maintaining significant domestic effort and according to (Anger, 2008, p. 2046) the supplementarity criterion "does not significantly decrease the economic benefits from project-based crediting, as the respective thresholds of CDM imports are generally not yet reached under unlimited CDM access."

[4] For an analysis of the impact of the use of CERs in the non-ETS sector, see (Neuhoff & Vasa, 2010). The use of CERs in the non-ETS sector has to take account of the supplementarity criterion and of the use of CERs in the ETS sector. Thus, it is not explicitly limited for the period 2008-2012.

to the current regulation. Auctioning CER usage rights and the pre-commitment option, furthermore shifts the rents created through the CER-EUA spread to the state.

The paper proceeds as follows: after a brief background on the legal foundations of the allowed use of the CDM within the EU ETS (Section 2), Section 3 illustrates how the CDM limit creates a rent and Section 4 illustrates options on how to give access to this limit to participants in the EU ETS. Section 5 analyses the available data on the surrendered CERs in the EU ETS and Section 6 concludes.

Background

The CDM is one of the three Kyoto mechanisms that can be used to achieve compliance with greenhouse gas emissions reduction obligations for developed countries.[5] The other mechanisms are Joint Implementation (JI) and International Emissions Trading (IET). The CDM is an offset mechanism, emissions that are saved in one region can subsequently be used to increase emissions in another region.[6] The circumstances under which CERs can be used within the EU for compliance are defined by EU law and implemented in national legislation of EU member states.

For achieving the emission reduction targets of the Kyoto Protocol and the Energy and Climate Package cost-effectively, the EU divides emitters into two categories: those belonging to the EU Emissions Trading Scheme (EU ETS) and those belonging to the non-trading sector (non-ETS).[7] The EU ETS and its rules for the period 2005-2012 are established through Directive 2003/87/EC (the "ETS Directive") and Directive 2004/101/EC (the "Linking Directive") (Council of the EU & European Parliament, 2003, 2004). The EU ETS Directive sets up a cap-and-trade system, which runs in three distinct phases – (trial) Phase I in 2005-2007, Phase II in 2008-2012 (the Kyoto commitment period) and Phase III in 2013-2020. The rules between these phases differ sharply, so that for instance banking is not allowed between phase I and II and auctioning is mandatory in phase III for power installations, while energy-intensive industry emitters are exempted from auctioning subject to benchmarks, when they are found at risk of carbon leakage (Council of the EU & European Parliament, 2003: Art. 10 a).

[5] Developed countries are listed in Annex I of the Kyoto Protocol and comprise mainly OECD countries.

[6] So-called certified emissions reductions (CERs) are generated through a complex validation and certification process governed by a United Nations body, the CDM Executive Board (EB).

[7] The economic impact of the separation of emissions reduction targets into a trading and non-trading sector is covered in Böhringer, Koschel, & Moslener (2008), Kallbekken (2005) and Michaelowa & Betz (2001).

The treatment of offset credits within the EU ETS sector is likely to be a critical decision element for individual emitters, whereas in the Non-ETS Sector, the government has a mandate to buy CERs. The paper focuses on the EU ETS sector in phase II.[8]

The allocations of EUAs and the CER limit are set through individual Member State National Allocation Plans (NAPs), which constitute the total cap in the European Union when added up. According to the Linking Directive, the NAPs need to specify the maximum annual amount of project-based (JI and CDM) credits which may be used by operators as a percentage of allocation of the allowances to each installation (Annex III para 12 of amended Directive 2003/87/EC). Allocation of allowances to installations must "not discriminate between companies and sectors in such a way as to unduly favour certain undertakings or activities, in accordance with the requirements of the Treaty, in particular Articles 87 and 88 thereof". Furthermore, the NAP should account for new entrants (Council of the EU & European Parliament, 2003 Annex III para 5-6). It is reasonable to believe that the guidelines on non-discrimination for EUAs should also count for CER limits.
The European Commission rejected a substantial share of NAPs for phase II and thus tightened the cap.[9] The EU Commission assesses the NAPs with regard to the competitive effects of allocation and the potential for reduction. "[F]or greater flexibility, Member States are recommended to apply the [CDM] limit for the entire trading period and collectively to all installations (European Commission, 2005: para 3.5.25)." Thus, the annual amount can be spread over the whole trading period in Phase II, meaning that entities are entitled to bank their CDM usage until later in the period. All Member States, defined the offset usage entitlement as a percentage of allocation rather than as percentage of actual verified emissions. As a result, installations that receive an over-allocation in terms of allowances also profit from a resulting generous CDM and JI limit.

The final Phase II CDM limits vary considerably between countries.[10] Figure 1 shows how the share of total CDM use allowed is distributed between EU Member States relative to EUA allocations in approved NAPs. It can reasonably be assumed that CDM limits are proportional to EUA allocations. This however is not the case.[11]

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[8] Gorecki et al. (2009) and Tol (2009) assess on the use of the CDM within the Non-ETS market and come to similar conclusions as this paper does for the EU ETS.

[9] Recently, the European Court of Justice (the Court of First Instance) decided in favour of Member States challenging the NAP decisions of the European Commission.

[10] In the following, only the CDM limit is analysed, while it implies the limit on emissions reduction credits (ERUs) from Joint Implementation. Due to its late start, the JI market is considerably smaller than the CDM market in terms of volume, although some observers see positive prospects for a prosperous JI market (Hoogzaad, 2009; Hobley & Roberts, 2009).

[11] The European Commission formula applied for setting the CDM limits can be found in Article 2.3 of (European Commission, 2006). It is based on half of the highest reduction effort needed from either 1990, 2004 or 2010 emissions, in order to reach the Kyoto targets. If this percentage was below 10%, the respective Member State could choose 10% as its offset import limit.

{insert Figure 1 here}

The grey bars in Figure 1 indicate the share of total CDM allowed in the period 2008-2012 that can be used by installations in respective EU Member States. The dotted bars indicate the share of approved EUA allocation for the respective EU Member States. Where the grey bar is higher than the dotted line, the country is allocated a disproportionately higher CDM limit compared to its share of EUA allocation in the EU ETS. Where the dotted bar is higher than the grey bar, the CDM limit is lower than the weight of the EUA allocation of the respective country. For example, the UK has opted to allocate less CDM credits than its weight in the EU ETS. This result stems from the differentiated CDM limits by countries (Communication by the European Commission, 2007).

These numbers suggest that a) some countries have proportionately received a higher CDM limit compared to their weight in the EU ETS and b) that company installations in the EU ETS are potentially treated differently. For instance, in Phase II, installations in Belgium may use fewer project-based offsets (8,4 % of allocation) for compliance, relative to French ETS installations, which can use 13,5 % of their allocation as offsets. If a Belgian installation receives 100 EUAs for free, it could use about 8 CERs towards compliance. If the same installation is situated in France, it could use around 14 CERs towards compliance. In the absence of the tradability of the rights to use offsets, this difference is likely to enhance the competitive distortions originally created by the free allocation mechanism. This is because CERs are cheaper than EUAs among other reasons, due to the CDM limit (Section 3).

The numbers furthermore indicate different interpretations of the CDM limit between Member States and imply potential competitive distortions between states and sectors. For instance, Belgium has differentiated CDM limits between the Walloon and Flemish regions and within sectors. Flemish industry sectors have a limit of 7% and power plant installations have a CDM limit of 24%. In total, this amounts to a limit of 11% of allocation for the Flemish region. In the EU Commission decision, the 11% limit for the Flemish region is confirmed, however, the differentiation between sectors is not agreed upon. Existing coal power installations receive a limit of 9,2% of allocation. Coal installations that did not have any allocation for Phase II can use CERs in the same share, 9,2%, of their verified emissions in the period 2005-2007.

For existing installations, Sweden uses historical emissions as a calculation basis for CDM limits instead of allocation, while new entrants' CDM limit is based on allocation (Sveriges Riksdag, 2005). Slovakia uses a first-come-first-serve basis: "This right will not be divided proportionally among all sources but it will be applied in ranking according to submitted units. That means that after reaching the 7% [allowed] level the National Register of Emission Allowances shall not accept other units from designed mechanisms (Ministry of Environment Slovakia, 2006: 20)." Slovakia is the only country

which followed the recommendation of the Commission to define the limit collectively (European Commission, 2005: para 3.5.25). The examples emphasize the finding in Figure 1 and indicate that the interpretation of the linking directive varies by member state and sector and can thus lead to competitive distortions.

Section 2 presented the rules for the use of CDM credits in the EU ETS. The following section analyses how the rent is created through the limit and assesses different options for implementing the CDM limit among emitting entities.

Rent creation due to CDM limits

This section evaluates the impacts of a limit Emissions Trading Scheme in Annex I countries. Figure 2 depicts the benefits from trade under the assumption of equalization of marginal costs. On the x-axis, the stringency r is the absolute amount of emissions reduction to be achieved by Country A.[12] Marginal abatement cost curves MAC_A and MAC_B denote the marginal abatement cost curves of Country A and B, an Annex I and a Non-Annex I country, respectively. Country A is a net buyer of emission reductions and Country B is a net seller of emission reductions. Country B's MAC curve is equal to the CDM supply curve. Its origin is inverted and starts at "O_B" rather than at "O_A", where MAC_A has its origin. The marginal abatement cost curve $MAC_A = f(r^*)$ is an increasing function of r. Each additional emission reduction r^* increases total abatement cost. In the case presented in Figure 2 the marginal cost of each additional emissions reduction increases with r. The area DB0C is equal to Country A's total costs for r^* emission reductions, if all emission reductions are domestic (no trading case). If Country A can abate emissions abroad through offsets, costs decrease to AB0C. The efficiency gain from trading is the area ADC. Domestic abatement by Country A (Annex I) is the distance r*- O_A", while abatement in Country B (Non-Annex I) is equal to the difference O_B - r*.[13] The equilibrium price of both allowances and CDM credits is equal to P_r.[14]

{insert Figure 2 here}

Now a restriction on the use of offsets is introduced. If the restriction is not binding, i.e. imposed somewhere between O_A *and* r^*, Country A is better off choosing domestic abatement equal to r*, resulting in the equilibrium price P_r.

[12] A similar curve could be drawn for a sector or private installation, with one installation being the buyer and the other the seller.

[13] The size of the area ADC depends on the shape of the marginal cost curves of the two trading countries. The shape of the marginal abatement cost curves determines the optimal ratio of domestic to external abatement in a static analysis. The ratio is different for each individual country.

[14] Our discussion assumes an absence of AAU supply at zero marginal cost. This is only the case if hot air AAUs are scrapped. In the presence of hot air, the marginal abatement cost curve MAC B is horizontal and never intersects with MAC A. I am grateful to Axel Michaelowa for drawing attention to this restriction.

Introducing a binding limit on the amount of offsets to be used, at the vertical line r_{limit}, increases the total costs of abatement by the triangle AEF. Domestic abatement increases by $r_{limit} - r^*$, while offset use decreases to the distance between r_{limit} and O_B. The binding restriction of offset use leads to a price divergence between domestic marginal abatement costs and marginal abatement costs within the CDM, all else equal. The price in the domestic market is P_A and the price in the offset market is P_B.[15] Thus, the difference $P_A - P_B$ is a rent if the right to use CDM credits is scarce. The next subsection addresses the current rent in the EU ETS, denoted as the spread between EUAs and CERs.

Experience with the EUA-CER spread

Currently the EU ETS is the single biggest demand market for CERs. CERs trade at a discount to EUAs in the market. Mansanet-Bataller, Chevallier, Hervé-Mignucci, & Alberola (2010) find significant evidence that this spread is influenced by three factors: 1) the uncertainty inherent in CER project delivery relative to EUAs, 2) the limit imposed on the usage of CERs, and 3) the non-fungibility of CERs and EUAs for speculative traders relative to compliance buyers who can profitably arbitrage between CERs and freely allocated EUAs.

The right to use CDM credits thus entails a rent equal to the price spread between allowances and CERs. The value of this rent has varied over time within the second trading period, from a peak of €11.50 in April 2008 to €1.58 in February 2009. Figure 3 shows the co-movement and historical spread between EUA and CER December 2012 futures prices. The spread, assuming equally distributed trade over the three years, is €4.67.[16]

{insert Figure 3 here}

Regulators are faced with the decision on how and to whom to give access this rent.

On one hand lower mitigation costs might protect the competitiveness of industry from unilateral shocks. On the other hand, the profit from the regulation could distort EU-internal competition. The rent could similarly be assigned to the national governments, if the revenue can be used to enhance mitigation.

On a country or installation basis, the more CERs are allowed, the higher the rent for the respective installation. Under the conditions specified above – that the EU is the only significant market for CERs – the greater the aggregate number of CERs allowed,

[15] The lower price has a greater impact on high sustainability and additional CDM projects, relative to non-additional ones, as additional projects are by definition more dependent on funding, whereas non-additional project would have happened anyway. This effect is similar under the proposal of discounting CERs if the discounting is not differentiated by project type (Hepburn, 2009; Schneider, 2009).

[16] Transaction costs are not accounted for here. Furthermore, using direct purchase of CERs from project developers might increase the spread relative to the spread between EUA and CER futures contracts

the lower the price differential. If all CERs registered by the CDM Executive Board must be accepted in the EU ETS, the price differential approaches transaction cost.
The question of how the regulator can provide access to the CDM limit rent is addressed in the next section. [17]

Allocating the rent
This section addresses three options the regulator can use to give access to the rent created through the CDM limit. In the presence of binding limits as in Figure 2, the entitlements to use CERs have a value equal to the spread discussed above. If these entitlements are tradable, the price of a CER plus the price of the entitlement to use CERs will be equal to the price of an EUA, in the absence of transaction costs

Currently, under the status quo limits are not tradable. After describing the status quo three possibilities are presented to address rent allocation. Changing from the current allocation base to the verified emissions base for allocating CDM entitlements. The "CER usage option" and the "pre-commitment option" cater to economic efficiency.

Optimal compliance strategy for installations under the current "Installation-based limits" rule
Under installation-based limitations, there are two options: "allocation-based limits" and "compliance-based limits". Allocation based limits (the status quo) stipulate that a certain percentage of allocation – the amount distributed freely through the regulator (A_{EUA}) – may be covered through CERs. If the allowed CDM limit is 10% (CER_i) and allocation is 100 units (A_{EUA}), 10 units ($CER_i * A_{EUA} = B_{CER}$) can be covered through CERs, independent of verified emissions (V). Thus, the absolute CER limit (B_{CER}) increases in both the free allocation (A_{EUA}) and the CDM percentage allowed (CER_i). The allocation option is currently used for existing installations having been granted an entitlement under their NAPs or Article 11a para 8 (1) (Council of the EU & European Parliament, 2009).[18]

The compliance option stipulates that a certain percentage of compliance needs – i.e. actual verified emissions (V) – may be covered through CERs. If the allowed CDM limit is 10% (CER_i) and verified emissions are 100 units (V), 10 units ($CER_i * V = B_{CER}$) can be covered through CERs. Thus, absolute CER limit (B_{CER}) increases in both verified emissions (V) and CER_i.

[17] De Cendra de Larragán (2006: 107) points to the allocation of rent established through the right to use offsets. So does Gorecki et al. (2009) for the Non-ETS sector.
[18] In this case the CDM limits, no matter how defined, are not tradable. This assumption is crucial as, in its absence, the efficiency gain is equal to the CER usage right and the pre-commitment options described above.

The following formula illustrates how an installation can comply with its emission obligations:

Formally, compliance costs under the "allocation option" are equal to:

1) $V = B_{EUA} + A_{EUA} + B_{CER}$ (The amount of EUAs and CERs used)

2) $C_V = P_{EUA}*B_{EUA} + P_{CER}*B_{CER}$ (Cost of compliance using EUAs and CERs)

3) $B_{CER} \leq CER_i * \mathbf{A_{EUA}}$ (CERs used are below or equal to the limit)

4) $P_{CER} \leq P_{EUA}$ (CER price is smaller or equal to the EUA price)

Where:

V = Verified Emissions

C_V = Compliance costs

B_{EUA} = Bought/Sold EUAs (+/-)

A_{EUA} = Free initial allocation of EUAs

B_{CER} = Bought/Sold CERs (+)

CER_i = Percentage of CERs that can be used, differentiated by i's Member State limit

P_{EUA} = Price of an EUA

P_{CER} = Price of a CER

By substitution, assuming $P_{CER} \leq P_{EUA}$ and rationality and complete information, an installation manager faces the following optimisation formula (1):

$$C_V = P_{EUA}*B_{EUA} + P_{CER}*\underline{CER_i * A_{EUA}} \quad (1)$$

Thus, the higher EUA allocation (A_{EUA}) the more CERs (B_{CER}) can be used. If the price difference between P_{EUA} and P_{CER} is higher than transaction costs, the installation manager buys the maximum amount of B_{CER} and sells a corresponding amount of B_{EUA}. Four cases, with the following volumes B_{EUA} and B_{CER} can be distinguished (negative values imply selling), respectively:

a) $V = A_{EUA}$, i.e. the installation has been allocated as many EUAs than it needs for compliance, the respective volumes are: $B_{EUA} = - CER_i * A_{EUA}$; $B_{CER} = CER_i * A_{EUA}$

b) $V < A_{EUA}$, i.e. the installation has been allocated more EUAs than it needs for compliance, the respective volumes are $B_{EUA} = A_{EUA}*(1-CER_i) - V$; $B_{CER} = CER_i * A_{EUA}$

c) $V > A_{EUA}$, i.e. the installation has been allocated less EUAs than it needs for compliance, but $V \leq CER_i * A_{EUA}$, $B_{EUA} = V - CER_i * A_{EUA}$; $B_{CER} = CER_i * A_{EUA}$

d) $V > A_{EUA}$, i.e. the installation has been allocated less EUAs than it needs for compliance, and $V > CER_i * A_{EUA}$, $B_{EUA} = V - A_{EUA}*(CER_i * + 1)$

$$B_{CER} = CER_i * A_{EUA}$$

Formally, compliance costs under the "compliance option" are equal to:

1) $V = B_{EUA} + A_{EUA} + B_{CER}$ (The amount of EUAs and CERs used)

2) $C_V = P_{EUA} * B_{EUA} + P_{CER} * B_{CER}$ (Cost of compliance using EUAs and CERs)

3) $B_{CER} \leq CER_i * \mathbf{V}$ (CERs used are below or equal to the limit)

4) $P_{CER} \leq P_{EUA}$ (CER price is smaller or equal to EUA price)

By substitution, assuming $P_{CER} \leq P_{EUA}$ and rationality and complete information, an installation manager faces the following optimisation formula (2):

$$C_V = P_{EUA} * B_{EUA} + P_{CER} * \underline{CER_i * V} \qquad (2)$$

Thus, the higher verified emissions (V) the more CERs (B_{CER}) can be used. If the price difference between P_{EUA} and P_{CER} is higher than transaction costs, the installation manager buys the maximum amount of B_{CER} and sells a corresponding amount B_{EUA}.
Here only one cases, with the following volumes B_{EUA} and B_{CER} can be distinguished (negative values imply selling):

1) For a) $V = A_{EUA}$, b) $V < A_{EUA,}$ and c) $V > A_{EUA}$ the respective cost optimising volumes are always:

$$B_{EUA} = - V * A_{EUA}$$

$$B_{CER} = V * A_{EUA}$$

The allocation option, currently employed by the EU ETS gives rise to substantial arbitrage profits, which are significantly distorted by initial allocation of EUAs (A_{EUA}). Where installations do not receive any EUA allocation ($A_{EUA} = 0$), they are excluded from profiting from the price spread which is likely to worsen their competitive position. The compliance option treats each installation, independent of allocation, equally in terms of access to CDM credits. While there is a potential to increase verified emissions (V) due to the production of emission-intensive goods, it is unlikely that installations increase their verified emissions only to get more access to CERs as it comes at a significant cost unless the price spread between P_{EUA} and P_{CER} is large. Under the allocation rule, entities have an incentive to lobby both for increased free allocation and for a higher percentage of CER use. The former effect is absent when the compliance option is taken. Furthermore, it is essential to note that the analysis above was conducted assuming that CER_i is equal between sectors and different countries. This is not the case in the EU, where CER_i is differentiated between countries (in some cases $CER_A > CER_B$ for limits in country A and B) and thus leads to additional inefficiencies which can be addressed by the two options below. Depending on the difference in CER_A and CER_B it is clear from the case analysis in Section 3 that installation A can sell more EUAs previously allocated for free and can set itself at a

competitive advantage, not based on any emission reduction or innovative effort, but merely by location of the installation in a specific Member State (Figure 1).[19]

Depending on the price spread between P_A and P_B, the difference between the compliance and the allocation option is substantial.[20] The example above is static and does not take into account price effects of selling and buying allowances for arbitrage. However, it illustrates how the allocation option, as a basis for calculating the CER limit, increases the distortions created by free allocation.

CER usage rights

As shown in Figure 2 and 3, the right to use the CDM is valuable. Once the installation has used up its quota, it cannot use more CERs under the status quo option presented above. If, however, there is a possibility to acquire the right to use CDM credits from other installations which are willing to give up part of their quota, there is a trade benefit for both. Essentially, that is the rationale for emissions trading (Coase, 1960; Dales, 1968).

This right to use CERs could be traded, with the rent going either to the emitter or to the state. The proposal is as follows. Each offset right carries the right to use one CER, equivalent to abatement of one ton of CO_2e. The "CER usage rights" option allows each installation to use as many CERs as it wants, as long as it holds and is able to surrender an equivalent amount of CER usage rights. Thus, CER usage rights and the underlying CERs are complementary instruments. Thus, an installation could use exclusively CERs, without any EUAs, and achieve its compliance with emissions reductions, if it holds the respective amount of CER usage rights. Economically, this would not result in an efficiency loss, because the installation would sell a corresponding amount of EUAs, providing liquidity to the market and making compliance easier for the other entities that do not use CERs – whether out of lack of materiality, or out of a lack of access to CER usage rights, of CERs or of all three. Due to the tradability of the entitlement to use CERs, the price of EUAs is equal to the price of CERs plus the price of the CER usage right. Thus, the cost of using the two instruments – EUAs and CERs – is equalized, assuming zero transaction costs.

After setting the total limit of CERs, the regulator decides how to allocate this limit as CER usage rights to participating entities. The government would not have to check in

[19] It is not clear if this case, installation in country A being advantaged over installation in country B, meets the criteria for state aid. However, in light of the competitiveness effects and the difference between existing entities and new entrants, pointed out in Section 1, it is important to analyze this issue. This analysis has not been conducted so far to the authors' knowledge.

[20] The profit also arises in the absence of over-allocation. The condition for arbitrage profit is that the installation is allocated more allowances than the compliance needs, minus the allowed CER use. This could therefore also arise if free allocation is contingent on benchmarking, as is the case in the EU ETS (Article 10).

real time how much of the offset limit is unused, as it would in the absence of CER usage rights. However, the regulator is faced with the same challenge as with the initial allocation of allowances in an emissions trading scheme. Each right carries an opportunity cost, a rent, irrespective how the right is allocated, on a spectrum between free allocation and auctioning of the rights. Thus, the allocation mechanism distributes wealth among entities and the regulator. This is likely to encourage and strengthen rent-seeking behaviour by entities.[21]

Free allocation of CER usage rights

If the CER usage rights are handed out for free to entities, the question arises as to the basis on which free allocation should be based. If the basis is historical emissions – as in the emissions trading allowance allocation case – the same known perverse incentives, to increase historical emissions to get access to more CER usage rights, arise (Neuhoff, Keats Martinez, & Sato, 2006). If the basis is sector benchmarks, a fairer distribution takes place, compared to historical emissions; however, the regulator makes an implicit assumption about the needs of the installation for compliance. The idea behind benchmarks in the EU, for example, is to allocate allowances at a level equal to the best ten percent in the specific sector (Council of the EU & European Parliament, 2009 Article 10). Due to this ambitious level, benchmarks entities must buy some allowances in the market. By basing CER usage rights allocation on the same basis as the allocation of allowances, entities are potentially allocated more allowances and CER usage rights than they need. Although all entities must acquire offsets in the market, holding an offset confers a benefit and a rent. So, although the CER usage rights have been allocated for free, they carry an opportunity cost, which is, absent transaction costs, equal to the spread of the allowance and the CER price. This is the same as the price difference between P_A and P_B in Figure 2.

Auction CER usage rights

If the regulator chooses to auction the CER usage rights, the amount of rights purchased by entities depends on their expectation about the future need to use CERs to comply with their obligations. Thus, firms which already hold or plan to buy CERs in the CDM market have an incentive to also purchase and hold CER usage rights. Auctioning CER usage rights distributes the rent to the regulator, rather than to entities, as would occur under free allocation. If there is already an auctioning mechanism for allowances, a second, separate auction would create an additional layer of complexity. This could be a particularly important point in terms of transaction costs for smaller installations. Auctioning these rights reduces arbitrage opportunities for installations that received generous free allocation.

[21] Coase admits that, in the presence of rent-seeking behaviour, the Coasian solution does not hold Coase (1959: page 27 Footnote 54). Medema (1997) first pointed to this early finding.

Due to the complementary nature of CER usage rights and underlying CERs, an installation must hold both in order to surrender them for compliance. In the presence of market power, when a single installation or group of entities can influence the market of CER usage rights, competing entities can be prevented from using their CERs. This effect is smaller if auctions are held periodically, with access for all entities. If the market power effect is small, the CER usage rights option minimizes the amount of CERs that remain unused.

Pre-commitment option

The third option, similar to making CERs fungible once they enter the EU registry, involves the active participation of the regulator. Under this approach, the regulator issues additional allowances in the volume equal to the allowed CER limit. The allowances can be sold through an auction or distributed freely among existing installations.

Under this option there are no CERs in the traded market, entities can use as many allowances as they need, without the need for the regulator to check or enact an installation-based limit. When the regulator issues the additional allowances, it signs an agreement to buy the same volume of offsets in the international market. No rents accrue to private actors from the difference between CER and EU ETS prices.

By acting as a large CER buyer, the regulator minimizes transaction costs and can impose certain quality purchasing standards on the CDM market. The regulator can sign long-term CER purchasing contracts to mitigate its own risk. This serves as a credible signal to project developers in the CDM market, and enhances certainty in the CDM market as to which projects are not only acceptable to the CDM Executive Board but also to the compliance market. According to European Commission (2008), the quality of offsets to be imported must be reviewed before the start of Phase III of the EU ETS.

Harmonizing the rules for approved CERs is a complex task, as shown by the difficulties of agreeing on harmonized criteria for the application of the World Commission on Dams (WCD) guidelines on CDM projects from large hydroelectric power plants (Article 11b (6)) of Directive 2003/87/EC amended by the Linking Directive).[22] However, once the quality criteria are agreed upon, the EU regulator will be able to consistently influence the quality of CERs for one segment of the market.[23]

[22] Different Member States applied different interpretations to this passage, which resulted in regulatory competition and one Member State, the Netherlands, receiving most requests for approval of large hydro-projects.

[23] This requires that other Annex I compliance markets apply similar quality standards, in order not to start a “race to the bottom” of approval criteria.

Discussion

The three options presented above can be assessed in terms of efficiency, practicability and feasibility. In some cases, the efficiency and practicability gains have to be paid for by the regulator. Installations have different abatement opportunities; thus, fixing a non-tradable CER amount that an installation can use is inefficient. The allocation option is currently used for existing installations within the EU ETS. New stationary installations, in Phase II and III, which have not received an entitlement to use offsets nor any free allocation, may use offsets "not below" 4.5% of their verified emissions in the period 2013-2020. The percentage for aircraft operators should not be below 1.5% (Council of the EU & European Parliament, 2009a: Article 11a (8)). Thus, for new installations, the EU stipulates the compliance option by default. If the limit for existing installations and new entrants is different, there is a potential competitive advantage for the entities receiving the higher limit. Changing from the current "allocation option" to the "compliance option" decreases the distortive effects from EUA allocation and is thus an improvement. However, changing from the allocation to the compliance option potentially carries a transaction (negotiation) cost if the limits have to be negotiated again (Flåm, 2009).

The CER usage rights and the pre-commitment option address this challenge.

Setting up a CER procurement or trading desk is costly and is often pursued only by large power installations that are used to trade electricity. The CER usage rights and especially the pre-commitment option benefit operators, for whom the benefit from using CERs is eliminated by the cost of procurement and the delivery risk.[24] The pre-commitment option is preferable as only one instrument, EUAs, is used for compliance, thus reducing the complexity and transaction costs. This is especially relevant for smaller installations. If the CER usage rights are auctioned off through the same mechanism as EUAs does not involve necessarily increased costs to only procuring EUAs. However, for using the CER usage rights, CERs need to be procured, which increases transaction costs.

For the procurement option, the regulator has to set up an institution for procuring CERs and negotiates the quality accepted at the EU level. Subsequent auctioning off of EUAs can be done through the auctioning structures to be implemented fully by 2013. The regulator carries the risk of large-scale speculative investments in CER and non-delivery of CERs.[25] If the procurement interval is long enough, speculators are unlikely to lock-up funds for so long, decreasing the price risk. There is a political drawback, not to be underestimated, as transactions become political, as in the example of AAU hot

[24] The CO2 barometer assesses the use of CERs for German ETS installations. Small installations have used their CER limit sparingly.

[25] The average time for a CDM project, from the submission for comments stage to the registration request is more than eight months for most project types (see Annex I).

air sales. The biggest upswing in the CDM market was due to the increase in liquidity when many private CER buyers entered the market. No substantial additional cost, through the auctioning of CER usage rights through the same structures, is to be expected.

The pre-commitment option is feasible under the revised EU ETS Directive, as the auctioning revenue can be used for the mitigation projects in developing countries. The Preamble to the Directive encourages the use of auctioning revenues to provide certainty for the CDM market in Least Developed Countries (Council of the EU & European Parliament, 2009: Preamble 31). Although no direct mention is made of the use of auctioning for the acquisition of CERs, the Directive earmarks "at least 50 percent of the auctioning revenue" for support of mitigation in developing countries (Council of the EU & European Parliament, 2009: Art. 10 para 3). This could be taken to mean support of highly sustainable CDM projects and improving the efficiency of the EU ETS itself.
The CER rights option gives the same positive signals to the CDM market as the pre-commitment option. In the EU ETS directive there are no provisions against implementing such a rights approach.

Depending on the future degree of auctioning, new entrants, with the different calculation basis and the percentage set at a lower level than existing installations those will be at a disadvantage if the CER limits are not harmonized across existing installations and new entrants.[26] In addition, the Revised EU ETS Directive (2009/29/EC) makes further use of offsets in Phase III (2013-2020) contingent upon international agreement.[27] In the absence of an international agreement, the unused portion of the offset limit from the period 2008-2012 and credits that started after 2012 are allowed only from Least Developing Countries (Council of the EU & European Parliament, 2009). Thus, harmonising the CDM limit rules before the third Phase starts reduces the complexity for EU installations and decreases the uncertainty in the CDM market.

Limitations
The above analysis is static and covers only the time frame of one period, e.g. one year. It does not take abatement decisions by firms into account. With multiple years or periods, the installation can either use the assigned percentage limit in the respective year only, or over the whole period, or trade the unused part with other entities. In the first instance, if an installation did not use its CER limit within the

[26] This issue is beyond the scope of this paper, however in light of increased auctioning in Phase III opens the debate on what is more efficient as a basis for the right to use CDM credits, allocation or verified emissions.
[27] The creation of Joint Implementation credits will not be not allowed post-2012 (Council of the EU & European Parliament, 2009: Preamble 28).

respective period, it would lose the right to use the unused part in the subsequent period, while in the latter two cases the installation has the choice *when* to use its CER limit or to sell it to another installation. The two latter cases are the same, because when the installation decides to use the CERs, it decides simultaneously how many allowances to sell instead. Allowing for inter-period flexibility leads to economic efficiency gains and makes planning easier for entities, as they do not have to plan offset use for each year ahead. The results of inflexibility are sub-optimal investment decisions, due to uncertainty (Lecocq, Hourcade, & Ha Duong, 1998). At the same time, increasing abatement flexibility decreases political flexibility. Other stakeholders might be concerned that CERs are used excessively in later periods, decreasing the incentive to innovate in the current period. Due to the limited supply of issued CERs, few entities would be able to fill their quota in the first years of a commitment period. An increase in the supply of CERs is in the long-term a function of trust in carbon markets and an effective and efficient project approval system. The EU ETS opted for inter-period flexibility, stating that the CER limit can be used in the period 2008-2020, while conversions from some CERs are only possible until the end of March 2015 (Article 11a).

The automatic access to CERs can induce substantial arbitrage profits. In this way, sectors continuing to receive free allocation profit from the regulation. The next section covers the empirical evidence of CER use in the EU ETS using 2008 data.

Empirical Results– CERs surrendered in 2008

The discussion above focused on the theoretical rationale for the allocation of the right to use CERs for compliance. It has been assumed that the right to use CERs is valuable and will be used to the upper limit by each installation, to capture the rent created by the limit. There are reasons not to use the whole CDM entitlement in one year and to bank it for subsequent years. First, entities that expect the spread between CERs and EUAs to widen could profit even more from using CERs when EUAs are priced higher relative to CERs. Historical data does not support this hypothesis (see Figure 3) as the gap has narrowed rather than increased. Second, it could be that the supply of credits does not meet demand by the EU ETS. Although there are more than 400 million CERs issued through the CDM, a large share could already be contracted by public funds for use in non-ETS sectors or other Annex I countries such as Japan. This is a temporal problem, because the registered CDM projects are expected to issue more than one billion CERs by the end of 2012 (UNEP Risoe, 2010). Third, the current economic slowdown has not warranted the extensive use of CERs for compliance. This is not relevant in the continuing presence of the price spread. Fourth, it is possible that operators of installations are not attentive to the compliance cost-decreasing impact of the CDM and have not yet used the CDM to the allowed extent. We examine the last option.

Using the ten sectors distinguished in the EU ETS it is possible to assess the extent of CER usage by sector for the EU-27.[28] Two measures are key for the analysis: the variable how many CERs each sector uses for compliance. Second, the variable how many CERs each sector can use if it uses its full annual CDM entitlement. Most of the information to calculate these measures is available in the EU ETS registry, the Community Independent Transaction Log (CITL). Each April, EU ETS verified emissions data is published for the preceding year, indicating, for instance, the installation name, the Member State the installation is located in, the sectoral scope, the verified emissions of the installation, the EUAs allocated for free to the installations, and the CERs and ERUs used by the respective installation for compliance. The EU ETS data for 2008 covers 12,114 installations, of which 9,970 installations – 82% of all EU ETS installations – have been allocated EUAs and 10,397 have had verified emissions, meaning they participated in the EU ETS.[29] Of these installations 1,737 installations have used CERs, and 1,353 installations did so despite the possession of sufficient EUAs to cover their compliance obligation without CER use (Table 1).

{insert table 1 here}

Adding the CITL data, the limit on the use of project-based credits, as defined by the national allocation plan of the Member State (Communication by the European Commission, 2007), allows to calculate how many CERs and ERUs the respective installation was allowed to use for compliance. We used 2008 CITL data and divided the aggregate of all used CERs per sector and aggregated for the whole EU-27.[30]

Using the four cases under the allocation rule under formula (1) in Section 3, Table 1 shows how many installations, as a share of all EU ETS installations, that have been allocated EUAs, fulfil the arbitrage criteria.[31] In total, 1,346 of 10,397 installations fulfil the conditions above: i.e. have surrendered CERs, while their initial allocation of EUAs did not make it necessary to buy as many CERs as have been surrendered. Installations that fulfil these conditions acted rationally from an economic point of view to optimise compliance costs.

The use of CERs is concentrated with a few emitters. The numbers in Table 2 depict the use of CERs and the respective allocated EUAs, and verified emissions by the 1,346

[28] The ten sectoral scopes are: Power, Refineries, Coke ovens, Metal Ore, Iron and steel, Cement and Lime, Glass, Ceramics, Pulp and Paper and installations that "Opted in" (Annex I of Directive 2003/87/EC).

[29] About 2/3 of the 2,144 installations that did not receive any allocation in 2008, where allocated EUAs in Phase I of the EU ETS.

[30] Complete verified EU ETS data for 2009 was not available at the time of writing. As of April 1, 2010, only 80% of all installations had submitted their emission reports.

[31] Missing values indicate that there are no installations in this sector and Member State that have received free EUA allocation.

installations. The table illustrates that more than half of all arbitraging installations – 805 installations – are in the Power sector. This represents 72% of all installations in the Power sector that used CDM, while enough EUAs were allocated. Furthermore, the Ceramics sector installations made use of the CDM most (89% of all installations using CERs), despite having enough EUAs. Overall, it seems that a small but significant share of installations (13%) in the EU ETS has used the CDM for arbitrage.

{insert table 2 here}

Furthermore, the numbers indicate that installations that used the CDM have mainly arbitraged. In total, over 54 million EUAs have been swapped for CERs, most of them (28.8 million) in the Power sector. The table suggests that some sectors, such as the Iron and Steel sector, have used CERs to a great extent, relative to other sectors.

Assuming that the CER and EUA purchases were made equally during the three-year period (2008-2010), the EUA-CER spread is €4.67. The bold row indicates in Euro the potential realised profit (or cost saving) that has gone to the respective sectors due to the presence of CERs, or equivalently the loss in revenue for the regulator from not selling CER import rights. The biggest winners were the Power and the Iron and Steel sectors, at €134 million and €41 million, respectively. The total profit from EUA-CER arbitrage is around 250 million Euro. It is interesting to note, however, that some installations, notably over 50% in some sectors have used significantly used a multiple of the annual share of CDM credits allowed. This is in conformity with the EU ETS directive, however is still impressive as for instance 71% of the arbitraged CERs in the Glass sector account for between the share equal to three to five years volume of the allowed limit. In the first year of Phase II, some installations have thus already used a majority of the CERs allowed over the five-year period in Phase II.

The data above suggest that the assumptions about arbitrage opportunities arising from free allocation and the presence of installation-based CER limits are correct. However, it is interesting that not all CER arbitrage opportunities have been harvested.

{insert Figure 4 here}

Figure 4 depicts the use of CERs as a share of allowed CER use and shows that most installations have used only around 5% of the allowed CER entitlement. Furthermore, only 644 installations used more than 20% of their 2008-2012 allowed CDM limit in the first year, and 44 installations used more or equal to 100%, i.e. the whole CDM limit allowed over Phase II (2008-2012). However, a majority, over 80% of installations, which were entitled to CER use, used significantly fewer CERs than they would be allowed if CER use were equally distributed over Phase II. Potential reasons have been given above: the lack of sufficient supply and competition from public buyers,

expected higher CER-EUA spread in the future and a lack of (financial) management attention to arbitrage and profit opportunities. It is also possible that limited information and management time available prevented the implementation of a strategy to swap EUAs. In addition transaction costs for using CERs are not zero.

Conclusion

This paper presented different options to distribute and administer the valuable CDM limit. The CER limit leads to a price spread between EUAs and CERs, which translates into a rent for installations in countries with a generous CDM limit. The rents created through this limit are in the order of 250 million Euro for the year 2008. This paper has suggested mechanisms for distributing this rent. We found that the current application of installation-specific limits within the EU is inefficient and gives rise to competitive distortions. This has implications for applying the limit within the EU. The analysis indicates that the EU can improve the current system by either shifting to auctioning CER usage certificates, or pre-selling allowances in the amount equal to the CDM limit and subsequently buying CERs. The main advantage of these approaches is achieving the lowest compliance costs across the EU and decreasing the rents and arbitrage opportunities awarded to participants in the EU ETS. These options have transaction cost limitations as they either require the regulator to participate actively in the market, or require that limits be allocated using an auction or for free for subsequent trading. A change in the baseline for allocating the limits from EUA allocation to a baseline of verified emissions leads to an efficiency improvement and mitigates the distortive effects of EUA allocation.

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Annex I

{insert Table A1 here}

Figures and Tables

Figure 1 CDM limits share by EU Member States relative to share of EUA allocations by EU Member States[32]

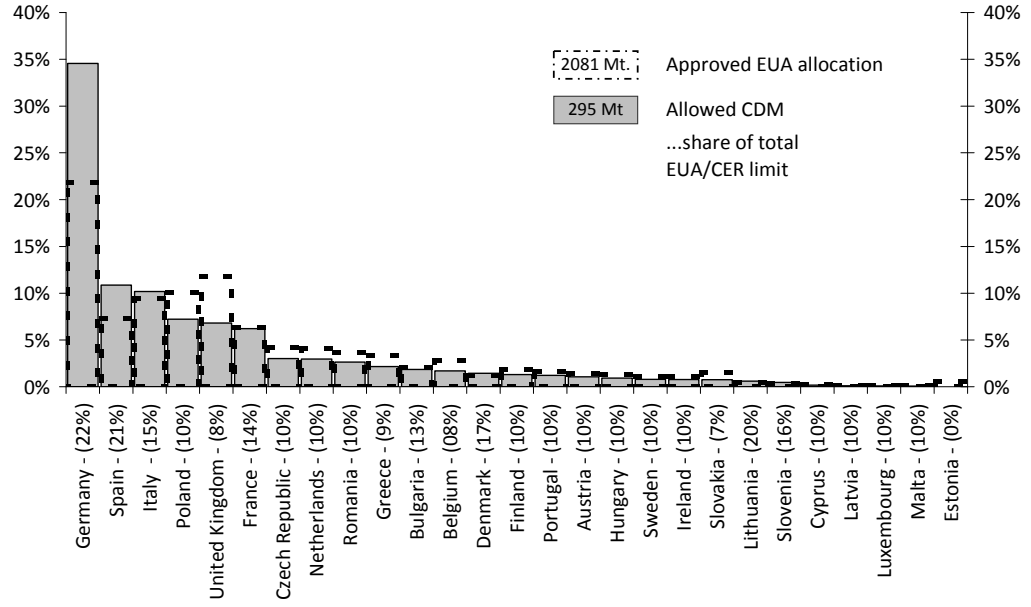
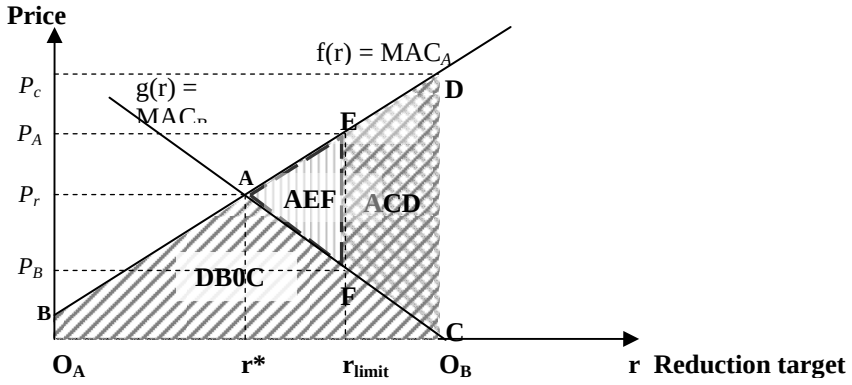


Figure 2 Domestic and external marginal abatement curves



[32] Source: EU Member State National Allocation Plans.

Figure 3 EUA (black) and CER (grey) December 2012 futures prices in Euro/t CO2 (ECX, 2010)

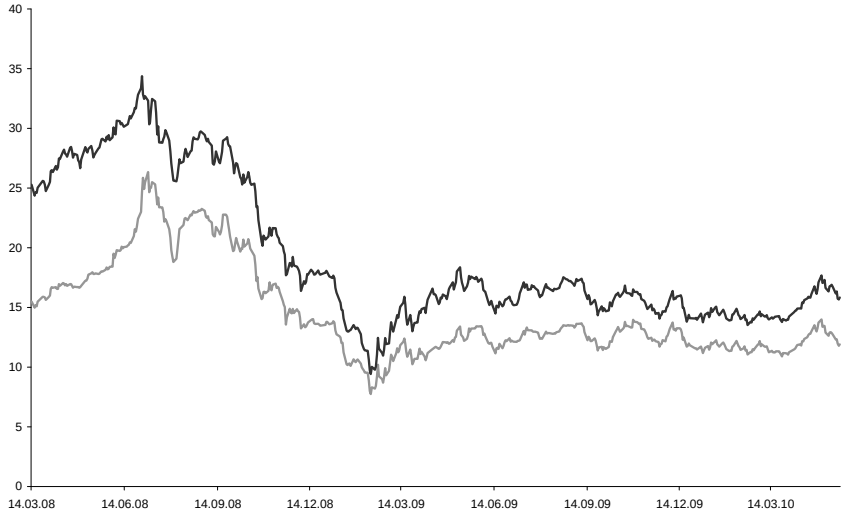


Table 1 Overview EU ETS installations 2008

	Total	With free allocation	Over-allocated	Using CERs	Used CERs despite sufficient EUA possession
Number of Installations	12,114	9,970	7,037	1,737	1,346

Table 2 Arbitrage in volume as share of allocated allowances and verified emissions of arbitraging installations (Share of CER arbitrage transaction of total)

	Power	Refineries	Coke ovens	Metal Ore	Iron or steel	Cement and Lime	Glass	Ceramics	Pulp and Paper	Opted-in	Total
CERs arbitraged in Mt. (% of total)	28.8 - (52%)	3.8 - (84%)	1.3 - (93%)	0.1 - (86%)	8.7 - (98%)	7.5 - (91%)	0.9 - (97%)	0.6 - (95%)	2.1 - (93%)	0.0 - (92%)	53.8 - (65%)
Arbitraging companies (% of all CER using companies)	805 - (72%)	23 - (64%)	3 - (75%)	2 - (67%)	25 - (81%)	138 - (87%)	39 - (89%)	174 - (92%)	132 - (90%)	5 - (45%)	1346 - (13%)
CER- EUA Arbitrage @ 4,67 Euro in Mln.	**134**	**18**	**6**	**1**	**41**	**35**	**4**	**3**	**10**	**0.1**	**251**
Share of 1 year	46%	100%	100%	3%	42%	65%	14%	49%	42%	100%	53%
Share of up to 3 years	35%	0%	0%	97%	58%	22%	15%	25%	24%	0%	33%
Share of between 3 and 5 years	17%	0%	0%	0%	0%	13%	71%	27%	31%	0%	14%
Share of more than 5 years	1%	0%	0%	0%	0%	0%	0%	0%	2%	0%	1%

Figure 4 Frequency distribution of CER use as share of allowed percentage of EUA allocation

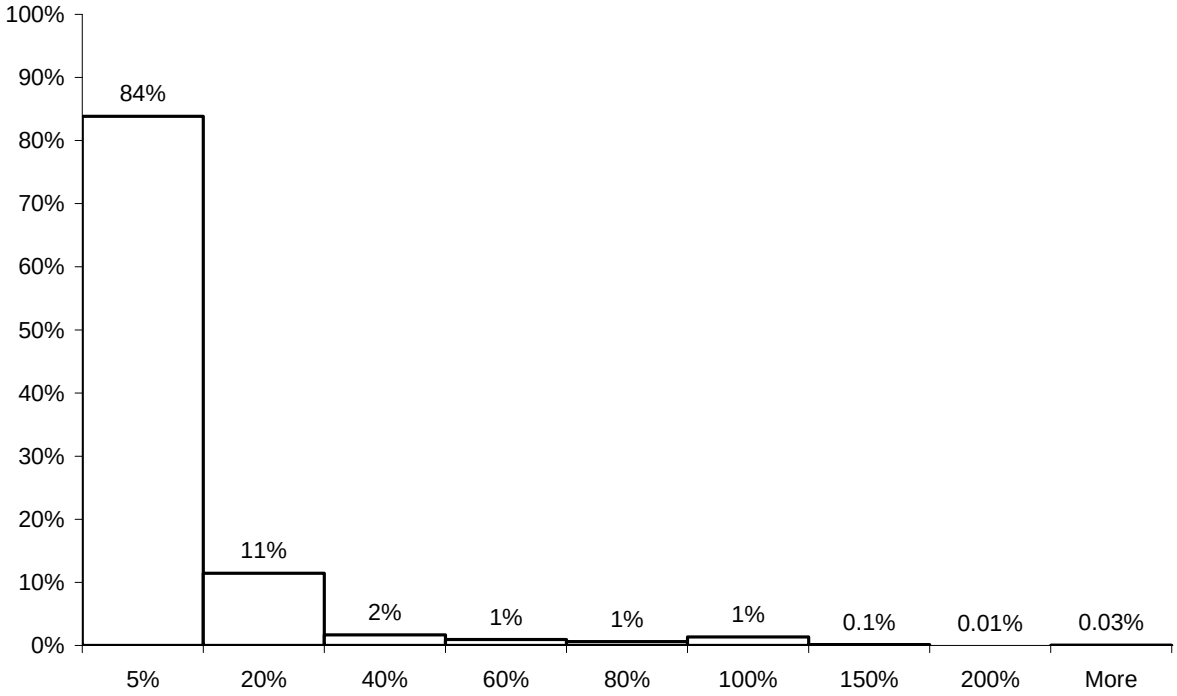


Table A 1: Average time from the start of commenting until request for registration for registered projects till August 2010 (UNEP Risoe, 2010)

Project Type	Registered Projects	Mean Time (in days) Start Comment - Registration	Standard Deviation
Hydro	599	350	166
Wind	341	299	132
Methane avoidance	323	276	193
Biomass energy	283	284	180
Landfill gas	159	313	181
EE own generation	136	293	125
N_2O	62	266	111
EE industry	57	280	144
Fossil fuel switch	45	314	155
Coal bed/mine methane	26	442	254
HFCs	21	242	143
Solar	20	245	77
Cement	19	222	73
EE supply side	19	347	156
Reforestation	13	423	267
Fugitive	12	304	259
Geothermal	9	403	241
EE Households	7	327	142
PFCs and SF6	6	374	179
EE service	5	192	132
Transport	3	250	183
Energy distribution	2	120	46
CO_2 capture	2	322	153
Afforestation	1	245	Not enough data
Tidal	1	194	Not enough data