CEPS SPECIAL REPORT

Thinking ahead for Europe

Scanning the Options for a Structural Reform of the EU Emissions Trading System

by

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Abstract

This paper provides a comprehensive overview and analysis of different options to reform the EU Emissions Trading System (ETS). The options discussed include changes to address the rigidity of supply on the auctioning side, as well as reforms to add flexibility to free allocation. Additionally, other options that may enhance the functionality of the EU ETS are covered, drawing on examples and practices in other carbon-pricing mechanisms around the world.

It is crucial to note that any reform of the EU ETS must consist of a package of options. Taken separately, the options may very well have beneficial effects, but they would also leave intact clear imperfections in the current design. Specifically where the auctioning supply mechanism and the flexibility in free allocation are concerned, we assess multiple options in each category, and present evidence for each option. Where appropriate, we suggest complementing these reform options with additional elements (presented in section 3.3).

The aim of any structural reform should be to arrive at a set of options that forms a consistent and credible package. With this paper, we provide an evidence-based assessment of the various building blocks of such a reform.

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Contents

Tables

Figures

Executive Summary

Taking decisive steps towards a reform of the EU Emissions Trading System (EU ETS) is a key element in the 2030 Climate and Energy Policy Framework adopted by the European Council in October 2014 by

- aiming at a more ambitious reduction of emissions,
- preventing the risk of carbon leakage.

This options paper aims at supporting the efforts for a reform of the EU ETS by putting the main reform proposals suggested so far into a coherent framework. The impact of these reforms, however, strongly depends on their exact design and implementation.

The basic intention is not to prescribe policy initiatives but to support the evaluation of various reform options that have emerged so far.

One final, but essential remark. The different ideas that are being examined below may or may not make sense when taken individually. What is needed is a package of measures that will make the EU ETS become an instrument that can deliver results in a realistic way, and contribute to the EU goals for energy and climate.

Lessons learned from the current state of the EU ETS

What the EU ETS has delivered

The EU ETS has managed to implement a functioning market infrastructure for more than 11,000 installations and 3,000 aircraft operators. This is manifested in a liquid market with a transparent carbon price signal. The system will deliver the intended emissions cap and will thus ensure that the ex-ante environmental target is met.

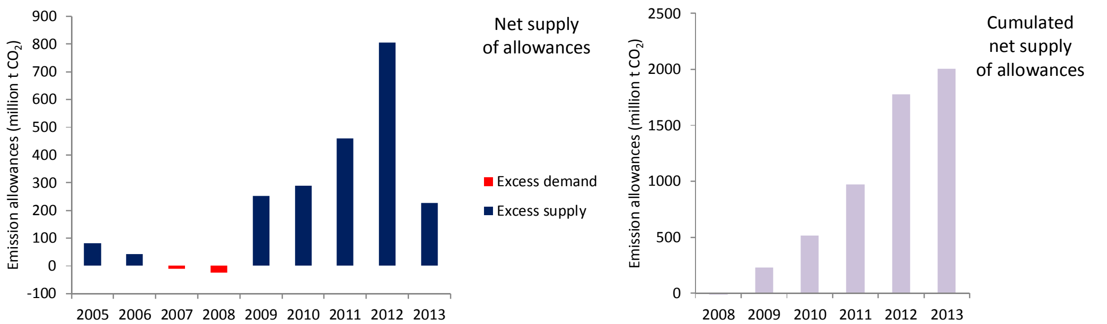
However, the objective of a cap and trade system to deliver a price signal that recognises GHG scarcity up to 2050 has not yet been sufficiently achieved. The gap between projections and realisation of emissions resulted in an oversupply of emissions allowances from the EU ETS beyond what can be considered a well-balanced market.

The current imbalance of the carbon market undermines the credibility of the EU ETS

A major symptom of the EU ETS is the huge imbalance between the supply, consisting of EU allowances (EUAs) plus international credits, and the demand for such emissions allowances. This is the result of the lack of flexibility on the supply side of the market, both in auctioning as well as free allocation. As shown in Figure 0-1 the surplus of allowances in the carbon market amounts currently to more than one year's emissions of the sectors covered.

Although it is recognised that the carbon market needs, in the short-term, allowances in excess of covering verified emissions in order to ensure liquidity, there is widespread consensus that the current excess supply is way too high.

Figure 0-1 Annual and cumulated net supply of allowances



Source: European Environment Data and European Union Transaction Log, own calculations.

The decline of the carbon price and its causes

A consequence of this surplus of allowances is a low carbon price, as shown in Figure 0-2, which prevents the price signal from reflecting scarcity of allowances up to 2050 and undermines incentives for investment and deployment of low-carbon technologies.

The main cause of the decline of the carbon price is the lack of supply- side elasticity which was not built into the regulatory design of the EU ETS. Surpluses and a low carbon price illustrate the impact of uncertainties (e.g. with respect to economic growth) and unexpected events (e.g. the large supply of CERs and ERUs). Reform options of the EU ETS thus need to address the causes of the outcome of the ETS compared to the expected performance.

Figure 0-2 Spot price of European Emission Allowances (EUAs)

Source: EEX.

Concerns about carbon leakage

Energy-intensive industries, which account for about a quarter of current emissions in the EU ETS, are concerned about carbon leakage, the relocation of production and investments to countries not subject to this trading system or comparable regulation. So far carbon leakage has not been a severe issue for a number of reasons, including the economic recession and efficacy of measures put in place by the EU ETS Directive. This might change, however, when the market faces more stringency.

A related issue is the role of the carbon leakage list in the current set-up for allocating free allowances, which is based on historical production levels and also contributed to the lack of supply-side flexibility.

Evaluation of the reform options proposed by the European Commission

Currently the following reform options are either being implemented or suggested by the European Commission:

- Postponement of the auctioning of allowances under the so-called backloading procedure
- A more ambitious reduction path of emissions after 2020
- A rule-based response to lack of flexibility in auctioning allowances, under a mechanism coined Market Stability Reserve (MSR).

Postponing the auctioning of allowances

In reaction to the surplus of allowances at the beginning of the third trading period in 2013, a decision was made to postpone the auctioning of 900 million allowances until 2019 and 2020, expecting that demand would pick up until the end of the third trading period.

A more ambitious reduction path

The European Commission proposed and the European Council supported in October 2014 the increase of the linear reduction factor of emissions in the EU ETS from the current 1.74 percent per annum to 2.2 percent after 2020.

A rule-based flexible supply mechanism responding to market imbalances

In order to address the persistent market surpluses because of the lack of supply-side flexibility, the European Commission proposed the Market Stability Reserve as a permanent and predictable measure. Starting after Phase 3 in 2021, this is a rule- based mechanism:

- The mechanism adds 12 percent of the total surplus of allowances to a reserve in year *t*, if this surplus in year *t-2* is higher than 833 million allowances and
- Provides 100 million allowances from the reserve and adds them to future auction volumes provided the total surplus is below 400 million allowances.

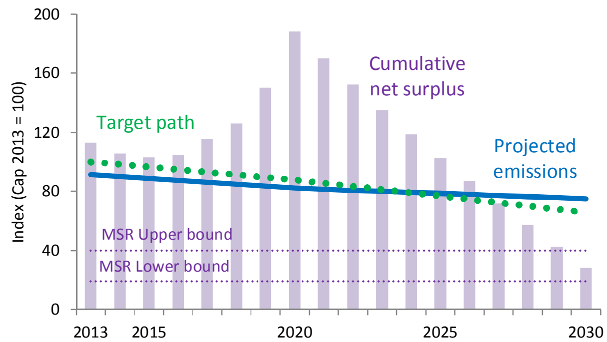
Continued surplus of allowances expected

Our simulations of the expected impact of the backloading procedure and the Market Stability Reserve as proposed by the Commission provide the following evidence as shown in Figure 0-3:

- Due to the expected low economic activity over the coming years and the reinjection of the withdrawn allowances under the backloading procedure, the cumulated net surplus is expected to increase further up to 2020.
- The Market Stability Reserve mechanism, which in the Commission's proposal is scheduled to start in 2021, will need many more years to reduce the accumulated surplus in order to reach the upper intervention level of this mechanism.

These results are robust with respect to variations of our economic reference path with annual GDP growth rates of 0.5 percent until 2020 and 1.0 percent afterwards.

Figure 0-3 Simulating the impact of backloading and the original Commission's proposal for *a Market Stability Reserve*

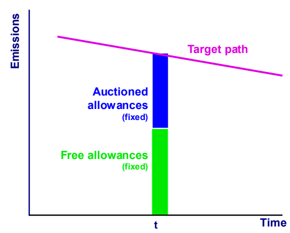


Source: European Environment Data and European Union Transaction Log, own calculations.

Options for a structural reform of the EU ETS

Most of the current deficiencies of the EU ETS result from rigid supply of free and auctioned allowanced as shown in Figure 0-4. Actual emissions, however, remained, over almost all years, below this supply. Together with a significant inflow of international credits this has resulted in a cumulated surplus of more than one year's emissions.

Figure 0-4 The basic fixed supply design of the EU ETS



Source: Authors.

Framing the options for a structural reform

Starting with the current proposals from the European Commission, a number of suggestions for a comprehensive reform of the EU ETS have emerged.

By framing these options for a structural reform into three packages, we want to indicate actions that might progressively change and extend the current set-up of the system. These reform packages can be summarised by their intentions:

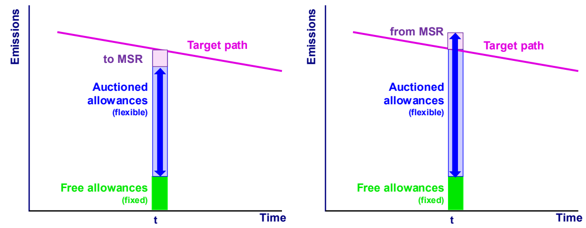
- Stabilising the market for emission allowances
- Adding flexibility and a long-term perspective to allocations
- Enhancing further the functionality of the EU ETS

Reform Package 1: Addressing auctioning rigidity and 'resetting' the market

A flexible supply mechanism such as the Market Stability Reserve (MSR) responds to a lack of flexibility in the supply side of the market design. Depending on the design features it can address past imbalances in the carbon market. It is essentially intended to shield the market against disturbances from economic cycles, as well as other unexpected influences on the quantitative stringency of allowances.

Figure 0-5 indicates that this mechanism responds to events described above, by varying the auctioning volume, via additions to the MSR, or re-injections from the MSR. The parameters that determine the size of the interventions via the MSR need to be carefully examined.

Figure 0-5 Flexible supply with a Market Stability Reserve mechanism



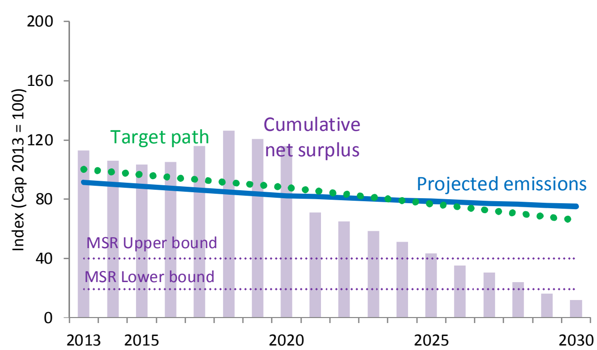
Source: Authors.

Our simulations indicate that an MSR based on the parameters suggested by the European Commission will not be able to deal with the huge accumulated surplus of allowances and achieve a stringency of the carbon market which provides price signals to 2050. This may include changes in operational patterns, as well as the development and deployment of low-carbon technologies. The following reform option would reflect a more ambitious design for an MSR:

- **No re-injection of withdrawn allowances**
  According to the backloading procedure, starting with 2014, 900 million allowances are withdrawn by 2016. The allowances are not re-injected but put into the MSR. In addition unused allowances are transferred into the MSR.
- **Early start of the Market Stability Reserve**
  The Market Stability Reserve is implemented 2019, which is an earlier start than suggested by the parameters given by the European Commission.

Figure 0-6 indicates that such a reform package would avoid a further increase of the already huge surplus of allowances and, in addition, would achieve more rapidly a tightening of the stringency in the carbon market, which would lead to a pathway to the 2050 target.

Figure 0-6 Simulation of an early start of European Commission Market Stability Reserve without re-injection of withdrawn and unused allowances



Source: European Environment Data and European Union Transaction Log, own calculations.

Reform Package 2: Adding flexibility to allocations in view of a long-term target path reflecting scarcity up to 2050

Investment decisions typically require a longer planning horizon, which can be provided by a long-term emissions target path beyond fixed trading periods as proposed by the European Commission:

- **Long-term emissions target path.**
  The current linear reduction path of 1.74 percent per year up to 2020 is extended after 2020 with an enhanced reduction factor of 2.2 percent per year, leaving the endpoint of this target path open.

The October Council conclusions indicate that the ratio of auctioned allowances should remain unchanged. However, adding flexibility to the allocation of allowances needs to be discussed: One way to address the adverse effects from the current rigid allocation procedure is by adding flexibility to the allocation of allowances:

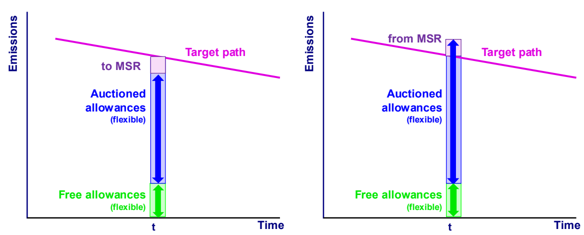
- **Flexibility for free allowances.**
  Free allocations are based on more recent activity levels and updated benchmarks, taking into account sectoral differences
- **Auctions are adjusted to free allocations in view of the emissions target path**
  The auctioning volume is determined by subtracting from the target path volume of a specific year the amount of free allowances previously determined.

Figure 0-7 visualises this reform package. Because of the built in flexibility of both free allocation as well as of the auction volume, one additional new feature is that there is no need for a cross-sectoral correction factor, as in the current setting.

In addition, fixed trading periods are no longer necessary, as the shift from fixed caps to a long-term target path will ensure the environmental integrity.

This reform package lowers the risk of carbon leakage by providing investors with a long-term dynamic reduction target, compensates installations by taking into account output fluctuations and provides free allocation based on updated and realistic benchmarks.

Figure 0-7 Flexible free allocations in view of a long-term target path



Source: Authors.

Reform Package 3: Enhancing the functionality of the EU ETS

A number of reform options are available which could enhance the functionality of the EU ETS:

- **Targeted allocation of free allowances**
  The risk of carbon leakage could be addressed by explicitly compensating the exposure of export and import competition, recognising currently unavoidable emissions from process emissions (e.g. in the cement and steel industry), as well as indirect emissions from electricity through the allocation of free allowances, or by providing compensation from auctioning revenues, possibly managed by the national electricity regulator.
- **Activating Domestic Offsets (Art 24a)**
  Article 24a of the EU ETS Directive makes provisions for the use of domestic (EU) credits from projects. This provision has not been used so far, but could provide the opportunity to allow for reductions from the non-ETS sector to be used in the ETS sector.
- **Different sectoral treatment within the same ETS**
  Target paths which are used for determining the supply of allowances could differ between sectors, e.g. between industry and combustion sectors.
- **Different treatment of small installations**
  Since 84 percent of the smaller installations account for only 10 percent

of total EU ETS emissions, a different treatment of the smaller installations could be considered that lowers the administrative burdens. This could be done with an emissions levy or the inclusion of upstream energy distributors into the EU ETS, as it is currently the case in California.

- **Emissions Performance Standard**

  As a means to speed up the decarbonisation of the power sector, some voices – such as the Greens group in the EP – are calling for an emissions performance standard, which would limit the amount of CO2 emitted per kilowatt hour.

- **Extending sectoral coverage**
  Another proposal, which was also mentioned above, is the inclusion of additional sectors to the EU ETS, including upstream fuel distribution.

- **Governance issues**
  Reactions to undesired events on the carbon market could be speeded up by installing an authority in charge of observing and maintaining the integrity of the carbon market, not dissimilar to the Australian Climate Change Regulatory Authority.

- **Innovation Reserve**
  The current NER 300 funding programme of innovative low-carbon energy demonstration projects could be extended both in volume and scope for targeted innovation policies. This is included in the Council Conclusions through the proposed NER400, which also covers industrial sectors.

Protecting against the risk of carbon leakage

There is emerging evidence that almost all elements of the EU ETS mechanism are of some relevance to the issue of carbon leakage. As a consequence, all reform options need to be checked against this issue.

Energy-intensive industries can be shielded from carbon leakage through the introduction of the following reform elements:

- Using a **long-term emissions target path** for the supply of allowances, which provides the desired long-term perspectives for investment decisions while keeping environmental integrity.
- Both the supply of free and of auctioned allowances **respond to output fluctuations**. This flexibility reduces unwanted effects from the current rigid allocation procedures and makes a Cross-Sectoral Correction Factor redundant.
- The behaviour of the supply side of the carbon market can be made more predictable through the introduction of a **Market Stability Reserve** type mechanism.
- **Free allowances** can be allocated in a more targeted manner. In the current benchmark system this can be accomplished by updating the parameters for technological developments. In addition, the exposure to international trade, the amount of currently unavoidable process emissions as well as indirect emissions from electricity, have to be explicitly taken into account.

Both the response to changes in activity levels and the use of better targeted criteria support a scheme for free allocations that protects sectors and installations against the risk of carbon leakage.

The insight that all elements which are relevant for a reform of the EU ETS have also a strong bearing on the risk of carbon leakage emphasizes a comprehensive instead of a piecemeal approach to this issue.

Benefits of a more flexible design

Basically all reform packages that have been put forward so far emphasise the benefits of more flexibility in the EU ETS.

- Reform elements based on a Market Stability Reserve react to supply inflexibility.
- Reform elements which react to output changes link the stringency of the carbon market to activity levels.

Together with a long-term emissions target path, these reform elements eliminate the need for fixed trading periods and for a cross-sectoral correction factor.

By compensating installations explicitly for trade exposure, process emissions and indirect emissions, free allocations can be made more targeted and the carbon leakage list is no longer required.

1 The current state of the EU ETS

The objectives of the EU ETS

The EU Emissions Trading System (EU ETS) is intended to be the cornerstone of the European Union's climate policy. It is a cap-and-trade system whose objective is price discovery, given a target to reduce greenhouse gas emissions in the sectors covered in the EU ETS in a cost-effectively manner to a long-term cap, with short-term milestones.

The short-term milestone for the EU ETS is a reduction of emissions in covered sectors by 21 percent compared to 2005 levels by 2020, and 43 percent by 2030 (as per the October Council Conclusions).

For 2050 the European Commission's Energy Roadmap provides pathways to achieve a low-carbon economy in Europe in line with a greenhouse gas reduction of 80 to 90 percent.

Key findings

Evidence on the current state of the EU ETS include:

- Rigidity of supply has led to the emergence of a significant surplus of allowances, which amounts currently to more than one year's emissions.
- This imbalance was caused not only by European Union Allowances (EUAs), but also by the inflow of international credits as Certified Emissions Reductions (CERs) form the Clean Development Mechanism and Emissions Reduction Units (ERUs) from Joint Implementation projects.
- As a consequence of this imbalance, the carbon market does not reflect scarcity up to 2050, which hinders the incentives for switching to low-carbon technologies.

1.1 The imbalance of supply and demand for allowances

The declining demand for allowances from verified emissions

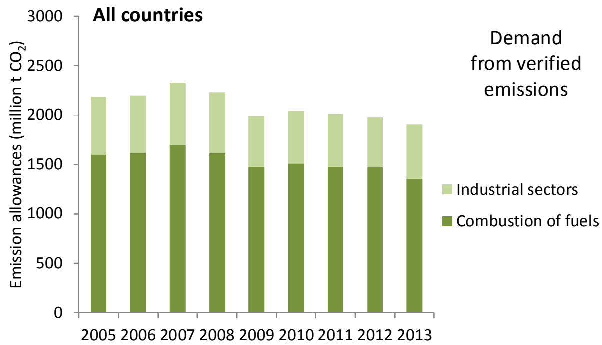
The main demand from allowances originates from verified emissions which in 2013 amounted to 1,904 million tonnes of CO_2. As can be seen from Figure 1-1, about 71 percent of those emissions result from installations whose main activity involves the combustion of fuels (for generating electricity and heat) and the remaining 29 percent are generated by industrial processes.

The emissions illustrated in Figure 1-1 are adjusted by the European Commission for changes in the scope of installations covered in order to allow comparison over time and show a declining trend since 2010.

Additional demand for allowances

Additional demand for allowances - as compared to verified emissions of a particular year - results from hedging, strategic trading activities and general liquidity requirements.

Figure 1-1 Demand for allowances from verified emissions



Source: European Environment Data and European Union Transaction Log, own calculations.

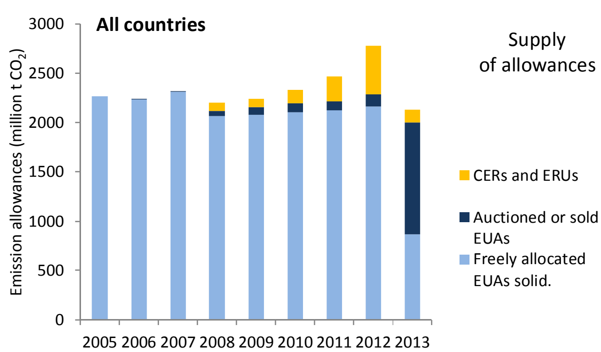
The excess supply of allowances

The supply mechanism for the EU ETS is through free allocation, auctioning of EUAs, as well as the availability of international credits (CERs and ERUs). Figure 1-2 indicates that up to 2012 most EUAs were allocated for free.

International offsets, CERs (Certified Emissions Reductions from the Clean Development Mechanism) and ERUs (Emissions Reduction Units from Joint Implementation projects) constitute a major supply source towards the end of Phase 2 (2008 – 2012).

Phase 3 of the EU ETS, starting in 2013, brought two major changes compared to the previous trading periods: National emissions caps were replaced by an EU wide cap; and the share of auctioned EUAs increased in 2013 to about 57 percent of the total supply comprising free and auctioned allowances.

Figure 1-2 Domestic and international supply of allowances



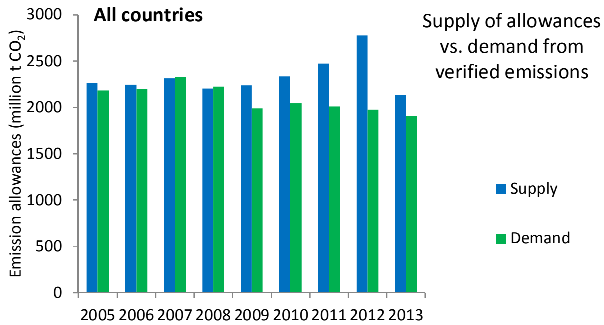
Source: European Environment Data and European Union Transaction Log, own calculations.

The huge accumulated net surplus of allowances

By comparing the demand for verified emissions with the supply, as illustrated in Figure 1-3, we realise that a significant imbalance emerged by the end of Period 2.

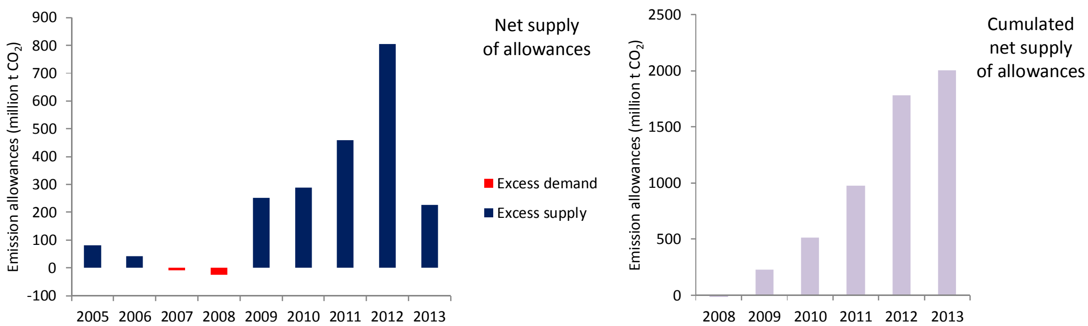
Details about the development of this imbalance are shown in Figure 1-4. In 2012, the annual net surplus of allowances amounted to about 40 percent of emissions in this year. At the beginning of Period 3 the accumulated surplus of allowances exceeds one year's emissions.

Figure 1-3 Supply vs. demand of allowances



Source: European Environment Data and European Union Transaction Log, own calculations.

Figure 1-4 Annual and cumulated net supply of allowances



Source: European Environment Data and European Union Transaction Log, own calculations.

1.2 The breakdown of the carbon price

The role of the price signal

The EU ETS was created with the intention to provide a price signal resulting from a legislated cap on GHG emissions. The overall level of the price signal needs to be clear, credible and consistent.

Due to the current surplus of allowances on the market, the CO_2 price has dropped to a level, which is not sufficient for stimulating investments in low carbon technologies.

Figure 1-5 Spot price of European Emission Allowances (EUAs)

Source: EEX.

1.3 The role of free allowances

A shift in the role of free allowances with Phase 3

In the first two trading periods, free allowances were given a key role in the design of the EU ETS. Figure 1-6 shows the share of free allowances in verified emissions, which could provide three insights:

- In Phase 1 a significant over-allocation was observed due to a lack of emissions data when national allocation plans were developed. Period 1, however, was a learning phase and the allowances could not be banked into the second period. This surplus is therefore not relevant for the current situation.
- In Phase 2, overall, more free allowances were available than needed for covering the verified emissions. Three reasons contributed to the surplus of allowances: the economic slowdown, the inflow of foreign offsets, and overlapping policies for renewable energy and energy efficiency. In Period 2, auctioning played a minor role (about. 3.5 percent of total allocation).
- In Phase 3, the supply of allowances via auctioning was substantially increased. The share of free allowances dropped to 45 percent of verified emissions in 2013.

Free allowances are relevant for the effective carbon costs

From the installations' point of view, the share of free allowances relative to their emissions is – together with the carbon price – the main determinant for the impact of carbon costs.

Carbon costs in turn may have the impact of shifting production and investment outside of the EU ETS covered jurisdictions, and therefore create carbon leakage. This takes place if carbon costs cannot be passed through due to global price formation. In the power sector (to a degree which is unclear) the pass through of carbon costs is possible.

The share of free allowances in relation to emissions therefore plays a prominent role in protecting industrial sectors from adverse effects of asymmetrical climate change policy.

Figure 1-6 Share of free allocation in verified emissions – all sectors

Source: European Environment Data and European Union Transaction Log, own calculations.

Different allocation approaches between combustion and industry sectors

Figure 1-7 shows that if we look at differences in the share of free allocations between sectors, we discover a pronounced difference between installations with combustion as main activity, which account for 71 percent of total emissions, and the remaining industry.

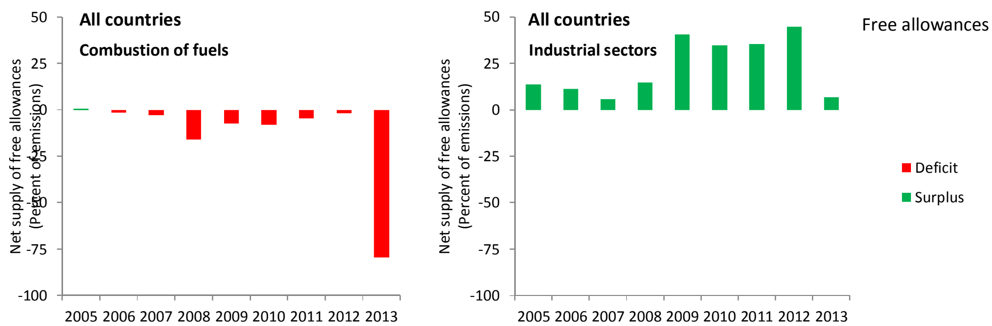
The combustion sectors, which include electricity and heat (but also industrial sectors with the activity combustion of fuels with a rated thermal input of more than 20 MW), were short of free allowances during all trading periods.

In the first year of the third trading period, the new EU-wide harmonised rules for free allocation came into effect. This lead to only 21 percent of emissions of the combustion sectors being covered by free allowances in 2013.

In contrast, other industry sectors received in all periods free allowances in excess of their emissions. Even after the reforms introduced at the beginning of Period 3, this surplus persisted, and amounted to 7 percent in 2013.

This is significantly lower than the surpluses in Phase 2, which peaked in 2012, with 45 percent, and generated substantial windfall profits.

Figure 1-7 Share of free allocation in verified emissions – combustion and industry



Source: European Environment Data and European Union Transaction Log, own calculations.

1.4 The decline of the emissions intensity

Not only absolute emissions matter but also emissions intensity

The success of a cap-based emissions policy can not only be judged by the fulfilment of a short-term cap (e.g. to 2020), but also the price signal that it gives to the long-term cap (i.e. to 2050).

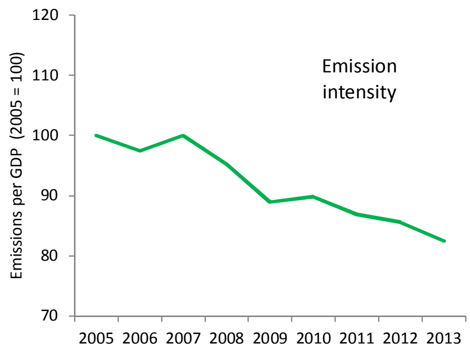
This is a lesson to be learned from the EU ETS so far, since to a large extent the decline of emissions was caused by the rather dramatic and persistent economic slowdown since 2008. Compliance with the 2020 cap did not pose a major challenge (i.e. virtually no investment in low-carbon technologies were required, and the carbon price did not add a significant incentive for such investments). As such, it is questionable whether structural progress towards the long-term target (i.e. 2050), was achieved during Phase 2.

Emissions intensities decline about 2 percent per year

To what extent emissions reductions originate from changes in technologies can be better judged from the pattern of carbon intensity, which corelates emissions to a measure of economic activities, such as GDP.

Such an indicator is depicted in Figure 1-8, which indicates a pronounced decline of emissions intensity (around 2% per year). Similar emissions intensities can be obtained for individual sectors and installations and serve as a metric, e.g. for the allocation of free allowances.

Figure 1-8 Emissions intensity of EU ETS



Source: European Environment Data and European Union Transaction Log, own calculations.

1.5 Taking stock

What EU ETS has achieved

The EU ETS has managed to implement a functioning market infrastructure for more than 11,000 installations and 3,000 aircraft operators covered which resulted in a liquid market with a visible carbon price signal. The system will deliver the intended emissions cap and will thus ensure that the environmental target is met.

What has not been achieved yet

However, the objective of a cap and trade system to deliver a carbon price signal to 2050, and encourage the deployment and development of low carbon technologies, as appropriate, does not seem to have been achieved yet.

The initially determined cap -– based on economic projections ahead of the economic crisis -– for the trading periods 2008 to 2012 and 2013 to 2020 was expected to be stringent.

However, the gap between projections, economic realities (and real emissions), combined with the impacts of overlapping policies, in particular for renewables, resulted in a different reality and emissions cap which was significantly higher than the actual emissions.

The gap between projections and actual numbers resulted in an oversupply of emissions allowances from the EU ETS beyond what can be considered a well-balanced market.

Another factor that played an important role was a major inflow of cheaper international offsets, which was seen as desirable at the time when EU ETS was designed.

The current imbalance of the carbon market undermines the credibility of EU ETS

A major issue of the EU ETS is the huge imbalance between the supply of EU allowances (EUAs) plus international credits and the demand for emissions allowances to cover verified emissions. The surplus of allowances in the carbon market amounts currently to more than one year's emissions of the sectors covered.

Although it is recognised that the carbon market needs, in the short-term, allowances in excess of covering verified, there is widespread consensus that the current imbalance is excessive.

The decline of the carbon price and its causes

A consequence of this surplus of allowances is a very low carbon price that no longer provides incentives for investing into low carbon technologies.

The cause of this decline is the lack of supply-side elasticity which was not built into the regulatory design of the EU ETS. Surpluses and a low carbon price illustrate the impact of uncertainties (e.g. with respect to economic growth) and unexpected events (e.g. the large supply of CERs and ERUs). Reform options of the EU ETS need to address the causes, and not the symptoms.

The issue of carbon leakage

Carbon leakage, the relocation of production and investments to countries outside of the EU ETS without similarly stringent carbon constraints, has always been a significant component in setting up the trading system.

It is evident that carbon leakage is mainly an issue for energy and trade intensive industries which cover about one fourth of total covered emissions. These industries have been allocated, so far, on an aggregated level, considerable more free allowances than needed for covering their emissions.

The issue of carbon leakage has shifted now to the expected design of the EU ETS post-2020, which might impact investment decisions already in progress.

2 Currently visible steps for a reform of the EU ETS

2.1 First steps for a reform of the EU ETS

Dealing with market imbalances and protecting against carbon leakage

There are at least three closely linked reasons that would call for a reform of the EU ETS:

- The surplus of allowances in the carbon market currently amounts to more than one year's emissions of the installations covered.
- This surplus erodes the expected functionality of a cap-and-trade mechanism for stimulating cost-effective abatement activities via price signals.
- Although there is no significant evidence at this time that the EU ETS has led to carbon leakage, there is considerable uncertainty about the impact post-2020. The compounding impact of the Cross-Sectoral Correction Factor (CSCF) in the current set-up also erodes the degree to which carbon leakage risk is mitigated before 2020.

These considerations have triggered first steps towards reforming the EU ETS. Additional efforts, however, might be needed to achieve the intended policy impacts with this mechanism.

Backloading, Market Stability Reserve, and a more ambitious emissions reduction path

As an ad-hoc measure targeted at reducing the surplus on the carbon market, a mechanism for changing the auctioning schedule in Phase 3 – coined backloading -– was implemented. This mechanism foresees a temporary removal of 900 million allowances from the market starting in 2014. These allowances will be returned to the market in 2019 and 2020.

In addition to this ad-hoc intervention, a further measure was proposed by the European Commission, which is currently making its way through the legislative process. The Market Stability Reserve (MSR) proposal aims to provide flexibility to the supply side of the market and will eventually address current market imbalances, caused by economic cycles.

Furthermore, the European Commission proposed a more ambitious emissions reduction path, in line with the envisaged reduction target for 2050.

Evaluating the impacts

First results from simulations of these reforms of the EU ETS (currently some implemented, and some suggested) indicate:

- The backloading procedure will have minimal impact on the market imbalance.
- By 2020 the market imbalance will increase further.
- The proposed Market Stability Reserve mechanism, as proposed by the European Commission, might need up to ten years to establish stringency in the carbon market.

2.2 Implemented and suggested reforms by the European Commission

2.2.1 Backloading of allowances

Postponing the auctioning of allowances

In reaction to the surplus of allowances at the beginning of the third trading period, a decision was made to postpone the auctioning of 900 million allowances until 2019-2020, expecting that demand would pick up until the end of trading period 3.

An important characteristic of this measure is that it does not reduce the overall number of allowances to be auctioned during phase 3 - it only changes the timing of auctioned allowances over the period.

Under this so-called backloading procedure, the auction volume in 2014 will be 400 million allowances lower than originally planned. Additional reductions of 300 million will be introduced in 2015, and 200 million in 2016. These 900 million allowances will be injected back into the market, 300 million in 2019 and 600 million in 2020.

This backloading procedure must be seen as an ad hoc measure in the absence of a systemic way of addressing supply-side rigidity, which is a design flaw in the EU ETS.

2.2.2 Market Stability Reserve (MSR)

In order to address the persisting market surpluses because of the lack of supply-side flexibility, the European Commission proposed an additional measure, the Market Stability Reserve (MSR). According to the original proposal, the MSR should be implemented after Phase 3, starting in 2021.

The MSR is a rule-based mechanism that:

- adds 12% of the total surplus of allowances to a reserve in year t, if this surplus in year t-2 is higher than 833 million allowances and
- provides 100 million allowances from the reserve and adds them to future auction volumes, provided that the total surplus is below 400 million allowances.

Therefore, the Market Stability Reserve is a mechanism that attempts to introduce a rule-based flexibility mechanism for tackling unexpected developments of the EU ETS allowance balance. Its effect would be, over a longer time, to also reduce the accumulated historical imbalance between supply and demand in the EU ETS.

The extent to which the MSR mechanism with the proposed parameters is able to cope with the huge accumulated surplus needs to be evaluated under different scenario assumptions.

2.2.3 A more ambitious reduction path

Linear reduction path

The emissions cap in Phase 3 is translated into a linear target path that starts in 2013 with 2,084 million allowances and decreases each year by a factor of 1.74 percent. This leads to emissions in 2020 that will be 21 percent lower than in 2005.

According to the 2030 Framework for Climate and Energy Policies as proposed by the European Commission in January 2014 and supported by the European Council in October 2014, the reduction of the target path will be increased to 2.2 percent per year after 2020 and reduce emissions to 43 percent below 2005 levels by 2030.

2.3 Projecting the demand for emissions allowances

Projected emissions depend on economic activity

The starting point for any simulations about the impacts of various reform options is a projection of the emissions paths up to 2030.

Using the historical relationship between emissions and economic activity, as measured by GDP, and observing the different emissions intensities between combustion and industry sectors, we obtain, for average GDP rates between 0 and 2 percent per annum, the emissions paths indicated in Figure 2-1.

Comparing projected emissions with target paths

In addition, the target path for emissions in Period 2, with 1.74 percent per annum reductions, and the enhanced target path starting in 2021 with 2.2 percent reductions, were added.

The value of 2,084 million tonnes of the target path in 2013 is normalised to 100, and all other series are adjusted to this normalisation.

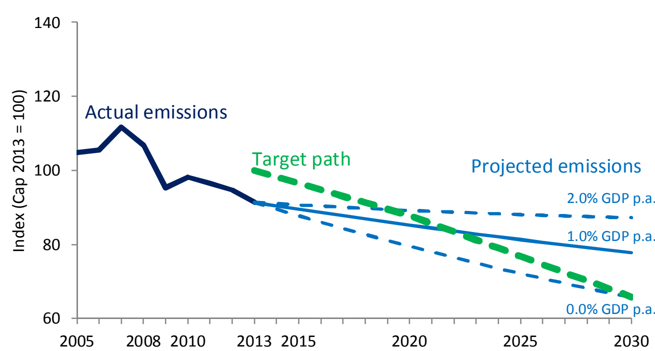
Based on these emissions projections, a number of simulations will be performed in order to obtain a better understanding of the steps needed for an effective reform of the design of the EU ETS.

As a reference path for the emissions, we assume a GDP growth of 0.5% to 2020, and 1.0%afterwards.

Continued surplus of allowances expected

When comparing the projected emissions to the target paths, we end up with a continuation of the surplus of allowances. This surplus amounts to about 9 percent at the beginning of Period 3. This surplus may continue well beyond 2020, depending on the actual GDP rates.

Figure 2-1 Projected emissions and emissions target path until 2030



Source: European Environment Data and European Union Transaction Log, own calculations.

2.4 Unused Phase 3 allowances

Additional unused allowances

Ecofys (2015) pointed out that unused allowances from the New Entrants' Reserve (NER) and from installations producing at low capacities might add up to a volume from 500 to 900 million by 2020.

According to the EU ETS Directive and Auctioning Regulation this volumes are to be auctioned in 2020, adding to the expected surplus by the end of Phase 3. Some MEPs have called for the transfer of these allowances to the proposed MSR.

3 Scanning the options for a structural reform of the EU ETS

Identifying three packages for a structural reform

Since the current European Commission proposals may not to be sufficient to handle the existing deficiencies of the EU ETS, which if allowed to continue may become existential, a number of suggestions for a comprehensive structural reform have emerged.

These proposals build on the reform options of the European Commission and add suggestions in particular from the CEPS Carbon Market Forum, CDC Climat, Climate Strategies, Ecofys, Euro-CASE, Fondazione Eni Enrico Mattei (FEEM), the Austrian Institute of Economic Research (WIFO) and the Wegener Center at the University of Graz (WegCenter).

By framing these options for a structural reform of the EU ETS into three packages we want to indicate actions which progressively might change the EU ETS, as currently set up:

1. Addressing auctioning rigidity and 'resetting' the market
2. Adding flexibility to allocations in view of a long-term target path reflecting scarcity up to 2050
3. Further elements to enhance the functionality of the EU ETS

Within each package we identify key options of a reform. The impact of these reforms, however, strongly depends on their exact design, and implementation.

Evaluating the impact of the reform packages

These reform packages will be assessed with respect to a number of criteria, which include

- meeting the environmental objective set by the EU,
- providing a price signal that recognises the long-term environmental objective,
- ensuring a well-functioning market,
- rules for dealing with carbon leakage, and
- political feasibility.

Choosing reform strategies

From this menu of reform packages single options may be picked, or put together to form strategies for a structural reform package.

The comprehensive framework in which the reform packages will be analyzed should facilitate an assessment of the chosen reform strategies.

3.1 Reform Package 1: Addressing auctioning rigidity and 'resetting' the market

3.1.1 Why a flexible supply mechanism is needed

Responding to unexpected demand and supply developments

The current set-up of the EU ETS is not able to respond to unexpected and major variations in demand, such as the ones resulting from the economic crisis, as well as from overlapping policies for renewables and energy efficiency. The system also cannot respond to unexpected supply movements, such as the inflow of international offsets.

The resulting imbalances can be addressed by a flexibility supply mechanism, such as the Market Stability Reserve (MSR) proposed by the European commission.

Design options for a flexible supply mechanism

Part of the supply for the carbon market can be varied by changing the volume of auctioning and/or the volume of free allowances. A reaction could be tied to:

- the market imbalances, i.e. the accumulated surpluses or deficits of allowances,
- the market stringency, i.e. the differences between target emissions and actual emission, or
- the market price, i.e. deviations of the actual price from a target price range.

A preference for volume-based supply responses

In Europe a preference seems to be given to supply mechanisms that are triggered by volume-related indicators, in contrast to price-related indicators. One is that carbon prices are not only influenced by the market fundamentals of supply and demand, but also, to a large extent, by speculative movements.

Other reasons are related to the EU institutional and fiscal architecture, which would make it difficult to introduce in the EU a price trigger, as currently introduced in California. Finally, rule-based interventions on the basis of quantity are seen by many as more befitting of a market mechanism.

3.1.2 EU ETS reform proposals of the European Commission

The starting point for the evaluation of various reform options for the EU ETS is the current set of reform options proposed by the European Commission:

- a flexible supply mechanism, coined Market Stability Reserve
- a more ambitious emissions reduction path

Already implemented is a temporary shift of the auctioning of allowances towards the end of Period 3.

Reform Option 1.1: Market stabilisation based on the backloading procedure and the Commission's Market Stability Reserve proposal

The backloading procedure until 2020 and the Market Stability Reserve as proposed by the European Commission afterwards

The following reform measures are planned, or have been implemented:

- From 2014 to 2020 the backloading procedure shifts the auctioning volume in Period 3 towards the end.
- The target path that reduces the emissions cap from 1.74 percent per year is increased to 2.2 percent after 2020.
- A flexible supply mechanism is installed after 2020 according to the Market Stability Reserve with parameters as suggested by the European Commission.

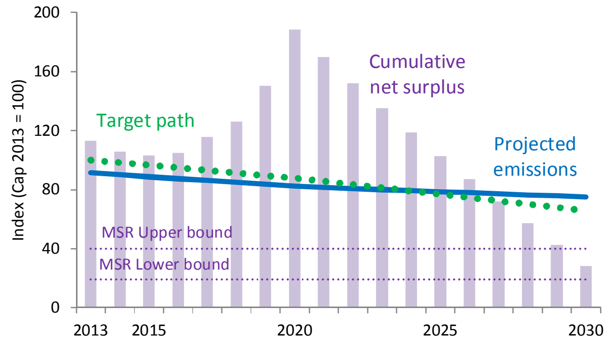
The simulated impacts

The simulation of this reform option serves as a reference for comparisons with other options that could be considered. It fully assumes the implemented backloading with the parameters proposed by the Commission.

Two insights unfold. First, the backloading procedure will only marginally reduce the current surplus, and by 2020 this surplus will rather dramatically build up. Secondly, the implementation of the MSR might need almost ten years to bring the surplus within the bandwidth of the MSR.

There are two reasons for this rather limited impact. First, it is the continuation of surpluses of allowances over the next ten years, due to the low expected economic activity. Secondly, the withdrawal rate of the MSR is very low.

Figure 3-1 Simulation 1 - Impact of backloading and Market Stability Reserve



Source: European Environment Data and European Union Transaction Log, own calculations.

Pros and cons

A flexible supply mechanism, as the currently proposed MSR, will shield the carbon market against economic fluctuations of unusual severity, as well as other unexpected influences on the quantitative stringency of allowances. The added flexible supply option in the design of the EU ETS acknowledges uncertainties on future developments

The impact of the flexible supply mechanism should also translate into a carbon price signal more consistent with the long-term scarcity (to 2050). The added flexible supply option in the design of the EU ETS thus represents a hybrid system which acknowledges uncertainties on future developments

The flexibility of the MSR is limited by the volume needed for auctioning which in 2013 accounted for 57 percent of EUAs. Reducing this share to 45 percent because of subtracting 12 percentage points from a withdrawal of allowances according to the MSR still maintains a substantial auctioning volume but has only a modest impact on reducing the accumulated surplus.

As a significant result from the first simulation thus emerges the insight that different parameters for market stabilisation might be needed for handling the accumulated surplus of past trading periods and upcoming market imbalances.

Also the use of an upper and lower bound for intervention is not evident since this might create unwanted boundary reactions.

3.1.3 Extended reform proposals for a Market Stability Reserve

Based on the experiences of the first simulation that analyses the impacts of the reforms proposed by the European Commission, we develop three extended reform proposals for stabilising the carbon market.

No reinjection of withdrawn allowances

The first extension suggests that the allowances withdrawn from the market between 2014 and 2016 according to the backloading procedure are not re-injected in the auctioning schedule, but put into the MSR.

Reform Option 1.2: Market stabilisation with Commission's Market Stability Reserve proposal without reinjection of backloaded allowances

No reinjection of allowances until 2020 and the Market Stability Reserve as proposed by the European Commission afterward

According to the backloading procedure, starting with 2014 900 million allowances are withdrawn by 2016. The allowances are not re-injected but put into the MSR.

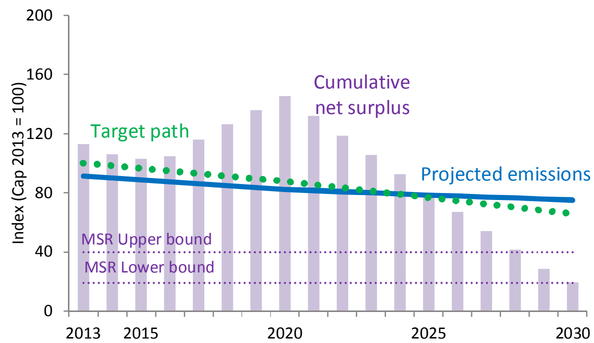
Starting with 2021 he Market Stability Reserve is implemented according to the parameters suggested by the European Commission.

The simulated impacts

In this second simulation we assume that the allowances taken out of the market via the backloading procedure will not be re-injected into the auctioning schedule.

It is visible from Figure 3-2 that this significantly lowers the peak of the accumulated surplus, and enables the MSR to enter the acceptable number of EUAs on the market earlier.

Figure 3-2 Simulation 2: Market Stability Reserve without re-injection of withdrawn allowances



Source: European Environment Data and European Union Transaction Log, own calculations.

Pros and cons

Putting the 900 million allowances that are withdrawn between 2014 and 2016 into the MSR has a stabilising impact on the cumulative surplus, but requires more than ten years to bring the market surplus to the upper boundary of the MSR.

This reform option lowers, however, expected, and unjustifiable price volatility towards the end of Phase 3.

Motivation for an early start of MSR

The evidence obtained from the previous simulation motivates in a third simulation to investigate in addition the impact of an early start of the MSR in 2019 and a transfer of unused allowances into the reserve.

Reform Option 1.3: Market stabilisation with early start of Commission's Market Stability Reserve proposal without backloading of withdrawn and unused allowances

900 million allowances are withdrawn until 2016 and early start of Market Stability Reserve as proposed by the European Commission is 2017

According to the backloading procedure, starting with 2014 900 million allowances are withdrawn by 2016. The allowances are not re-injected but put into the MSR. In addition unused allowances are transferred to the MSR.

The MSR is implemented in 2019 according to the parameters in the EC proposal.

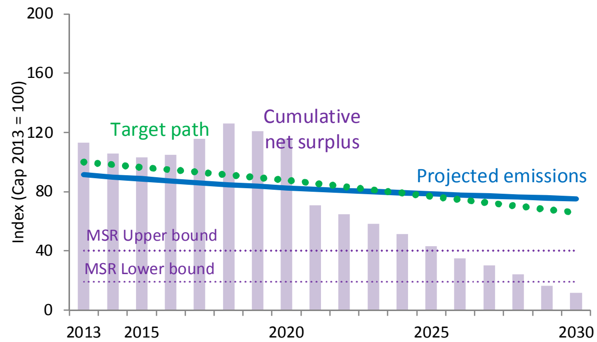
The simulated impacts

The reform steps considered so far indicate the need for treating the accumulated surplus with more ambition. This is done in the third simulation which implements the MSR already in 2019 and transfers also unused allowances into the MSR.

The results can be judged from Figure 3-3 and reveal that this reform option will avoid a further increase of the accumulated surplus. It might take, however, still up to 2025 until this surplus meets the upper bound of the MSR.

Figure 3-3 Simulation 3 - Early start of European Commission Market Stability Reserve without re-

injection of withdrawn and unused allowances



Source: European Environment Data and European Union Transaction Log, own calculations.

Pros and cons

An early start of the MSR without re-injecting the withdrawn and unused will not prevent an increase of the cumulative market surplus up to 2020, although at lower volume. This, therefore, will not be sufficient for creating a price signal that drives investment decisions to reach the 2050 target.

3.1.4 Conclusions from stabilising the market for emissions allowances

Avoiding adverse effects from market imbalances

Market Stability Reserve type mechanisms are able to deal with market imbalances which might create adverse effects. Persistent surpluses of allowances blur the carbon price.

Differentiating between past and upcoming market imbalances

The proposed designs differentiate between excessive market imbalances that originated from previous trading periods and the market imbalances from upcoming unexpected market development. Because of the significant surplus which currently exists, an MSR mechanism will need time to reduce the impact of past imbalances. In addition, therefore, a one-time action that removes these allowances from the market may be considered.

Flexible supply via adjustment of auctioning volume

All interventions are made via changing the volume for auctioning and booking additions or withdrawals of allowances into the MSR. There is no cancellation of allowances.

No further changes in the current design of the EU ETS are needed, as free allocations and fixed trading periods remain unchanged.

Open issues: liquidity requirements and price impacts

There are at least two issues with the MSR which require further discussions. One concerns the parameters which are related to liquidity requirements of the market. The other is the uncertain impact on the carbon price.

The liquidity issue is mainly linked to the hedging behaviour of market participants, in particular the producers of electricity.

It is fair to say that any predictions about the impact of a Market Stability Reserve on the carbon price are highly uncertain.

The need for a political consensus

A main obstacle for implementing such an effective MSR might be the lack of political consensus which again depends on the commitment to generate stringency on the carbon market in expectation of a credible price signal.

What's new

- With a Market Stability Reserve type mechanism attempts are made to cope with the historic and upcoming market imbalances.

- This rule-based flexible supply responds by adjusting the auctioning volume.
- No allowances are cancelled but put into a reserve and taken out when needed.

3.2 Reform Package 2: Adding flexibility to allocations in view of a long-term target path, reflecting scarcity up to 2050

Dealing with vertical and horizontal imbalances on the carbon market

An MSR-type flexible supply mechanism addresses above all discrepancies between the supply and demand of the total market of allowances (between what was expected and what is actually happening). This may be coined as “vertical imbalances” since they aggregate bottom-up all installations of all sectors covered by the system.

Additional imbalances occur, however, also between installations because of the rigidity in the allocation of free allowances which is based mainly on historic benchmarks and historic activity levels.

Since the allocation of free allowances within certain thresholds does not respond to output fluctuations, this might also have a distorting impact on the competitive positions among installations.

This problem emerges when the entitlement for free allocations for installations in a particular sector remain unchanged although activity levels among installations exhibit different dynamics.

These imbalances between installations can be coined as “horizontal” and motivate a second reform package, which addresses options for flexible allocations which are guided by a long-term target path.

3.2.1 Providing a long-term perspective for emissions reductions

Investment decisions require a longer planning horizon than the currently used trading periods

The set-up of the cap and trade mechanism of the EU ETS is characterised by emissions caps for fixed trading periods, currently spanning from 2013 to 2020.

Investment decisions typically require a longer planning horizon, which can be provided by a long-term emissions target path beyond fixed trading periods.

An emissions reduction path is already implemented for Period 3 where the emissions cap is translated into a linear reduction path of 1.74 percent per year up to 2020. This path starts with emissions of 2,084 million in 2013.

The European Council supported in October 2014 a proposal by the European Commission to extend this path post-2020, with an enhanced reduction of 2.2 percent per year, leaving the endpoint of this target path open.

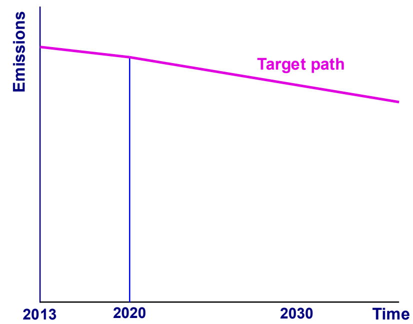
Reform Option 2.1:A long-term target path for emissions defines the emissions caps

Providing a perspective beyond fixed trading periods

The emissions reduction path of Period 3 that starts with 2,084 million in 2013, and declines at a rate of 1.74% per year to 2020. It is then extended post 2020, with a reduction of 2.2% per year.

Depending on the implementation of flexible supply options in the EU ETS, this emissions reduction path may replace fixed trading periods.

Figure 3-4 Long-term target path



Source: Authors.

Pros and cons

Such a target path reflects the long-run ambition of EU energy and climate policy, and implicitly defines an emissions cap and the long-term perspectives for installations.

With the introduction of such a target path designs can be thought of that need no explicit trading periods.

3.2.2 The current set-up for allocating allowances

The rigid framework for free and auctioned allowances

Supply of allowances originates both from auctioning and from free allocations.

According to the cap-based design the allocation starts from an overall cap which for Period 3 is defined by a linear emissions reduction path that starts in 2013 with 2,084 million and declines until 2020 by 1.74 percent per year.

For each year the emissions target is divided between the allowances that are allocated for free, and allowances that are auctioned. Thus, within a trading period, for each year both the volume for free and auctioned allowances is mainly predetermined.

The basic allocation procedure for free allowances

The amount of free allowances is basically determined by historical production levels, combined with benchmarks, which are defined as emissions intensities:

free allocation = benchmark x activity level

Determination of benchmarks

In the current set-up of EU ETS the procedure for free allocations is based on benchmarks which are related to emissions intensities. Each installation reports for a benchmark reference period emissions and activity levels. Using this information, emissions intensities are calculated and ranked.

Depending on the position of an installation in the range of emissions intensities of all installations considered, the share of free allowances per unit of activity is determined. Top performing installations with a low emissions intensity ratio obtain 100 percent free allowances while the remaining installations depending on their ranking receive less. This procedure therefore contains a reward element.

The use of historic benchmarks and historic activities requires a cross-sectoral correction factor

In the current set-up of the EU ETS historic benchmarks and historic activity levels dominate the allocation procedure for free allowances.

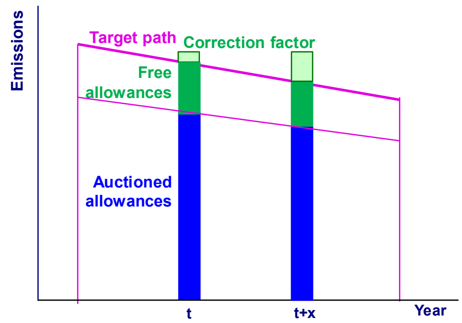
The procedure for allocating free allowances therefore looks like this:

free allocation = historic benchmark x historic activity level x cross-sectoral correction factor

The total volume of free allowances calculated by historic benchmark times historic activity level will exceed the overall cap for free allowances and therefore a uniform reduction by what is called a Cross-Sectoral Correction Factor (CSCF) is applied. This correction factor started with 5.73 percent in 2013 and increases gradually to 17.56 percent in 2020.

Figure 3-5 depicts the current rigid scheme for allocating free and auctioned allowances.

Figure 3-5 The current rigid set-up for allocating allowances



Source: Authors.

Carbon Leakage List contains sectors eligible for free allocations

Industry sectors are eligible for free allocations if they pass the trade and carbon cost criteria thresholds for entering the Carbon Leakage List which was updated in October 2014. Since 164 out of 175 sectors are now on this list, it is considered as being rather unfocused.

3.2.3 Adding flexibility in allocating free allowances

Motivation and recommendations of the European Council

Flexibility in free allocations for preventing carbon leakage

Reform options addressing the allocation of free allowances propose a more realistic reflection of activity levels, updated benchmarks, and a more targeted approach for calculating the volume of free allowances.

These reform options are intended to stabilise expectations with respect to the stringency of allowances on all levels of the EU ETS, from installations, to sectors and the overall carbon market. In addition, such flexibility should avoid cost distortions among installations, and shield against carbon leakage risks.

Recommendations of the European Council

The following guidelines for adding more flexibility to free allocations can be found in the Council Conclusions of October 2014:

- Free allocations will continue after 2020
- Benchmarks for free allocations will be periodically reviewed
- Future allocations will ensure better alignment with changing production levels and thus also combat carbon leakage more efficiently
- Direct and indirect carbon costs will be taken into account
- Administrative complexity will not be increased

Three flexibility issues

Addressing three flexibility issues

Flexibility in the allocation of free allowances typically addresses the following issues:

- Adjusting the benchmarks
- Responding to dynamic activity levels

- Meeting the cap

Based on a thorough analytical analysis of design option for dynamic allocations in Chapter 7, we summarise the various reform options, differentiated through their level of flexibility.

Benchmark flexibility

Benchmarks need flexibility because of changes in technologies which in turn quite often reflect investment cycles. It may be necessary, therefore, to update benchmarks at different intervals, depending on the sector.

By ranking installations based on their emissions performance, benchmarks could be considered to represent an incentive.

The benchmark process will result in the share of emissions to be allocated as free allowances. This share will also define benchmark intensity for free allocation, i.e. the amount of free allowances allocated to a unit of activity.

Benchmarks may be determined as in the current procedure by ranking installations based on their emissions intensity. For more targeted benchmarks, other criteria, such as explicit indicators for trade intensity, indirect emissions, currently not avoidable process emissions, etc. could be taken into account.

Flexibility with respect to activity levels

Allowing free allocation to respond to activity levels is considered to be important in avoiding cost distortions among installations.

Design options that incorporate flexibility to reflect activity levels are based on recent, or actual, output data. Similarly, other approaches could be considered which are linked to compensation based on emissions that correspond to the installation benchmark. This design might be attractive from an administrative point of view, since the determination of flexible allocations could be integrated into the auditing procedures.

Flexibility with respect to emissions caps

Flexibility in determining free allocation has to be reconciled with the overall cap on emissions. The current approach provides for fixed shares from free allocation and auctioning.

A more flexible design could consider restricting only the overall emissions cap, but allowing for variation in the share of free and auctioned allowances.

It should be noted that the October Council Conclusions state that the share of auctioning in total allocation should not be reduced. This, in some interpretation, could limit the design choices for flexible designs.

3.2.4 Reform options for the flexible allocation of free allowances

Reform options for flexible designs

There are different options that can be developed for the allocation of free allowances, depending on the degree of flexibility that is allowed, and they are outlined in this section. These options are independent of previously made benchmark decisions.

Reform Option 2.2.1: Partially flexible allocations with capped free allowances without a compensating reserve

Flexible free allocations are compensated by an adjusted correction factor

Free allowances are allocated by allowing flexibility with respect to activity levels and benchmarks.

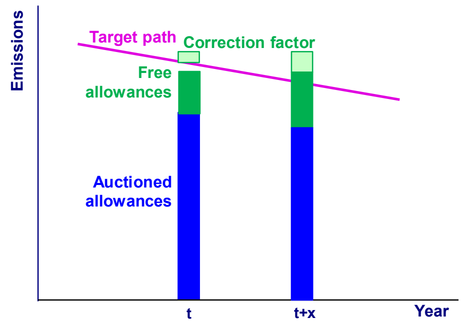
free allocation = recent benchmark x recent activity level x adjusted correction factor

Since the total volume of free allowances is capped, a correction factor is used for adjusting for the difference between the calculated free allocation and the volume of free allocations allowed under the cap.

The auctioned volume remains fixed.

This design maintains over a period a fixed ratio between flexible and auctioned allocations. Free allocation respond to activity levels, and discrepancies from the total free allocation available under the cap are adjusted ex post through a correction factor.

Figure 3-6 Flexible allocations of free allowances without a compensating reserve



Source: Authors.

Reform Option 2.2.2: Partially flexible allocations with capped free allowances and compensating reserve

Flexible free allocations are compensated by a reserve

Free allowances are allocated by allowing flexibility with respect to activity levels and benchmarks.

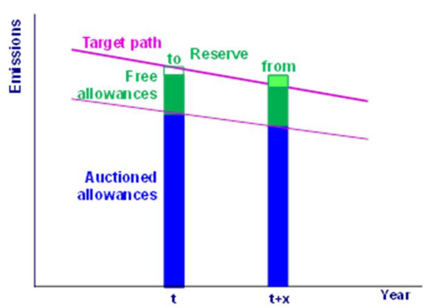
free allocation = recent benchmark x recent activity level

Since the total available volume of free allowances is capped, the difference between the calculated free allocation and the caped volume is in this scenario adjusted via a reserve. The MSR could be used for this purpose.

Also this design as visible in Figure 3-7 maintains over a period a fixed ratio between free and auctioned allocations. Any discrepancies between actual and target free allocations are ex post compensated via the MSR.

This design does not need a correction factor.

Figure 3-7 Flexible allocations of free allowances with compensating reserve



Source: Authors.

Reform Option 2.2.3: Fully flexible allocations with capped total allowances and compensating reserve

Both free and auctioned allocations are flexible

Free allowances are allocated by considering flexibility with regard to the

compensated by a reserve

activity levels and benchmarks.

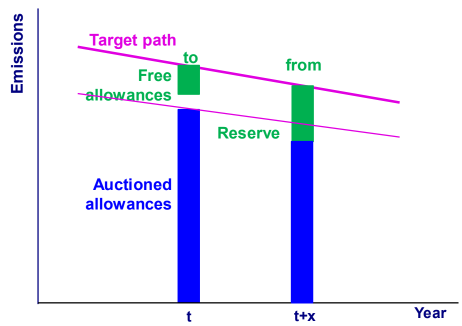
free allocation = recent benchmark x recent activity level

Only the total volume of allowances is capped. The auctioning volume is ex post adjusted to the difference between the total overall cap and free allocations.

The difference between actual total allocations and the total volume is adjusted via a reserve, such as the MSR.

This design offers as can be seen from Figure 3-8 flexibility in the ratio between free and auctioned allocations. The stringency of the overall allocation is maintained by ex post adjustments of the auctioning volume. No correction factor is needed.

Figure 3-8 Flexible allocations of free allowances with compensating reserve and adjusted auctioning volume



Source: Authors.

3.2.5 Conclusions from adding flexibility to allocations

Advantages from the flexibility of allocations

For installations the stringency of free allocations, defined as the share of free allowances relative to their total emissions, is a key determinant for evaluating emissions costs.

The current practice with respect to free allocation generates a number of negative impacts:

- reductions in activity levels have within defined thresholds (so-called partial cessation rules) no impact on the allocation of free allowances, i.e. the stringency of free allocation is varying with activity levels,
- the correction factor reduces increasingly over time the amount of free allowances without differentiating between sectors
- the historical benchmarks could become outdated.

The switch from historic to more recent activity levels reduces the variation of the stringency of free allocation at the installation level, and therefore eliminates a lot of uncertainty with respect to the impacts of carbon costs resulting from output fluctuations.

Variations in the amount of free allocations can be fully, or partially, adjusted through the variations in the auctioning volume. This eliminates the need for a correction factor and will allow emissions to fluctuate around the target path.

Provisions need to be made, however, to avoid actual emissions staying over a longer period above the target path, and thus violating the environmental target.

Market stabilisation and target path adjustments

Basically all mechanisms for stabilising the carbon market, such as the MSR, or dynamic free allocation, follow a design that is depicted in Figure

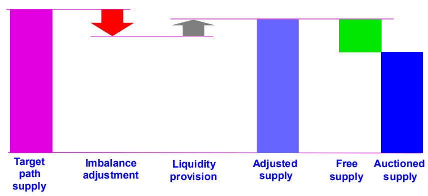
by adjusting the auctioning volume

3-9.

- Market imbalances are determined by comparing target path emissions with actual emissions and are addressed through adjustments in the supply of allowances.
- Liquidity requirements result from hedging and other trading operations, and provisions need to be made for that.
- The supply is split between free allowances and the volume to be auctioned.

This adjustment can be done for fixed trading periods, as in the current set-up of the EU ETS, in shorter intervals, or annually, as in the proposed MSR and flexible allocations.

Figure 3-9 Flexible free allowances in view of a long-term target path



Source: Authors.

Three typical adjustment needs

We obtain further insights into flexible supply mechanisms by considering three typical adjustment needs:

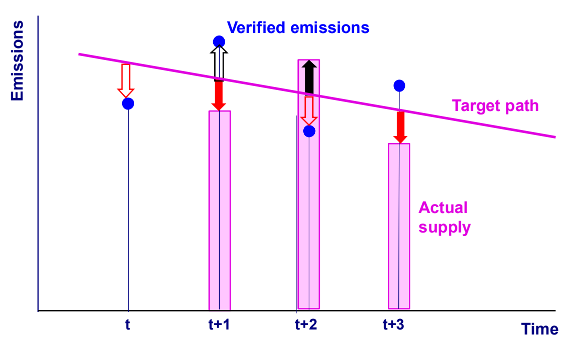
- Case 1: Current imbalances fluctuate around the target path
- Case 2: Current imbalances remain below the target path
- Case 3: Current imbalances remain above the target path

Case 1: Imbalances fluctuate around target path

If imbalances just fluctuate around the target path as depicted in Figure 3-10, supply flexibility maintains the market stringency by responding each year to previous imbalances.

In this case the actual emissions will just fluctuate around the target path and no significant deviations from the implicit emissions cap will occur.

Figure 3-10 Imbalances fluctuate around target path



Source: Authors.

Case 2: Imbalances remain below target path

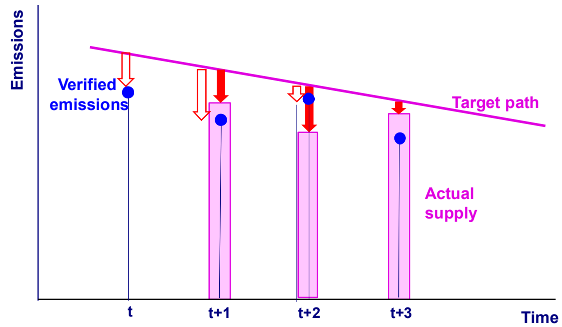
So far the carbon market for the EU ETS has exhibited systematic imbalances below the target path. According to the supply flexibility proposal, adjustments can be made both by changing the supply of free allowances and/or the auctioned amount.

Since in this case actual emissions will remain under the implicit emissions cap as illustrated in

Figure 3-11, the emissions target will be over-fulfilled.

This procedure does not only avoid the accumulation of surpluses, but also maintains the stringency of the carbon market.

Figure 3-11 Imbalances remain below target path



Source: Authors.

Case 3: Imbalances remain above target path

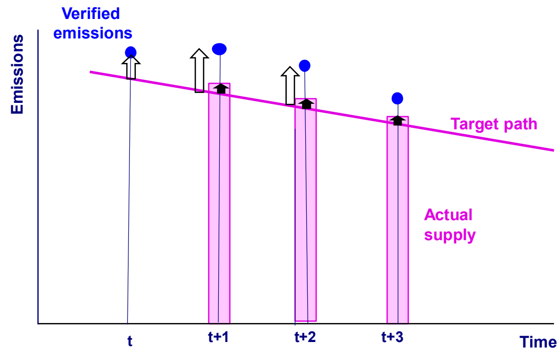
Additional considerations need to be given to the case of imbalances that are caused by actual emissions that exceed the target path over a longer period as indicated in

Figure 3-12.

This case leads to the risk that the implicit emissions cap specified by the target path will not be met. There are a number of options for reducing this risk.

- We can rely on the price mechanism, since persistent shortages on the carbon market will increase the carbon price and thus make abatement options more attractive.
- We can limit the amount of supply adjustments and thus increase the scarcity of allowances which in turn triggers a higher carbon price.
- We can increase the activities in overlapping policies from renewables and energy efficiency in order to reduce the imbalances.
- We might want to put a ceiling on the carbon price in order to prevent excessive carbon costs. This should, however, be reconciled with the current Art.29a mechanism, which allows for an adjustment of the auctioning schedule in case EUA prices remain significantly higher than in the preceding years.

Figure 3-12 Imbalances remain above target path



Source: Authors.

Pros and cons

Flexible supply of free allowances enables to respond to changes in output and technologies, and therefore avoids horizontal imbalances among installations.

Is there a risk that flexibility in the number of free allowances, which interact with the volume of auctioned allowances, might have a crowding-out effect on this volume, i.e. the remaining auctioning volume might be judged becoming too low?

The share of free allocations for industry, the only sectors eligible for free allocations in the long-term (if they are considered to be at risk of carbon leakage), is currently less than 30 percent of total EUA supply. Since the remaining sectors, which represent mainly electricity and heat, will be able to continue with a higher reduction of the emissions intensity than industry sectors, there is little risk that expansions of industry output might have adverse impacts on the auctioning volume that is relevant for the remaining sectors. However, all this implies that the burden of emissions reductions shifts to sectors that obtain their allowances via auctions.

Nevertheless, in the long-term perspective, environmental integrity has to be ensured even in prolonged periods of economic growth.

What's new

- Recent activity levels are used together with updated benchmarks for determining the allocation of free allowances.
- There is no need any more for a Cross-Sectoral Correction Factor.
- Switching to flexible supply mechanisms that are based on long-term target paths eliminates the need for explicit fixed trading periods.

3.3 Reform Package 3:Further elements to enhance the functionality of the EU ETS

A number of additional reform options are currently being mentioned and deserve to be reflected upon and mentioned.

Targeted allocation of free allowances

A more targeted allocation of free allowances

The allocation of free allowances can be made more effective by revising the factors that determine the amount for free allocation is calculated.

These could be elements of an allocation procedure that either complements or substitutes the current benchmark-based procedure:

All industry sectors are eligible for free allocations, based on a flexible and sector-specific allocation mechanism that is based on

- exposure to export competition
- exposure to import competition
- process emissions
- indirect emissions via use of electricity

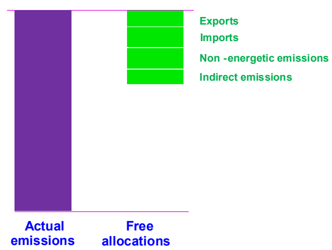
It should also be considered to always combine trade and emissions-related criteria, as both are required for carbon leakage to actually materialise.

Implementing the targeted supply of free allowances

This reform option addresses the current uniform treatment of sectors concerning the allocation of free allowances once they are on the carbon leakage list.

A potential advantage of this procedure is the explicit consideration of the factors relevant for the risk of carbon leakage as indicated in Figure 3-13. In order to meet the target path any necessary adjustment to the supply of allowances would be done via the auctioning volume. A sectoral correction factor would be redundant in this case.

Figure 3-13 Targeted supply of free allowances



Source: Authors.

Explicit criteria for allocating free allowances

The allocation is based on a set of transparent criteria which can be selected either on sector or even installation level and updated over time.

- **Exposure to international competition**
  Free allowances are allocated proportional to the share of exports and imports related to the volume of production that corresponds to actual emissions.
- **Process emissions**
  Those emissions which result from industrial processes, can't be reduced with current technologies, are fully or partially compensated by free allowances.
- **Indirect emissions**
  The spillover effects of emissions in the power sector via electricity costs on other sectors can be compensated with free allowances.

What's new

- Targeted free allocations explicitly consider and compensate for (combinations of) trade exposure, indirect emissions and emissions from processes.
- All installations are eligible for free allowances based on transparent and flexible rules.
- There is no need any more for a Carbon Leakage List.

Different sectoral targets

As can be seen from Figure 3-11, the distribution of emissions by sector in the EU ETS market is dominated by combustion sectors compared to a rather small share of industry sectors. This classification may point at differences in abatement capabilities, the risk to carbon leakage but also to divergent interests as to the size of a carbon price.

This could motivate the split, within a single EU ETS, of an overall reduction target into different sectoral targets, which would be used for adjusting the sector-specific free and auctioned volumes but maintain the unitary ETS.

Design of different sectoral target paths

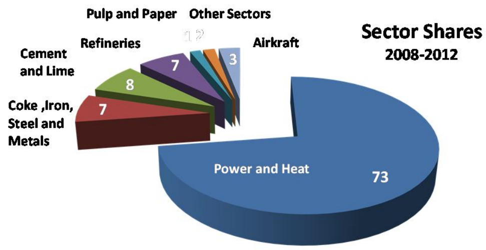
Based on the observed division of the market for the EU ETS allowances, different reduction targets could be considered for power and non-power sectors. Same could be done for different industrial sectors.

Further sectoral differentiation is possible according to abatement capabilities.

Implementation of different sectoral target paths

These different sectoral targets could be used together with flexible allowances as the auction volume would be adjusted for each sector. The condition precedent is that we would still have a unitary carbon market.

Figure 3-14 Sector shares of emissions



Source: Authors.

Different treatment of compensation for indirect carbon costs

The issue of state aid

In the current EU ETS Directive, compensation for indirect carbon costs is only possible through state aid, which Member States may grant at their own discretion on an ex-post basis. While the EC has adopted harmonised guidelines for such state aid, the approach as such has considerable disadvantages with respect to mitigating carbon leakage risk. As it considered operating aid, the aid needs to be tapered over time.

Options for compensation

Different Member States may also have different fiscal capacities and willingness to grant aid, leading to an uneven playing field for indirect carbon cost compensation. Some options to create a more level playing field could be considered:

- Compensation could take place at EU level, by extending free allocation to include indirect carbon costs. This adds some complexity, however, and it would be unclear how such a mechanism would relate to state aid.
- Auctioning revenues could be used to compensate indirect carbon costs. Specifically, a model like in California might be considered, where electricity generators use the proceeds from auctioning to compensate the higher prices which result from passing through carbon costs. Such a system would mean moving away from the state aid approach altogether.

Different treatment of small installations

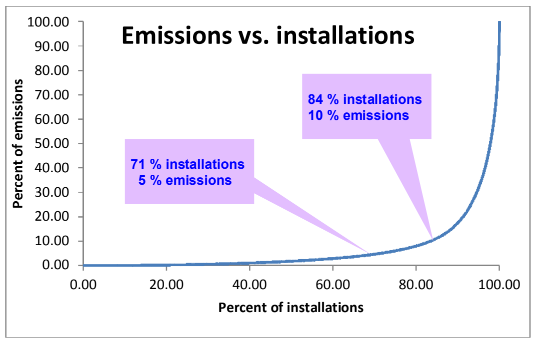
Highly unequal distribution of the size of installations

Figure 3-15 reveals the highly unequal size distribution of installations covered by the EU ETS. 84 percent of the smaller installations account for only 10 percent and 71 percent for only 5 percent of total EU ETS emissions. This highly unequal distribution as to the size of installations could justify a different treatment of the smaller installations.

Design of a different treatment for smaller installations

A reform option for smaller installations could be an emissions charge that is based on the consumption of fossil energy and multiplied with an annually adjusted rate which reflects the carbon content and previous year's average carbon price.

Figure 3-15 The highly unequal size distribution of installations



Source: Authors.

Inclusion of upstream distributors

Distributors of fossil energy could be included into EU ETS as it is done in California. This could be also an option for dealing with small installations.

In the Californian scheme, electrical distribution utilities receive allowances for free, yet they must use the auctioning revenue to compensate their customers for the higher electricity costs as these are passed through.

Governance issues

Rule-based flexibility might not be sufficient

There are many reasons why just some rule-based flexibility might be not sufficient for maintaining a desired state of the carbon market. Since the co-decision procedure required for changes to the ETS Directive can take significant amounts of time, which thereby creates a lot of uncertainty not beneficial to the carbon price signal, the use of delegated governance procedures could be considered.

Use of EU credits

Create a link between the ETS and non-ETS sectors

Currently Article 24a of the EU ETS Directive states that EU Member States can adopt measures for issuing allowances from projects not covered by the EU ETS. This aspect is not on the front burner of the agenda for the EU ETS structural reform. In the current existing glut new supply is hardly needed. However, in the context of a package, a link between the ETS and non-ETS covered sectors covered could be an interesting avenue to explore. This also needs to be looked in the context of debate over a more dynamic based allocation and potential additional burden on non ETS sectors

4 Framing a structural EU ETS reform with new perspectives on carbon leakage

An important experience with the EU ETS was the insight that this policy instrument cannot be judged and handled independently from other EU policies or from global economic conditions.

This insight has a strong bearing on the evaluation of the risk of carbon leakage, and on the harmonisation needs with other policies.

4.1 An extended view of the interactions on the carbon market

The non-operational concept of marginal abatement costs

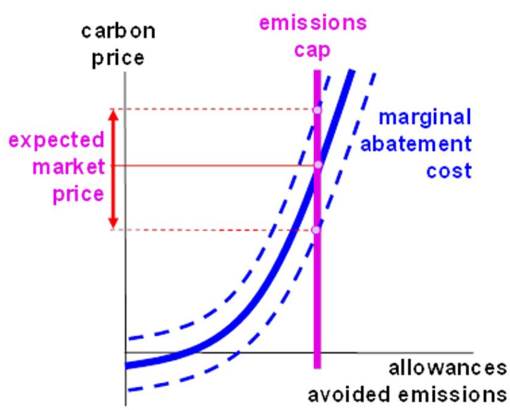
Carbon markets at the outset of the design of the EU ETS were understood as an interaction between marginal abatement costs and an emissions cap with a resulting carbon price as indicated in Figure 4-1.

For several reasons this understanding of the carbon market has turned out not being operational because of the underlying information requirements. One of the constraints is that marginal abatement costs may not be well-defined because they depend on the time horizon and assumptions about a wide range of factor prices, including financing options. In many cases marginal abatement costs just cannot be singled out from other effects if, e.g., complex production processes are involved.

Given this uncertainty about marginal abatement costs on the level of installations, the market is confined to delivering credible signals about these costs.

In most cases the required conditions for a well-defined (and for all market participants visible) marginal abatement cost curve do not hold. But only if these optimal conditions, among others, prevail a well-defined cap would determine a transparent price signal to ensure the cost effectiveness of the system in the short and long run.

Figure 4-1 A simplistic of the carbon market



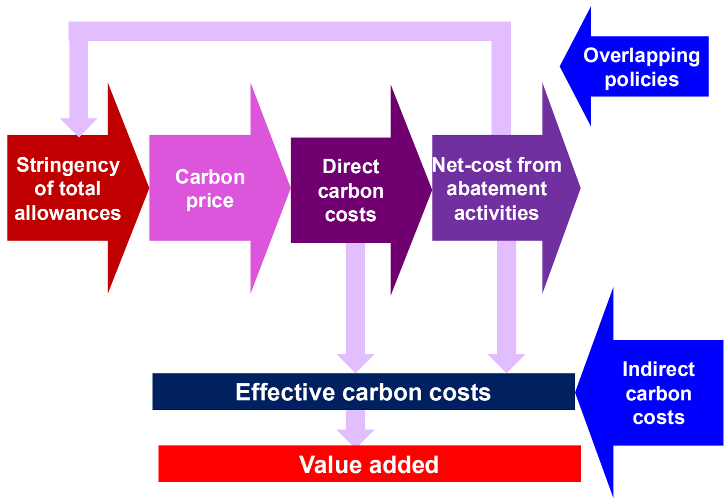
Source: Authors.

Meanwhile it has turned out, that the interactions on the carbon market are much more complex as Figure 4-2 suggests.

- The **physical stringency** between supplied and demanded allowances is meant to be the main determinant of the carbon price, aside from the motivations of actors on the financial market.
- Direct **carbon costs** are the product of the carbon price times the number of allowances needed.
- Additional costs occur from **abatement activities** which in turn have a feedback on the stringency of allowances.

- **Overlapping policies, such** as those for renewables and energy efficiency, have an impact both on abatement costs and the physical stringency of allowances.
- The **effectiveness of carbon costs** have at least three components: the direct carbon costs and the abatement costs, as well as indirect carbon costs, which result from purchases of electricity with a carbon content.
- Ultimately it is the change in the **value added** that finally determines the impact of complying with carbon targets, which in turn depends on the ability to shift carbon costs to the price of the product.

Figure 4-2 The interactions on the carbon market



Source: Authors.

4.2 Facts on the stringency of the carbon cap for carbon leakage

We complement this enhanced conceptional understanding of a cap-and-trade system with some empirical evidence of the EU ETS which adds to our understanding of carbon leakage issues.

Share of free allocation in verified emissions

From the point of view of a single installation the physical stringency of a carbon cap can be measured by the share of free allocation in verified emissions.

In Period 1 and 2 the volume of free allocation exceeded verified emissions

This indicator is visible for all sectors in Figure 4-3 and reveals, that both in Period 1 and in Period 2 there was an excess of free allowances compared to verified emissions.

Because of a change in the allocation method in Period 3 starting with 2013 the share of free allocation dropped to 45 percent of verified emissions and 43 percent of total supply which includes also the auctioning volume. Remarkably, also, in 2013 total supply of allowances exceeded the volume of verified emissions by almost 5 percent.

Combustion sector was short whereas industry sector was long of free allowances

There are significant differences with respect to the share of free allocations between the combustion and fuel sector (which account for about 71 percent of emission), and the remaining industry sectors.

The industry sector so far had a surplus of free allowances over verified emissions, whereas the combustion sector was short, as can be seen from

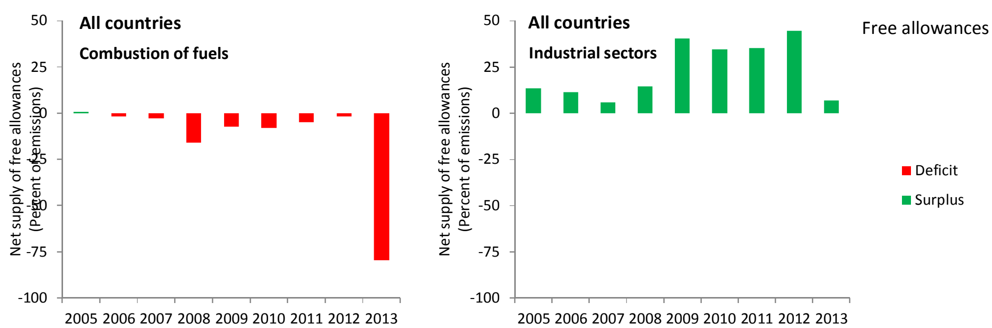
Figure 4-4.

This pronounced fragmentation of the EU ETS sectors has a strong bearing in the evaluation of carbon leakage. With exception of a few installations, the industry sector has so far not experienced a physical stringency of allowances at the installation level. More details about industry sectors can be found in the Appendix.

Figure 4-3 Share of free allocation in verified emissions – all sectors

Source: European Environment Data and European Union Transaction Log, own calculations.

Figure 4-4 Share of free allocation in verified emissions – combustion and industry



Source: European Environment Data and European Union Transaction Log, own calculations.

So far EU ETS has only faced very low carbon costs

This evidence of the physical stringency of free allocation indicates that both in Phase 1 and in Phase 2 there was an oversupply of free allowances compared to verified emissions, which was even more pronounced for the industry sector.

Phase 3 reduced significantly this share of free allowances but together with the volume of auctioned allowances total supply of allowances exceeded verified emissions in 2013.

The impact of this supply surplus resulted in overall lower carbon costs than predicted by, for example, impact assessments of the Commission, which frequently make reference to carbon prices of 30EUR per EUA.

This does not exclude that individual installations faced significant cost impacts because of adverse effects resulting from the allocation of free allowances. These distortions result in particular from the allocation of free allowances which within thresholds are independent from output levels.

4.3 Reform elements for shielding against carbon leakage

4.3.1 Structural reforms of the EU ETS relevant for carbon leakage

Using this extended view of the interactions on the carbon market we obtain additional insights how the risk of carbon leakage can be avoided.

Carbon price, costs and technological change

For a given carbon price it is the technology, represented by the emissions intensity, which determines the direct carbon costs. Any measures that support improvements of the carbon intensity are obviously highly relevant. The assumption of optimal theoretical market conditions would ensure that just the carbon price would deliver the required technological changes. In reality, however, an unstable carbon price – which might meet opposition from stakeholders and policy-makers, depending on the level – might not be sufficient to trigger radical technology switches.

More targeted allocation of free allowances

One option to reduce direct carbon costs is the allocation of free allowances, as has been practiced in the EU ETS. There are many reasons, however, to do this in a more targeted way than in the current set-up which more or less treats all sectors that are on the carbon leakage list in a uniform manner.

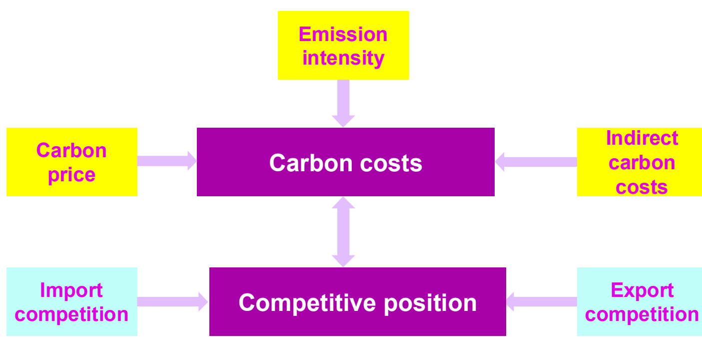
A more targeted approach to the allocation of free allowances would explicitly consider the exposure to trade outside the EU, process emissions from industrial processes, as well as indirect emissions.

Supporting targeted technology policies from the auctioning revenues

In the long run it will be most important to support the transition to low-carbon technologies for which strategic decisions are already set today.

Since carbon prices might not provide sufficient incentives for embarking on such strategies, additional support for research and development will be needed. Necessary financial resources could be mobilised from auctioning revenues beyond the volume allocated for this purpose so far.

Figure 4-5 Factors relevant for the risk of carbon leakage



Source: Authors.

4.3.2 Overlapping policies

Renewables and energy efficiency

Research points at the fact that the EU ETS has been influenced by other EU policies, in particular those for renewables and for improving energy efficiency.

There is still further analysis needed, on how a particular carbon price affects the energy mix or vice versa, as well as how a particular renewables policy impacts the carbon market.

Some of these interactions point at a rather surprising and even counterproductive result. The subsidies for renewables e.g. not only lowered the demand for fossil fuels but also lowered the wholesale price for electricity and made electricity generation from coal cheaper and electricity from gas not competitive anymore. This calls for a fundamental rethinking of the market design for heat and power in view of the carbon price signal.

4.3.3 Targeted technology policies

Visionary low-carbon options for energy intensive industries need targeted technology policies

Abatement options in particular for the industry sectors will heavily depend on new technologies which in most cases will be radically different from current processes.

This holds in particular for iron and steel, where ultra-low carbon technologies can be envisaged, but are still far away and need a major commitment for research and development and pre-commercial testing.

Similar breakthrough technologies seem to be possible for cement in terms of the emissions intensive clinker content and the re-use of carbon emissions from clinker production.

Rather obvious are new options for paper and pulp where the technology roadmaps indicate the way to bio-refineries.

These technology options will very likely not be mobilised just by a carbon price. They require a highly targeted commitment in terms of goals and resources. Parts of the auctioning revenues would be an obvious source for supporting these targeted technology policies.

4.4 Framing a structural reform strategy for the EU ETS

The future of the EU ETS

The experience with the EU ETS so far and its current state open several future strategies, and continues to raise the issue whether it should be evolutionary or revolutionary:

- **No reform actions.**
  This will lead to a further increase of the already huge surplus of allowances which would harm the effectiveness of the EU ETS and damage the credibility of this policy instrument.
- **Reform actions as proposed by the European Commission.**
  Because the proposed MSR, according to the EC proposal will not become effective before 2021 (this is currently under debate), this will not stop the build-up of additional surpluses by 2020, and might afterwards still maintain excessive surpluses even until 2030.
- **Structural reforms for enhancing the proposed reform actions**.
  Based on the operating experience obtained so far with the EU ETS more ambitious reform actions could be envisaged for strengthening this policy instrument.

Targets and stakeholders

Reaffirming the intentions of a structural reform

At the outset of discussions about reform strategies it might be worth remembering the fundamental objectives of this policy instrument:

- **Meeting a long-term environmental target** by complying with an emissions reduction path to 2050.
- **Providing a clear prices signal** that would influence economic asset allocation. This translates into a clear, consistent and credible carbon price signal, as well as other incentives for catalyzing transformations in the energy and industrial sectors.
- **Avoiding carbon leakage** by shielding energy intensive industries from the adverse impacts of carbon costs, as long as no comparative actions are put in place outside the EU.

Considering stakeholder interests

Seemingly divergent stakeholder interests have emerged. Some electricity producers consider an EU ETS with a high carbon price as a means for driving out coal from the electricity market. Compared to other sectors the power and heat sector can rather easily shift carbon costs to end consumers.

Industry sectors, however, if they are facing international competition on import and export markets, are vulnerable with respect to high carbon prices.

Observing political feasibility

It seems difficult to find a political consensus for a comprehensive reform of the EU ETS

Steps for designing a structural reform of the EU ETS

This analysis of the current state of the EU ETS, and the lessons learned since its implementation in 2005, as well as the steps for a reform of this policy could have the following elements.

Responding to market imbalances

Priority in all reform strategies needs to be given to the reduction of the imbalance in the carbon market that accumulated since 2008, and to making in the future the supply of allowances more responsive to changes in demand, irrespective of what drives these demand changes. The expected impact of such reform actions is a gradual increase of the carbon price which in turn would strengthen incentives for switching to low-carbon technologies.

This could be achieved with activities which were summarised in Reform Package 1. A core element is a Market Stability Reserve which needs a careful evaluation with respect to its parameters for intervention and the timing of introduction.

Adding flexibility and a long-term perspective to allocations

A long-term perspective to installations could be given by a long-term emissions target path as suggested by the European Commission. Both free and auctioned allocations can be based on this target path. These allocations can be made flexible through updated benchmarks and outputs, thus linking abatement efforts with activity levels. Together with the MSR, this would ensure compliance with the environmental target.

These reform elements are the substance of Reform Package 2 which suggests switching from fixed trading periods to flexible allocations along a long-term target path but maintaining the stringency of the carbon market.

Enhancing further the functionality of the EU ETS

These two basic reform packages could be further enhanced by additional reform elements which are summarised in Reform Package 3.

Priority deserves a more targeted allocation of free allowances by explicitly compensating the exposure of export and import competition, currently unavoidable process emissions, and indirect emissions contained in the purchase of electricity. These indirect costs are still a problem without a satisfactory solution. It needs to be addressed at the EU level

What a structural reform could achieve

In total such a structural reform of the EU ETS would exhibit a number of new designs compared to the current set-up:

- Allocation would exhibit more flexibility without compromising the environmental target.
- All sectors would benefit from a more predictable carbon price.
- Energy-intensive industries would face a better targeted carbon leakage protection and allocation of free allowances.

This added flexibility would also change the administrative requirements. Because of the added flexibility there is no need for fixed trading periods with related problems at the boundary years, no need for a cross-sectoral correction factor and also no need for a carbon leakage list if explicit criteria for the allocation of free allowances are used.

5 Emissions trading in a global context

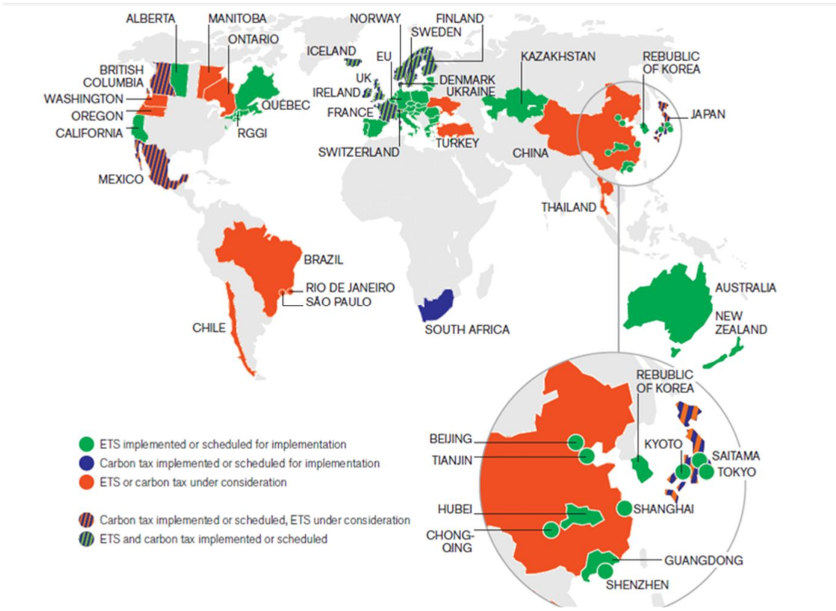
An increasing number of countries and regions around the world are developing and implementing emissions trading schemes as a means to place a price on greenhouse gas (GHG) emissions. Trading schemes are now in place or are being planned in Europe, North America, South America and throughout the Asia Pacific region.

Since Copenhagen 2009, achieving consensus on emissions mitigation through multilateral negotiations has been difficult. Momentum appears to have shifted from the international level to that of nation states and regions. A particularly strong dynamic is visible in rapidly developing and transitioning economies, with new trading systems under discussion, or being put in place in China, India, Brazil, South Korea and Vietnam.

5.1 Existing and emerging schemes

Globally, 39 national and 23 sub-national jurisdictions have implemented or are scheduled to implement carbon pricing instruments, including emissions trading systems and taxes. The Chinese pilot systems form the world's second largest carbon market after the European Emissions Trading Scheme (EU ETS), covering the equivalent of 1,115 million tonnes of carbon dioxide emissions compared to the EU ETS with 2,084 million tonnes in 2013 (World Bank, 2014).

Figure 5-1 Overview of emerging emissions trading schemes



Source: World Bank (2014).

Both in the US and Canada national schemes were planned but so far they have not been implemented. However, regional schemes *are* emerging. The EU ETS is the largest emissions trading market, followed by smaller ETS such as in New Zealand and the US regional Greenhouse gas initiative (RGGI) or the Canadian provincial scheme in Alberta. A strong dynamic to implement an ETS can be observed in Asia, even if at the same time Australia chose to repeal its ETS.

5.1.1 Emissions trading in North America

In North America no ETS have been implemented on a federal level, but regional ETS have emerged both in the US and Canada.

Regional Greenhouse Gas Initiative (RGGI)

RGGI

The Regional Greenhouse Gas Initiative (RGGI): a state-level emissions trading system in the North East US that started trading on January 1, 2009. It is covering CO2 emissions only from power generation. RGGI represents the first mandatory CO2 cap-and-trade program in the United States. RGGI covers fossil-fuelled electric power plants greater than 25 megawatts (MW) located in any of the nine participating states (EIA, 2014). CO2 emissions in the RGGI region accounted for 4% of the total emissions from the electric power sector in the United States in 2012.

The cap was tightened in 2014 primarily because actual CO2 emissions in the region since 2009 have been roughly 35% below the cumulative cap. This lower level of emissions is partially attributed to low natural gas prices, which have shifted a large share of electricity generation in the region toward natural gas, but also to lower overall electricity demand (EIA, 2014). In 2005, when CO2 emissions in the RGGI states reached peaked, coal accounted for 23% of the regional generation mix and petroleum accounted for 12%. By 2012, coal's share had declined to 9%, while the natural gas share had risen from a 25% share in 2005 to 44%. Petroleum's generation share in the region fell below 1% by 2012 (EIA, 2014).

Western Climate Initiative (WCI)

WCI

The Western Climate Initiative (WCI) is an initiative of US states and Canadian provinces to develop emissions trading systems. Currently only California and Quebec have implemented trading systems, and trading formally started on January 1, 2013;

The basic structure of the WCI is a decentralised cap-and-trade program in which jurisdictions cooperate to design individual systems that can be linked to create a single market (Tuerk et al., 2013). Each jurisdiction is responsible for setting its own cap in light of the regional aim of a 15% reduction of 2005 GHG levels by 2020. While some general guidelines for establishing jurisdiction-specific caps were agreed upon, these guidelines were extremely broad in the hopes that flexibility in this regard would facilitate greater participation (Tuerk et al., 2013). However, prior to linking one jurisdiction's system to another, each would have the opportunity to review the others jurisdiction's program to assess its consistency with the program design.

Within the jurisdiction in which it is adopted, the coverage of the cap and trade scheme is very high. In the initial phase of development, the majority of large-emitting installations in all industrial and power sectors would be included, and transportation and commercial sectors are due for inclusion in the second phase (Tuerk et al., 2013). Between 85% and 90% of total GHG emissions in the participating sectors would be covered in the second phase which, in theory, would start in 2015. In participating jurisdictions all installations emitting over 25.000 tCO2e per year would be included in the scheme. The basic guidelines of the WCI allow for some cost containment measures, including allowance reserves, limited borrowing, and auction floor prices, but exclude hard price caps and unlimited borrowing as contained in some of the earlier proposals for a federal US cap-and-trade system.

Table 1 shows the current positions of the 11 WCI partners. Depending on the final participants in the scheme the WCI could account for about 800 mega-tonnes of CO_2e per year, over half of which represent emissions from California.

Table 5-1 Summary of WCI jurisdictions' current positions on cap-and-trade regulation

Cap-and-trade regulations adopted	Expressed interest but no regulations	Will not be implementing cap- and- trade
California	Ontario	Montana
Quebec	British Columbia	Utah
	Manitoba	
	Washington	
	Oregon	New Mexico
		Arizona

Source: Based on Tuerk et al. (2013).

5.1.2 Korean Emissions Trading Scheme

Korean ETS

The Korean ETS is set to start in January 2015. The draft National Allocation Plan (Korean) includes five sectors: power generation, industry, public water and waste utilities, buildings, and transport (mainly domestic aviation). Around 500 entities will be covered by the ETS.

While the allocation of allowances should generally not be changed during an allocation period, readjustments of allocations can be made to help covered firms "in the event of an important change in the economic situation which could not be predicted at the time of setting up the allocation plan." The readjustment can take two forms:

- First, in exceptional cases, important changes in the overall economic situation might lead to an increase in the total volume of emissions allowances.
- Second, businesses may request readjustments by drawing on reserve allowances. However, the criteria under which businesses may request additional allowances are limited to three circumstances: (a) when emissions increase over the allocated allowances due to an unexpected expansion of a firm's facilities or the transfer/merger of a factory; (b) if emissions of a power-generating facility have increased due to the Government's request for increased power generation; and (c) if a firm's emissions have increased by more than thirty percent over its allocated allowances due to an unexpected change in the product line or business plan (Hawkins et al, 2014).

According to current plans for the South Korean ETS, the Government will be allowed to intervene with market-stabilising measures in case of significant changes in prices or trading volumes. The plans stipulate the situations under which such interventions are permitted and the type of measures that can be taken. Stabilisation measures are authorised if one of following scenarios applies (Hawkins et al., 2014).

- First, when the price for allowances increases more than threefold for six straight months compared to the previous year or the year before that.
- Second, when the average price increases more than twofold compared to the average allowance price of the past two years because the trade volume increased more than twofold in a one month period compared to the average monthly volume of the previous year or the year before that.
- Third, when there is a 60% price decrease in a one month period compared to the average prices of the past two years.

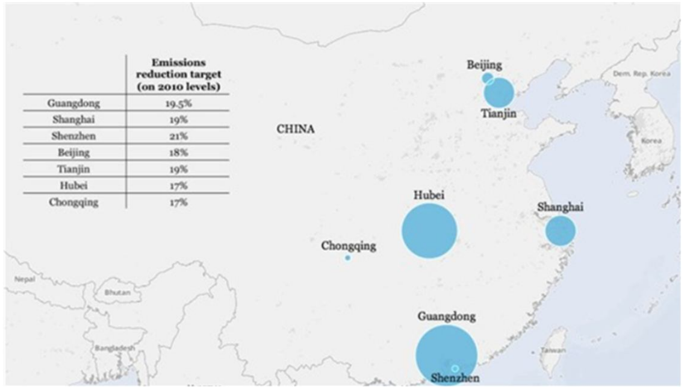
In those cases, the Government has permission to take the following measures to stabilise the market: (a) auction up to 25 percent of permits from the reserve; (b) set a maximum or minimum limit for the holding of allowances by each participant; (c) increase or reduce the borrowing limit; (d) increase or reduce the offset limit; or (e) set the highest or lowest prices (Hawkins et al., 2014).

5.2 The Chinese pilot schemes

5.2.1 The regions involved

China is implementing several pilot emissions trading systems. The National Development and Reform Commission announced its plan to develop seven official ETS pilot programs (Beijing, Shanghai, Tianjin, Chongqing, Guangdong, Hubei and Shenzhen) in 2011.This plan began to be implemented from 2013. By October 2014, six of the seven pilot schemes started trading started operation with the remaining one – Chongqing – due to start in late 2014. China plans to implement a national scheme from 2016. China's strategy has been to mandate creation of several pilot trading systems with different designs, allowing it to compare experiences prior to deciding on an approach for a future nationwide system. Before the specific systems will be discusses some main design options are presented.

Figure 5-2 Emerging emissions trading schemes in China



Source: Climate Group (2014)

For most of the involved industrial entities and commercial buildings, overall allowances are determined in accordance with their historical record over the period from 2009 to 2011. In case the growth rate over these three years is higher than 50%, the emissions level of 2011 will be taken as a benchmark. Power generation, aviation, harbour and airport sectors will take their allowance according to specific sectoral emissions benchmarks for per unit of production activity, which is further multiplied by their historical average activity level over the period from 2009 to 2011. The allowances are grandfathered in a lump sum fashion for the period from 2013 to 2015; however, borrowing allowances from subsequent years for compliance purposes is prohibited.

5.2.2 Synthesis of design features of Chinese pilot schemes

Pilot emissions trading schemes vary across cities and regions, in terms of caps and targeted sectors in order to provide a solid basis for implementing a unique and national wide emissions trading scheme.

Beijing is the only pilot that requires annual absolute emissions reductions for existing facilities in the manufacturing and service sectors. Companies in these sectors will receive fewer allowances each year—starting with 98% of their average 2009-2012 emissions in 2013 and dropping to 94% in 2015.

The other ETS don't require absolute reductions, but a reduction of carbon intensity per unit of Industrial added value. Shenzhen and Tianjin allow individual investors and entities that are not covered by the ETS, such as financial institutions, to participate in trading, resulting in higher trading frequency and potentially larger price fluctuations.

Focusing only on CO2, the pilots cover roughly 40 to 60 percent of a city or province's total emissions, and apply to power and other heavy manufacturing sectors such as steel, cement, and petrochemicals.

Figure 5-3 Overview of emerging emissions trading schemes: covered entities, cap, trade volume *and trade amount*

Pilots	Covered Emitters	Annual Cap Million Ton	Trade Volume Million Ton	Trade Amount Million ¥
Guangdong	242	388	1.29(11.1)	70.6(667)
Hubei	138	324	5.28	125
Shanghai	191	160	1.55	60.9
Tianjin	114	160	1.06	21.9
Chongqing	240	130	0.145	4.46
Beijing	490	78	2.03	100
Shenzhen	832	30	1.66	113

Source: Zhong (2014).

Allocation

The standard method for distributing allowances in China is grandfathering based on historical emissions data in the past few years, while sectoral characteristics and mitigation costs are taken into consideration as well.

In most cases the cap is an emissions intensity cap. For the purpose of price management and cost containment, the local governments of Tianjin, Shanghai and Hubei may reserve some allowances.

At the same time, auctioning may be used as a complementary method in Beijing, Tianjin, Shanghai, Shenzhen, and Guangdong pilots for a small portion of allowances (Calderon, 2013). Shenzhen plans to increase the portion towards full auctioning in the future. Hubei is unique in that it will reserve 20% of initial allowances for early action rewards (Calderon, 2013).

In the Chinese ETS the majority of the allocation is free and based on grandfathering; Apart from power and heat, benchmarking has not been deployed at a large scale (Ecofys, 2014). However two of the ETS, Shenzen and Guangdong started to experience with a small amount of auctioning.

Figure 5-4 Schemes with intensity based allocations

Pilots	Electricity Generation Sector	Non-Electricity
Guangdong	○	
Hubei	○	○
Shanghai	○	:
Tianjin	○	
Chongqing	○	○
Beijing	○	:
Shenzhen	○	○

Source: Zhong (2014).

Sectoral coverage

An important difference between the ETS in China and the EU ETS (and other OECD trading schemes) is the intention to cover the building sector (e.g. Beijing), or in some cases also the transport sector. The Chinese Ministry of Housing and Urban-Rural Development (MOHURD) has developed different options for carbon trading for the building sector (Han, 2102). The options are about to be tested in a handful of pilot cities.

While MOHURD's primary intention is to limit the amount of energy that is being wasted, the extension of a carbon trading scheme to the building sector has to be aligned with China's overall climate change strategies. At the moment, MOHURD is among the first to present detailed options for a carbon trading scheme among the sectoral ministries (Han, 2102).). Since electricity prices are heavily regulated in China, power plants cannot pass their carbon costs on to consumers through electricity prices. This policy therefore provides little incentive for demand-side electricity management. To address this issue, the Chinese pilots also require large electricity users to submit emissions permits to the government. Therefore, also indirect emissions are covered by most Chinese ETS.

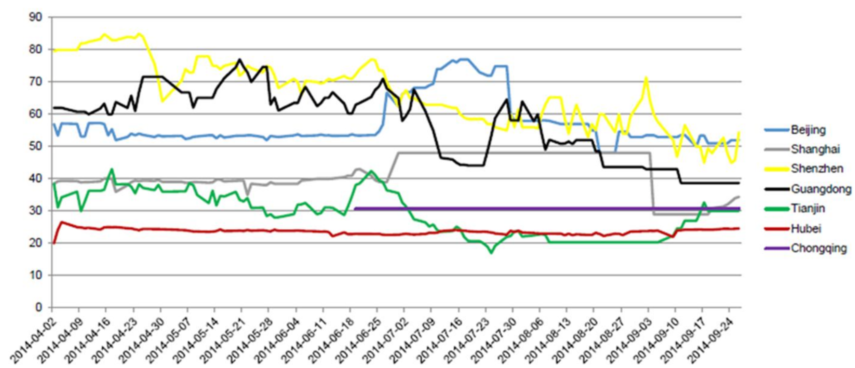
Market stabilisation and offsets

Most Chinese schemes consider to set aside permits to regulate the market, e.g. to buy / sell allowances in case of market fluctuation. Regarding the use of offset credits, the Chinese trading schemes allow the use of Chinese Certificated Emissions Reductions (CCER). Depending on the scheme, this can go up to 10% of total supply.

Market prices (in Yuan)

Figure 5-5 shows that the market prices have a range of 20-80 Yuan in early 2014 (2,6-10,4 Euro) and between 25 and 55 Yuan in late 2014 (3,24-7,15 Euro). The price ranges currently are similar to the ranges of the EU-ETS.

Figure 5-5 Overview of market prices in the Chinese pilot schemes so far (in Yuan)



Source: Zhong (2014).

5.3 Comparison of design features of the EU ETS with other ETS worldwide

Existing and emerging trading schemes are very different regarding design features such as scope of the systems or allocation methods.

Sectoral coverage

While the EU-ETS focuses on industry and large energy producers, and ETS schemes in the US and Canada have similar coverage, some of the emerging schemes in Asia try other avenues often involving smaller facilities, buildings, or include indirect emissions from energy consumption as well.

Type of targets

While schemes in the US, Canada or Europe have absolute caps the Chinese pilot ETS have relative caps, sometimes complemented by absolute caps.

Allocation method

Only few ETS worldwide use auctioning as a primary allocation method from the system's inception. Similar to the EU-ETS where grandfathering was used in the beginning, the Chinese ETS pilots allocate most allowances

	for free.
User of offset credits	All existing and emerging systems allow the use of offset credits, but do so to very different amounts and following different international or national standards.
Market stabilisation measures	Most ETS, in contrast to the EU-ETS, provide market stabilisation measures to manage price fluctuation and give more price certainty to included companies.

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7 Appendix 1: Dynamic allocation in EU ETS under different design options

We discuss different design options for allocating free allowances based on actual activity levels and focus in particular on procedures which lower the administrative burden.

7.1 Overview of procedures for activity based allocations of free allowances

7.1.1 Static free allocations

Based either on historical emissions or historical activity levels

The current procedure for free allocation is static (apart from the partial cessation rules which allow for some rough adjustments) and can be represented either in relation to historical emissions by

(F1) fixed free allocation =
benchmark share of free allowances x historical emissions x correction factor

or in relation to historical activity levels by

(F2) fixed free allocation =
benchmark intensity x historical activity level x correction factor

Cross-sectoral correction factor

In the current set-up a so-called cross-sectoral correction factor (CSCF) is needed in order to meet the capped total volume of free allowances.

7.1.2 Flexible free allocations

Some proposed reform options (e.g. from Ecofys, 2014) aim for flexible free allocation which respond to actual activity levels. We provide an argumentation that flexible free allocation, which are also referred to as dynamic or output-based, can y be framed either in relation to actual activity levels as mentioned above or – as we add to this discussion – to actual emissions adjusted for benchmark requirements. Both representations open different design options for implementing such a dynamic allocation procedure.

Based either on actual compensated emissions or actual activity levels

A dynamic procedure for free allocations to installations can also be based, either on actual emissions that are adjusted for the benchmark requirements

(D1) flexible free allocation =
benchmark share of free allowances x actual benchmark emissions

or in relation to actual activity levels by

(D2) flexible free allocation =
benchmark intensity x actual activity level

Flexible free allocation so far have been mainly discussed in the activity based representation (D2). However, also considering representation (D1), which is emissions based, opens new options for implementation. Discussion of a CSCF is omitted; as such a correction may become redundant in a reformed allocation procedure.

7.2 An analytical framework for activity based allocations of free allowances

Notation

We introduce for our analytical framework the following notation:

- C carbon emissions (volume)
- F free allocations (volume)

Q activity level (volume of production)

(C/Q) emissions intensity

s share of free allowances (F/C)

i free emissions intensity $(s\cdot C/Q)$

The following subscripts are used:

t *year t*

B *benchmark period related*

7.2.1 Current and other design options for allocating free allowances

Linking free allocations to emissions or to activities

Free allocation F can either be linked to emissions C or to activities Q measured as the volume of production.

For a given share s of free allowances F in total emissions C, which reflects the outcome of any procedure for allocating free allowances, we can relate free allowances to emissions:

(1) $F = s\cdot C$ with $0 \leq s \leq 1$

By substituting C with the emissions intensity (C/Q) and activity Q we obtain an equivalent representation of free allowances proportional to activities:

(2a) $F = i\cdot Q$

with the free emissions intensity i being defined as the free emissions per unit of activity;

(2b) $i = s\cdot(C/Q)$

Current benchmark procedure for determining free allocations

In the current set-up of EU ETS the procedure for free allocation is based on benchmarks which are related to emissions intensities. Each installation reports for a benchmark reference period B, emissions C_B, and activity levels Q_B. Using this information, emissions intensities (C_B/Q_B) are calculated and ranked. The share s_B of free allowances per unit of activity is determined based on the position of an installation relative to all other installations in the subsector. Top performing installations with a low emissions intensity ratio (C_B/Q_B) obtain 100 percent free allowances while the remaining installations, depending on their ranking, receive less. This procedure therefore contains an incentive element.

For a particular installation free allocations are determined analogous to (1) as either proportional to emissions

(3) $F_B = s_B\cdot C_B$

or alternatively according to (2) as proportional to activity levels

(4a) $F_B = i_B\cdot Q_B$

with the benchmark intensity for this installation

(4b) $i_B = s_B\cdot(C_B/Q_B)$.

Other benchmark procedures for determining free allocations

Free allocation could be made more focused by explicitly basing the volume of free allocations on trade intensities, on indirect emissions via electricity consumption, or on emissions from industrial processes that currently cannot be avoided.

For a predetermined reference period B such a procedure will yield the volume of free allocations F_B for known emissions C_B and known activity level Q_B. With this information a regime for free allocations being well defined, following (3) the share of free allowances s_B and from (4b) the benchmark intensity i_B results.

7.2.2 Fixed allocations of free allowances

Currently, the EU ETS uses a procedure for free allocations that is based on a reference period and remains fixed over a trading period. The allocation procedure can be represented by (3) as

(F1) fixed free allocation =
benchmark share of free allowances x historical emissions x correction factor

or by (4) as

(F2) fixed free allocation =
benchmark intensity x historical activity level x correction factor

Deficiencies of this procedure

This procedure for determining free allocation is being debated at least on two grounds. First, the volume of free allocation within only a few, far-apart, thresholds does not respond sufficiently to changes in output levels and thus creates distortions among installations with different dynamics in their activities. Second, the so-called cross sectoral correction factor reduces the degree of mitigation against carbon leakage risk.

7.2.3 Flexible or dynamic allocations of free allowances

We assume that for a certain time span benchmarks are predetermined either by the benchmark share of free allocations s_B according to (3) or the benchmark intensities i_B as defined in (4b).

Similar to the basic relationships (3) and (4), between free allocations and emissions and activities respectively, we arrive at the following two equivalent representations for the allocation of flexible free allocation.

For each year t the free emissions $F_{B,t}$ that are compatible with the predetermined benchmark regime are calculated as a proportion of the benchmark emissions $C_{B,t}$:

(5a) $F_{B,t} = s_B \cdot C_{B,t}$

with benchmark emissions being defined by the benchmark emissions intensity (C_B/Q_B) and actual activities Q_t:

(5b) $C_{B,t} = (C_B/Q_B) \cdot Q_t$

Similarly, for each year t the free emissions $F_{B,t}$ that match the benchmark regime can be presented proportional to the actual activities Q_t:

(6a) $F_{B,t} = i_B \cdot Q_t$

with benchmark intensities i_B defined as in (4b), namely

(6b) $i_B = s_B \cdot (C_B/Q_B)$

The volume of free allocations in a flexible allocation system can therefore be represented in view of (5) as

(D1) flexible free allocation =
benchmark share of free allowances x actual benchmark emissions

or, in an equivalent way, in view of (6) as

(D2) flexible free allocation =
benchmark intensity x actual activity level

Both representations of free allocations can be used for implementing mechanisms that respond to fluctuations in activity levels.

7.3 Design options for activity based allocations of free allowances

The implementation of a flexible mechanism for free allowances comprises two steps: the determination of the benchmark restrictions and the calculation of the volume of free allowances.

Determination of the benchmark restrictions

Free allowances are allocated according to benchmark restrictions which in turn need to be determined only once for a predetermined time span during which these restrictions remain unchanged.

For a reference period *B,* installations need to report emissions C_B and activity levels Q_B and obtain in return the volume of free allocations F_B, irrespective of the rules that are applied.

This information is sufficient for determining the benchmark share s_B of free allowances:

(7a) $s_B = F_B/C_B$

or, in a similar way, for obtaining the benchmark emissions intensity i_B which uses, in addition to the share of free allowances s_B, information about the emissions intensity$\cdot(C_B/Q_B)$ in the reference period:

(7b) $i_B = s_B \cdot (C_B/Q_B)$

In addition, the actual benchmark compensated emissions $C_{B,t}$ are needed, i.e. the emissions that are compatible with the benchmark restriction for actual activity levels Q_t, by multiplying the emissions intensity (C_B/Q_B) of the benchmark with actual activity levels:

(7c) $C_{B,t} = (CB/Q_B)\ Q_t$

These benchmark compensated emissions $C_{B,t}$ may deviate from the actual emissions C_t if the benchmark restrictions are not fulfilled.

Calculation of the flexible free allocations

There are two design options for determining the volume of free allocation for installations.

Observing the benchmark restrictions, for each year the volume of free allocation for an installation is found, either by applying the benchmark share of free allocations to the actual benchmark emissions:

(8a) $F_{B,t} = s_B \cdot C_{B,t}$

or by applying the benchmark emissions intensity to actual activity levels:

(8b) $F_{B,t} = i_B \cdot Q_t$

Although (8a) and (8b) obtain identical results, it is representation (8a) which may substantially ease the implementation of a flexible allocation of free allowances since this requires only data about actual emissions, but does not require data about activity levels.

The administrators only need to provide to installations (once; as part of the benchmark procedure) a table or formula such as (7c) that indicates which emissions volumes correspond to various activity levels under the valid benchmark restrictions. As part of the validation of emissions by auditors, he volume of free allocations can be determined right away.

A cross-sectoral correction factor can be applied if this is still part of the allocation procedure for free allowances.

Robustness of this mechanism for flexible free allocations

We check how this mechanism for flexible free allocations reacts to deviations from the benchmark restrictions by replacing in (8a) benchmark emissions by actual emissions C_t and in (8b) benchmark intensities by deviating intensities i_t:

$$(9) \quad F_t = s_B \cdot C_t = i_t \cdot Q_t = s_B \cdot (C_t/Q_t)\ Q_t = F_{B,t} \cdot [(C_t/Q_t)/(C_B/Q_B)]$$

From installations expected free allocations F_t obviously differ from the benchmark compatible free allocations $F_{B,t}$ which will be actually allocated. The term in square brackets will become greater than one if actual emissions intensities (C_t/Q_t) increase compared to the benchmark intensities (C_B/Q_B) and become less than one if there is an improvement. This means that in case emissions intensities increase, installations will need to purchase additional allowances, whereas a reduction of emissions intensities will create a surplus of allowances that can be sold. Thus this mechanism has the desired property of maintaining incentives, i.e. installations will be motivated to reduce their emissions intensities.

Conclusions and caveats

Flexibility in free allocations refers to benchmarks and to activity levels. It is expected that benchmarks are revised less frequently than activity levels.

Benchmark characteristics are determined based on information from a historical reference period. The essential information needed is the volume of free allocations in relation to the volume of actual emissions. The procedure is neutral with regard to different ways the volume of free allocations is determined. The current set-up of EU ETS uses a ranking of emissions intensities. Modified set-ups could take into account explicitly trade intensities, indirect emissions and process emissions.

We demonstrated that for a given benchmark regime, an allocation procedure that allows the volume of free allowances to respond to activity levels can be based either on benchmark compensated emissions without having explicit information about activity levels or use explicit information about those activities. The former mechanism for flexible free allocations offers design options that may ease the implementation and substantially lower the administrative burdens.

Whatever design option is chosen, benchmark procedures always require, however, a periodic review of the benchmark parameters taking into account sectoral differences.

8 Appendix 2: Key data of EU ETS

8.1 Database

Table 8-1 All countries – Overall position

All Countries [kt CO2]	2005	2006	2007	2008	2009	2010	2011	2012	2013
All installations									
Total EUA allowances	2,096,444	2,078,546	2,154,880	2,011,070	2,051,352	2,089,763	2,109,672	2,179,737	2,001,248
Auctioned or sold	0	6,782	1,730	53,130	79,315	91,862	92,943	125,034	1,135,627
Freely allocated	2,096,444	2,071,764	2,153,151	1,957,940	1,972,037	1,997,901	2,016,729	2,054,703	865,621
Verified emissions	2,014,077	2,035,789	2,164,732	2,119,676	1,879,611	1,938,884	1,904,517	1,867,162	1,904,129
Freely allocated scope corrected	2,266,030	2,235,127	2,315,415	2,064,858	2,078,955	2,104,819	2,123,647	2,161,621	865,621
Verified emissions scope corrected	2,183,663	2,199,152	2,328,747	2,226,594	1,986,529	2,045,802	2,011,435	1,974,080	1,904,129
Totel surrendered units	1,645,271	2,384,787	2,151,843	2,104,966	1,910,682	1,931,014	1,887,323	1,874,879	1,909,567
Surrendered EUAs	1,645,271	2,384,787	2,151,843	2,021,380	1,829,846	1,793,862	1,633,697	1,382,134	
Surrendered Offsets	0	0	0	83,585	80,836	137,153	253,625	492,745	
Surrendered CERs	*0*	*0*	*0*	*83,536*	*77,605*	*117,037*	*177,832*	*213,944*	
Surrendered ERUs	*0*	*0*	*0*	*49*	*3,231*	*20,116*	*75,794*	*278,801*	
All combustion of fuels									
Freely allocated	1,488,420	1,466,122	1,530,331	1,286,712	1,294,407	1,316,158	1,331,697	1,363,083	278,970
Verified emissions	1,478,765	1,491,336	1,576,238	1,534,071	1,397,430	1,432,680	1,398,216	1,389,341	1,355,816
All industrial sectors									
Freely allocated	608,025	605,642	622,819	671,228	677,630	681,743	685,032	691,620	586,651
Verified emissions	535,312	544,453	588,494	585,605	482,181	506,204	506,302	477,821	548,313

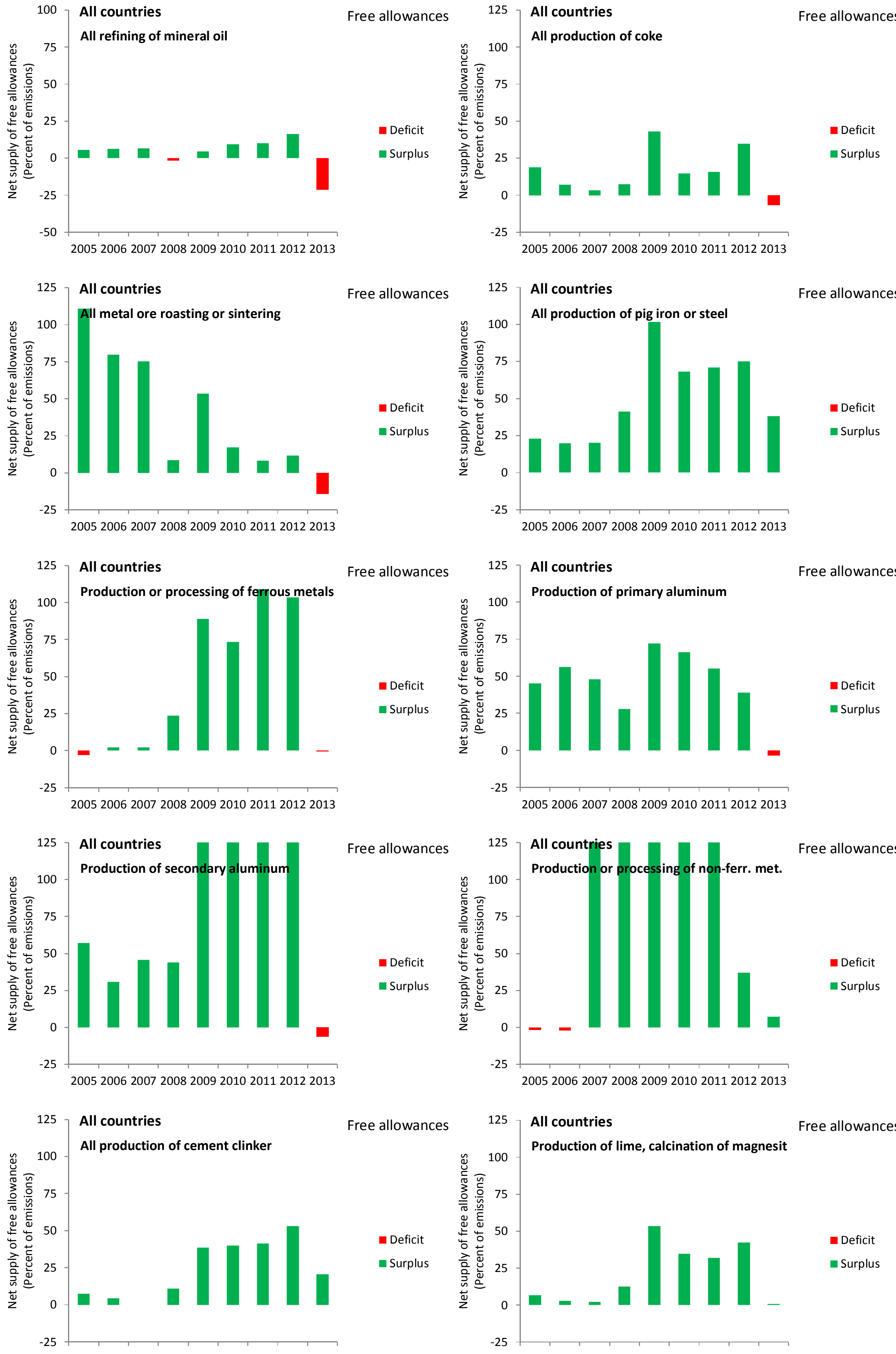
Table 8-2 All countries – Industry sectors (1)

All Countries [kt CO2]	2005	2006	2007	2008	2009	2010	2011	2012	2013
All refining of mineral oil									
Freely allocated	157,161	156,340	158,788	148,149	148,285	152,713	152,216	155,038	105,242
Verified emissions	148,756	147,289	148,989	150,387	141,947	139,591	138,336	133,391	134,159
All production of coke									
Freely allocated	22,789	22,789	22,789	22,597	22,573	22,912	22,620	22,641	21,535
Verified emissions	19,193	21,301	22,074	21,039	15,786	19,984	19,528	16,811	23,045
All metal ore roasting or sintering									
Freely allocated	14,851	14,910	15,083	4,464	4,229	4,265	4,285	4,301	3,000
Verified emissions	7,036	8,293	8,610	4,109	2,751	3,640	3,960	3,848	3,496
All production of pig iron or steel									
Freely allocated	140,787	140,226	141,041	169,174	169,414	169,464	170,600	170,677	139,532
Verified emissions	114,412	117,092	117,200	119,758	83,936	100,804	99,901	97,520	100,971
Production or processing of ferrous metals									
Freely allocated	2,987	3,011	3,428	3,861	3,896	3,951	3,986	3,989	9,925
Verified emissions	3,078	2,949	3,353	3,128	2,062	2,280	1,907	1,962	9,985
Production or primary aluminum									
Freely allocated	433	433	512	470	470	471	474	474	6,704
Verified emissions	298	277	346	367	273	283	306	341	6,935
Production of secondary aluminum									
Freely allocated	108	108	108	84	84	84	84	84	866
Verified emissions	69	83	74	58	26	24	21	15	926
Production or processing of non-ferr. met.									
Freely allocated	20	20	125	116	116	116	116	116	5,742
Verified emissions	21	21	40	39	40	46	39	84	5,348
All production of cement clinker									
Freely allocated	177,310	176,344	186,581	196,009	197,538	198,987	198,802	200,457	156,043
Verified emissions	164,802	169,103	186,771	176,795	142,587	142,116	140,783	130,885	129,327
Production of lime, calcination of magnesit									
Freely allocated	10,778	10,778	11,758	13,387	13,863	13,892	13,912	13,900	10,351
Verified emissions	10,099	10,490	11,496	11,885	9,035	10,313	10,529	9,772	10,280
All manufacture of glass									
Freely allocated	22,194	22,175	22,548	24,884	25,183	25,315	25,735	25,802	17,653
Verified emissions	19,921	19,818	21,147	22,496	19,174	19,993	20,546	19,547	18,819
All manufacture of ceramics									
Freely allocated	17,926	18,100	18,229	18,327	18,581	18,669	18,236	17,811	14,915
Verified emissions	14,814	14,955	14,947	13,355	9,115	8,983	8,961	7,941	12,816
All manufacture of mineral wool									
Freely allocated				174	174	197	280	271	305
Verified emissions				146	146	192	205	231	415
Production or processing of gypsum									
Freely allocated				205	205	205	205	205	803
Verified emissions				173	150	154	159	154	954
Production of pulp									
Freely allocated	3,163	3,162	3,162	2,407	2,369	2,367	2,386	2,424	2,698
Verified emissions	1,976	1,961	1,943	1,857	1,734	1,753	1,676	1,711	1,747
All production of paper or cardboard									
Freely allocated	34,292	34,494	34,929	36,937	37,780	38,631	38,767	39,482	29,382
Verified emissions	28,525	28,646	28,042	30,550	27,136	29,215	28,074	26,907	26,065

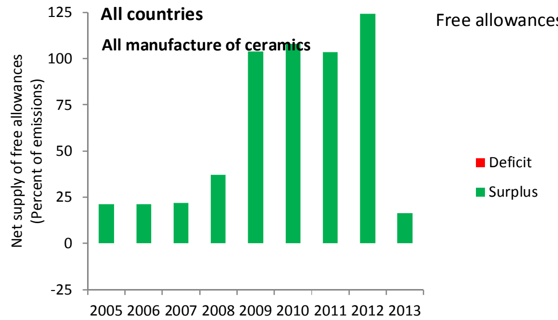
Table 8-3 All countries – Industry sectors (2)

All Countries [kt CO2]	2005	2006	2007	2008	2009	2010	2011	2012	2013
Production of nitric acid									
Freely allocated				0	0	251	251	218	2,353
Verified emissions				0	0	64	48	53	1,592
Production of adipic acid									
Freely allocated									485
Verified emissions									142
Production of amonia									
Freely allocated	1,773	1,773	2,619	1,074	2,446	1,840	1,702	1,599	12,245
Verified emissions	1,404	1,331	1,886	1,107	1,041	1,157	1,404	1,393	13,687
Production of bulk chemicals									
Freely allocated	1,223	757	835	6,019	6,297	6,158	6,158	6,158	19,300
Verified emissions	750	698	730	5,648	5,366	5,358	5,183	5,358	13,374
Production of hydrogen and synthesis gas									
Freely allocated									7,332
Verified emissions									7,150
Production of soda ash and sodium bicar.									
Freely allocated									4,378
Verified emissions									1,878
Other activity opted-in under Art. 24									
Freely allocated	228	222	285	22,758	23,994	21,124	24,084	25,839	15,608
Verified emissions	158	148	20,845	22,596	19,771	20,122	24,608	19,791	25,021

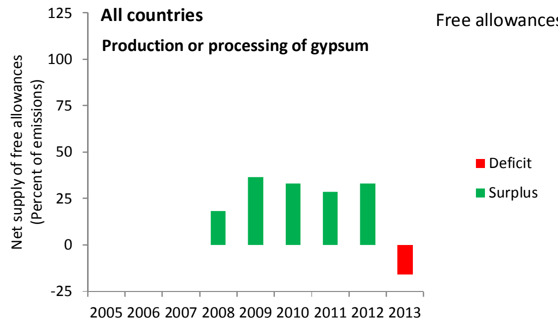
8.2 Share of free allocation in verified emissions by industry sectors

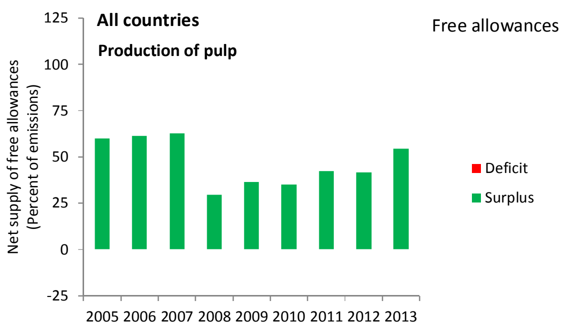


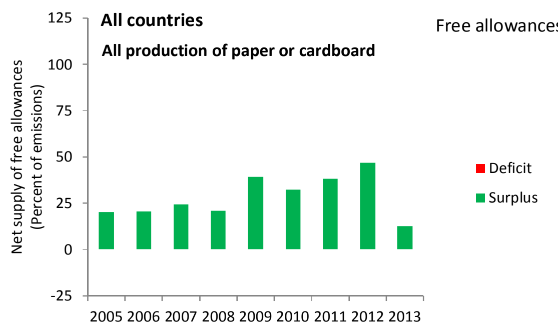

All countries
All manufacture of glass
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013

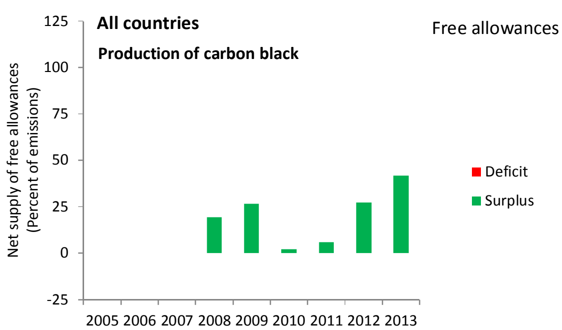

All countries
All manufacture of ceramics
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013

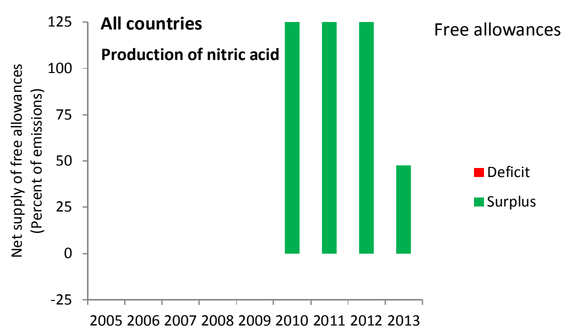

All countries
All manufacture of mineral wool
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
100 75 50 25 0 -25 -50
2005 2006 2007 2008 2009 2010 2011 2012 2013

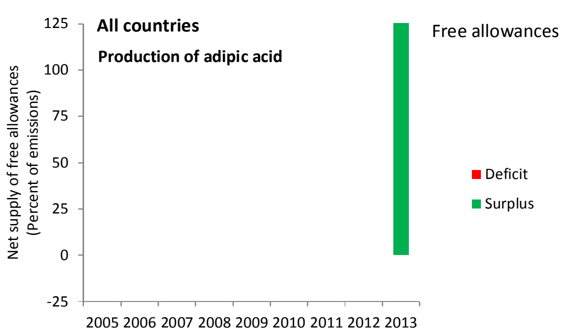

All countries
Production or processing of gypsum
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013

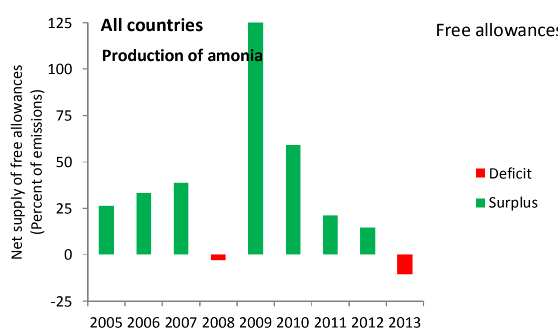

All countries
Production of pulp
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013

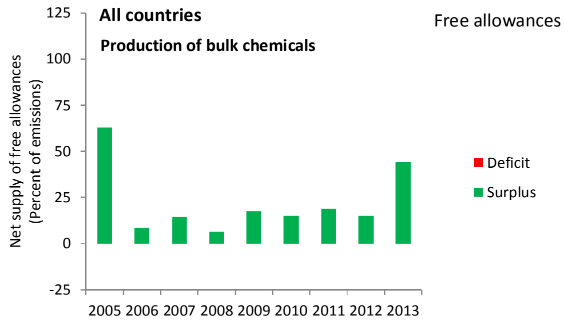

All countries
All production of paper or cardboard
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013


All countries
Production of carbon black
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013

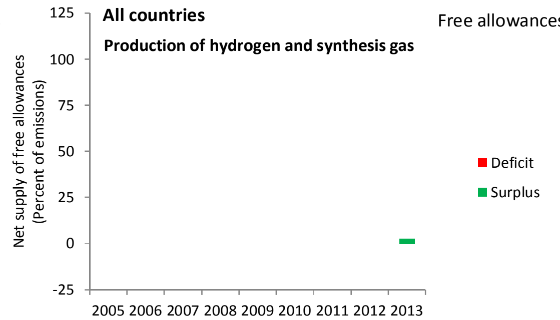

All countries
Production of nitric acid
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013


All countries
Production of adipic acid
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013


All countries
Production of amonia
Free allowances
Deficit
Surplus
Net supply of free allowances (Percent of emissions)
125 100 75 50 25 0 -25
2005 2006 2007 2008 2009 2010 2011 2012 2013

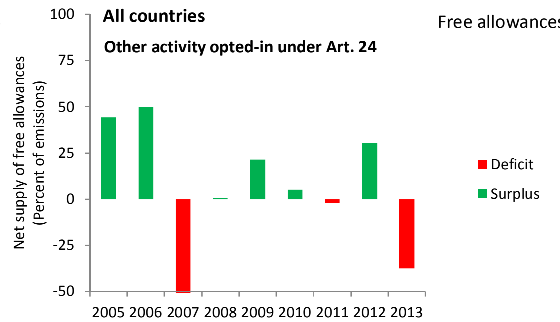


All countries
Production of bulk chemicals
Free allowances
Net supply of free allowances (Percent of emissions)
125
100
75
50
25
0
-25
Deficit
Surplus
2005 2006 2007 2008 2009 2010 2011 2012 2013



All countries
Production of hydrogen and synthesis gas
Free allowances
Net supply of free allowances (Percent of emissions)
125
100
75
50
25
0
-25
Deficit
Surplus
2005 2006 2007 2008 2009 2010 2011 2012 2013

All countries
Production of soda ash and sodium bicar.
Free allowances
Net supply of free allowances (Percent of emissions)
125
100
75
50
25
0
-25
Deficit
Surplus
2005 2006 2007 2008 2009 2010 2011 2012 2013



All countries
Other activity opted-in under Art. 24
Free allowances
Net supply of free allowances (Percent of emissions)
100
75
50
25
0
-25
-50
Deficit
Surplus
2005 2006 2007 2008 2009 2010 2011 2012 2013

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