Leakage Protection for Carbon-Intensive Materials Post-2020

By Karsten Neuhoff, William Acworth, Roland Ismer, Oliver Sartor and Lars Zetterberg

Climate protection is a global challenge that all countries have a common but differentiated responsibility to address. However, not all governments are willing to commit to targets of equal stringency, and individual countries may put different emphases on carbon pricing in their policy mix. Carbon prices may thus continue to differ over longer time horizons. Therefore, measures to protect production of carbon-intensive materials from carbon leakage might be required not only as short-term transition instruments, but also for longer periods.

Leakage protection measures therefore need to preserve carbon price incentives for emission mitigation across the value chain. If ex-ante or dynamic free allocation of emission allowances is used as a leakage protection measure, only the primary producers face the full carbon price signal for efficiency improvements. Accordingly, shifts to lower-carbon fuels and the carbon price signal for intermediate and final consumers are muted. Thus a large share of mitigation opportunities cannot be realized. Combining dynamic allocation of allowances with a consumption charge (Inclusion of Consumption into the The European Union Emissions Trading System, EU ETS) or combining full auctioning with Border Carbon Adjustment could reinstate the carbon price signal along the value chain and create incentives for breakthrough technologies, the use of higher-value products with lower weight and carbon intensity, alternative lower-carbon materials and more tailored use of materials. Border Carbon Adjustment is, however, politically contentious as it has often been discussed as an instrument to discriminate against foreign producers. Hence it is important to further explore design details to implement the combination of dynamic allocation with Inclusion of Consumption in the EU ETS.

The European Union Emissions Trading System (EU ETS) is the main instrument for European climate policy. Entities in the regulated sectors are required to surrender allowances to cover their emissions. The allowance price gives incentives for innovation and mitigation. In the absence of a global carbon price, the additional costs of acquiring these allowances could create incentives to relocate production and result in carbon leakage. Hence sectors considered to be at risk of carbon leakage currently receive allowances for free.

The European Parliament has asked – as part of its decision on the implementation of the EU ETS Market Stability Reserve on July 8th 2015 – the European Commission to make a proposal for the design of the mechanism for carbon leakage protection for the period after 2020. It is now being discussed whether to refine the existing criteria so as to reduce the length of the overall carbon leakage list,[1] whether to apply differentiated treatment to sectors covered by the list, or more broadly, whether to change the approach to carbon leakage protection within the EU ETS.

This report evaluates leakage protection mechanisms for carbon-intensive materials. We find that a dedicated analysis of carbon-intensive materials is necessary because many of the mitigation choices reside not only with producers, but also with intermediate and final consumers, i.e. throughout the whole value chain.[2] Carbon-intensive materials are also particularly suitable for efficient leakage protection measures due to the existence

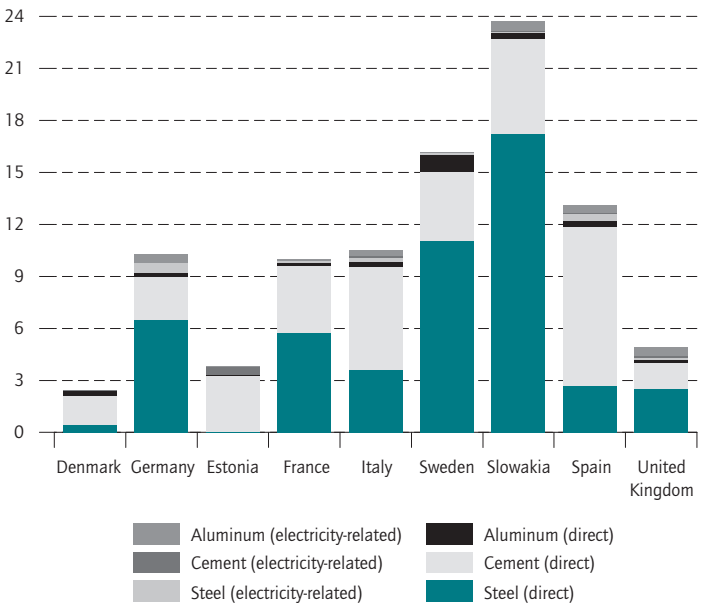
1 The existing EU ETS Directive has defined a set of criteria to identify sectors that are part of a carbon leakage list and for which different mechanisms can be applied to avoid the risk of carbon leakage. See Zaklan, A., Bauer, B. (2015): Europe's Mechanism for Countering the Risk of Carbon Leakage. DIW Roundup 72.

2 Compare also: Neuhoff, K., Ancygier, A. et al. (2015): Modernization and Innovation in the Materials Sector: Lessons from Steel and Cement. DIW Economic Bulletin 28+29/2015; Neuhoff, K., Vanderborght, B. et al. (2014): Carbon Control and Competitiveness Post 2020: The Cement Report. Climate Strategies. London, February 2014; and Neuhoff, K., Acworth, W. et al. (2014): Carbon Control and Competitiveness Post 2020: The Steel Report. Climate Strategies. London, October 2014.

Figure 1

CO_2 emissions related to the production of selected carbon-intensive materials in 2007[1]

Share of national CO_2 emissions in percent



1 The five European countries with largest population and two countries with smallest or largest emission shares of selected materials.

Source: Pauliuk, S., Owen, A. et al. (2015): Consumption-based extension of EU ETS for emissions intensive materials. Unpublished Manuscript.

Steel, cement and aluminum production are responsible for at least 10 percent of CO_2 emissions in many countries.

of clearly defined product benchmarks. Detailed analysis is also warranted because of the large share of emissions attributed to materials production.

We find four different options for carbon leakage protection including: (i) continuation of ex-ante free allocation, based on historic production levels with activity thresholds; (ii) dynamic or "output-based" free allocation, based on current or recent production levels; (iii) full auctioning of allowances combined with Border Carbon Adjustments (BCAs); and (iv) dynamic free allocation combined with a consumption charge for energy-intensive materials, referred to as Inclusion of Consumption in the EU ETS.

Selected carbon-intensive materials warrant focus

A major share of European industrial emissions is linked to the production of carbon-intensive materials. As an example, the production of iron and steel and cement together accounted for 38 percent of industrial greenhouse gas emissions in the EU-28 countries in 2012.[3] Iron and steel, cement, and aluminium together account for at least 10 percent of total emissions in many European countries (Figure 1). Within these sectors, the majority of emissions are linked to the production of the primary material, for example iron (85 percent of steel-related emissions) or clinker (90 percent of cement-related emissions). Further refinement to different types of steel or cement is capital- and labor-intensive and increases the value added, but is linked to only a relatively small share of total emissions. However, more efficient and innovative use of the primary (CO_2-intensive) part of the product at these later stages of the value chain offers large abatement potentials. Therefore it is important to ensure that leakage protection measures retain the full incentive of the carbon price for mitigation potential linked to the production as well as intermediate and final consumption choices of carbon-intensive materials.

The production cost for carbon-intensive materials would increase more than other products if in the absence of leakage concerns all allowances were to be auctioned. However, carbon-intensive materials are internationally traded, and in many instances exhibit little product differentiation. Therefore, carbon leakage risk is of greater concern compared to other sectors. As such, more tailored leakage protection measures are warranted for carbon-intensive materials than, for example, in manufacturing, where cost increases in the case of full auctioning of allowances only add little to total production costs.[4]

Moreover, clarity on long-term climate policy is more important in the materials sector, as production of carbon-intensive commodities is capital-intensive. Accordingly, investment decisions in innovation and modernization of the respective installations are based on longer time horizons than in case of consumer-oriented manufacturing.

Leakage protection needs to be designed with a long-term perspective in mind

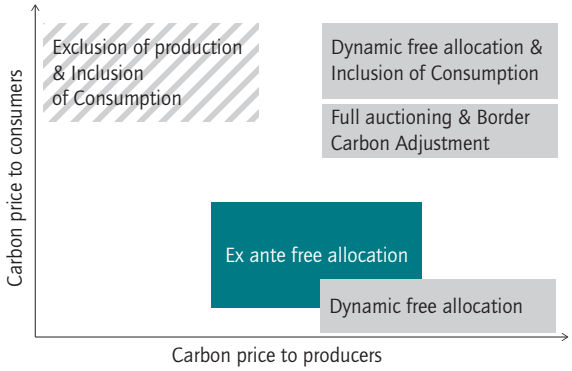
Climate protection is a global challenge that all countries have a common but differentiated responsibility to address. However, not all governments are willing to commit to targets of equal stringency. Moreover, countries may have different views on which policy mix is the most appropriate. Some countries may put a stronger emphasis on carbon prices whereas other countries may

3 According to EEA greenhouse gas data provided in 2015.

4 Sato, M., Neuhoff, K., Graichen, V., Schumacher, K., Matthes, F.C. (2015): Sectors under Scrutiny - Evaluation of Indicators to Assess the Risk of Carbon Leakage in the UK and Germany, Environmental and Resource Economics 60, 99–124.

Figure 2

Carbon price incentives with different mechanisms to address leakage concerns[1]
For steel, cement and aluminum



1 Based on analysis in the project Carbon Control Post 2020 in Energy Intensive Industries.

Source: Own illustration.

Carbon leakge protection with free allocation mutes the carbon price signal in materials sectors.

make more use of other regulatory instruments. Carbon prices may thus continue to differ between countries or regions over longer time horizons.

Measures to avoid carbon leakage have therefore been put in place to complement carbon pricing in the production of carbon-intensive materials, and they most likely will continue to be in place for the foreseeable future. All existing emission trading mechanisms covering industrial emitters offer some free allowance allocation and all carbon tax schemes have implemented special provisions for materials production.

Previously, such protection measures were considered of temporary nature and therefore primarily focused on securing leakage protection. However, if leakage protection measures might be required for the foreseeable future, there is now a need to ensure that leakage protection does not undermine incentives for innovation and modernization throughout the value chain.

In a hypothetical world with a common carbon price and no carbon leakage concerns, all allowances could be auctioned. Producers would then face the full carbon cost and would pass these costs onto consumers. Yet in a world with differentiated carbon pricing and free allowance allocation as leakage protection, producers can be expected to limit the extent to which carbon prices are passed to product prices in order to protect market shares from international competitors. Thus, a priori there are persuasive reasons to expect that leakage protection based on free allocation alone will blunt the carbon price signal.

The extent to which the carbon price is able to perform its role effectively in the presence of leakage protection measures can be broadly characterized by the extent to which the measure ensures that both producers and consumers face the full carbon price signal (Figure 2). The carbon price signal for producers creates incentives for efficiency improvements, fuel switching, and shifting to alternative lower-carbon production processes. A carbon price signal to consumers creates incentives for more tailored and more efficient use of the material and market opportunities for innovative lower-carbon products. Many of the choices will not be made by final consumers, but rather by intermediate consumers selecting, for example, materials for building components or cars.

Leakage protection with free allocation limits incentives for innovation and modernization

Until 2012, free allocation to industrial emitters was largely linked to historic emission volumes. As the baseline for emissions used for future allocation was not kept fixed, this undermined incentives to reduce CO_2 emissions. Hence since 2013, the free allocation to materials producers is based on product benchmarks of CO_2 emissions, reflecting the average emission performance of the top 10 percent of the most efficient installations in the EU.[5] The benchmark is multiplied with historic production volumes to determine the free allocation volume. In case of new investments and substantial capacity changes of installations, the allocation is based on installed production capacity. Thus emission volumes will not directly impact future allowance allocation. Materials producers thus face a carbon price signal for efficiency improvements and for a shift to lower-carbon fuels.

However, a fixed ex-ante allocation on its own will not create leakage protection against relocation of production.[6] Hence for leakage protection, the allocation has to be linked to the activity level of an installation. Such activity level requirements, however, lead to undesired threshold effects. For example, during Phase II of the

5 European Commission (2011): Decision determining transitional Union-wide rules for harmonised free allocation of emission allowances. April 27, 2011.

6 Concerns about leakage linked to relocation of investment choices can be addressed with ex-ante free allocation, using specific allocation rules for new installations, substantial capacity changes of installations, and partial or full cessation of business. Cp. Neuhoff, K. Matthes, F.C. (2008): The role of auctions for emissions trading. Climate Strategies Report.

EU ETS, it was required in most countries that installations remain operational for continued free allocation. As cement demand had dramatically declined in Europe, this resulted in large-scale surplus allocation to cement companies, with benefits of well over one billion Euros from 2009 to 2012. These profits went directly into the overall corporate budget of companies and did not support efficiency or emission reduction projects.[7] The perceived ineffectiveness of the mechanism together with extensive complaints about these windfall profits reduced the credibility of the EU ETS with companies in the materials sector, and thus undermined the incentives it can create.

Since 2013, allocation rules require, for example, a 50 percent utilization of the historic activity level to receive full free allocation for the next year. These activity thresholds created incentives for companies to spread production over several installations to maintain the full issuance of free allowances, and have led to production inefficiency resulting in approximately 5.2 million tons of excess CO_2 emissions in 2012.[8] Thus benchmark-based allocation based on historic production volumes or capacity will deliver much of, but not the full carbon price for producers.

The bigger concern remains, however, the level at which carbon costs are passed to material prices if ex-ante free allocation is used as leakage protection mechanism. A producer of a homogeneous material, globally traded with low transport cost, cannot pass carbon cost to the product price without losing market share. In contrast, a producer of a difficult-to-trade commodity—for example, electric power—which is not traded much beyond Europe's borders, can pass all carbon costs to the product price. In practice, most materials fall in between these two extremes, and thus producers will partially pass through carbon prices so as to trade off a higher product price with the risk of losing market share. It is also possible that, while carbon prices may be passed through at low levels, at higher pass-through rates windfall profits would trigger public attention, which could lead to the removal of free allocation – as occurred with the power sector in Phase 1 of the EU ETS. Thus, there may be strategic reasons why companies will be unable or unwilling to fully pass-through carbon prices to consumers under ex-ante free allocation.

The concern that ex-ante free allocation eliminates incentives for intermediate and final consumers to realize mitigation opportunities has resulted in political pressure to reduce the level of the free allocation. A cross sectoral correction factor reduces allocation for all sectors—for example, for sectors on the carbon leakage list, decreasing to 91 percent of the benchmark in 2015, and to around 82 percent in 2020.[9] For post-2020, differentiating the level of allocation among sectors on the carbon leakage list is under discussion.

Limited carbon price pass-through also poses a challenge for breakthrough production processes that incur incremental costs, for example Carbon Capture and Sequestration (CCS) or Use (CCU). Primarily they require a carbon price signal for producers to incentivize such investments. But exposure of the carbon price to consumers is also necessary to create a credible business case for paying for the investment. Otherwise, investments in these technologies depend on selling unused freely allocated allowances to emitters in other sectors, de facto expecting a cross-sector subsidy from sectors that can pass carbon costs to consumers towards materials sectors that continue to not internalize the carbon cost. This is not necessarily a stable regulatory arrangement, and thus is unlikely to be a sufficient justification for undertaking investments in new production processes with long payback periods.

Dynamic allocation further reduces incentives for intermediate and final consumers

To avoid distortions of ex-ante free allocation discussed above, it has been proposed to apply the benchmark-based allocation using current production volumes (of the same year) or recent production volumes (of the previous year) instead of historic production volumes. This is referred to as dynamic or output-based allocation, which can be designed and implemented in numerous ways. What is common to all design options is that allocation is more closely aligned with allowance requirements, thus avoiding perceived unfairness of surplus allocation. Dynamic allocation also ensures that for the majority of installations, free allowance allocation is below emission volumes, thus ensuring that emitters face real costs, and not only opportunity costs, for marginal emissions to strengthen the incentive for implementing mitigation actions.[10]

7 Neuhoff, K., Vanderborght, B. et al. (2014) l.c.

8 Branger, F., Ponssard, J.P. et al. (2014): EU ETS Free allocations and activity level thresholds in the cement sector: the devil lies in the detail. London School of Economics Working Paper.

9 The cross sectoral reduction factor is calculated so that total allocation to industrial emitters does not exceed the pre-defined industrial share of the overall emissions cap. European Commission (2013): Commission Decision of 5 September 2013 concerning national implementation measures for the transitional free allocation of greenhouse gas emission allowances in accordance with Article 11(3) of Directive 2003/87/EC of the European Parliament and of the Council.

10 Firms typically allocated revenue from selling surplus allowances to general corporate budget, and may therefore not consider the opportunity cost of using allowances that could otherwise be sold in decisions on mitigation efforts. They only fully consider benefits of mitigation efforts at the level of a business unit, if allowances have to be acquired.

Dynamic free allocation, however, further limits the carbon price pass-through compared to allocation based on ex-ante free allocation. Producers only bear costs for their emissions above the benchmark. This is because for any additional ton of material produced, an additional allocation of allowances according to the benchmark will be received. Thus only allowances corresponding to emissions above the benchmark need to be acquired. Only costs for purchasing allowances above the benchmark will be passed through to materials prices, to the extent that international competition allows.

However, as dynamic allocation limits the carbon price pass-through, it also further reduces incentives for mitigation options from carbon prices for intermediate and final consumers and the long-term business case for innovative process technologies like CCS. As such, dynamic allocation can only be expected to leverage production efficiency mitigation opportunities, which are limited for carbon-intensive materials such as steel and cement.[11]

Border Carbon Adjustments politically challenging

To restore incentives for producers and consumers lost with free allocation as leakage protection, be it based on historic or current production levels, full auctioning of allowances could be combined with BCAs. Under BCAs, imports and exports are adjusted for the carbon price differential between trading countries. Thus the full carbon price signal remains intact and creates incentives for innovation in new production processes, products and services, and supports the substitution towards lower carbon alternatives.[12]

This idea is already widely applied in schemes of value-added taxes (VAT) within Europe. Furthermore, BCAs are being discussed and starting to be implemented in regional cap-and-trade schemes such as one in California, where risk of inter-state leakage is high. Specifically, the California cap-and-trade scheme includes BCAs for electricity imports, and the state is considering applying similar measures to carbon-intensive materials such as cement.[13]

The compatibility of BCAs with World Trade Organization (WTO) rules could, in principle, be ensured through careful implementation.[14] Specifically, there must be no differentiation between like products by foreign and domestic producers without due justification. This requirement is met when charges levied at the border for imports or reimbursed for exports do not exceed the carbon costs of producing with the best available technology.[15] Also, from a WTO perspective, BCAs can only be applied to the extent that installations pay for their allowances—for example, in auctions.

The politics of BCAs are more challenging. Developing countries have experienced a long history of border provisions in trade with agricultural and other goods, with adverse impact on their economic development. This situation was not simplified by various proposals to use border measures as a stick to enforce participation in climate policy.[16] Therefore, the clear anchoring in the general rules of the WTO is important to prevent such abuse. This can involve international cooperation that clearly limits the scale and scope of BCAs on carbon prices and creates trust and shared understanding about the objectives and constraints of BCAs.

Indeed, rather than creating barriers between countries, BCAs should ideally focus on correcting for carbon price differentials, not unlike VAT adjustments at the borders between many European countries. In this way, BCAs could allow countries to implement carbon pricing schemes with higher carbon prices so as to increase their decarbonization effort, which would ultimately be beneficial for all countries.

Combining Inclusion of Consumption with dynamic allocation for an effective carbon price along the value chain

Dynamic allocation only creates carbon price signals for producers. Hence it is of interest to reinstate a carbon price signal for intermediate and final consumers. A consumption charge could achieve this objective.

Consumption charges are already levied on products like alcohol, tobacco or fuels. They do not differentiate between product processes or the location of the covered products, and are not considered a trade-related meas-

11 Neuhoff, K., Ancygier, A. et al. (2015), l.c.

12 For simulation results in the case of cement, see Demailly, D. and Quirion, P. (2006): Leakage from climate policies and border tax adjustment: Lessons from a geographic model of the cement industry. CIRED Working Paper, HAL 0009337.

13 Munnings, C., Acworth, W., et al. (2015): Pricing Emissions from Carbon Consumption. Unpublished Manuscript.

14 See Zhang, Z. X. (1998): Greenhouse Gas Emissions Trading and the World Trading System. Journal of World Trade 32 (5), 219–239.

15 For a description of the implementation at the level of best available technology and a discussion of WTO compatibility, see: Ismer, R. and Neuhoff, K. (2007): Border Tax Adjustments: A feasible way to support stringent emissions trading. European Journal of Law and Economics (24), 137–164.

16 Some proposals aim to compensate for average carbon intensities, or to differentiate based on the climate policy implemented by the trade partner. This would, however, discriminate against some foreign producers. Also, if carbon prices continue to differ across regions, the leakage risk might not necessarily follow the lines of signatures of the international environmental agreement, but rather would be linked to carbon price differentials.

Box

Inclusion of Consumption into EU ETS: not a substitute for upstream coverage of a sector

If a consumption charge on a material would replace the coverage of materials production under the EU ETS, then this would only create a carbon price to consumers that incentivizes more tailored use of carbon-intensive materials and the use of lower-carbon materials. However, no incentives for efficiency improvement of production, fuel switching, or breakthrough process technologies would exist. Therefore a consumption charge is no substitute for coverage of a sector under the EU ETS.

Charges to consumers could in theory create incentives for the production process as well, if the emissions from the production of the specific material contained in each product were to be traced along the value chain as the basis for the charge (instead of using an emission benchmark for a generic material). This tracing of product-specific emissions would, however, multiply administrative complexity both within countries and for imports; would be difficult to monitor; and would constitute a trade-related measure, as it is specific to the production process, unlike a consumption charge.

ure. Consumption charges could also be levied on carbon-intensive materials.

Consumption charges are based on upstream recording of the production of the material. The sale of the carbon-intensive material is then traced along the supply chain. A charge based on the weight of the carbon-intensive materials contained in a product, multiplied with a benchmark emission rate for the material and the carbon price from the EU ETS (e.g., average of the last quarter), is then levied on the final product. The money would be raised for national trust funds to support climate action. Consumption in this context not only relates to demand by households, but also to the use of the material as an input for other industries in the production of cars or the construction of buildings.

Where a product is exported outside the region covered by the carbon pricing system, the liability for the consumption charge is acquitted. For imported carbon-intensive commodities or products in Standard International Trade Classification (SITC)—categories with significant shares of carbon-intensive commodities—the importing firm acquires a liability for the carbon-intensive commodities contained in the imported goods, and can again pass this on to consumers.

Consumption charges would be levied on selected carbon-intensive materials. Materials that are close competitors and see significant price increases with a consumption charge, like clinker, steel, and aluminium should be jointly covered so as to avoid distortions to product choices. The charge would apply both to carbon costs related to direct and indirect emissions.[17]

Administrative and compliance costs are likely to be higher than for other approaches. However, they can be limited by following long-established protocols for the recording of production levels and trade of goods. Reporting requirements under the Inclusion of Consumption may in many cases only be marginally additional to standard business reporting. As the consumption charge is not linked to the specific emissions of a product, Inclusion of Consumption does not require the tracing and allocation of emissions along the value chain.

Inclusion of Consumption could be implemented as part of the EU ETS Directive and thus apply homogeneously across the European Union as environmental regulation. A set of requirements for an environmental regulation are met, including that Inclusion of Consumption secures incentives towards environmental objectives. In order to ease administration and reduce transaction costs, it is merely implemented as a charge instead of an obligation to surrender allowances. An environmental regulation implementation at the European level is more acceptable for many member states that would object to an implementation of a European tax.

Inclusion of Consumption is compatible with WTO laws as long as it is implemented without any discriminatory components. Like other consumption charges, the proposed charge is independent of country of origin, thus avoiding concerns about discrimination. As part of a current Climate Strategies project,[18] international experiences with similar approaches have been gathered that suggest that other regions are experimenting with

17 Indirect emissions refer to emissions from production of the electric power that is used in the production process. EU State Aid Guideline on Power Price Compensation provides electricity benchmarks, at which EU member states can compensate producers for power price increases linked to the EU ETS. A consumption charge could re-instate the carbon price signal that is suppressed by such compensation payments as leakage protection measures.

18 Ismer, R. and Haussner, M. (2015): Inclusion of Consumption into the EU ETS – Legal Basis under European Law. Unpublished Manuscript.

a similar mechanism, and might potentially cooperate in the implementation—for example by sharing data to improve the quality of benchmarks. Better benchmarks would also bring the benefit of improving the quality of free allocation more generally.

While dynamic allocation and the consumption charge face disadvantages if implemented in isolation (Box), the combination of leakage protection using dynamic free allowance allocation with a consumption charge could facilitate effective carbon price signals to both producers and consumers. The dynamic upstream allocation limits carbon price pass through to, at most, the emissions above the benchmark allocation level, and thus creates the space for a consumption charge levied at the benchmark rate without creating the risk of double pricing. Thus incentives for innovation and modernization across the value chain could be provided. This may also foster credible business cases for breakthrough technologies like CCS as it creates a mechanism to allocate incremental costs to consumers of steel.

Inclusion of Consumption could offer a long-term stable framework for investment by aligning the interests of the main stakeholders. Consumers are not charged twice, as producers receive free dynamic allocation at the benchmark and thus do not pass on the corresponding carbon cost. Producers of carbon-intensive materials face a stable investment framework, and can make strategic choices as if the full carbon price is present throughout the value chain without facing concerns of carbon leakage. Environmental interests are also addressed, because the full carbon price creates incentive for mitigation along the value chain. Finally, fiscal concerns could be satisfied by creating resources to finance climate action that would have been financed otherwise from emission allowance auction revenues.

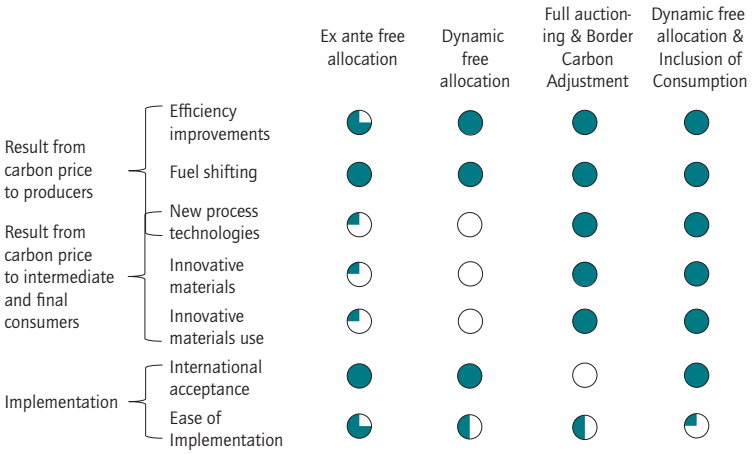
The qualitative assessments of the four options discussed above with respect to incentives for producers and consumers, as well as implementation, are summarized in Figure 3.

Further considerations

The analysis focuses on the specific situation of carbon-intensive materials, and is not necessarily transferable to other sectors with smaller carbon intensity of production, a smaller role for mitigation in the value chain, and less scope for definition of benchmarks relative to simple metrics like material weight. This may offer clear criteria for a differentiated use of leakage protection measures as already envisaged in the EU ETS Directive, which allows in its current form for the choice among different mechanisms for sectors on the carbon leakage list.

Figure 3

Assessment of leakage protection approaches for carbon intensive materials



Source: Own illustration.

Incentives along the value chain require either full auctioning with Border Carbon Adjustments or dynamic allocation with Inclusion of Consumption.

Another criterion to be considered with the further development of leakage protection measures is the compatibility with longer-term perspectives of globally converging climate policy. If allowances are allocated for free, then producers of carbon-intensive materials benefit from continued free allocation, even if international carbon prices converge. Thus they might lobby for continued free allocation, and if they are only successful in one of the regions covered by converging global carbon prices, there may be a risk of an extended lock-in situation with free allowance allocation. If dynamic free allocation were to be combined with Inclusion of Consumption, then all actors would face the full carbon price of the region and no one would benefit from or have an incentive to lobby for the continuation of the leakage protection mechanism. Thus the design of the leakage protection mechanism may create incentives for all actors to advance international climate policy so as to abandon the need for leakage protection.

Summary and conclusions

The emission targets embedded in the EU ETS generally offer a long-term perspective to guide strategic investments towards a low-carbon transition. This does require clarity on provision for carbon leakage protection, as well, which may be necessary for a longer-term perspective. The EU ETS directive has already started providing the space for the use of differentiated leakage pro-

tection systems for sectors considered at risk of carbon leakage. As such, it seems warranted to discuss, specifically, the possible options for carbon-intensive materials.

Continuation of ex-ante free allocation based on historic production levels and special provisions for new entrants, cessations, and significant changes in capacity require the least administrative effort of all options considered. Yet the extended debates on the level of benchmarks and free allocation have demonstrated the potential for this approach to dominate any constructive discussions on innovation and modernization of the sector, while reducing the credibility and thus the robustness of the incentives from the instrument with stakeholders.

The main concern about the use of free allowance allocation to provide leakage protection to carbon-intensive materials is linked to the failure to create a carbon price signal to intermediate and final consumers, thus not create incentives for a large share of the mitigation potentials in the sectors. Thus, ex-ante free allocation may only constitute a transition strategy warranted in the hope that the international climate change negotiations in Paris by the end of 2015 will result in an outcome that provides confidence in quickly converging international carbon prices.

A shift from free allocation based on historic to recent production levels (dynamic allocation) may marginally improve the incentives for process efficiency improvements by eliminating distortions from discrete activity level thresholds. Yet it further reduces the carbon price signal to consumers at the level of the free allocation, and thus reduces the incentives for innovation and modernization this shift can deliver.

Implementing Border Carbon Adjustment for selected carbon-intensive materials would allow for full auctioning of emission allowances and thus create an effective carbon price along the value chain. Administrative effort would increase, as not only primary carbon-intensive materials, but also products with significant shares of these materials would need to be covered. However, implementation is politically contentious and would require close international cooperation to avoid political repercussions.

Hypothetically excluding carbon-intensive materials production from the EU ETS, and only covering materials use with a benchmark-based consumption charge would eliminate incentives for all mitigation opportunities in materials production. It would also seriously undermine predictability of emissions under the emission cap from shifts between fuel-based and electricity based-emissions, and undermine credibility of the commitment to an overall emission trajectory and the role of the EU ETS. Thus the Inclusion of Consumption alone is not considered a viable policy option, but merely an element of a leakage protection strategy.

Yet combining Inclusion of Consumption of selected carbon-intensive materials in the EU ETS with dynamic allocation could create a credible long-term perspective in which not only producers, but also intermediary and final consumers are exposed to the full carbon price signal. Thus it could provide incentives and a long-term business case for all mitigation and innovation opportunities. Inclusion of Consumption could also result in revenues for national trust funds that are available for climate action, including for investment in innovative materials and processes. The details for the implementation are being explored in many regions with carbon pricing mechanisms, offering an opportunity for closer cooperation, for example to share data to guide the design on benchmarks.

The analysis shows that the various options for leakage protection for carbon-intensive materials sectors exhibit large differences in the extent that they create incentives for modernization and innovation in the value chain. These need to be in the focus when designing leakage protection measures for the period post 2020, such that the EU ETS can provide a robust investment framework for realizing low-carbon opportunities in the materials sector.

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JEL: D62, H32, L5

Keywords: EU ETS, Mitigation, Leakage protection, Allocation

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