CEPS SPECIAL REPORT
Thinking ahead for Europe

Carbon Leakage: An overview

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Abstract

Carbon leakage is central to the discussion on climate policy, given the confluence of issues that are currently being debated, including the 2030 Energy and Climate Framework and the review of the EU carbon leakage list by 2014**.** Carbon leakage is the result of asymmetrical carbon policies, especially carbon pricing, and the resulting carbon cost, which affects the international competitive position of some EU industry and could displace production and/or investment, and the emissions of the activities displaced.

This paper identifies the difference between carbon price and carbon cost to leakage-exposed industry as one of two fundamental issues to be understood and addressed; lack of visibility on future climate policies and anti-leakage provisions is the other key issue. While this is a global issue, most of the experience has been accumulated in the EU. Carbon leakage is only one of the factors that could affect the competitive position of sectors, but it is difficult to attribute the impact of carbon costs versus other variables such as energy costs, labour, etc. Studies have predicted the risk of a significant amount of production leakage in a number of energy-intensive industries. To address the danger, they were included in the EU ETS carbon leakage list, which gave them access to free allowances. However, a limited number of studies undertaken after the end of the second trading period (2012) show little evidence of production leakage and asks the question whether the issue has not been blown out of proportion.

The paper argues that the past may not be a good representation of the future, as it was heavily influenced by a high level of free allocation, the exceptional economic downturn, CO_2 prices significantly below what was anticipated, as well as the potential for changes in some fundamental variables such as the shrinking pool of allowances available for free allocation. It emphasises the need for a well-informed debate in the EU on measures to address carbon leakage post-2020, underpinned by a number of options, and objective criteria to evaluate those options. It emphasises that the debate should cover both investment and production leakage, caused by both direct and indirect carbon costs.

This paper was prepared by the CEPS Carbon Market Forum (CMF) for the Project on Carbon Leakage: Options for the EU. The CEPS Carbon Market Forum was established in 2012 with the aim of creating a neutral space where policy-makers and regulators are able to meet carbon market participants and other stakeholders to discuss carbon market regulation and general policy issues.

The objective of the Carbon Leakage Project is to prepare policy options that can be used to address concerns regarding carbon leakage in the context of EU internal discussions, international negotiations and bilateral discussions. See the penultimate page for more information about the project.

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List of Abbreviations

AAU	Assigned Amount Unit
APCR	Allowance Price Containment Reserve
BCA	Border Carbon Adjustment
CBDR	Common But Differentiated Responsibilities
CCER	Chinese Certified Emissions Reductions
CCR	Cost Containment Reserve
CDM	Clean Development Mechanism
CERs	Certified Emissions Reductions
CFI	Carbon Farming Initiative
CL	Carbon Leakage
CLL	Carbon Leakage List
CMB	Corporate Management Board
CMF	Carbon Market Forum
CP	Compliance Period
C-T	Cap-and-Trade
EITE	Emissions Intensive and Trade Exposed
EBITDA	Earnings Before Interest, Taxation, Depreciation and Amortization
EDU	Electricity Distribution Utilities
EPA	Environmental Protection Agency
ERUs	Emission Reduction Units
ETS	Emissions Trading Scheme
EUA	European Union Allowance
GDP	Gross Domestic Product
GVA	Gross Value Added
ICAO	International Civil Aviation Organization
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
MRV	Monitoring, Reporting and Verification
NAP	National Allocation Plan
ODS	Ozone Depleting Substance
OECD	Organisation for Economic Cooperation and Development
PPP	Purchasing Power Parity
RGGI	Regional Greenhouse Gas Initiative
SD	Sustainable Development
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
WCI	Western Climate Initiative

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Andrei Marcu, Christian Egenhofer, Susanna Roth and Wijnand Stoefs*

1. Introduction

This Special Report, prepared as a background paper by the CEPS Carbon Market Forum for the Carbon Leakage Project, should be seen as a primer that provides policy-makers, politicians, regulators and industry with a document that is easily readable and yet sufficiently rigorous to be illuminating, and which outlines the issues and why they are important. The depth of the discussion is therefore limited at times by the desire to keep the length of the paper manageable.

The paper is meant to paint a picture, and not to engage in a policy debate and a thorough review of options. That discussion will take place in a second paper, which will be delivered by the Carbon Leakage Project at a later date.

The main questions explored in the paper include:

- What is carbon leakage?
- What may cause carbon leakage?
- What are the implications of carbon leakage?
- How does carbon leakage manifest itself?
- In the context of carbon-pricing mechanisms that have been developed, or are being developed around the world:
  - What are the provisions/mechanisms to determine whether there is risk of carbon leakage?
  - What are the provisions to prevent carbon leakage?
- What is the current state of the debate on carbon leakage in the EU?
- What are the relevant issues in international negotiations that are related to carbon leakage?

2. The Economics of Carbon Leakage

2.1 Definition

In order to address the issue of carbon leakage, there is a need to first agree on what it is, what causes it and what are its consequences. Lack of agreement in the EU and/or globally on these fundamentals will only complicate the search for an efficient and acceptable solution.

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In fact, there are two sides to the issue. Firstly, how do we determine whether carbon leakage is a threat and what sectors and/or products are at risk? The second part of the problem is to determine what options are available to prevent carbon leakage and how to evaluate the effectiveness of those options.

Broadly speaking, carbon leakage can be defined as the displacement of economic activities and/or changes in investment patterns, that directly or indirectly cause GHG emissions to be displaced from a jurisdiction with GHG constraints, to another jurisdiction, with no or less GHG constraints. Visible carbon pricing through a cap-and-trade system is the most commonly used example of a climate change constraint that may lead to leakage. For further illustration, a number of other definitions put forward by well-known institutions are presented below.

The Intergovernmental Panel on Climate Change (IPCC) (2007) uses a ratio to define carbon leakage as: "The increase in CO_2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries."

The IPCC illustrates this as follows:

> It has been demonstrated that an increase in local fossil fuels prices resulting, for example, from mitigation policies may lead to the re-allocation of production to regions with less stringent mitigation rules (or with no rules at all), leading to higher emissions in those regions and therefore to carbon leakage. Furthermore, a decrease in global fossil fuel demand and resulting lower fossil fuel prices may lead to increased fossil fuel consumption in non-mitigating countries and therefore to carbon leakage as well. However, the investment climate in many developing countries may be such that they are not ready yet to take advantage of such leakage. Different emission constraints in different regions may also affect the technology choice and emission profiles in regions with fewer or no constraints because of the spillover of learning.

The EU ETS Directive has a number of ways in which it defines carbon leakage. Recital 24 of Directive 2009/29/EC defines it as follows:

> In the event that other developed countries and other major emitters of greenhouse gases do not participate in this international agreement, this could lead to an increase in greenhouse gas emissions in third countries where industry would not be subject to comparable carbon constraints (carbon leakage), and at the same time could put certain energy-intensive sectors and subsectors in the Community which are subject to international competition at an economic disadvantage. This could undermine the environmental integrity and benefit of actions by the Community.

Paras 15-17 of Directive 2009/29/EC provides the condition under which a sector or subsector is deemed to be at risk of carbon leakage (this is discussed further below).

Finally, the DG Climate Action website defines carbon leakage as:

> The term often used to describe the situation that may occur if, for reasons of costs related to climate policies, business were to transfer production to other countries which have laxer constraints on GHG emissions. This could lead to an increase in their total emissions. The risk of carbon leakage may be higher in certain energy-intensive sectors.

The OECD's definition focuses more on the environmental impact of carbon leakage:

> Carbon leakage can be defined as the ratio of emissions increase from a specific sector outside the country (as a result of a policy affecting that sector in the country) over the emission reductions in the sector (again, as the result of the environmental policy) (Reinaud, 2008).

While these definitions may appear as straightforward and uncontroversial, the challenge remains in how to differentiate the shift in emissions and the changes in production and investment patterns caused by climate policy, from what is attributable to other drivers. It seems like another counterfactual debate, similar to the one many are familiar with from discussions on additionality in the clean development mechanism (CDM).

The definition that we work from must not only acknowledge production relocation (or production leakage), but also encompass investment displacement (or investment leakage) caused by climate policies. If that is not the case, it will give the wrong signals and possibly err in determining whether carbon leakage is taking place or not.

2.2 Impacts and forms of carbon leakage

2.2.1 Impacts

The impacts of carbon leakage can be divided into environmental and socio-economic impacts. The environmental impacts are the result of emissions migrating from a jurisdiction with carbon constraints/pricing to one without, or with different levels of carbon pricing. Environmental leakage is important as it can reduce, and may even reverse, the environmental outcomes that we seek through the imposition of a carbon price.

The environmental impact could be measured through the carbon leakage ratio. Reinaud (2008) defines this as:

> The ratio of emissions increases from a specific sector outside the country (as a result of a policy affecting that sector in the country) over the emission reductions in the sector (again, as a result of the environmental policy).

Besides environmental leakage, there are two other aspects that can impact the sustainability of policies that introduce carbon pricing: social and economic/competitive aspects. Economic impacts include investment avoidance, investment relocation and shifting of production (including impacts on the value chain) outside the jurisdiction imposing carbon constraints. The social impacts – closely linked to the economic impacts – are due to job losses and the resulting changes to livelihoods and communities.

2.2.2 Forms of carbon leakage

Carbon leakage can take place internally, within the EU, or externally, that is between the EU and its trading partners. Internal leakage in the EU ETS has been identified as potentially occurring in two main forms.

Firstly, several member states are more reliant on coal or other carbon fuels for electricity production or industrial activity and so face higher carbon costs and could lose competitiveness vis-à-vis other member states. Secondly, the thresholds for installations to enter the EU ETS might have a perverse effect as they are correlated to the size of installations.

Internal leakage can also occur within jurisdictions where sub-national regimes impose a carbon price, and there are no equivalent policies in the rest of the national jurisdiction. Such examples can be cited for California, RGGI, WCI states in the US and WCI Canadian provinces.

With respect to provisions to address internal leakage, for illustration purposes, California has put in place measures to address this issue by requiring that entities importing and distributing electricity generated out-of-state, must account, and are responsible, for the embedded emissions.

We must emphasise that while we recognise the importance of a discussion on internal leakage, the remit of this project is to focus on 'external' carbon leakage, that is, between the EU and other countries.

2.2.3 Channels for carbon leakage

Another way to examine carbon leakage is the channels through which it is delivered, and the time-horizons. From this point of view the most relevant are:

- **Production leakage** is the impact on short-term competitiveness which is due to differences in cost structure between GHG activities in GHG-constrained jurisdictions and less or differently GHG-constrained jurisdictions. The former could lose competitiveness, which might lead to a loss of market share to the latter. This takes place on the international stage between the same sectors. It must be also emphasised that internalising carbon costs in an asymmetrical way affects exports as much as competitiveness in internal markets.
- **Investment leakage,** which is a long-term impact, is the result of loss of competitiveness caused by climate policies that is high enough to shift investment to jurisdictions that have not taken similar measures.
- Changes **in global fossil-fuel prices** changes **in global fossil-fuel prices**. While this avenue for carbon leakage is recognised in this study, it will not be the focus of this project.

While we acknowledge the importance of all three channels described above, the remit of this project is to focus on short-term competitiveness and investment leakage only.

2.3 What causes carbon leakage?

There are many issues, beyond climate policies, carbon prices and carbon costs that affect competitiveness and changes in trade and investment patterns. It is difficult to separate the impacts of each of them individually. Carbon pricing is one of them, but just one of many.

Competitiveness can be defined at either a national or a sectoral level, whereas competitiveness on a sectoral-level is the more relevant when discussing carbon leakage. The OECD offers the following definition for sectoral competitiveness:

> In theory, the competitiveness of a sector in a region vis-à-vis another region is defined as its ability to maintain profits and market share.

Moreover:

> A substantial increase in costs for a sector in one region (entailing loss in profits compared to international competitors) would affect an industry's competitiveness (its ability to retain market shares) through various ways: enhanced competition from cheaper competitors on domestic and overseas markets, lower profits leading to lower capacity to invest and expand activities (Reinaud, 2008).

Carbon leakage is one of the factors that influence competitiveness. Other elements will weigh heavily, including energy, labour, general price of regulation, etc. Each of them will have a different weight, depending on the characteristics of the industry and product.

Some factors can be influenced by the EU (for instance carbon pricing, labour and environmental regulation, etc.) while others cannot (global cost of raw materials or energy).

2.3.1 Asymmetrical carbon policies

Carbon leakage is caused by asymmetrical climate policies, that is, policies that impose a price for carbon in one jurisdiction, while another jurisdiction has no, or less stringent, climate policies and/or prices.

Asymmetrical climate polices have their roots in the UNFCCC and the concept of common but differentiated responsibilities (CBDR), which in its current interpretation, resulted in the Annex B/ non Annex B differentiation between parties in the Kyoto Protocol (KP).

In the Kyoto Protocol, developed countries took the lead to reduce emissions, with the understanding that the costs of doing so would be mitigated through the availability of offsets from developing countries, which would lower their cost of compliance. The CBDR principle includes developing countries in the Kyoto Protocol and facilitates their sustainable development. It also helps with the transfer of technology, leads to an early switch to a less carbon-intensive development – and provides the ability to contribute more to mitigation actions under future climate regimes.

Also, the world of emissions and GDP was different when the KP was adopted than it is now. At that time it was deemed acceptable to provide support for sustainable development, through instruments such as the CDM. While support for development was seen as acceptable and desirable, support that helps competition in a world that has significantly changed since the UNFCCC was agreed in Rio de Janeiro at the UNCED in 1992 and the KP adopted, has become a controversial issue, questioned by many. Echoes of this evolution can also be heard in the rise and fall of CDM credits from rapidly emerging economies.

The idea of carbon markets was advocated in Kyoto by the US and was included in the KP. The EU was a trailblazer and introduced a domestic cap-and-trade to help meet its KP obligations. A price of carbon was imposed on many of its industries at a time when its competitors from emerging economies, as well as from some developed countries, did not face the same costs. Many countries today, however, are catching up with EU.

2.3.2 A changing world

Carbon leakage was not much of a concern at the time when the KP was negotiated. Today, GDP statistics look rather different when compared to 1997 (Table 1), and the same holds true for CO_2 emissions (Table 2).

Table 1. GDP in selected global economies, 1997 and 2011

Country	GPD 1997 ($ bn. in PPP)	Share worldwide GDP, 1997 (%)	GDP 2010 ($ bn. in PPP)	Share worldwide GDP, 2011 (%)	Δ 1997-2011, share worldwide GDP, in %
China	2,285.33	6.297	1,0128.4	13.562	115.4
India	1,251.59	3.449	4,051.36	5.425	57.3
Singapore	112.4	0.31	293.69	0.39	25.81
Russia	965.11	2.659	2,237.41	2.996	12.7
Chile	133.49	0.368	276.8	0.371	0.8
South Africa	263.26	0.725	526.95	0.706	-2.6
Brazil	1,125.57	3.012	2,186.54	2.928	-2.8
Saudi Arabia	314.94	0.868	628.93	0.842	-3.0
Australia	444.15	1.224	877.22	1.175	-4.0
Indonesia	523.76	1.443	4,051.36	1.385	-4.0
Mexico	887.66	2.43	1,569.89	2.1	-13.6
UK	1,273.62	3.51	2,223.25	2.977	-15.2
US	8,332.35	22.961	14,498.93	19.414	-15.5
EU-27	9,124.47	25.143	15,283.06	20.464	-18.6
Germany	1,914.29	5.275	2,957.38	3.96	-24.9
Japan	3,105.05	8.556	4,384.48	5.871	-31.4
World	3,6246.7	100	74,683.81	100	

Source: IMF World Economic Outlook 2012.

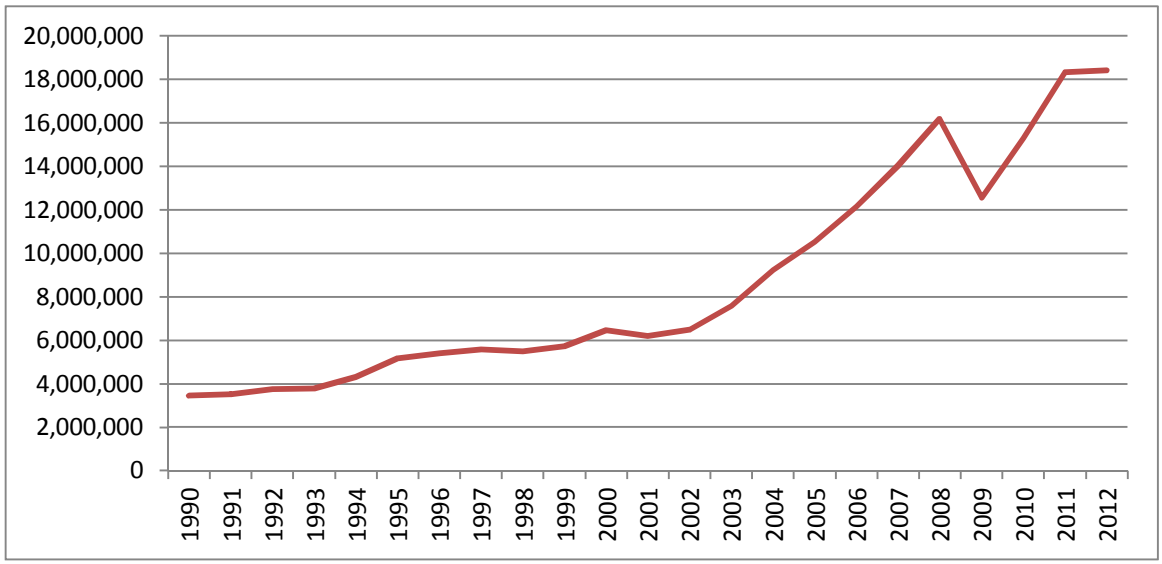
Table 2. CO_2 emissions in selected global economies (in thousands of metric tonnes of CO_2), 1997 and 2009

Country	1997	2009	Growth (%)
Australia	333,624	395,094	18.4
Brazil	300,547	367,147	22.2
Chile	56,171	672 67	19.8
China	3,469,510	7,692,211	121.7
Germany	862,277	732,249	-15.1
India	1,043,940	1,982,263	89.9
Indonesia	278,659	453,106	62.6
Japan	1,201,632	1,100,650	-8.4
Mexico	358,383	446,237	24.5
Russia	1,559,238	1,574,368	1.0
Saudi Arabia	216,239	431,027	99.3
Singapore	69,240	24,767	-64.2
South Africa	371,328	503,941	35.7
UK	545,573	475,108	-12.9
US	5,419,441	5,311,840	-2.0
EU-27	3,952,562	3,573 607	-9.6

Source: UNstat, Millenium Development Goals Indicator.

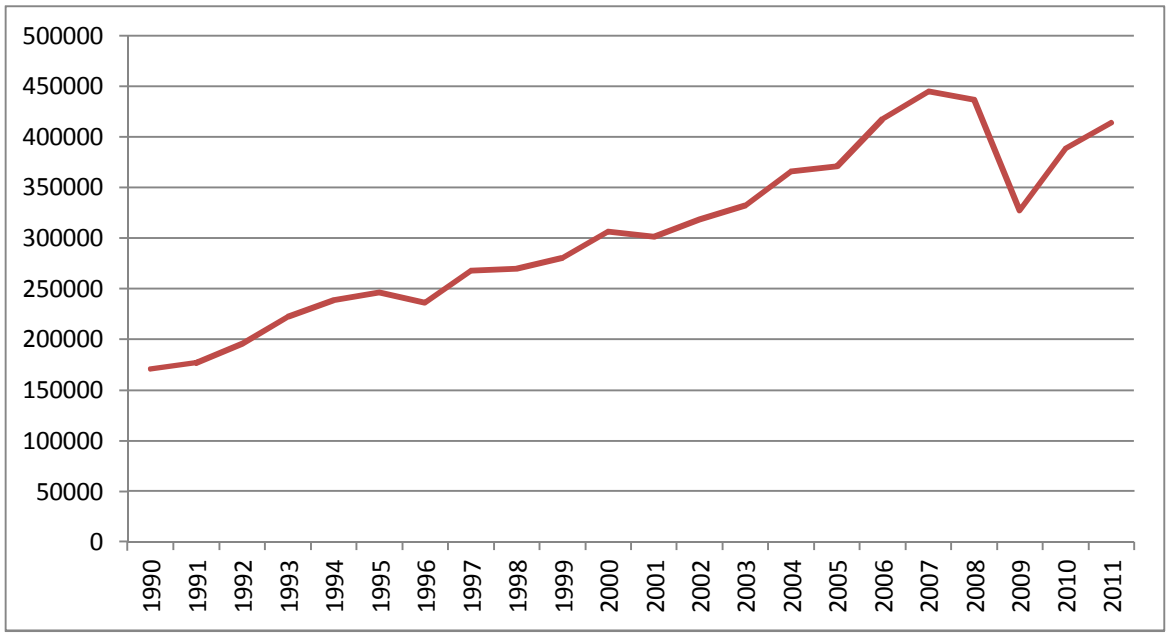
Changes in economic development and emissions statistics must also be combined with the fact that we live today in a more globalised world, where trade, especially in commoditised goods, has increased dramatically (see Figures 1 and 2). The same holds true for investment patterns.

Figure 1. World merchandise trade, value of export ($ mil.)



Source: WTO statistics database.

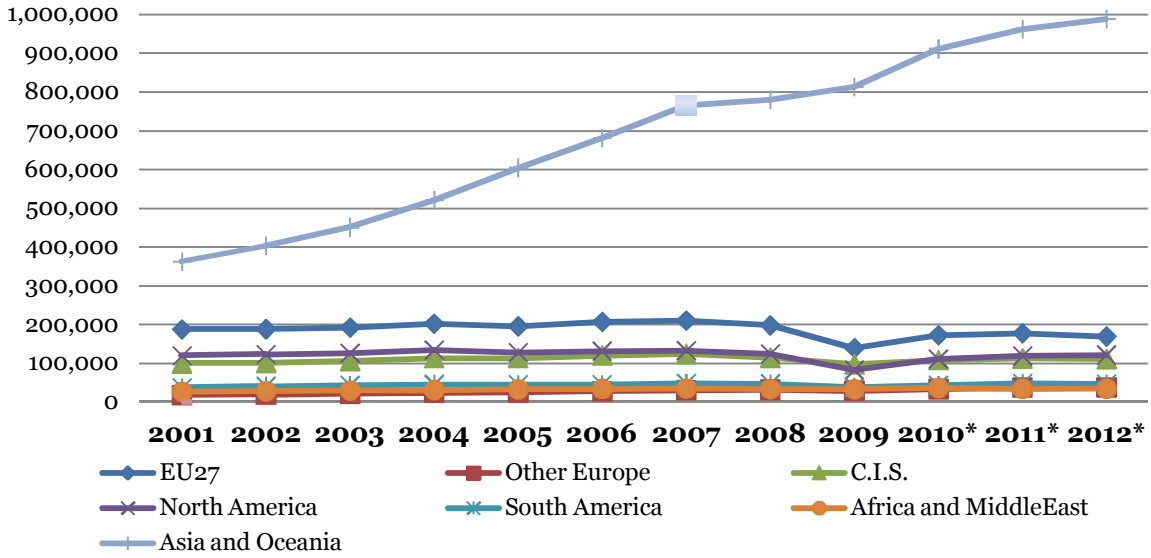
Figure 2. Export of semi-finished and finished steel products (thousand metric tonnes)



Sources: Steel Statistical Yearbook, 2000, 2003 and 2012.

At the same time as trade flows increased, production capacity of many energy-intensive industries in developing countries has also increased significantly. Figure 3 illustrates for the steel sector crude steel production from 2001 to 2012. Led by China, capacity has increased at a steep pace. Production in the EU decreased in 2009 as a result of the economic crisis, which has been followed by a weak recovery in the following three years.

Figure 3. Global production of crude steel, 2001-12 (thousands of tonnes)



Source: Authors' own calculations based on Renda et al. (2013b).

The figures and tables above present well-known statistics, but they are worth briefly highlighting as they point out that some developing countries have now become significant emitters of GHGs (China is now no. 1 in the world), and many developing countries have advanced to become significant economic powers and competitors in many sectors at the global level.

As such, the old paradigms that the Kyoto Protocol was built on and in which carbon leakage was not a concern simply do not reflect today's realities. In many cases the shift in investment and production capacity has resulted in slack capacity being available outside the EU and other OECD countries, creating different trade patterns for the EU, and accompanying GHG emissions.

The significant shift in trade patterns has also given rise to the discussion about production and consumption patterns for GHG emissions.

2.3.3 Carbon prices: Visible vs shadow

One way of looking at what causes carbon leakage is to examine the way carbon prices emerge. They can be visible resulting from a cap-and-trade regime, or they can result from other policies and measures that are intended to address climate change, have a mitigation impact and produce a de facto carbon price, which is not explicit. Policies without a visible carbon price will impose a 'shadow' price for carbon. As a result of the reductions they trigger, shadow carbon contribute to lowering the visible price of carbon.

A number of examples include:

- The Renewable Energy Directive and the Energy Efficiency Directive produce carbon prices in the EU that are not visible. They contribute to GHG reductions and reduce the amount of 'work' the EU ETS must do in order to reach its targets. The impact is lower EUA prices.
- The California Global Warming Solutions Act of 2006 (also known as Assembly Bill 32), is the basis for the California cap-and-trade programme, but also of a number of

Complementary Measures that produce a much higher 'shadow' price. One such example is the Low Carbon Fuel Standard. In this case, California has made a choice to aim for low visible carbon prices from it ETS.

- Comparing domestic actions for low-carbon electricity generation, Vivid Economics (2010) concludes that mandating the use of certain types of technologies in China in the coal sector leads to a higher implicit carbon price in China than for example in Australia or the US.
- Taxes on energy can be a powerful tool to influence patterns of energy use.
- Regulatory standards - The impact of the limitation on plant emissions being proposed in the US by the Environmental Protection Agency (EPA) through the recently announced "Carbon Pollution Standard for New Power Plants" will need to be quantified. The limitation may not constitute a direct carbon price but it could have a significant impact. There are also discussions on whether states could use their regional ETS as an alternative to meet these standards.

The recent OECD report on "Climate and carbon: Aligning prices and policies" (OECD, 2013) recognises that 'shadow prices' resulting from "using feed-in tariffs and capital subsidies are on average (note: over all OECD countries) €169 per tonne and €176 per tonne respectively, with high estimates in individual countries of up to almost €800 per tonne".

It must also be highlighted that studies on carbon leakage that are referenced in this report, as well as most, if not all, of the existing literature, do not include shadow prices, but focus on visible carbon prices.

2.3.4 Carbon prices and carbon costs

Beyond the actions that result in a carbon price, it is also important to examine what imposes a carbon cost. A difference must be made between carbon prices, which is the result of the constraint (e.g. cap and trade) and carbon cost (the cost to meet the obligation by those that have to meet carbon constraints).

There are different types of carbon costs:

1. **Direct costs** are the result of meeting emissions constraints and result from the procurement of compliance instruments, e.g. EUAs to meet emissions.
2. **Indirect costs** are the price of emissions allowances that need to be surrendered by electricity producers and that are passed through to electricity consumers. Electric utilities face increased production costs through their ETS compliance costs. They pass those costs on to their customers via higher electricity rates. Industrial consumers therefore face an extra cost because of the cost of CO_2 embedded in electricity prices. The pass-on rate of the CO_2 cost for producing electricity is a number that is subject to intense debate and may vary significantly between member states. *The indirect costs are calculated as: Electricity intensity of production x Carbon intensity of electricity x CO_2 price x Pass-on rate.*
3. **Administrative costs** are related to compliance with carbon legislation, for instance MRV, back-office operations, etc.

In addition to the cost of carbon, there are other important factors that will determine if a sector or product is at risk. Some of the criteria that need to be considered when examining if a sector is at risk of carbon leakage may include:

- Direct CO_2 intensity from process or energy use
- Use of energy that internalises CO_2 costs – electricity-intensive industries
- Use of components or semi-finished products that internalise CO_2 costs
- Trade intensity
- Importance of the cost of carbon relative to other variables
- Ability to pass costs downstream or through to consumers
- Abatement potential or cost of abatement

2.3.5 Pass-through of carbon prices

One element in the list above that deserves further elaboration is the ability to pass through carbon costs. Asymmetrical climate policies and carbon costs do not necessarily result in carbon leakage unless they become a cost that impacts competitiveness.

The availability of data on the pass-through of carbon costs is scarce and difficult to evaluate; hence, this criterion is not always (if at all) included in assessments on carbon leakage.

If costs can be passed through, then the risk of carbon leakage diminishes or disappears, depending on the percentage of pass-through. If, on the other hand, costs cannot be passed through, due to international competition or global pricing mechanisms, profit margins will be eroded.

The elements that will impact the ability to pass through costs are several (see e.g. Reinaud, 2008 and Droege & Cooper, 2010):

- Exposure to international competition
- Market concentration
- Product differentiation
- Available substitutes that are less emissions-intensive or energy-intensive
- Transport cost relative to CO_2 cost
- Exchange rate risks
- Customer reaction to a price increase, based on: vertical integration of the industry, quality issues and long term contracting
- Legal and political environment
- Global pricing mechanism

An additional important element is the market structure of the EU ETS with the top 15% emitters accounting for 90% of total EU ETS emissions and the power and heat sector dominating with a share of about 73% of emissions.

While in principle asymmetric carbon constraints and prices will affect industrial competitiveness and the economy as a whole, some specific industries and products could be affected more severely (Reinaud, 2008). For example Hourcade et al. (2008) found that emissions-intensive industries represent 1% of the UK GDP and the Öko Institute (2008) found that they represent 2% of German GDP.

Costs tend to be concentrated in a limited number of sectors, and benefits dispersed both within an economy and inter-generationally (Drew, 2010; Lennox et al., 2013). When analysing carbon leakage and competition, this is an important factor to take into account.

As such, an important observation is that measures to address carbon leakage need to be targeted, and the right instruments must be used to ensure that those that really need assistance to address leakage can get it.

2.3.6 Criteria and sectors at risk

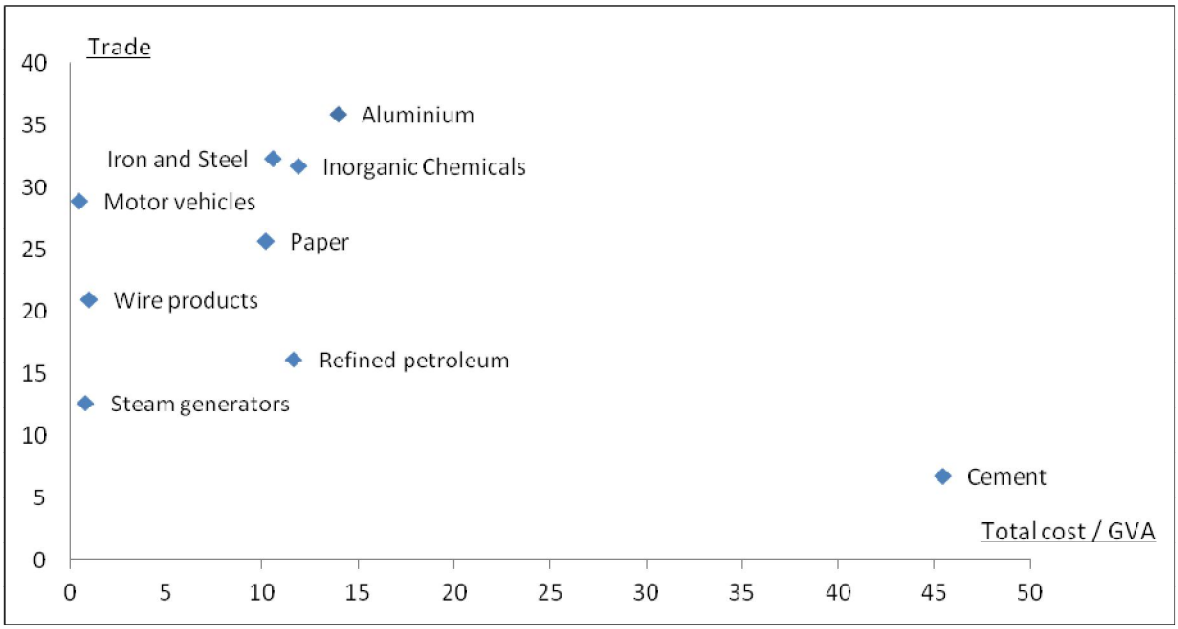
The most-often cited sectors and products that are potentially at risk of carbon leakage include:

- Cement
- Aluminium
- Iron and steel
- Paper
- Refineries
- Chemicals[1]

A number of studies point to these sectors as being at risk from carbon leakage and are discussed below. The criteria that are used most often in evaluating the risk of carbon leakage are the significance/relative importance of the cost of carbon and trade intensity.

The European Commission uses these two criteria in evaluating the risk of leakage and the sectors mentioned above are plotted in Figure 6 using data from Annex II of the 2009 Impact Assessment for ETS costs over Gross Value Added (GVA) and trade exposure.

Figure 4. Selection of sectors plotted by trade exposure and total ETS costs/GVA



Note: Sectors at NACE-4 code level.

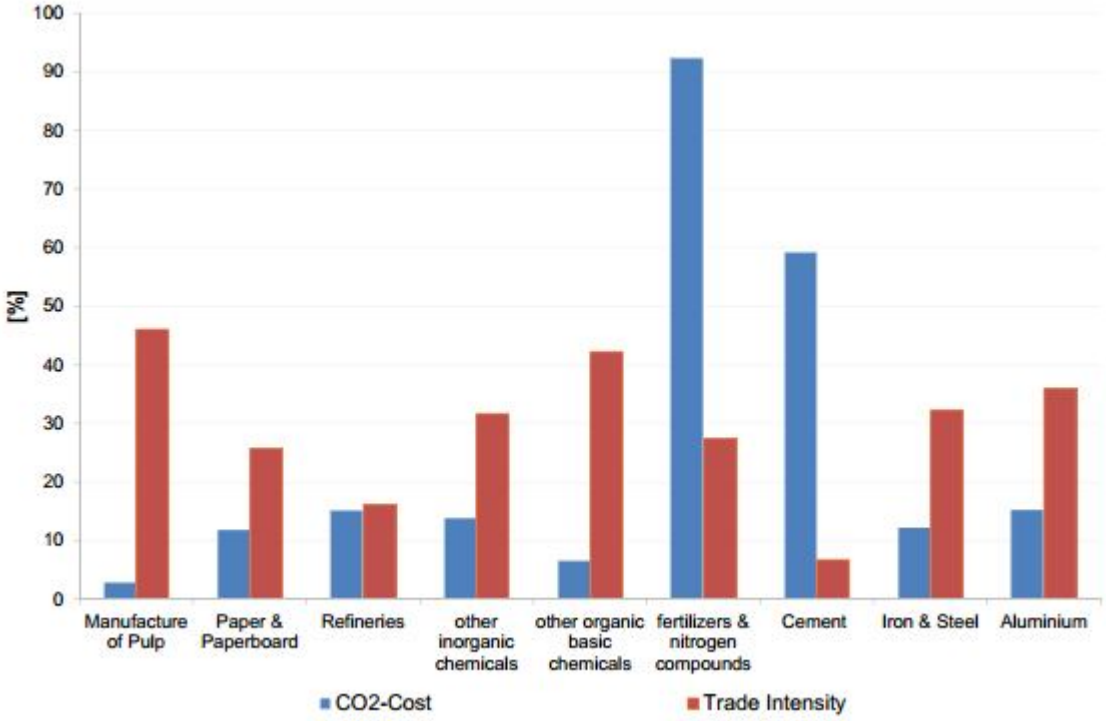
Source: Authors' elaboration on Annex II of the Impact Assessment accompanying the initial EU ETS Carbon Leakage List (European Commissions, 2009a)

[1] Not all chemical sectors are covered by the EU ETS. It does include e.g. Acids and bulk organic chemicals.

The EU used these results to determine which sectors were placed on the initial EU ETS carbon leakage list in 2009 and to show those sectors grouped that meet the criteria devised. Some extremes, on one dimension, such as cement, are included in the diagram in recognition of the extreme impact that carbon costs may have.

Figure 5 shows exposure to leakage in a different way, also using the quantitative assessment conducted by the European Commission (European Commission, 2009a).

Figure 5. Quantitative assessments of the main sectors at risk of carbon leakage



Note: Column on the left denotes CO_2 cost and the column on the right, trade intensity.
Source: European Commission (2009a).

Most of the data that shows sectors at risk come from ex-ante models to assess the impact of the EU ETS on carbon leakage in different sectors. There is limited ex post information, some of which is discussed in section 6.2 of this paper.

According to Ecofys (2013), the potential scale of carbon leakage in the literature ranges from 2 to 73%,[2] for sectors covered by EU ETS. The higher rates are often associated with higher carbon prices and no preventive measures such as free allocation.

Moreover, the higher rates seem to be associated with simpler assumptions, such as homogenous products. The assessments with lower rates tend to assume low carbon prices and preventive measures such as free allocations.

For cement, there have been a number of ex-ante studies that indicated that significant leakage could be expected. The order of magnitude obtained for leakage in these models depends on modelling assumptions, i.e. 14% for steel and non-metallic mineral products (which includes cement, glass and ceramics) in Fischer & Fox (2012), 50% in Demailly & Quirion (2008) and 70% in Ponssard & Walker (2008).

[2] The emissions increase in non-regulated jurisdictions is relative to reductions in regulated jurisdictions.

With respect to steel production, ex-ante studies by Ritz (2009) show that leakage could register between 9 and 75%, depending on assumptions on elasticity of demand and room for improving carbon efficiency in that sector. Higher levels of possible improvements in carbon efficiency and more rigid demand for steel lead to lower leakage risks. Dröge and Cooper (2010) see a leakage risk of up to 39% to 2016, under certain assumptions (including full auctioning and no carbon pricing implemented by major trading partners).

In the case of aluminium, not many ex-ante studies can be found. The work of Dröge and Cooper (2010) shows a risk of aluminium leakage of 21% to 2016.

However, Droege and Cooper (2010), for example, believe that too many sectors appear on the list of sectors exposed to carbon leakage, due to inadequate choice or indicators and/or too low thresholds in the assessment. As an illustration, many sectors qualify based on the trade-intensity indicator, which implies that this threshold may have been set too low (Ecofys, 2013).

3. Leakage provision in current, proposed and contemplated carbon-pricing mechanisms

This section reviews the anti-leakage provisions for existing and emerging carbon-pricing mechanisms. In-depth research was conducted for this paper on nine main mechanisms for carbon-pricing – the EU ETS, Australia, California, New Zealand, Quebec, South Korea, China, RGGI and the Waxman-Markey bill. A separate Fact Sheet was prepared on each mechanism and appended in the Annex to this paper.

This section also includes an Overview, which summarises and analyses the provisions in each of the systems researched and reviewed on the basis of a number of key axes:

- Leakage list and free allocation
- Compensation and support measures
- Offsets
- Linking

In general, provisions for carbon leakage can be divided into two main groups those whose actions can be implemented unilaterally and require little or no international cooperation, and those measures whose application requires significant international cooperation.

Purely domestic or unilateral actions could include free allocation based on benchmarks, free allocation based on output levels or revenue-recycling measures. The latter could either be unconditional or tied to innovation efforts.

Purely domestic measures may need to be complemented by others that may have a broader range and also cover impact on exports. Among the measures that have been repeatedly referred to and that have international implications are border-tax adjustments, import quotas and technical regulations and standards.

One example that has been at the centre of discussions recently is the set of measures aimed at aviation and maritime transportation. Since 2012, emissions from international aviation are included in the EU ETS. However, in 2013, the EU decided to suspend enforcement on flights from or to non-European countries, to allow the International

Civil Aviation Organization (ICAO) to reach a global agreement on tackling aviation emissions.

In June 2013, the European Commission set out a strategy for integrating maritime emissions into the EU's policy for reducing domestic GHG emissions. The strategy includes MRV (monitoring, reporting and verification) of CO_2 emissions from large ships using EU ports, GHG reduction targets for the maritime transport sector and further measures, including market-based measures, in the medium to long term.

Aviation and maritime transportation are international sectors and should be a case study on how different jurisdictions can cooperate to avoid carbon leakage. The difficulty the EU is facing is a good example of the complexity of addressing this issue at the national level.

We would like to conclude with by highlighting several issues. One is that this paper does not review or assess the adequacy of existing national solutions to address carbon leakage. The information is, and is intended to be, factual. Analysis of different options will be carried out in the second deliverable for this project mentioned in the Introduction.

The second remark concerns the anti-leakage provisions in different national programmes that are covered in this section. One category of measures addresses carbon leakage directly and covers sectors that are deemed to be at risk. A leakage list and free allocation fall in that category.

However, there are many measures that are broader in coverage and represent more general cost mitigation. Cost mitigation also helps prevent carbon leakage but its general objective is to minimise costs. International offsets are in this category, as they have other objectives related to the creation of a global carbon market, international negotiations, etc. In terms of addressing leakage concerns, offsets and free allocation can be seen as choices, in which case those that have obligations, if given a choice, will almost certainly opt for free allocation.

Finally, there are some measures that are even broader such as linking of carbon markets, which aim to create a level playing field but also contribute to good market functioning through increased liquidity.

3.1 Overview of carbon pricing mechanisms

The anti-leakage provisions in the existing and emerging carbon-pricing mechanisms are outlined in the Fact Sheets in the Annex. There are many common features, but also significant differences.

There are a number of other important dimensions in addition to the axes listed above. One of the most important provisions that needs be closely monitored is the predictability and stability of the measures. Are these measures here to stay? Do those who rely on them for investment decisions have a credible, long-term basis for making decisions? It is important to inquire whether the measures have sunset clauses, when the concept is up for review, and what elements need to be reviewed.

Accompanying and complementary characteristics would include the level of transparency and flexibility. How are these decisions made, how well they are understood, and how predictable is the process to stakeholders? These are other important features. Also, having strict and clear rules is important, but rarely do rules

provide for every circumstance. Consequently, having the flexibility to allow adaptation to changing circumstances and to incorporate additional factors in the decision-making process is also important.

The reasons for establishing carbon-market mechanisms/emissions trading schemes may vary, and this has an impact on the need for and treatment of anti-leakage provisions. The EU ETS is seen, by some, as a tool for encouraging transition to a low-carbon economy, which requires highly visible carbon prices. Leakage has therefore been an important element in the discussions and is becoming more so. In California, the cap-and-trade (C-T) mechanism is seen as a residual mechanism for complementary measures, and seems to have set a low visible price for carbon as an objective.

The New Zealand ETS was set up to ensure that the country reached its Kyoto commitments in a cost-effective manner. The system does not cap free allowances and has no limits on offsets. Transitional measures are also in effect: free allocation does not decrease on an annual basis, and several sectors need only surrender one allowance for every two tonnes of emissions produced.

Finally, the carbon-pricing mechanisms and their anti-leakage provisions must be also looked upon from the perspective of time. As more is known, and as carbon prices play a more significant role in competitiveness, provisions to address the threat of carbon leakage seem to bubble up to the top.

3.2 Leakage lists and free allocation

There are significant differences between the reviewed carbon-pricing mechanisms with respect to how activities or sectors that are at risk of carbon leakage are identified. The EU ETS, the California C-T, Australia's CPM, Korea's ETS and the Waxman-Markey Bill in the US all use criteria based on trade exposure and energy or emissions intensity (EITE) to define sectors at risk.

Those sectors found to be at risk receive proportionally more free allocation. However, a wide variety of thresholds and definitions are used.

The Korea ETS and the EU ETS use similar wording to describe their three quantitative thresholds. Both systems consider a sector at risk (or 'significant' risk in the EU ETS language) if it is either very trade-intensive, very emissions-intensive or a combination of the two (with lower thresholds):

- Production costs increased by 5% and trade intensity is over 10% OR
- Production costs increased by 30% OR
- Trade intensity is over 30%.

There are however significant differences in how 'increased production costs' are defined. The EU leakage list includes both indirect and direct costs, while the Korean ETS expresses production costs solely in terms of direct costs: annual emissions of the sector times the price of allowances.

This combination of trade exposure and emissions intensity can also be found in the California C-T, which then leads to a classification in three distinct categories: *low, medium* or *high Leakage Risk*. Each classification leads to a specific level of free allocation and a specific slope of decreasing allocation.

The Australian CPM includes different tiers of free allocation for sectors at risk as well. However, in this system, sectors have to be found to be trade-exposed before an

emissions-intensity criterion is applied. It is based on this second criterion that sectors are then categorised as either *highly* or *moderately emissions-intensive activities.*

One important feature, which needs to be highlighted, is that contrary to the EU ETS and Korea's ETS, the level of emissions intensity is not based on production costs, but calculated as either tonnes of emissions over revenue (in millions of AUD – Australian dollars) or tonnes of emissions over value added (in millions of AUD).

The New Zealand ETS also uses a measure of revenue to define emissions-intensity, but drops any mention of trade exposure to decide which activities are eligible for free allocation. Free allocation is not only used to compensate for direct costs, but specific mention is also made of using it to compensate for decreased values of assets for businesses in the forestry and fishing sectors.

In terms of flexibility, only the EU ETS combines quantitative criteria with qualitative ones. If an activity has borderline values on the quantitative criteria mentioned above, a set of qualitative criteria can be considered. Of the nearly 160 sectors and sub-sectors on the leakage list only six were included on a qualitative basis.

Two of the mechanisms addressed in this study do not state clear thresholds for eligibility for leakage provisions. RGGI currently has no leakage provisions, although member states have added the subject to the workload for the coming years. There are no anti-leakage provisions in the EU ETS for the power sector as the interconnections outside the EU are not significant. In contrast, RGGI states are interconnected in the North American grid on the East Coast, and as such there is a danger of leakage in this case.

Quebec, which is member of the WCI, does have leakage provisions and a list of sectors that receive free allowances, but the process that resulted in the current list of sectors is not as transparent as it could be.

ETS-wide free allocation was used in the EU ETS and will be used in the Korea ETS to protect businesses from carbon costs ONLY during the first phases of the respective schemes.

One could speculate that free allocation programmes were copied from the carbon-pricing forerunner (the EU ETS), but free allocation is pervasive in the different carbon-pricing mechanisms under review in this paper and the similarities are superficial. Moreover, the mechanisms use very different methods and thresholds to identify which activities receive free allocation and how these allowances are distributed over time. As mentioned earlier, for example, the EU ETS is the only scheme that includes qualitative criteria and the Australian CMP and New Zealand ETS uses measures of revenue to define emissions intensity.

3.3 Compensation and support measures

A wide variety of compensation measures is included in the various carbon pricing mechanisms. These measures can be discussed from two points of view: who compensates and for what?

The EU ETS allows member states to compensate their domestic industry for indirect ETS costs. However, compensation measures require approval from the European Commission. This method could potentially lead to a fragmentation of compensation measures, and put a strain on the internal market. A significant feature is that the ETS is

an EU-wide programme, while a fundamental matter – how enterprises are compensated for indirect carbon costs – is handled at the member state level.

Australia and Korea implement a sectoral-driven approach. Direct funding or support for innovation and development is provided to specific sectors deemed at risk of leakage. These sectors are generally very emissions-intensive industries (for example, coal-fired generation and steel production) and are supported in their transition towards a low-carbon future.

Provisions in the Waxman-Markey Bill and the California C-T aim at alleviating electricity-price increases for consumers. The Waxman-Markey Bill provides support at the source by compensating electricity and natural gas distributers directly, while the California C-T compensates consumers themselves. Electricity distribution utilities are granted free allocation (initially 90% of 2008 emissions, declining to 85% by 2020). Those allowances must be auctioned, and the full auctioning proceeds are earmarked to compensate ratepayers.

3.4 Offsets

Offsets are included in all the schemes as a cost containment mechanism, but implementation varies significantly between schemes, primarily with respect to the types and quantities of offsets allowed. Every scheme analyzed in this paper uses both quantitative and qualitative restrictions for offsets.

In most carbon pricing mechanisms reviewed there is a clear trend of allowing progressively more offsets into the system as time passes. The EU is, in some ways, maybe as it is the longest and biggest system in the world, and the one that has made the CER market possible so far, the one exception to this trend.

In Phase 3 (2013-2020) fewer international credits will be accepted for compliance. In terms of credits for post 2012 project, only those originating from Least Developed Countries are eligible.

The quantitative restrictions allow offsets to be used until the quota for Phase 2 is used up, plus a small addition for Phase 3. The main reasons for this is the downwards pressure international credits have had on the price of EUAs, as well as the impact that CERs produced in emerging economies have on competitiveness. In the Australian CPM the opposite reasoning is prevalent: offsets are encouraged as a crucial cost containment mechanism.

Qualitative restrictions have two dimensions: geographical and environmental. From a geographical perspective domestic offsets are frequently allowed in greater quantities and earlier on. The EU, while it has provisions in the EU ETS for domestic offsets, has not yet operationalised that provision. It seems it is the only system that does not have domestic offsets, except as it may be provided under JI.

In the RGGI model and the China pilots, only domestic credits are accepted, with no indication that this will change in the nearby future. Korea ETS and Australia CPM do not allow any international offsets in their first periods, but from respectively 2021 and mid-2015 onwards these schemes open up to international credits. In the Australian case EUAs will be eligible for compliance from mid-2015 onwards, when the one-way link to the EU ETS was planned to be operational.

California and Quebec both have frameworks to accept limited international offsets (though they must originate in Canada, USA and, in the case of California, Mexico), but both the types and levels of acceptable international offsets are set to increase in the nearby future due to the upcoming link between both schemes.

The other side of qualitative limits is the restrictions used in terms of accepted protocols. Each mechanism has a list of accepted offset-protocols, but most have a clear mechanism to review and possibly accept new protocols. Offsets are not only linked to direct emission reductions, but frequently projects on forestry or ozone depleting substances are allowed.

3.5 Linking

At the moment two links are planned. Links can be either horizontally (between distinct jurisdictions) or vertically (between overlapping mechanisms within the same geographic area, but different levels of governance) (OECD, 2013). Both announced links are horizontal.

A recent OECD study seeks to quantify and model the potential advantages of linking between schemes (OECD, 2013b). The results show that linking can address some, but not all of the competitiveness issues arising from carbon pricing. Different levels of linking however lead to different results. The study reports that competitiveness and leakage effects from climate policies can be reduced in three ways:

- more countries act and/or link
- more emission sources are covered
- climate mitigation policy is harmonised across countries (via linking for example)

California and Quebec should link in 2014, but from a legislative point of view not all the necessary changes have been made in California. The California Air Resources Board is expected to approve the necessary measures at their next meeting in October 2013. Quebec has already streamlined its system to allow linking with California. No political hurdles remain for this full link and the first joint auction is proposed for January 2014.

The phase-by-phase linking between Australia and the EU was set to start mid-2015, but is now uncertain due to the new government in Australia. Draft legislation was released on the 15th of October to scrap the Carbon Pricing Mechanism altogether.

Three facets of linking are interesting. First, it provides a cost containment strategy for jurisdictions with high mitigation costs, for example in Australia. Second, it allows a bottom-up movement towards an international or even global carbon market. Finally, if two mechanisms are fully linked, the issue of carbon leakage between those two mechanisms disappears. One of the main findings of the OECD Environmental Outlook to 2050 is that macroeconomic and sectoral impacts of mitigation efforts are the largest when carbon pricing mechanisms are not linked (OECD, 2012).

3.6 Post-2020

A common denominator for all leakage provisions addressed in this paper is the lack of certainty towards the future, which could be an important issue for investment decisions and hence investment leakage. The respective leakage lists in the California and EU schemes run up to 2020 and from a legislative point of view leakage provisions

end there. Australia and New Zealand initially has a fixed rate of 1.3% yearly decrease in free allocation, but in New Zealand this rate was put on indefinite hold.

4. International climate change regime

Parties to the UNFCCC are working towards a new international climate change agreement, to be completed by 2015, and which will enter into force by 2020.

It must be expected that some aspects of the international climate change regime will have an impact on the domestic policies that countries will implement in order to meet their international commitments, including carbon-pricing policies.

While carbon leakage and competitiveness are not items negotiated under UNFCCC, it is important to identify those aspects of the global agreement that may translate into carbon leakage concerns.

Similarly, they way carbon markets will evolve globally post-2020 will also impact the discussions on carbon leakage. An outcome that will see a globally linked carbon market, with a global price of carbon, could start to address leakage concerns. A fragmented market, with different, or no carbon price in some jurisdictions, will result in increased stress regarding carbon leakage. As referred earlier, carbon costs is what will impact carbon leakage and competitiveness.

Two issues in the international agreement are likely to impact the stance of countries will take with respect to carbon leakage: clarity on commitments, and the instruments that are being used to meet those commitments.

With respect to commitments made by countries under a post-2020 international agreement, lack of clarity (KP had a clear base year and budgets) will increase suspicions over comparability of effort. The current agreement is profiling as much more heterogeneous, with everyone making some commitment in its own way. This makes these commitments more difficult to understand and compare.

The second aspect is that of the type of units or instruments that can be used for compliance with international obligations. As mentioned above, a fragmented and heterogeneous market is developing, with many mitigation units produced nationally, according to national protocols, and with an unknown mitigation value for international commitments.

The more decentralised the system, with each country able to decide on the type of units that it can use for international compliance, the bigger the uncertainty on the level of effort that individual companies and installations have to undertake.

Uncertainty on these dimensions could translate into lack of clarity, and reactions that will lead to measures oriented to avert what is perceived as policies that may lead to carbon leakage.

From an EU perspective, to eliminate or reduce concerns related to carbon leakage, a 2015 international climate change agreement would have, ideally, provisions for

- Global participation by all countries,
- Some link between the EU and the general level of ambition and
- The level of ambition of key trading partners.

5. Evolution and current situation

5.1 Evolution

Carbon leakage has been a significant topic of debate in all jurisdictions where a carbon pricing mechanism was introduced as part of the policies to address climate change. By observing the way these provisions were introduced, current provisions and parameters in different carbon pricing systems around the world, as well as the current issues that are emerging, we can draw a picture illustrating the evolution of thinking on this topic.

Carbon pricing has a special impact on society, and the economy, and it is different from its role model, SO_2 pricing in the US through cap and trade. It is much broader, multi-sectoral, global in nature, with very different abatement costs, with inter- and intra-generational reach, etc. Leakage impacts that emerge are slow to be recognised, as they may take time to become apparent, and the cause may be difficult to link to the effect. The result is an on-going debate, one that has evolved over time.

The discussion on carbon leakage has been ongoing since the start of the EU ETS. It has had distinct periods when work was more intensive. However, as mentioned, the EU ETS is by no means the only jurisdiction where anti leakage discussions have figured prominently. An interesting case to be examined is that of the proposed US federal cap and trade legislation, which the US Congress never approved.

5.1.1 EU discussion

In the EU ETS, some of the work was done when the EU ETS Directive was initially introduced, but it was not extensive. At that time, the concern over carbon leakage was not significant given the fact that during the first trading period, 2005-07, all allocation was free, and was based on historical emissions. There was a limited provision for auctioning, with the upper limit set at 5%. Some member states tested the auctioning process, but in a very limited way.

Cost containment, which was meant to keep cost of compliance down, and implicitly address leakage concerns, was also addressed through the linking Directive that was introduced in 2004. There were few limits in the linking Directive on the number and type of international offsets that could be introduced in the system.

In the second trading period, which spanned 2008-2012, little change was introduced. The cap for auctioning was raised to 10%. Some member states brought allowances to the market via auction. The amount of international offsets allowed in each National Allocation Plan (NAP) was proportional to the tightness of the cap through a complex formula that insured more access to “cheap” international offsets if the cap was set tight.

However, as the financial crisis unfolded and recession started to bite, emissions from capped installations declined, and with them the price of carbon to levels which, coupled with the free allocation, lowered the concerns about carbon leakage for the second trading period.

However, the EU ETS review that took place in 2008-2009, to enter into force in 2013 for the third trading period, brought the discussion over carbon leakage again into focus. Competitiveness and carbon leakage were significant elements of the review debate. This was mainly triggered by changes in P3 of the EU ETS which included significant increases in auctioning, the introduction of benchmarking as an allocation method for industry, along with a decreasing cap. However, because these P3 amendments

anticipated an international Agreement (Copenhagen COP 15) carbon leakage is not incorporated post 2020.

During this debate, industry had strong positions with significant interventions by various business associations and companies. One example of the type of concerns and examples that were provided during, and right after the review of the EU ETS in 2008-9, was the example provided by Hydro and that is captured in the box below, which shows the importance of the anti-leakage provisions adopted in the 2008-9 review.

Box 1. The effect of compensation measures for indirect costs on corporate decisions by Hydro with respect to the Neuss plant

In January 2009, the Corporate Management Board (CMB) decided to: "...initiate a procedure with the intention of closing the electrolysis and carbon plant at Neuss as soon as possible" since "….production is highly unprofitable and place a severe cash drain on Hydro".

However, the potential full closure discussion was overtaken by a discussion (June 2009) on partial closure due to continued dialogue with the German government on "full CO_2 relief for 2009, with the intention to continue through 2010-2012. A direct compensation for indirect CO_2 related costs is from 2009 up to 2012 will represent a de-facto early implementation of the compensation regime for indirect CO_2-costs opened up for in the ETS regime 2012-2020".

Signals from the German government included decisions on €40 million in support measures, stated to be worked to be fully conforming to EU rules.

These signals were taken on board by the Hydro CMB, and determined to be of vital importance for the continuation of production at the Neuss plant (July 2009 meeting).

Source: Internal communication within Hydro.

The initial proposal introduced by the EC included a provision for qualitative criteria to be included on the leakage list. There were no quantitative criteria included in the original EC proposal.

In the course of the co-decision process Member States, and especially the EU presidency held by France, asked for a more quantitative methodology, providing less political latitude. However, it must also be recognized that qualitative criteria could introduce more flexibility for a more thorough means of evaluating risk (it can look at abatement potential, market characteristics, etc.)

The carbon leakage list (CLL) was, and is, central to the anti-leakage provisions in the EU ETS. The dimensions that are considered for being included in the CLL are carbon intensity and trade intensity (see Annex 1, Factsheet 1). In doing the initial analysis, the position of different sectors in the EU energy intensive industries could be plotted against these axes (similar to Figure 6 above).

One key number that was used to test for inclusion on the CLL was a carbon price of 30 Euros (included in the Impact Assessment accompanying the package of implementation measures for the EU's 20-20-20 targets). At that time, given the evolution of carbon prices, this sounded like a very reasonable forecast, maybe even conservative.

The other factors, the combined 5% (CO_2 cost) and 10% (trade exposure), came from an internal EC study. The 30% for carbon cost (as stand-alone test), was a more political choice, driven by the desire to ensure that certain sensitive industrial sectors, with a high cost of CO_2 were included.

The additional 30% test for trade intensity was enshrined to same degree to ensure symmetry with carbon costs. It now seems as having been an overreach.

5.1.2 USA discussion

The discussion in the USA and elsewhere (Australia, Korea, California) followed after the EU experience. Superficially, one may conclude that other jurisdictions have adopted similar approaches. However the debate was very much driven by local conditions and priorities, which differ from the EU by virtue of the type of economy, political systems arrangements, cultural and political realities, etc.

In the US a good example is the Lieberman/Warner America's Climate Security Act was debated, but not passed, in June 2008. This act included a number of provisions designed to address competitiveness concerns that were increasing in the US, especially as China, and other emerging economies, which are strong economic competitors (as outlined in Chapter 3), would not have to face similar carbon related costs.

Some of these measures included at that time in this proposed legislation included:

- Cost containment mechanisms, such as free allocation of allowances, the ability to bank and borrow allowances, provisions for the use of offsets and price caps on allowances on the market.
- Trade measures: mechanism that address trade disadvantages, border carbon adjustment (BCA)

Table 3 below illustrates the evolution of the Lieberman-Warner Bill from the committee stage, to when it was introduced in the Senate, and the diverse interventions that emerged during that period.

Table 3. Evolution of the Lieberman-Warner Bill

Provisions	2007 (S 2191)2	2008 (S 3036)
Emission Reduction Target	15% below 2005 by 2020	Same
Free allowances	73% of allowances free in 1st year (majority going to large stationary sources). Gradual removal of free allocation to full auctioning by 2031.	Same
Banking and borrowing	Carbon Market Efficiency Board can ease restrictions on borrowing	Reserve of portion of future allowances that would be released in 2nd auction if prices rise above expected levels. Floor price set by EPA of $22-30 in 2012 and rises at a real rate of 5% each year
Offsets	Board can increase amount of offsets allowed. 15% from domestic offsets (agr. and forestry) 15% from linkage with Emissions Trading Systems in EU etc.	10% allowed for international forestry credits 5% for international project-based credits 15% for domestic offsets
BCA	International allowances required for importers from 2020	Brought forward to start from 2014

Source: Ellermann et al. (2009).

A key component was the Carbon Market Efficiency Board, which could undertake a lot of measures to impact market functioning such as tighten or ease banking or borrowing, etc.

A number of aspects were introduced from other proposed federal cap and trade bill, such as the as the requirement that importers purchase allowances from a separate international allowance pool. This provision could be triggered if the relevant trading partner had not adopted "comparable efforts to reduce emissions by 2020". However, a key plank for some industrial stakeholders, the safety valve or price cap, was not imported from other bills under consideration.

One conclusion that needs to be internalised is that, at the time of the discussions over a Federal cap-and–trade bill, there seemed to be a broad consensus in the US regarding the introduction of a BCA. When that discussion returns a BCA is likely to be a starting point for discussion.

5.2 Current Debate

In 2013, carbon leakage and the CLL have again become central in the EU, given the confluence of issues over carbon pricing and climate change that are currently being debated. They include:

- Backloading
- EU ETS structural reform
- 2030 Energy and Climate Framework, including overlapping policies
- Review of the CL list by 2014
- 2015 international agreement
- Linking to Australia

One issue that needs to be identified is that there are two streams that are being discussed. One stream seems to aim to "fix" the EU ETS, whether by short-term fix, such as back loading, or longer term, more structural measures. What short term and long-term have in common is the perception among some stakeholders, and especially industry, that their final aim is to lift carbon prices in the EU ETS.

The second activity, the review of the carbon leakage list, will have to be completed by the end 2014. It is a mandated review of the data and assumptions that underpin the algorithm for being on the carbon leakage list, and receiving free allowances. It could be modifying certain parameters, with the result of removing a significant number of sectors and products from the carbon leakage list. The criteria themselves will remain the same. If a sector is dropped from the carbon leakage list the impact is the loss of an average of 50% of free allocation for the five-year period between 2015 and 2019 (European Commission, 2011a)

Some industrialists perceive both of these streams as potentially working in the same direction in terms of disadvantaging industry, which is already concerned with competitiveness due to a number of other factors, such as energy costs, etc.

Some level of stress exists between, on the one hand, the wish to keep a low carbon price, and on the other hand the desire to maintain the same carbon leakage list devised for a €30 price level.

The relationship between carbon price and carbon costs and the importance for the industrial base – and how these two strands interact– do not seem as well appreciated and understood as they should be.

The discussion can be also seen as driven by two other important aspects. Firstly, due to a number of external conditions, many of the sectors under the ETS were left with a significant surplus of allowances provided for free during the second trading period. This lead to a perception, which is possibly inaccurate, of a windfall for these sectors, and elicited strong criticism from NGOs, especially at a time when the leakage list is under review. This is putting pressure for a stricter review of who is in danger from carbon costs and should be included in the carbon leakage list

Secondly, and as mentioned earlier in this paper, emerging systems, or existing systems that have started operation recently, all have anti-leakage provisions. It is, however, virtually impossible to judge their effectiveness due to their limited time of operation, the resulting lack of data, external conditions and the free allocation that existed for many installations in the EU ETS until the end of 2012.

5.2.1 Ex-post results

However, most ex-post studies, limited as they may be, seem to indicate little or no carbon leakage – and force the question: Is carbon leakage a real problem or is it overblown? As expected, any substantive discussion will be around the largest and longest operating carbon-pricing mechanism, the EU ETS.

As discussed most of the analysis on carbon leakage was been done from an ex-ante point of view. This has resulted in forecasts of the type and magnitude of carbon leakage that can be expected from the EU ETS.

At this time there is very little empirical evidence of the impact of carbon prices from the EU ETS on the industrial sectors discussed in Chapter 3 as being most exposed to risk of carbon leakage. A number of empirical studies are now emerging, including work that shows the indirect impact of the ETS carbon price on electricity prices, as well as others that refer directly to the impact of the EU ETS on products such as cement, steel, and primary aluminium. Table 4 below presents a selection of Ex-ante and Ex-post studies on carbon leakage.

Table 4. A selection of Ex-ante and Ex-post studies on carbon leakage

Study	Ex-ante/ Ex-post	Sectors/geography coverage	Estimated carbon leakage rates from EU to non-EU (%)
Grubb and Counsell, 2010	Ex-ante	Electricity, steel, cement and aluminium/UK, US Poland and the EU	0-39
Demailly and Quirion, 2008	Ex-ante	Cement/Global	0-50
Ponssard and Walker, 2008	Ex-ante	Cement/Western European	70-73
Ritz, 2009	Ex-ante	Steel/EU ETS	9-75
Chan, Li and Zhang, 2012	Ex-post	Power, cement, iron and steel/EU ETS	For cement, iron and steel; no evidence of carbon leakage
Ellerman, Convery and Perthius	Ex-post	Oil refining, aluminium, iron and steel, cement	No observed impact in the oil refining, cement, aluminium or steel
Sartor, 2012	Ex-post	Aluminium	No strong evidence for leakage

Ex-post studies have generally concluded that there was no leakage (Ellerman et al, 2010; Chan et al, 2012). The factors that have been put forward to explain this discrepancy are the following ones:

- The high level of free allocations
- Strategic barriers to trade
- Large fluctuations in the level of CO_2 prices and/or low CO_2 prices

In the case of aluminium, an ex-post the study by Sartor (2012) shows little evidence of leakage for the aluminium industry.

It has also been empirically observed that the relative EU level of economic activity has significantly influenced the trade flows.[3] Climate policy (and regulatory uncertainty) in the EU certainly has had an impact on investment, together with other factors, such as social costs and energy costs.

Since investments generate capacity constraints, which trigger imports, climate policy should be expected to have a significant long-term impact on leakage. Such an analysis remains to be done.

Recent work done by CEPS for the EC looking at the impact of ETS prices on steel and aluminium is also very relevant, and discussed below.

With respect to aluminium, Table 5 below shows the impact of ETS cost on productions costs for the period 2005-2012, as well as the impact of ETS cost on EBIDTA. The figures show that the impact of ETS on aluminium production can be seen as significant. The figure refers only to indirect and admin costs, as aluminium was not included in the ETS until the start of Phase 3.

The large variation in the ETS costs/EBITDA (Earnings Before Interest, Taxation, Depreciation and Amortization) ratio is explained by two factors. First, the strong fluctuations in the price of allowances in the period analyzed. Secondly, the economic fluctuations, with a boom in 2006-2007, and a strong downturn starting in 2008 also contribute to these results.

Table 5. Aluminium ETS costs as a proportion of production costs and EBITDA

Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
ETS cost/ production costs	*11%*	*8%*	*0%*	*10%*	*7%*	*6%*	*6%*	*3%*
ETS costs/ EBITDA	*38%*	*18%*	*1%*	*51%*	*99%*	*27%*	*30%*	*43%*

Source: Authors' elaboration on Renda et al. (2013a).

For steel, Table 6 below shows ex-post data in terms of the impact of direct and indirect costs of ETS on the steel industry, relative to EBIDTA. The steel industry was included in the EU ETS from the beginning, and as such some of the indirect costs were balanced, with the historical free allocation used in P1 and P2. Impacts in this case are less strong than in the case of aluminium.

[3] This has been pointed out in Hourcade, J.-C., Demailly, D., Neuhoff, K. and Sato, M., 2008. *Differentiation and dynamics of EU ETS competitiveness impacts: final report*, Report, Climate Strategies, Cambridge, section 3, 60-93 and recently econometrically tested in Branger, Quirion and Chevallier, 2013, *Carbon leakage and competitiveness of cement and steel industries under the EU ETS: Much ado about nothing*. CIRED Working Paper.

Table 6. Steel ETS costs as a fraction of EBITDA

Period	P1	P2
BOF ETS costs/EBITDA	0%	-9%
EOF ETS costs/EBITDA	5%	12%

Source: Authors' elaboration based on Renda (2013b).

Table 7. Steel total energy cost as a fraction of EBITDA

	2010	2011	2012
EAF-WR	116.6%	105.8%	108.8%
BOF-HRC	45.5%	43.7%	52.6%

Source: Authors' elaboration based on Egenhofer et al. (2013).

Table 7, is included to compare the impact of ETS and energy costs on EBIDTA. It is clear that energy plays a much more dominant role in the cost structure than carbon, and points to the relatively low impact of ETS.

5.2.2 What does the future hold?

In addition, there is continued uncertainty and a lack of clarity on what the provisions of the 2015 international agreement will look like, and whether other national jurisdictions will also impose a comparable carbon cost on industries that compete globally.

It is therefore to be expected that there is an increase in the interest on how carbon leakage will be addressed in the EU to 2020, and beyond. It must be noted that the EU ETS Directive is silent on the fate of the current anti-leakage measures post-2020.

In addition, the current debate in the EU over carbon leakage is also being influenced by what has been learned from other jurisdictions. In a changing and globalised world, where the IPCC has again signalled urgency through its Fifth Assessment report the EU cannot be indifferent on how carbon pricing (or the absence of), and anti-leakage provisions, are treated by its competitors. Analysis shows different approaches and priorities in other jurisdictions, which is true in terms of:

- Priority to address climate change (leading with energy or climate policies).
- Addressing interaction between the EU ETS and other policies and measures that impact climate change and the price of carbon. These policies overlap and the lack of active coordination and will impede the carbon price signal.
- Decision on the role that carbon pricing plays in climate policy. Carbon pricing is, and must be seen, as a tool for price discovery, but it cannot be expected to do everything. For example, the California 'complementary measures' are doing the heavy lifting to ensure GHG reductions, while the ETS is seen, to some degree, as the 'safety precaution' in case those measures do not perform as expected. In comparison the primary mechanism for CO_2 reduction in the EU is the EU ETS. In addition, carbon markets are new, and their price signal, if left alone, will only have at this time certain relevance in the long-term.

Concerns regarding carbon leakage are not about the past, but about the future. As discussed, current data do not seem to indicate that carbon leakage has been a decisive, or even influential factor, but the ex-post analysis is just now taking place, and the information is emerging. In addition, as mentioned before, existing studies cover direct carbon costs and do not include indirect costs. It is also mostly directed towards production leakage.

At the same time, it is difficult to tell to what extent the future will be a reflection of the past, given the changes in variables during the second trading period (P2), and the fact that in many ways the EU ETS in the third trading period (P3) and beyond, may look very different.

The outcome of current discussions that are shaping the future of EU climate policy and of the EU ETS, as with every political negotiation, is far from certain. The same is true about the international climate regime that will be in place post-2020, the global economy, etc.

The EU ETS P1 and P2 were seen, to some degree, as very important and useful tests, and a way to understand the impact of carbon pricing on the economy, trade flows, carbon leakage, etc. The largest experiment with carbon pricing, the EU ETS, was run with dramatically changed external conditions in terms of key parameters, including:

- Changes in global GHG emissions patterns,
- Changes in the global economic order and a
- Departure from key assumptions on energy price data.

In addition, sourcing and investment decisions are rarely, if ever, made on the basis of one variable alone, but a combination of many factors, each carrying a weight, which will vary from occasion to occasion.

The past may not be a good indicator of the future and therefore provisions must be available to address carbon leakage in a flexible way, which will work under different scenarios. Many issues may change in the future such as:

- More stringent caps
- Higher price for carbon in the EU and internationally
- Shrinking amount of free allowances available (in 2013 at 809,315,756) as it declines at a rate of 1.74% a year, resulting in lower free allocation for those that are on the leakage list
- Economic recovery and growth
- A new international climate change regime with contributions from all
- Carbon pricing at the domestic level in different jurisdictions – Is this going to become a reality or a perpetual promise?
- Evolution and prices in energy markets. The EU has a certain structure for energy markets and energy prices are very much aligned with that model. In many jurisdictions energy prices are negotiated and not the result of market forces which have also a significant influence on competitiveness. Note that indirect costs can be alleviated by self-generation, contracts with carbon-neutral generators or long-term contracts. Long-term contracts are important for large baseline consumers (such as primary aluminium plants) and although these are allowed in the EU, there are strict conditions imposed by case law. Many long-term contracts are due to expire between

2014 and 2016, which will expose large industrial electricity consumers to the carbon price embedded in their electricity.

Now is the time to understand what are the options for the future as safety measures to prevent carbon leakage. The key questions to explore are:

- What are the options?
- What are the criteria by which to judge those options?
- How does each option stack up against these criteria?

Bibliography

Australian Government Department of Climate Change and Energy Efficiency (2011a), "Clean Energy Act 2011" Act No. 131, Canberra, November.

_____ (2011b), "Assessment of activities for the purposes of the Jobs and Competitiveness Program, Guidance paper", Canberra, September.

Baron, R. and S. Bygrave (2002), "Towards International Emissions Trading: Design Implications for Linkages", OECD/IEA Publishing, Paris

Bloomberg New Energy Finance, Ernst and Young (2013), "White Paper on South Korea's emissions trading scheme", May.

Boneva M. (2013), "Carbon Leakage: new list 2015-2019". Presentation by DG Clima (unit B.2) at the Stakeholder consultation meeting on the 23rd of May, 2013.

Branger, F., P. Quirion and J. Chevallier (2013), "Carbon leakage and competitiveness of cement and steel industries under the EU ETS : much ado about nothing". CIRED Working Paper.

Burtraw, D., D. McLaughlin and S.J. Szambelan (2012), "California's New Gold, A primer on the use of allowance value created under the CO_2 Cap-And-Trade Program", Resources for the Future Discussion Paper, Washington DC, May.

California Air Resources Board (2006), "Assembly Bill 32: An act to add Division 25.5 California Global Warming Solutions Act (commencing with Section 38500) to the Health and Safety Code, relating to air pollution.", Sacramento, 27.09.2006.

_____ (2012), Public Workshop on "Cap-And-Trade Program: Emissions Leakage, Research and Monitoring", 30.07.2012.

_____ (2013), "Article 5. California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms", Sacramento, July.

California Environmental protection Agency (2013), "Overview of ARB Emissions Trading Program".

California Cap-and-Trade Program (2012), Public Workshop on Emissions Leakage Research and Monitoring.

Center for Climate and Energy Solutions (2013), "California Cap-And-Trade Program Summary". Arlington Virginia.

_____ (2013), "Comparison chart of Waxman-Markey and Kerry-Lieberman".

Chan, H. R., S. Li and F. Zhang, (2012), "Firm Competitiveness and the European Union Emissions Trading Scheme".

Convery F., A.D. Ellerman and C. de Perthuis (2008), "The European carbon market in action: lessons from the first trading period", Interim Report No. 162, the MIT Joint Program on the Science and Policy of Global Change, Cambridge MA.

Demailly D. and P. Quirion (2008), "Changing the Allocation Rules in the EU ETS: Impact on Competitiveness and Economic Efficiency".

Denne, T. (2011), "Impacts of the NZ ETS on Emissions Leakage". Covec Report, written for the Ministry for the Environment.

DG Clima Action website (2013), Carbon Leakage, http://ec.europa.eu/clima/policies/ets/cap/leakage/index_en.htm (2013-11-05)

Drew, A.J. (2010), "Two Directives, Two Politics – Prospects for the EU ETS", Law, Society and Economy Working Papers, London School of Economics, Law Department, London.

Droege, S. and S. Cooper (2010), "Tackling Leakage in a World of Unequal Carbon Prices", study conducted by Climate Strategies for the Greens/EFA Group.

Droege, S. (2013), "Carbon pricing and its future role for energy-intensive industries, Key features of steel, cement, aluminium, basic chemicals, pulp and paper", Climate Strategies

Ecofys (2013), "Support to the Commission for the determination of the list of sectors and subsectors deemed to be exposed to a significant risk of carbon leakage for the years 2015-2019 (EU Emission Trading Scheme)", Final Report.

EDF and IETA (2013), "The World's Carbon Markets: A Case Study Guide to Emissions Trading", Environmental Defense Fund and the International Emissions Trading Association.

Egenhofer, C., A. Marcu, J. Pelkmans, L. Schefler, G. Luchetta, F. Simonelli, F. Genoese, V. Rizos, S. Roth, F. InfeliseJ. Wieczorkiewicz, W. Stoefs, L. Colantoni, J. Timini, (2013), "Study on composition and drivers of energy prices and costs in energy intensive industries: The case of the xhemicals industry (Ammonia, Chlorine and Ethylene), the ceramics industry (Bricks and Roof tiles, and Wall and Floor tiles), the glass industry and the steel industry," CEPS, Brussels, November.

Ellerman A.D., F. Convery and C. de Perthuis (2010), *Carbon Pricing, The European Union Emissions Trading Scheme*, Cambridge: Cambridge University Press.

Ellermann, C., P. Oliver and L. Xingyu (2009), Competitiveness and carbon leakage: Implications for China and the world".

European Commission (2009a), Commission Staff Working Document Impact Assessment accompanying Commission Decision C(2009)10251 final, SEC(2009) 1710 Final, Brussels, 24.12.2009.

_____ (2009b), Commission Decision determining a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage pursuant to Article 10a (13) of Directive 2003/87/EC, C(2009)10251 final, Brussels, 24.12.2009

_____ (2011a) Commission Decision determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (2011/278/EU).

_____ (2011b), Communication from the Commission to the European Parliament, the Council, European Economic and Social Committee and the Committee of the Regions on a Roadmap for moving to a competitive low carbon economy in 2050, COM(2011) 112 final, Brussels. 8.3.2011

_____ (2012), Commission Regulation amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-2020. (Also known as the Back-loading proposal)

_____ (2013a), Commission recommendation on opening formal negotiations for linking EU ETS with Australia (http://ec.europa.eu/clima/news/articles/news_2013012401_en.htm)

_____ (2013b), Communication from the Commission to the European Parliament, the Council, European Economic and Social Committee and the Committee of the Regions, The 2015 International Climate Change Agreement: Shaping international climate policy beyond 2020, COM(2013) 167 final, Brussels, 26.3.2013.

_____ (2013c), Green Paper A 2030 framework for climate and energy policies, COM(2013) 169 final, Brussels, 26.3.2013.

_____ (2013d), Commission launches stakeholder consultation of new carbon leakage list (http://ec.europa.eu/clima/news/articles/news_2013060601_en.htm)

_____ (2013e), Communication from the Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012 (SWD(2012) 130 final), OJ C 158, 5.6.2012, pp. 4-22.

European Council and Parliament (2003), Directive 2003/87/EC of 25 June 2009 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC OJ L 275, 25.10.2003, p. 32. Amendments included; Directive 2004/101/EC, Directive 2008/101/EC, Regulation No 219/2009 and Directive 2009/29/EC.

_____ (2009a), Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC OJ L 140, 5.6.2009, p.16-62.

_____ (2009b), Directive 2009/29/EC of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community OJ L 140, 5.6.2009, pp .63-87.

_____ (2009c), Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 OJ L 140, 5.6.2009, pp .136-148.

_____ (2012a), Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, OJ L 315, 5.6.2009, pp .1-56.

_____ (2012b), Report from the Commission to the European Parliament and the Council on The state of the European carbon market in 2012, COM (2012), 652 final, Brussels.

Fisher C. and A.K. Fox (2012), "Climate Policy and Fiscal Constraints, Do tax Interactions Outweigh Carbon Leakage?", Resources for the Future Discussion Paper

Grubb, M. and T. Counsell (2010), "Tackling carbon leakage, Sector-specific solutions for a world of unequal carbon prices", Carbon Trust.

Hood, C. (2010), "Reviewing existing and proposed emissions trading schemes". IEA Information Paper.

Hourcade, J.-C., D. Demailly, K. Neuhoff, M. Sato, M. Grubb, F. Matthes and V. Graichen (2008), "Differentiation and Dynamics of EU-ETS Industrial Competitiveness Impacts: final report", Climate Strategies.

ICIS (2013), "EU 2020 oversupply forecast exceeds analyst expectations", http://www.icis.com/heren/articles/2013/10/09/9713881/emissions/edcm/eu-2020-oversupply-forecast-exceeds-analyst-expectations.html (2013-11-07)

IETA (2013), "A User Guide to Emissions Trading in China". Jeff Swartz, the International Emissions Trading Association, Paris.

IMF (2012), World Economic outlook , Growth resuming, dangers remain", Washington DC, April.

Intergovernmental Panel on Climate Change (2007), "Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change" (eds Metz, B., Davidson, O. R., Bosch, P.)

Lennox, J., J. Turner, A. Daigneault, K., Jhunjhnuwala (2013), "Regional, sectoral and temporal differences in carbon leakage".

Low, P., G. Marceau and J. Reinaud (2011), "The interface between the trade and climate change regimes: scoping the issues", World Trade organization Staff Working Paper, NO. 2011-1, WTO, Geneve.

Meunier G, S. Monjon and J.P. Ponssard (2011), "Competitiveness and Carbon Leakage in Unilateral Climate Polcies".

Monjon S. And P. Quirion (2010), "Addressing leakage in the EU ETS: Border adjustment or output-based allocation".

New Zealand (2012), "Climate Change Response Bill (Emissions Trading and Other Matters) Amendment Act 2012", Public Act 2012 No 89, Wellington, November.

OECD (2012), "OECD Environmental Outlook to 2050 (the Consequences of Inaction)", OECD/IEA Publishing, Paris.

OECD (2013a), "Climate and Carbon, aligning Prices and Policies", OECD Environment Policy Paper, October 2013 n°01, OECD/IEA Publishing, Paris.

OECD (2013b), "Addressing Competitiveness and Carbon Leakage Impacts arising from multiple carbon markets, A modeling assessment". Environment Working Paper No. 58. Authors: Lanzi EL, Mullaly, D., J. Chateau and R. Dellink.

Paltsev, S. (2001), "The Kyoto Protocol: regional and sectoral contributions to the carbon leakage". Energy Journal, 22(4), 53-79.

Pauwelyn, J. (2012), "Carbon Leakage measures and border tax adjustments under WTO law", in D. Prevost and G. Van Calster (eds.), Research handbook on Environment, Health and the WTO.

Ponssard J.P. and N. Walker (2008), "Capacity decisions and carbon leakage: the uncertainty effect", Climate Policy 8 (2008) 467-493

PriceWaterhouseCoopers (2012), Environmental Finance Report on South Korea "Emissions Trading: South Korea steams ahead", Changmin Yoo, Seoul, Autumn.

Öko-Institut, Fraunhofer Institute for Systems and Innovation Research, and German Institute for Economic Research, (2008), "Impacts of the EU Emissions Trading Scheme on the industrial competitiveness in Germany". Report on behalf of the Federal Environment Agency, UBA Climate Change 10/08. Dessau-Roßlau, September

Quebec (2011), "Regulation pertaining to the Cap-and-trade system for greenhouse gas emission allowances", Decree No 1297-2011, Quebec Official Gazette, Part 2, NO 50B on December 16.

Rahman, M.M. (2011), "The proposed carbon tax in Australia: impacts on income distribution, employment and competitiveness". University of Southern Queensland.

Renda. A., J. Pelkmans, C. Egenhofer, A. Marcu, J. Pelkmans, L. Schefler, G. Luchetta, R. Zavatta, E. Giannotti, G.M. Stecchi, F. Simonelli, D. Valiente, F. Mustilli, J. Teusch, F. Genoese, F. Infelise, J. Wieczorkiewicz, W. Stoefs, L. Colantoni, J. Timini, (2013a), "Assessment of Cumulative cost impact for the aluminium industry", CEPS and Economisti Associati, Brussels, November.

Renda. A., J. Pelkmans, C. Egenhofer, A. Marcu, J. Pelkmans, L. Schefler, G. Luchetta, R. Zavatta, E. Giannotti, G.M. Stecchi, F. Simonelli, D. Valiente, F. Mustilli, J. Teusch, F. Genoese,, F. Infelise, J. Wieczorkiewicz, W. Stoefs, A. Fumagalli (2013b), "Assessment of Cumulative cost impact for the steel industry", CEPS and Economisti Associati, Brussels, June.

Reinaud, J., (2008), "Issues behind Competitiveness and Carbon Leakage. Focus on Heavy Industries". IEA information paper.

_____ (2009), "Trade Competitiveness and Carbon Leakage: Challenges and Opportunities". Chatham House, London.

Ritz, R.A. (2009), "Carbon Leakage under incomplete environmental regulation: and industry-level approach, Discussion Paper, Department of Economics, University of Oxford.

Sartor, O. (2012), "Carbon Leakage in the Primary Aluminium Sector: What evidence after 6.5 years of the EU ETS?", CDC Climate Research Working Paper, CDC Climat, Paris.

Schleicher and Zeitlberger (2013), "Die österreichischen Anlagen in der ersten und zweiten Handelsperiode des EU ETS", Karl-Franzens-Universität-Graz, April.

Schyns, V. (2005), "Illustration of market distortions under a cap and trade regime. How to reduce emissions under PSR". Utility Support Group.

Spencer, T. C-A. Senit and A. Drutschinin (2012), "The political economy of Australia's climate change and clean energy legislation: lessons learned". IDDRI paper.

Steel Statistical Yearbook, (2000), International Iron and Steel Institute. Committee on Economic Studies, Brussels November 2000.

_____ (2003), International Iron and Steel Institute, Committee on Economic Studies, Brussels February 2004.

_____ (2012), Worldsteel Association, Economics Committee, Brussels.

Stiglitz, J.E. (2006), "A new agenda for Global warming", The Economists' Voice 3(7).

South-Korea (2012), "Act on the Allocation and Trading of Greenhouse-gas Emissions Allowances", Act No 11419, Seoul, May.

UN (1992), "United Nations Framework Convention on Climate Change", New York.

_____ (1998), "Kyoto Protocol to the United Nations Framework Convention on Climate Change", New York.

UNstat, Millenium Development Goals Indicator, (http://mdgs.un.org/unsd/mdg/Default.aspx).

US Environmental protection Agency (2013), "Proposed Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units", 40 CFR Part 60, Washington DC, September.

Vivid Economics (2010), "The implicit price of carbon in the electricity sector of six major economies". Report prepared for the Climate Institute.

Waxman-Markey Bill (2009), "American Clean Energy and Security (ACES) Act of 2009", H.R. 2454 of the 111th Congress, Washington DC, June.

WTO statistics database, http://stat.wto.org/Home/WSDBHome.aspx?Language=

Annex
Fact Sheets on Carbon Pricing Mechanisms

Factsheet 1: EU Emissions Trading Scheme (ETS)

Criteria for leakage provision		There are both quantitative and qualitative criteria in place. The quantitative criteria are based on cost increases due to the ETS and trade exposure (the precise criteria and thresholds are listed below). If an activity has borderline values after an assessment based on the quantitative criteria, several qualitative criteria can be taken into account. These qualitative criteria are also listed below.
Coverage of leakage provision		Approximately 160 sectors and sub-sectors are on the Leakage List. District heating and high efficiency cogeneration also receive free allocation, although they are not on the leakage list.
Cost-containment measures	**Free allocation**	Sectors and activities that are on the Leakage List receive 100% of the benchmarked allocation for free. Generally the product benchmarks are set at the average emissions intensity of production of the 10% least emissions-intensive installations at EU level. Free allocation for activities not on the List is currently set at 80% of the benchmark. This will decrease to 30% by 2020. There is currently no clarity on leakage provision post-2020. The explanation above simplifies the actual provisions of the cross-sectoral correction factor. This correction factor is uniformly applied to all free allocation to ensure that the sum of preliminary total free allocation (as submitted by member states) does not exceed the Union-wide limit.
	Offsets and linking	Linking negotiations are going ahead with Australia and Switzerland. Linking with Switzerland could be completed in 2014. The timeline for linking with Australia has become uncertain due to the change of government in Australia after the general election of 7 September 2013. Previously a one-way link was to be operational in 2015 and full linking in 2018. Offsets: post 2012 only CDM projects from LDCs are accepted. In addition, post-2012 CERs may not derive from industrial gas projects. In the current trading periods quantitative limitations apply. Installations that received free allocation or were entitled to use international credits over the period 2008-12 can continue to do so up to whichever of the following amounts is higher: a) The amount allowed in Phase 2 (2008-12) b) The amount corresponding to 11% of its allocation in Phase 2. Stationary installations that did not receive free allocation or were not entitled to use international credits in Phase 2 shall be entitled to international credits in the period 2008-20 to cover a maximum of 4.5% of its verified emissions over the period 2013-20. These limitations translate into a quantitative cap of around 1.6-1.8 billion (projection from ICIS) CERs and ERUs than can be surrendered before 2020.

	Measures to address price volatility	A measure is in place to respond to 'excessive price fluctuations'. If, for more than six consecutive months, the allowance price is more than three times the average price of allowances during the two preceding years, a meeting of the Climate Change Committee shall be convened. This Committee can implement two measures (if the high price is not due to changing market fundamentals): 1) Bring forward the auctioning of a part of the total allowances to be auctioned 2) Auction up to 25% of the allowances in the new entrant's reserve. Structural reform discussion is currently underway; one option on the table is a supply side flexibility mechanism, which might be in the form of an allowance reserve.
	Banking	Unlimited banking is allowed, although this was not the case between Phase 1 (Pilot Phase 2005-07) and Phase 2 (2008-12). Borrowing is allowed to some degree, because allocation for the following year is made before allowances have to be surrendered for the previous year.
Compensation and support measures		State-aid guidelines allow member states to compensate domestic industry for indirect costs (incurred due to increased electricity prices caused by the EU ETS). Those compensation measures shall be based on ex-ante benchmarks of the indirect emissions of CO_2 per unit of production. The European Commission needs to approve any compensation falling in the scope of these guidelines. Member states also have the option to issue transitional free allocation for the modernisation of electricity generation, although under strict conditions.
Review mechanism for leakage provisions		Leakage List is reviewed every 5 years, this review not only looks at the list itself, but also the criteria and mechanisms used while compiling the list. The first review is currently ongoing and is scheduled to be finalised by the end of 2014. Every year, (sub-) sectors can be added if it is demonstrated that a (sub-) sector fulfills the criteria below. The initialisation of this sectoral review can be done by the European Commission or at the request of a member state.
Complementary measures		Among the most prominent complementary measures in the EU are the two other pillars of the 20-20-20 target (the first pillar reducing GHG emissions): a Renewable Energy target of 20% by 2020 and an Energy Efficiency target of reducing primary energy consumption by 20%.

Additional Notes:

EU ETS leakage list criteria

If an activity fulfils any of the following three thresholds, they are added to the leakage list:

a) Direct and indirect costs increase production costs by at least 5% of gross value added **and** trade intensity (calculated as the value of imports plus exports over annual turnover plus imports) is over 10%,
b) Direct and indirect costs increase production costs by at least 30% or
c) Trade intensity is over 30%.

Please note that for the calculations of ETS-related costs a price of €30 per EUA was considered. This price might also be reconsidered during the ongoing review of the leakage list.

If a sector has borderline values on the quantitative criteria, then the following qualitative criteria can be considered:

a) Emissions levels and electricity consumption reduction potential of individual installations in the sector,
b) Current and projected market characteristics and
c) Profit margins as an indicator of long-term investment or relocation decisions.

The focal point of the approach to leakage in the EU ETS is the leakage list. Sectors and activities on this list receive a larger proportion of free allocation (with respect to their compliance obligations) than sectors that are not on the list. If an installation is among the most carbon-efficient entities in the sector and production has not increased beyond production in the reference years (the three most-recent years for which data are available), that installation receives full free allocation (if we do not take the cross-sectoral correction factor into account).

The leakage list itself is, however, extremely long and covers a very wide variety of activities.

Factsheet 2: Australia Carbon Pricing Mechanism (CPM)

This analysis is based on the CPM as it was proposed and implemented before the Australian general election of 7 September 2013. The new Conservative government has indicated it will attempt to repeal the CPM. Draft repeal legislation was released for public comment on 14 October 2013. The repeal legislation will be introduced into Parliament in its first sitting week (early November) but may not be able to be passed until changes to the composition in the Senate occur on 1 July 2014.

Criteria for leakage provision		Industry must be Emissions Intensive and Trade Exposed (EITE) industries. • Trade exposed: Sum of imports and exports is larger than 10% of domestic production for sector or product in one of the financial years 2004-05, 2005-06 or 2007-08; or there being a demonstrated lack of capacity to pass through costs due to the potential for international competition. • Emissions intensity defined over either industry revenue or added value: Highly emissions-intensive activities: At least 2,000 tCO_2e emissions per million AUD revenue or 6,000 tCO2e emissions per million AUD of value added Moderately emissions-intensive activities: At least 1,000 tCO_2e emissions per million AUD revenue or 3,000 tCO_2e emissions per million AUD value added Allocation for both categories declines by 1.3% yearly.
Coverage of leakage provision		Moderately emissions-intensive activities: 15 sectors on list. Highly emissions-intensive activities: 34 sectors on list.
Cost-containment measures	**Free allocation**	'Jobs and Competitiveness' programme: Output-based free allocation, linked to historical industry-average emissions for EITE industries: Moderately emissions-intensive activities: 66% free allocation Highly emissions-intensive activities: 94.5% free allocation Liquefied natural gas receives 50% of allocation for free. Energy Security Fund: Coal-fired generators with emissions intensity above 1.0 tCO_2/MWh collectively receive 41.7 million permits annually for four years.
	Offsets and linking	Linking negotiations had been progressing with the EU ETS and Australian legislation passed to facilitate such linkage (2015-18 one-way linking, after 2018 full link). A review of linking options with the NZ ETS has also been conducted. Linking is seen as a key cost-containment mechanism. Domestic offsets: Carbon Farming Initiative (CFI), a scheme aiming at sequestering carbon via agriculture or reducing emissions from land-use. Quantitative limit on offsets from CFI is set at maximum 5% of compliance obligation till mid-2015. There is no limit after mid-2015. International credits can also be used from mid-2015 onwards up to a maximum of 50% of an entity's compliance obligations. The limits for CERs and ERUs have been announced at maximum of 12.5% of an entity's compliance obligation. Another source of international units are EUAs (after the linking to the EU ETS).

	Measures to address price volatility	First phase (mid-2013 till mid-2015) has a fixed price (23 AUD in 2013; increases to 25.40 AUD in 2015); allowances are to be bought directly from the government (and surplus allowances from free allocation can be sold to the government). Floating price with a price ceiling in Phase 2 (mid-2015 till mid-2018); price maximum is 20 AUD above the EUA price. The price ceiling is to be dropped after mid-2018.
	Banking and borrowing	Banking and limited borrowing of carbon units is allowed in the flexible price period to enhance the efficiency of the carbon market. Unlimited banking of carbon units is allowed in the flexible price period.
Compensation and support mechanisms		5.5 billion AUD Energy Security Fund was originally available for coal-fired generators through a "contracts for closure" programme to speed and soften transition to low-carbon generation. Coal-fired generators with emissions intensity above 1.0 tCO_2/Mwh collectively received 1 billion AUD in cash during 2011-12. This programme has been abandoned. A fund of 300 million AUD has been made available to aid innovation and investment within the steel sector. Underground coal mines with high fugitive emissions intensity are also eligible for 982 million AUD industry support over 6 years.
Review mechanism for leakage provisions		Yearly application rounds for industry to join Jobs and Competitiveness Programme. Major review by the Productivity Commission is scheduled for 2014-15 and at regular intervals after that.
Complementary measures		Australian Renewable Energy Agency was established to oversee 3.2 billion AUD for research and development of new energy technologies. Clean Technology Program was established to distribute 1.2 billion AUD in grants for projects that develop and deploy emissions-reducing technology in agriculture and manufacturing. Funding for these programmes was cut during the 2013 budget process. Clean Energy Future Corporation to manage a 10 billion AUD fund for co-investments in commercial renewable energy and energy efficiency projects.

Factsheet 3: California Cap-and-Trade

Criteria for leakage provision		Industry Assistance Factor is defined as a combination of emissions intensity and trade exposure (see Tables A1 and A2 for details on how these two criteria are combined). Emissions intensity (very low to high): tonnes CO_2e emitted per $1 million value added. Trade exposure (low to high): imports plus exports over total shipments plus imports. Entities importing electricity into California from neighbouring states and Canada have to account for the emissions related to generating that electricity.
Coverage of leakage provision		High risk: 15 sectors Medium risk: 14 sectors Low risk: 3 sectors
Cost-containment measures	**Free allocation**	Industry assistance factor is different over three initial compliance periods (CP) and over *high, medium* and *low* leakage risk industries. Allocation is determined via a sector-specific intensity benchmark and is output-based. Initially the benchmarks are set at about 90% of average emissions. Free allocation is declining over time. High-risk industries will receive 100% of the benchmark for free till at least 2020. Medium-risk industries receive 100% for free in CP1, declining to 50% in 2020. Low-risk industries also receive 100% for free initially, declining to 30% in 2020. There is no clarity on how this will evolve post-2020, although at the beginning of October 2013 the CARB released a draft update to the initial Scoping Plan (in which the practical implementation and planning of California's Global Warming Solutions Act of 2006, or Assembly Bill (AB) 32).
	Offsets and linking	Domestic and international offsets which follow four protocols (ozone depleting substance, livestock, urban forests and US forest projects) are accepted; more protocols could be added. At the moment offsets are accepted by the US, but there is a framework for accepting international credits and negotiations are ongoing with respect to REDD+ projects from several Mexican and Brazilian states. Quantitative limit: up to 8% of compliance obligation can be covered using offsets (of which international offsets can be one-quarter in compliance period 1, and one-half in compliance periods 2 and 3). Link with Quebec is being established; the first joint auction should be held in January 2014. Both are partners of the Western Climate Initiative.
	Measures to address price volatility	The Allowance Price Containment Reserve (APCR) receives allowances every budget year and holds auction every quarter at pre-established prices. In budget years 2013 and 2014, 1% of the total number of allowances enters the APCR, 4% for budget years 2015-17 and 7% for budget years 2018-20.

		The allowances in the APCR are split into three equal segments. These three segments are made available for auction with respective price levels of $40, $45 and $50 (2013). These prices increase yearly by 5% plus inflation. The APCR is linked to a floor price ($10 in 2012, increasing yearly): allowances that remain unsold at government auctions (because the value of the allowance is deemed less than the floor price) enter the APCR.
	Banking and borrowing	A number of flexibility mechanisms are included in the Californian Cap-and-Trade programme. First: covered entities surrender allowances in two phases. At the end of each compliance period, entities must surrender allowances to cover at least 30% of their previous year's emissions. One year after the end of each compliance period, entities surrender allowances for emissions that were not yet covered. This 'true-up' allows new data to be used and is a form of intra-compliance period borrowing. Borrowing from future periods is also allowed if it is used for compliance obligations, but not for speculation. Entities have two holding limits: one holding limit for allowances that are eligible for compliance in the current compliance period, and one holding limit for units that can be used in future years. Both are calculated as a base limit plus a fraction of that entity's annual allowance budget. Banking is allowed as long as both holding limits are respected.
Compensation and support mechanisms		Private electricity distribution utilities (EDU) are granted free allocation at 90% of 2008 emissions. From 2013 onwards all these allowances must be auctioned and the proceeds of those auctions are earmarked to compensate each EDU's customer for any price increased caused by the cap-and-trade system. A proposal by the California Public Utilities Commission would limit the compensation scheme to households and small businesses (consuming less than 20 kWh) to keep motivating large electricity consumers to increase their electricity efficiency. Energy-intensive installations can opt to have their allowance cap determined on the basis of their energy consumption instead of their production output.
Review mechanism for leakage provisions		Yearly revision of allocations and benchmarks. The leakage risk classification of any sector can be reviewed after the California Air Resources Board approves a request by the sector itself.
Complementary measures		A myriad of complementary measures (all part of the 2008 AB 32 Scoping Plan) have been implemented or proposed in California. These include energy-efficiency initiatives, building standards, performance standards for cars, renewable targets (among which 33% renewable by 2020) and the Low Carbon Fuel Standard. The Cap-and-Trade programme is called the 'cornerstone' of the larger plan: if the complementary measures fail to produce the desired emissions reductions, the Cap-and-Trade programme will ensure them. Around 22.5% of the desired emissions reductions are to be provided by the Cap-and-Trade programme, the complementary measures should pull the rest of the weight.

Additional notes:

The following two tables give an overview of how the sectoral leakage risk classifications are calculated. Table A1 presents the threshold values for emissions intensity and trade exposure, Table A2 shows how these two criteria are combined to establish one risk classification.

Table A1. Leakage criteria thresholds

Emissions intensity	
Risk level	Threshold (tCO_2e/$ million Value added
High	> 5000
Medium	1000 – 4999
Low	100 – 999
Very Low	< 100
Trade exposure	
Risk level	Threshold (imports + exports)/(shipments + imports)
High	> 19%
Medium	10% – 19%
Low	<10%

Source: Authors' elaboration on California Assembly Bill 32.

Table A2. Leakage risk categorisation in Californian Cap-and-Trade

Leakage Risk	Emissions Intensity	Trade Exposure
High	High	High Medium Low
	Medium	High
Medium	Medium	Medium Low
	Low	High Medium
Low	Low	Low
	Very Low	High Medium Low

Source: Air Resource Board public workshop on Emissions Leakage, Research and Monitoring, 30 July 2012.

Factsheet 4: Quebec Cap-and-Trade

The Quebec Cap-and-Trade is one of the main partners of the Western Climate Initiative (WCI) (along with California).

Criteria for leakage provision		List of sectors at risk was defined at a political level, and as such there are no known objective leakage criteria.
Coverage of leakage provision		8 sectors receive assistance in the form of free allowances: Aluminium, Lime, Cement, Chemical and petrochemical industry, Metallurgy, Mining and pelletizing, Pulp and paper and Petroleum Refining. 4 sub-sectors also receive free allowances: manufacturers of glass containers, electrodes, gypsum products and some agri-food establishment.
Cost-containment measures	**Free allocation**	Free allowances will be provided to the sectors listed above. There are yearly caps on free allowances to be distributed by the Ministry. For 2013 this cap is 23.30 million units. This cap will reach a maximum of 65.30 million units in 2015 and then decrease to 54.74 million units in 2020. The allocation per entity is based on average historical emissions intensity for 2011 and adjusted for production output, with 100% allocation for process emissions, 80% for combustion emissions and 100% for emissions from other sources. Free allowances are also available for electricity imported from cap-and-trade systems that are not linked to Quebec.
	Offsets and linking	Offsets are accepted, but both the types of offsets and the geographical source are limited. Three protocols have been accepted: agricultural methane destruction and small landfill site methane destruction (both only in Quebec) and Ozone Depleting Substance (ODS) destruction (in Canada and US, but ODS must originate in Canada). 8% of compliance obligations can be covered by offsets. Credits for early action can also be used for compliance. Link with California is being implemented. Other partners within WCI could join that link.
	Measures to address price volatility	An allowance reserve is supervised by the Minister of Sustainable Development, Environment, Wildlife and Parks. This reserve is filled with percentages of the allowances under the cap (1% in 2013-14; 4% in 2015-17; 7% in 2018-20 and 4% beyond 2020). The reserve is used as a soft price ceiling. The allowances in the reserve are split into three equal segments. These three segments are made available for auction with respective price levels of 40 CAD, 45 CAD and 50 CAD (2013 prices), once those same price levels are reached in the market. The three price levels increase yearly by 5% plus inflation. Only entities that are not holding allowances in their general account are eligible to join sales from the reserve. These allowances go straight to compliance accounts. Allowances in the reserve can also be used to change the levels of free allocation at the discretion of the Ministry. A floor price of 15 CAD was established in 2012. This floor price increases by 5% (plus inflation) yearly.
	Banking	There is a holding limit for banking allowances.

Review mechanism for leakage provisions	Review mechanism is not very transparent and has some room for political maneuverability. There is no clear timeline for reviewing provisions or coverage.
Complementary measures	Revenues from auctions will be transferred to the Green Fund, with the stated goals of financing GHG reductions, compensation for economic and social impacts of GHG-mitigation policies, adaptation and public awareness campaigns.

Additional Notes:

The Quebec Cap-and-Trade scheme is characterised by its degree of political manoeuvrability. The sectors eligible for free allowances and the amount of free allocation are not set in stone and can be reviewed by the Ministry if and when it is deemed necessary. The auction calendar is also subject to political decisions.

Two additional exceptional issues should be noted:

- Electricity imported from other cap-and-trade systems that are not linked to Quebec's system is also eligible for free allocation.
- From 2015 to 2020, free allocation decreases annually, determined by an emissions-intensity target that also decreases annually. Different industrial activities will see different levels of decrease.

Factsheet 5: New Zealand ETS

Starting in 2008 with the forestry sector, the New Zealand ETS has gradually expanded. In 2010 energy and industry joined and in 2013 synthetic gases and waste sectors were included. Agriculture has had a mandatory reporting obligation for biological on-farm emissions from 2012 and was previously legislated to have surrendered obligations for these emissions from 2015, but this has been placed on hold indefinitely.

Criteria for leakage provision		Eligible industries are divided into highly emissions-intensive industry and moderately emissions-intensive. Highly emissions-intensive industry: 1,600 t/million NZD (or 4% of revenue at 25 NZD/t). Moderate emissions-intensive: 800 t/million NZD (or 2% of revenues at 25 NZD/t). When there are obligations to surrender for biological emissions from agriculture, then participants will be able to apply for an allocation of NZUs. One-off allocations were given to fisheries and forest for compensation for higher costs.
Coverage of leakage provision		Eligible industries currently receive an allocation of allowances (forestry, fishing and industry). Should agriculture be obliged to surrender allowances in the future, then they will be able to apply for an allocation of NZUs.
Cost-containment measures	**Free allocation**	For eligible industries, free allocation is determined by product baselines. 90% free allocation for highly emissions-intensive actions and 60% free allocation for moderately emissions-intensive activities. All agriculture activities with ETS obligations will receive free allocation (covering 90% of an emissions baseline). There is no cap on free allocation; if production increases, so does free allocation. The original legislation provided for a gradual phase-down of the allocation level at 1.3% per year after a transitional period – this period has been extended indefinitely
	Offsets	International trading of NZU was possible, as they could be exchanged for one AAU from New Zealand account up till 2013; as NZ voted out of KP 2. There is no quantity limit of KP CERs accepted into the scheme, but no CERs created after 2012 can be traded. There are some qualitative limits. Linking to other schemes was always part of the plan, although the EU and Australia have stated that some significant changes to the NZ ETS are necessary before linking.
	Measures to address price volatility	At the moment, there are two transition measures: Fixed price on (25 NZD/allowance) for buying from the government and obligation to surrender only one allowance for two tonnes emitted for several sectors (liquid fossil fuels, stationary energy and industrial processes). It will also apply to waste and synthetic gases).
	Banking and borrowing	There are no limits on banking in NZ ETS.
Compensation and support mechanism		Free allocation has also been used as compensation. One-off allocations were provided to individuals in the fishing sector to compensate for increased fuel costs and were also available to pre-1990 forestry owners to compensate for land-value effects of a deforestation liability. In addition, post-1989 forest owners can opt to receive an allocation of removal units (as voluntary ETS participants) but this also implies potential responsibilities for subsequent emissions.

Review mechanism for leakage provisions	The Minister for Climate Change Issues has a discretionary power under statute to review the operation of the ETS at any time. The Government has indicated that the next ETS review will occur in 2015.
Complementary measures	Complementary policies include a 90% renewable target by 2025, measures to improve energy efficiency and agriculture research projects aimed at decreasing the emissions of the agriculture sector.

Additional Notes:

Allocation in the NZ ETS is intensity-based, meaning that it can increase as production in eligible activities increases. Hence, there is no absolute emissions limit on allocation for those sectors. Free allocation is used to manage leakage risk for the industrial (energy-using) sector and potentially for agricultural on-farm biological emissions, should they face surrender obligations in the future (this would require legislative and regulatory changes).

One-off allocations have also been provided as compensation for fishermen and pre-1990 forest owners.

In the NZ ETS there are no limits for trading domestic or approved international units, at least until the end of the Kyoto Protocol CP1 'true-up' period. However, since NZ is excluded from KP 2, no CERs can be traded that are created post-2012.

Factsheet 6: RGGI

The Regional Greenhouse Gas Initiative (RGGI) is currently in its second trading period, 2013-14. This scheme focuses exclusively on power generation. RGGI completed a programme review and released an updated Model Rule in February 2013.

Criteria for leakage provision		Leakage has as yet not been a major concern (low prices), but is part of the work programme. After a 2012 Program Review, RGGI member states have stated that work is needed on identifying carbon leakage in the electricity sector.
Coverage of leakage provision		No leakage provision yet.
Cost-containment measures	**Free allocation**	No free allocation, 100% auctioning.
	Offsets	Entities can surrender offset credits for max 3.3% of total emissions. These offsets can only be from RGGI states or others states that have signed the MOU. No linking is planned to date.
	Measures to address price volatility	Cost Containment Reserve (planned for 2014) if allowance prices were to exceed predefined price level. In 2014, limit of 5 million allowances, 10 million from 2015 onwards. The CCR allowances would be made available immediately in any auction in which demand for allowances at prices above the CCR trigger price exceeds the supply of allowances offered for sale in that auction prior to the addition of any CCR allowances. • If the CCR is triggered, the CCR allowances will only be sold at or above the CCR trigger price. • CCR triggers prices: $4 in 2014, $6 in 2015, $8 in 2016, and $10 in 2017. Each year after 2017, the CCR trigger price will increase by 2.5%. Each auction also has a reserve price, at which no allowances can be sold under. The current reserve price is $1.98 per allowance. The reserve price increases by 2.5% annually.
	Banking and borrowing	Banking is allowed, although the cap for states is reviewed according to the amount of allowances banked in that state.
Compensation and support measures		All revenues from auctioning are returned to the state and invested in consumer benefit programmes such as energy efficiency, renewable energy, climate change abatement and direct energy bill assistance.
Review mechanism for leakage provisions		Previous programme reviews concluded in February 2013, next comprehensive review is foreseen for 2016.
Complementary measures		Several states have additional state-specific GHG emissions reduction policies, for example each RGGI state has a renewable portfolio standard.

Additional Notes:

There are currently no leakage provisions in the RGGI ETS and the RGGI does not regulate emissions from electricity generated outside the region and then used within the region. If has been stated that work is needed on identifying carbon leakage, which is explicitly called for in the updated 2012 programme review. However, so far, the cap has had low effect on the relative sources of electricity. The risk may increase with the newly proposed emissions cap.

RGGI uses three-year compliance periods, to offer flexibility to covered entities. Compliance periods also have flexible durations.

Factsheet 7: The US Waxman-Markey Bill

The Waxman Markey Bill (H.R. 2454) was approved by the US House of Representatives in 2009 but later defeated in the Senate. The bill includes a proposed cap-and-trade programme.

Criteria for leakage provision		An entity is eligible to receive emission allowances rebates if it is in a sector that meets both criteria (i) and (ii), or criteria (iii): (i) Energy/GHG intensity of at least 5% (ii) Trade intensity of at least 15% (iii) Energy or GHG intensity of at least 20%.
Coverage of leakage provision		EITE, coal generators and oil refineries.
Cost-containment measures	**Free allocation**	Output-based allocation for eligible EITE entities: Free allocation with a continuously updating output-based formula for direct and indirect emissions. Maximum 15% of the overall cap but declines in tandem with the overall cap. After 2025, default phase-out of rebates with complete phase-out by 2035 (but can be delayed by the President). Emission allowances are also provided to merchant coal generators (50% of qualified emissions) and oil refineries.
	Offsets	Offsets could account for 2 billion tonnes of carbon. The percentage limit of offsets for entities varies. Moreover, not more than half can come from domestic offsets and not more than half from international offsets.
	Measures to address price volatility	Reserve price on auctions ($10 in 2012 and then increases with 5% per year). Strategic reserve auction. Allowances are offered at a threshold price. The following % of allowances will be held annually: 2012-19: 1%; 2020-29: 2%; 2030-50: 3%.
	Banking and borrowing	Two-year rolling compliance period with unlimited banking. Unlimited next-year borrowing with no interest and borrowing up to 15% beyond that at 8% interest.
Compensation and support mechanism		The bill includes support for electricity and natural gas distributors to alleviate price increases for consumers, green jobs and retraining, low-income consumers, energy efficiency and clean energy investments, deployment of clean energy technologies in developing countries and climate change adaptation measures.
Review mechanism for leakage provisions		The initial list of eligible industrial sectors was planned to be published in 2011. From 2013, and every four years after, an updated version of the list would be published.
Complementary measures		Included in the bill is the International Reserve Allowance Programme. Beginning in 2020, if a multinational agreement has not been reached, the programme could go into effect for covered industrial sectors where 15% or more of imports are from countries that do not meet criteria on GHG regulation, emissions-intensity and emissions levels. The Act requires emissions allowances for the import of products in eligible sectors. The bill's centrepiece is the ETS, but it also includes other major complementary initiatives on clean energy and energy efficiency.

Additional Notes:

The Waxman-Markey Bill includes output-based allocation to EITE entities. In addition utilities (electricity and gas local distribution companies) also receive allowances, with a clear mandate that the value of those allowances should be used to protect consumers from higher energy prices. This allocation, hence, offsets a portion of the effect that the cap-and-trade programme would have on production costs.

The price intervention mechanism in the Waxman-Markey Bill includes both a reserve price on auctions (approximately 15% of allowances would be auctioned to start with) and a strategic reserve auction, to keep prices from rising above a certain threshold level. If there is demand for allowances above the threshold, the reserve will help contain prices that otherwise would have been above this level. If the market price is below this level, there would be no demand for these reserve allowances.

Factsheet 8: Korea Emissions Trading Scheme

The Korea ETS is set to kick-off in January 2015, and as such the scheme has not been finalised yet. Two main legislative proposals still need to be published: the Master Plan (the main regulatory text) and the National Allocation Plan (which includes the allocation procedures and criteria for free allocation). Drafts are scheduled to be released in the course of Q1 2014 and the plans are expected to be confirmed in June 2014. There is still a high level of uncertainty surrounding the Korea ETS, and all the information provided in this paper relate to proposals issued in November 2012 and analysis thereof.

Criteria for leakage provision		Proposed leakage criteria are related to energy-intensive and trade-exposed industries.
Coverage of leakage provision		Sectors are considered EITE if they experience: 1) production cost increases over 5% and trade intensity is over 10%; 2) production cost increases over 30% or 3) trade intensity is over 30%. Production costs are expressed as annual emissions of the sector times the price of allowances, divided by the annual value of that sector. Trade intensity per sector is calculated as value of imports plus value of exports over total revenue of the sector plus value of imports. A list of sectors is not available yet.
Cost-containment measures	**Free allocation**	In the initial three trading periods auctioning will be limited. In Phase 1 (2015-17) 100% of the cap will be free allocation, in Phase 2 (2017-20), 97% free allocation and in Phase 3 (2020-?) 90% free allocation. Both grandfathering and benchmarking are being considered for determining free allocation. EITE industries will receive 100% free allocation over the first three periods.
	Offsets and linking	Proposed limit of 10% compliance obligation: eligibility of offsets is restricted to Korean offsets; the list of eligible offset types is in development. Installation level limits will be reported in the National Allocation Plan. International offsets to be accepted from 2021 onwards for 50% of total offset limit. Studies have been conducted by a research institute linked to the Korean government related to linking with New Zealand. CEPS is currently involved in a study on linking possibilities between Korea and the EU ETS.
	Measures to address price volatility	Five measures are listed in the ETS Act and may be implemented: 1) Additional allocation of 25% of reserve allowance, 2) Setting max or min holding limit of allowance, 3) Expansion or limitation of borrowing limit, 4) Expansion of limitation of acceptance rate of offset and 5) Temporary setting of max or min price of allowance. Three cases have been specified that would trigger price stabilisation measures are: 1) Price climb: for six consecutive months the allowance price is 3 times higher than the average price over the previous three years. 2) Demand climb: the average price increases more than two-fold due to a more than two-fold increase in trade volume from the average in a one-month period; and 3) Price crash: the price decreases more than 60% in a one-month period compared to the average price during the two prior years.
	Banking	Banking would be allowed, but a holding limit might be implemented.

Compensation and support measures	The proposed ETS allows for free allocation to support companies which would lose international competiveness. Financial and tax benefits could be granted on a project basis for mitigation technology development and diffusion, CCS development, GHG measuring and management, renewable energy and energy efficiency.
Review mechanism for leakage provisions	Not yet in place.

Factsheet 9: China

Seven ETS pilots' first trading periods, 2013-15 are part of China's 12th five-year plan (2011-15). The 13th five-year plan (2016-20) may include provisions for national emissions trading in China.

Criteria for leakage provision		The Chinese pilot programmes use free allocation to address leakage. Allocation differs between the schemes; some use auctioning. There is very little publicly available information on the proposed national ETS and how it will address the issue of leakage.
Coverage of leakage provision		Unknown.
Cost-containment measures	**Free allocation**	Free allocation is currently the basis in the pilot schemes. Auctions have been planned, but in most cases, only as a complementary allocation method. Free allocation in the different ETS pilots: Beijing (Allocation for free or based on emissions intensity), Shanghai (full free allowances), Guangdong (historical emissions linked with a product benchmark), Shenzhen (pre-allocated for free in trial period based on production capacity), Tianjin (full free allocation), Hubei (historical emissions). For Chongqing and Zhejiang there are no publications on criteria for leakage provision.
	Offsets	Domestic offsets (Chinese Certified Emissions Reductions, CCERs) have been included as a cost-containment mechanism. Currently CCERs are the only offsets allowed. Limits are in place, but differ between pilot phases.
	Measures to address price volatility	There is no information on price intervention mechanisms in the Market Readiness Proposal (MRP). For the national ETS, according to IETA, China is likely to establish a price containment mechanism to keep prices stable, but no details were provided in the MRP.
	Banking and borrowing	Some pilots allow unlimited banking of surplus allowances.
Compensation and support mechanism		Unknown.
Review mechanism for leakage provisions		Currently no information on review mechanisms for leakage provisions.
Complementary measures		China is implementing or planning a variety of complementary measures. The most relevant are an energy intensity target of 16% reduction in energy consumption by 2015 and reducing carbon emissions per unit of GDP by 17% by 2015.

Additional Notes:

Regarding carbon leakage, there is currently some lack of clarity on how this will be addressed in the different pilot schemes and the announced national ETS. The Chinese pilot programmes use free allocation to address leakage. Leakage, however, might not be

as large an issue in the Chinese pilot schemes due to the current low manufacturing cost in China. The carbon price needs to be relatively high to cancel out this competitive advantage.

Drafts on national ETS mention the intention to include largest emitters (could be interpreted as the sectors with the largest emissions growth rates). Sectors with strong emissions reductions potential could also be included. The national ETS will start with including state-owned enterprises. Leakage will probably not be a large issue for state-owned enterprises, but it is still too early to assess the national scheme as very little is publically known.

As a cost-containment measure, domestic offsets have been included. The quantity limit on CCERs differs in the pilot schemes, and for some the limit is still unclear. There may be linking outside the national ETS in the future, but no further details on how this could be done is currently available.

About the Carbon Leakage Project

This paper is one of the deliverables of the CEPS project entitled "Carbon Leakage: Options for the EU", co-funded by five EU member states (France, Germany, the Netherlands, Poland and the UK) and seven companies from different sectors of the economy (BP, EdF, ENI, Hydro, Lafarge, Solvay and ThyssenKrupp Steel Europe).

This project has two objectives, outlined below:

1) To prepare options that can be used to address concerns regarding carbon leakage for:

- EU internal discussions, e.g. in the discussion on the review of the Carbon Leakage list, EU structural reform, treatment of carbon leakage in the EU ETS post 2020 (specifically for Phase 4 of the EU ETS), and the 2030 energy climate framework.
- International negotiations, e.g. negotiations on the international agreement on post 2020 climate change regime that are to be concluded in 2015 at the Paris COP.
- Bilateral discussions, e.g. in linking with Australia.

2) To engage in a series of Outreach Workshops, which will use the two papers, produced by this project in order to stimulate a well-informed and active debate on this topic in the EU.

It is not the intention of this project to provide a definitive answer, such as a proposed solution, but to identify Issues, develop Options to address carbon leakage, as well as Criteria to appraise the different approaches identified.

This project has a number of deliverables

- Background Paper for discussion
- Options Paper – which will outline policy options to address leakage, and criteria to evaluate these options.
- A number of workshops, some of them to Review the two papers produced, others that have an Outreach objective.

Both papers are:

- Intended to be "briefs for policy makers".
- Not intended to determine if there is leakage, or to what extent.
- Intended to provide a menu for policy makers to help them determine what leakage provisions are most effective and make choices.

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