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Implications of Linking on Leakage

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Implications of linking on leakage

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Abstract

After the climate conferences in Copenhagen and Cancun, it is likely that the EU remains more ambitious regarding greenhouse gas reduction targets than other countries. The possible problem of carbon leakage and instrument to tackle it therefore remains an important issue in the European Climate policy debate. The reduction of competitive distortions and carbon leakage induced by different CO_2 prices in the EU and important trading partners is one of several reasons for the EU to aim for the establishment of a trading link between the European Emission Trading Scheme (EU ETS) and other domestic or regional emissions trading systems in developed and developing countries. Main reasons for linking include higher cost efficiency to meet a given reduction target as well as improved market liquidity resulting in more robust and stable price signals.

The aim of this paper is therefore to answer the question to what extent linking can be a solution to leakage concerns in developed and developing countries and how the effects depend on the countries, regions or sectors that establish a link. This paper shows that linking can play a role in addressing leakage, but it can also aggravate it. An analysis of the leakage sensitivity of the two systems that are linked is essential to assess the total effect of linking on leakage. Bilateral leakage is in principle already addressed by the introduction of separate caps in both countries. Against the background that the introduction of emissions trading is delayed on the federal level in the US, as well in Australia and Japan only few bilateral links can be expected in the coming years. If links to sectoral mechanisms in developing countries that have no national cap are established the sectors that link may play a role. As sectoral crediting mechanisms in developing countries may provide low cost credits to industrial countries, production may expand and leakage may be the consequence unless developing countries implement absolute caps. Without absolute caps developing countries may also see country internal leakage from the capped sector to other sectors. Regardless of how sectoral credits will be created, within the UN or outside, sector based credits that could be used in the EU ETS still are several years ahead, and bilateral links between EU ETS and developing countries' ETS cannot be expected before 2020. Thus, the uncertainties for European companies on the amount and price of international credits and possible implications on the European carbon price and as a consequence on leakage will remain.

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1 Introduction

After the climate conferences in Copenhagen and Cancun, it is likely that the EU remains more ambitious regarding greenhouse gas reduction targets than other countries. The possible problem of carbon leakage, i.e. the "migration" of emissions to locations without or with less stringent reduction targets, therefore remains high on the European policy agenda. Several policy instruments are discussed to tackle possible carbon leakage, including border tax adjustment or free allocation. But also linking emissions trading schemes was brought up as an instrument to tackle leakage.

Creating a trading link between the European Emission Trading Scheme (EU ETS) and other domestic or regional emissions trading systems is a strategic goal of the European Union. In particular in the run-up to the Copenhagen Climate summit the European Commission propagated to create an OECD wide carbon market by 2015 and a link to schemes in advanced developing countries by 2020 as a wider plan to create a new global climate architecture based on a global carbon market. The reduction of competitive distortions and carbon leakage induced by different CO_2 prices in the EU and important trading partners is one of a set of reasons, including primarily higher cost efficiency to meet a given reduction target and achieve larger trading volumes as well as improved market liquidity resulting in more robust and stable price signals (European Commission, 2009). The idea of linking emissions trading systems however has not only attracted interest in the European Union: most existing or emerging carbon markets, such as in California, Australia and Japan, provide for some form of linkage to other systems. Also these regions fear carbon leakage mainly to developing countries. The aim of this paper is therefore to answer the question to what extent linking can be a solution to leakage concerns and how the effects depend on the countries, regions or sectors that establish a link. The paper will first address OECD carbon market links and possible implications on leakage and will then analyse how and under which conditions links to developing countries may be a suitable instrument to reduce carbon leakage.

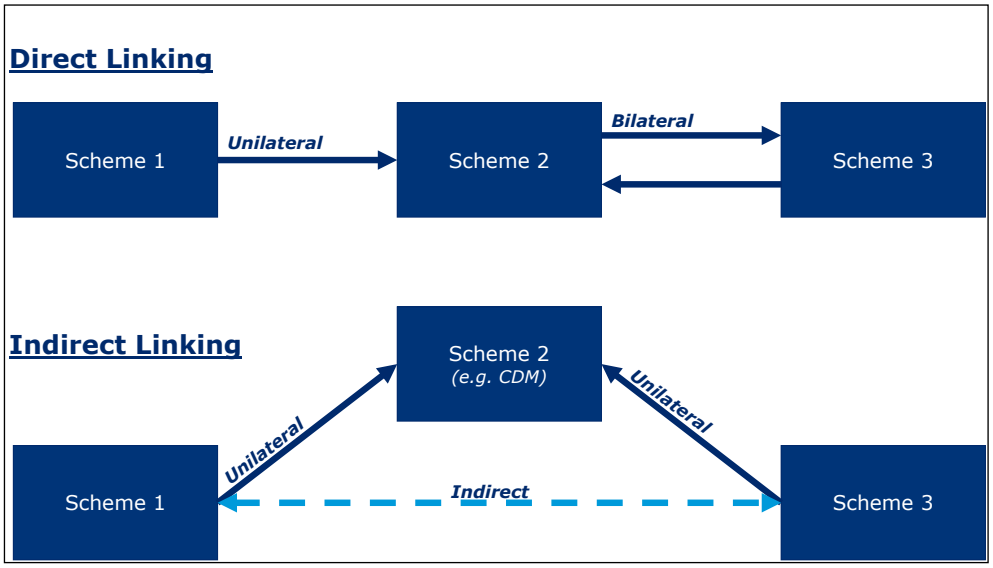
2 Forms and implications of linking

Conceptually links between trading systems can be either indirect or direct (Figure 1). Direct links can be divided into unilateral and bilateral links. Under a unilateral link, entities in one system can purchase and use trading units from another system for compliance, but not vice versa[†]. Administrators of a system can establish such a unilateral link by agreeing to accept allowances or credits issued by another system for compliance purposes. In a full bilateral link, by contrast, allowances can be freely traded between both systems, and allowances from

[†] One example for such a unilateral link is the possibility to use CDM credits for compliance in the EU Emission Trading Scheme.

each system are equally valid for compliance in both systems (Tuerk et al., 2009). Even if two systems are not directly linked, they can be indirectly linked through separate unilateral links with a common third system, such as the Clean Development Mechanism (CDM). Through trading between each system and the common third system, the supply and demand for allowances in one system can affect that in the other system even though the two systems are not directly linked. Depending on the supply curve for offset credits, cap levels, marginal abatement costs and quantity limits on the import of credits, indirect linking will lead to a complete or incomplete convergence of the allowance prices in indirectly linked cap-and-trade markets (Flachsland et al., 2009). So far several emissions trading schemes (ETS) such as the EU ETS and the Japanese Voluntary Emissions Trading Scheme (JVETS) have established unilateral links to the CDM and therefore are indirectly linked.

Figure 2: Direct and indirect links



Source: Carbon Trust (2009).

A link between emissions trading systems promises a number of benefits but also trade-offs that have to be considered. The benefits include in particular the lowering of the costs of achieving specified emission mitigation objectives if there are cheaper reduction options in other schemes. In theory, the more systems link, the larger are the potential efficiency gains (Tuerk et al., 2009). Linking promises a wider range of abatement costs by expanding the choice of available mitigation options. To the extent that this promise is fulfilled, greenhouse gas (GHG) mitigation can hence be achieved more cost-effectively as emissions are reduced where reductions are least expensive. If schemes are fully bilaterally linked the carbon price in the high price scheme will fall and the price in the low price scheme will rise until a full price convergence is achieved. This may eliminate carbon price related competitiveness distortions (see Blyth and Bosi, 2004; Anger, 2008). The degree of economic efficiency gained from international or interregional allowance trading is correlated to the

divergence in mitigation cost between each trading system prior to their linkage, but can potentially be significant (Lazarowicz, 2009). The greater the difference, the greater the potential gain in economic efficiency. Furthermore, a trading link also creates a larger, more liquid carbon market, thereby reducing volatility and the likelihood of market manipulation. At the same time, however, linking can also transmit volatility from one system to other systems, and generally will reduce the extent of control administrators have over their own system (Tuerk et al., 2009). Another trade-off of linking is that purchasing credits from other schemes means less domestic mitigation including the loss of co-benefits of climate change reduction measures.

Linking of emissions trading systems does not require that all design features of the affected trading systems are harmonised. Some differences can be tolerated without detriment to the link, others require only minor technical changes. Significant barriers to effective direct linking of trading schemes can arise from the following design features:

i) differences in the relative stringency of targets;

ii) differences in the eligibility and definition of offset credits;

iii) differences in the nature of emission targets; and

iv) price management and cost containment mechanisms (Tuerk et al., 2009).

Clearly, the relative stringency of emission caps is of paramount importance given its relevance for carbon prices in each trading system. Although different prices theoretically offer the greatest efficiency gains from an economic perspective, politically they will likely not be palatable to decision makers: not only is the comparability of efforts important from the point of view of public perception, but price differences also have very real allocative implications for the linking partners: allowances from the system with the lower price will continue to flow to the system with a higher price until prices converge; the result is a flow of capital from the latter system to the former, as well as a price decrease in the latter and an increase in the former. That this can result in significant political pressures, especially if the price gap is large to begin with, should be evident (Flachsland et al., 2009). Difficulties can also arise if some types of offset credits are considered eligible in one trading system, but not in the trading system of a potential linkage partner. Another obstacle relates to the nature of the mitigation target. While it is possible to link trading systems with absolute targets to systems with intensity targets (Ellis and Tirpak, 2006), the accompanying degree of uncertainty and technical challenges would make such a link politically very difficult. Finally, much concern has centred on the potential of price management features to prevent or impede a market linkage. If these provisions are present in one system, they will become available to participants in linked systems, regardless of whether the latter have opted to incorporate the same features. If for example the EU and the US introduce different provisions for price management this would be a significant obstacle for linking. Although a system can impose restrictions on the quantity and type of allowances that may be traded across the link, such

qualifications can impede the efficiency of the link and even affect the willingness to integrate markets.

3 Implications of linking OECD trading schemes on leakage

Emerging OECD trading schemes

Emissions trading schemes are emerging in several OECD countries. The European Emission Trading Scheme (EU ETS) is the frontrunner in this development, with the scheme up and running since 2005, but also in the US, Japan, Australia, and Canada the introduction of (regional) emissions trading schemes is being discussed (see Figure 2).

United States

In the US a federal ETS was discussed in Congress for more than two years. Given the outcome of the midterm elections in November 2010, however, prospects for successful climate legislation on the federal level in the next years seem highly unlikely. The most significant initiative that came out of Congress since the 2008 elections is a bill by Henry Waxman and Edward Markey, titled the American Clean Energy and Security Act of 2009 (ACES 2009)‡. Even if after the results of the midterm election there is no national legislation expected to be implemented in the US in the short term, this bill will be one of the blueprints for future national cap-and-trade initiatives. In contrary to previous bills it does not provide for a price cap, however includes several other price control mechanisms. An ETS based on the Waxman-Markey bill would capture approximately 85% of US GHG emissions. The Waxman-Markey bill foresees a mixed upstream-downstream system. In this context, upstream entities are those who extract, refine or import fuels that when used release GHGs. Downstream parties are those that combust fuels. The bill provides for downstream coverage in the electricity sector, i.e., obligations fall on electricity generators, and large industrial emitters (emitting more than 25,000 tons CO_2-eq. per year). Upstream coverage is foreseen in the transportation sector. Until 2020, the provisions under the Waxman-Markey bill would limit offsets to 30% of the emissions allocation, to be split evenly between domestic and international offset credits. The bill provides that a specified quantity of allowances would be set aside each year for a "Strategic Reserve", from which allowances would be auctioned on a quarterly basis subject to a specified minimum auction price. The Waxman-Markey bill permits unlimited banking of allowances for use during future compliance years.

While at the federal level no climate legislation can be expected soon, regional schemes in the US are emerging. The first regional scheme in operation, the Regional Greenhouse Gas Initiative (RGGI), a trading system for the electricity-producing sector, has been operational in

‡ http://www.pewclimate.org/acesa

ten Northeast and Mid-Atlantic States since 1 January 2009, and efforts to implement trading schemes are underway on the West Coast within the Western Climate initiative (WCI). It is likely that California, part of the WCI, will implement its planned ETS in 2012 (Mehling et al., 2011). The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by ten US North-East and Mid-Atlantic states to implement a regional cap-and-trade system. RGGI, which represents the first mandatory GHG emissions trading scheme in the US, began operations in 2009. Emissions from fossil-fuel electricity generators larger than 25 MW are restricted under the cap, with a goal of stabilizing these emissions between 2009 and 2014 and reducing them by 10% by 2019. Each participating state receives an emissions budget and is free to determine how to allocate 75% percent of the corresponding allowances among covered participants. At least 25% of the allocated allowances must be assigned to consumer benefit or strategic energy purposes, such as new technologies, yet in practice most of the allowances are auctioned (RGGI, 2008). Offsets are restricted to 3.3% of a generation unit's emissions during an initial control period. If the 12-month rolling average of allowance prices exceeds 7 USD per ton, units may use offset credits to meet up to 5% of their obligation; if the 12-month rolling average exceeds US 10 USD, plants may offset up to 10% of emissions. In the event that up to 10% of emissions can be offset, participants may also use credits from the EU ETS and the flexibility mechanisms under the Kyoto Protocol (RGGI, 2008). Offsets thus serve as a safety valve to limit costs of the system.

On the West Coast there was a dynamic development regarding the implementation of emissions trading schemes within the Western Climate Initiative (WCI). The WCI is comprised of seven Western states and four Canadian provinces that have developed a comprehensive strategy for reducing global warming pollution by 15% below 2005 levels by 2020, including a regional carbon market set to begin in 2012. Cap-and-trade will be the central policy instrument for mitigation, complemented by additional policies for specific sectors and activities. Among the WCI members California is the most advanced. The approval of the design of a cap-and-trade system by the Californian Air Resources Board (CARB) in December 2010 paves the way for its implementation from 2012. The scheme would include electricity production (as well as imports) and large industrial facilities (>25,000 metric tonnes of carbon dioxide per year). In line with the overall WCI design starting in 2015, distributors of transportation fuels, natural gas, and other fuels will be included. The scheme will establish a declining aggregate emissions cap on included sectors. The cap starts at 165.8 million allowances in 2012, which is equal to the emissions forecast for that year. The cap declines approximately 2% per year in the initial period (2012–2014). In 2015, the cap increases to 394.5 million allowances to account for the expansion in program scope. The cap declines at approximately 3% per year between 2015 and 2020. The 2020 cap is set at 334.2 million allowances; allowances will be distributed through a mix of direct allocation and auctioning. The scheme will allow an offset limit of 8% of the compliance obligation and allows REDD§

§ Reducing Emissions from Deforestation and Degradation

and sector-based credits. In addition the scheme will include a tiered price reserve. Approximately 5% of total allowances between 2012 and 2020 will be placed in reserve (1% for 2012–14; 4% for 2015–17; 7% for 2018–20). Of the total allowances available, one-third would be available at 40 USD/metric ton, one-third at 45 USD and one-third at 50 USD (increasing by 5% plus inflation each year). Linking to other WCI states is a short term goal of the Californian system (Mehling et al., 2011).

Japan

Japan has a voluntary emission trading scheme (JVETS) in place and over the last two years discussed the introduction of a mandatory scheme. The implementation of a mandatory scheme however has been postponed because of intense lobbying by powerful business interests and because the implementation of ETS was delayed in other key countries. The scheme would have covered large emissions sources, and possibly included also intensity based targets (Kimura et al., 2009). In Tokyo however a mandatory ETS was launched in 2010. In the first phase of the scheme (the fiscal years 2010-2014), the targeted entities will be required to cut CO_2 emissions by either 6% or 8% from base-year levels that are calculated from average emissions over a period of three consecutive years between fiscal 2002 and 2007. The program took effect in April 2010 and covers 1,340 large facilities including industrial factories, public buildings, educational institutions and commercial buildings. In the second phase (the fiscal years 2015-2019) they will be required to slash emissions by 17% from their base-year. Also Japan's Saitama prefecture has introduced a cap-and-trade scheme on 1 April 2011 after the region's government approved its budget (Point Carbon, 2011). The approval means Saitama, Japan's fifth largest prefecture by population, will become the second Japanese prefecture to introduce a mandatory emissions trading scheme. Saitama's trading system imposes emission targets on around 600 corporate installations that consume at least 1,500 kilolitres of crude oil equivalent a year. The firms will be required to cut their CO_2 emissions by an average of 7% between 2011 and 2014, compared with average annual emissions over three consecutive years the companies can choose between 2002 and 2007 (Point Carbon, 2011). Last September, Tokyo and Saitama signed a pact to link their cap-and-trade schemes, which allows cross-border trade of allowances between covered companies.

Australia

The Australian government has committed to cutting greenhouse gas emissions by 60%, compared with 2000, by 2050, and stated a short-term goal of 5-25 % by 2020, with the more ambitious target of 25% dependent on agreement for international action. Preparations for an ETS in Australia began in 2008, when the Australian government published a White Paper proposing the introduction of an ETS in Australia. The design of the planned 'Carbon Pollution Reduction Scheme' (CPRS) was modified several times. But emissions trading legislation suffered parliamentary defeat in 2010, leaving the 2020 goal in doubt. While it was initially intended that the scheme commences in 2010, it was subsequently delayed until at least

2013, due to lack of bipartisan support for the legislation (Tuerk et al., 2011). In February 2011 Australia launched its third attempt to force intense polluters pay for their emissions, introducing plans for a fixed carbon price from 2012 through the CPRS. According to the Australian government's plans polluters will pay a fixed price from July 2012 and the system will move to be market-based within five years.

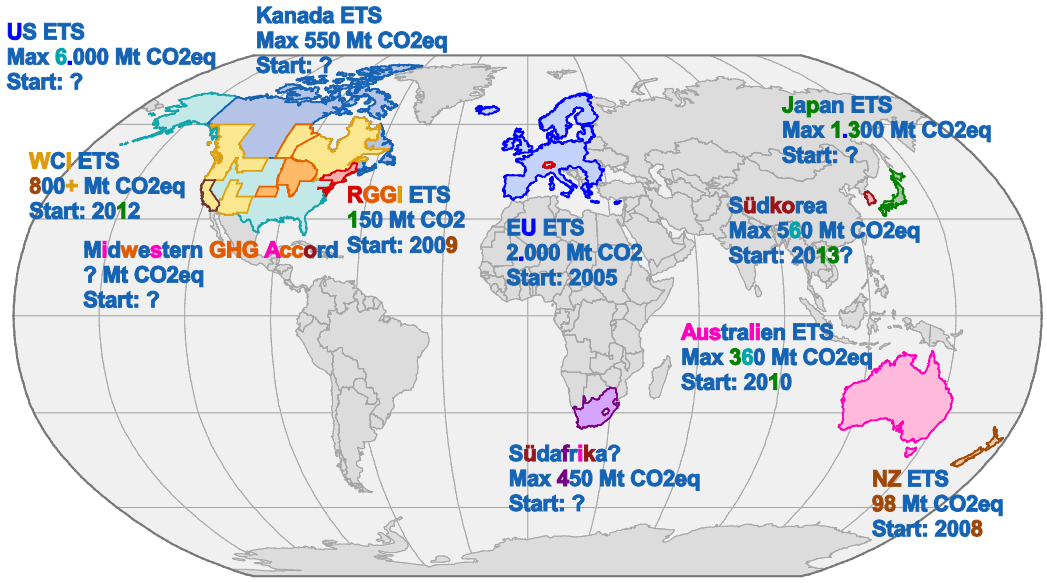
Canada

Canada discussed the introduction of a federal ETS for several years, but has currently no plans to introduce its own ETS. For a possible Canadian scheme intensity targets were considered. There is however initiative at the regional level. While Alberta has implemented its own ETS, several other provinces along with Western US states are part of the Western Climate Initiative.

Non-EU CEE countries

Also in non-EU CEE countries, such as Ukraine and Belarus, the implementation of emissions trading schemes and possible links to the EU ETS are under preparation. Ukraine is currently drafting an ETS legislation and a key bill was already discussed in parliament (Government of Ukraine, 2010). Also in Belarus the legislative process to implement an ETS in has started.

Figure 3: Existing and emerging emissions trading schemes



Source: based on Flachsland, 2009b.

Linking and leakage

This section will answer the question to what extent linking is a solution to leakage concerns and to what extent linking reduces leakage over and above simply introducing a non-linked scheme or carbon price. Full bilateral linking between different ETS will equalize the carbon price and is therefore a possible way to reduce competiveness distortions caused by diverging CO_2 prices and possibly also leakage. However the effect on leakage also depends on the schemes to be linked as will be shown in the following paragraphs.

If there are price differentials linking can lead to one system's allowance price to increase and the other's to decline. This can potentially lead to increased leakage in the former system and reduced leakage in the latter system. The amount of the effect on leakage depends on the extent to which each system's allowance price changes, and on the sensitivity of leakage from each system to changes in that price (Jaffe, 2007). In particular regional schemes in countries without a national cap could be more sensitive regarding leakage than national schemes as they may be surrounded by regions without emissions caps**. In addition the CO_2 price in small schemes will change more strongly if linked to a large scheme than vice versa. For example a link of the RGGI system with the EU ETS, given each system's relative size and current allowance price, would lead to a significant increase in RGGI's allowance price, but only to relatively small decrease in the EU ETS allowance price. The same would happen if the EU ETS for example would link to the Tokyo ETS. In the RGGI region there is a high risk that industries move outside the region, to the neighbouring states that are not under any ETS or binding CO_2 reduction targets. The reduction of the CO_2 price in the EU ETS after linking with the RGGI system would be comparably small and therefore only a small decrease of leakage in the EU ETS would occur. There would be a net increase in global emissions by increasing leakage from the RGGI system more than it reduces leakage from the EU ETS (Jaffe, 2007).

However if the EU ETS would be linked to a federal US scheme the picture would be different. A federal US ETS would cover up to 6 GT of emissions compared to about 2 GT in the EU ETS. If the US scheme has a lower CO_2 price than the EU ETS before linking this could imply a higher decrease of EUA prices than increase of US allowance prices. In this case leakage from the EU ETS might be reduced more than leakage from an US ETS might increase (Schlömer et al., 2009). However an analysis of the sensitivity of each system regarding leakage would be needed in order to assess the effects.

Linking is a way to equalize carbon prices and can be a vehicle for countries to adopt comparable stringent carbon policies as other countries or regions. In principle the relocation of emissions from one country to the other would be already addressed by the introduction of separate and comparable stringent caps in both countries.

** In this case, leakage would probably rather occur to other regions within the same country as to other countries.

4 Implications of linking to developing countries schemes on leakage

Linking to the CDM

The EU ETS linking directive (2004/101/EC) provides for the use of "Certified Emission Reduction Units" from the CDM to be used up to a certain limit for compliance in the EU ETS. In the first phase of the EU ETS this limit was 11% of the companies' emissions allocation. CDM credits from afforestation/reforestation (AR) activities, however, are excluded. The usage of CERs in the EU ETS lowers the EUA allowance price and can be regarded as cost containment mechanisms as long as EUA prices are higher. Hedging against too high CO_2 prices implies an insurance against leakage. However some project types of the CDM, such as removal of HCFC-22 and N_2O from adipic acid production also cause leakage due to perverse investment incentives to continue to produce it or even increase the production.

As GHG abatement of industrial gases is far more profitable than that of CO_2, due to their much higher global warming potential, there are indications that this has led to possible leakage. Data on adipic acid production, plant utilization and international trade patterns for example show that adipic acid production shifted from non-CDM plants to CDM plants during the economic downturn in 2008 and 2009 (Schneider et al., 2010). The study concludes that it is likely that the production partially moved away from plants that abate N_2O emissions without the CDM or that are operating in countries with a cap under the Kyoto Protocol and that the revenues from the CDM were the main reason for these shifts. The extent of this form of carbon leakage is uncertain (Schneider et al, 2010). The EU has therefore forbidden the use of CERs from HCFC-22 and N_2O projects in the EU ETS beginning with May 2013.

Linking to new market mechanisms

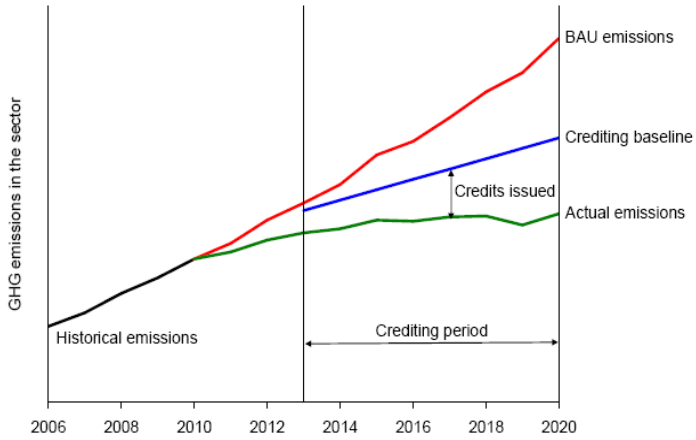
At the Cancun Climate Summit in December 2010 it was decided to consider the establishment of one or more new market mechanisms at the next Global Climate Conference in Durban in December 2011. Indeed, due to its design as a project-based mechanism, the CDM does not promote structural changes at the scale necessary to encourage the transition towards low-carbon economies.

Although an attempt has been made to encourage the aggregation of small decentralised projects into larger projects through so-called "Programmes of Activities", the CDM continues to fall short of triggering the needed level of GHG emission reductions. Currently it is unclear to what extent new mechanisms will be governed under the UN and which offset mechanisms will emerge outside the UN. New mechanisms under the UN would imply that common methodologies could be developed for given sectors and a common trading unit would be agreed on. The current mechanism would be scaled up to sector based mechanisms. New mechanisms outside the UN would lead to a more fragmented carbon

market, regional emission trading systems would negotiate with countries interested in scaled-up mechanisms on a bilateral basis.

The term "sectoral crediting mechanism" (SCM) is used for a mechanism under which credits are issued for the difference between actual emissions of a defined sector and a pre-established baseline. Sectoral crediting follows the CDM logic: Credits from the mechanism are only issued ex-post if actual emission reductions are achieved. This implies that the country would need to provide considerable upfront resources to mitigate emissions (Schneider et al., 2009). Another concept is sectoral trading in which a sectoral cap is established and emissions units are allocated ex-ante following the cap-and-trade logic. Sectoral trading facilitates the financing of mitigation. Units can be traded before reductions have occurred, as there is an ex-ante issuance of emission units.

Figure 4: Sectoral crediting



Source: Schneider et al. (2009)

As Figure 3 shows credits are issued for the difference between actual emissions of a defined sector and a pre-established baseline that is under BaU emissions. As the baseline is not a binding, but a so-called "no-lose target", no sanctions will be applied if the actual emissions are not reduced below the baseline. However the host country would need to compensate for increases of actual emissions above the crediting baseline in later years if credits were already issued in earlier years. Another option could be that any increase of emissions above the crediting baseline does not need to be compensated immediately but is subtracted from the amount issued in the subsequent year(s) (Schneider et al., 2009).

Currently the country positions regarding new crediting mechanisms are very diverse. The EU prefers new sectoral mechanisms under the UN and in principle wants to save the current UN mechanisms. International credits are allowed in the EU ETS as cost-containment, in particular if the EU moves to a higher 2020 target they might play a crucial role. But even if the EU keeps its current 2020 target it is unclear if enough CERs are available for the EU ETS up to 2020. The

EU recently has imposed quality restrictions on the use of CERs in the EU ETS. From May 2013 on no CERs from HFC-23 and N_2O projects will be allowed reducing the CERs available by 2020 for companies under the EU ETS significantly. If no new mechanisms will be established under the UN, the EU may also go ahead with bilateral agreements e.g. with China or CEE countries. However it is unclear when a new mechanism will deliver credits. The current unclear situation means a high degree of regulatory uncertainty for EU ETS companies.

In contrary to the EU the Californian emissions trading scheme that will start in 2013 does not aim for international UN approved offsets. It allows sector based credits from developing countries but all credits have to be issued by the Californian Air Resource Board (CARB). The governance and oversight of offset credits from other countries is with the CARB independent of future developments under the UNFCCC. All offset credits, domestic or international, must be verified by a CARB-accredited verifier. The proposed regulation provides for requirements for a verification program that are consistent with international standards however subject to CARB oversight. This oversight includes verifier accreditation, verification body accreditation, requirements for verification services, and conflict-of-interest requirements (CARB, 2010).

Japan on the other hand is developing a bilateral crediting mechanism and plans to design such a mechanism in a way that could make it acceptable under the UN. Japan aims particularly for agreements with China and other Asian countries and has about 30 pilot projects in the pipeline.

Leakage: Symmetric and asymmetric links to developing countries

This chapter discusses whether it makes a difference regarding the reduction of leakage whether the country has absolute or intensity caps and to which sector in developing countries an Annex-I trading scheme links. If the EU ETS for example links to a sectoral crediting mechanism in China the link could be established to the Chinese transport sector, a sector that is not part of the EU ETS (asymmetric link), or to the energy sector, a sector that is part of the EU ETS (symmetric link). In case the EU ETS would link to the Chinese electricity sector, the output of Europe's ETS sectors would rise as they could import emissions credits at lower costs. Also the output of the EU's non-ETS sectors could rise due to the homothetic preferences of consumers (now also having a higher demand for non-ETS goods) leading to an increase in its price and creating induced leakage (for a trade-theory analysis see Flachsland, 2010). This can particularly be the case if the host country has no national absolute cap, as the case for China that has proposed a national intensity cap for 2020. In an asymmetric link these effects would not occur. If the EU ETS links to the Chinese transport sector, the allowance price in the EU ETS would be lowered, reducing leakage, while no leakage would occur to the Chinese transport sector that is capped (see Flachsland, 2010).

Capping the electricity sector in China may also lead to country internal leakage: If the Chinese electricity sector is capped while other sectors remain uncapped leakage might occur, i.e. the reduced use of coal in the electricity sector leads to a reduced coal price and may lead to more coal use in the other sectors, if there is no absolute cap for these sectors.

Emerging schemes in developing countries and possible links

In several developing countries cap-and-trade schemes are emerging or are being discussed, such as in China, South Korea, Taiwan and Mexico. In particular China currently is seeing a dynamic development regarding the implementation of trading schemes at the regional level.

China

China aims to reduce carbon intensity – the amount of carbon dioxide produced per unit of gross domestic product – by 40-45% by 2020 relative to 2005 levels. For the next five years, China plans to improve energy intensity by 16% while reducing the carbon intensity of its economy by 17%. China's next five year plan will put a hard target on overall energy use, capping consumption at 4 billion tonnes of coal equivalent by 2015. China is currently working on ways to distribute its national energy intensity target to provinces. Shanghai and the heavily industrial Guangdong province could each face targets of 18% energy intensity improvement by 2015. Several regional schemes trading carbon or energy related credits are currently emerging in China. Up to six provinces plan to launch pilot schemes in 2013, including Beijing, Chongqing, Guangdong, Hubei, Shanghai and Tianjin. The regional initiatives may pave the way to a national Chinese ETS on the long term. Currently national sectoral crediting or trading mechanisms in China however are not in sight.

South *Korea*

South Korea is planning a national emissions trading scheme to begin in 2013. The cap-and-trade scheme would involve over 300 of the country's largest companies, emitting some 60% of the nation's greenhouse gases. It aims to reduce greenhouse gas emissions by 30% by 2020 compared to 'business-as-usual' as announced as voluntary target after the Copenhagen climate change summit. The companies under the South Korean ETS would also be able to purchase CERs for fulfilling their emission reduction commitments. The national carbon reduction instruments would be traded at the Korea Power Exchange, Korea Exchange as well as at an emissions trading exchange currently under planning. The Korean government is also contemplating implementing carbon tax on fossil fuels in the future (Climate Connect, 2010).

Mexico

In 2009 Mexico announced to implement an ETS starting in 2011 that would cover the oil, cement, electricity and steel sectors (Bloomberg, 2009). On the long term a Mexican scheme plans to establish a bilateral term link to an US ETS. Sector-based international credits from Mexico could thus be used in the US (e.g. in the WCI). Currently however there is no progress regarding the implementation of a trading scheme in Mexico.

5 Conclusions

Emissions trading schemes are emerging in several industrialized as well as developing countries. Bilateral linking of the EU ETS to other trading schemes has often been brought forward as argument to reduce leakage. This paper showed that bilateral linking can play a role in addressing leakage, but it can also aggravate it. An analysis of the leakage sensitivity of the two systems that are linked is of big importance to assess the total effect of linking on leakage. Bilateral leakage is in principle already addressed by the introduction of separate caps in both countries. Against the background that the introduction of emissions trading is delayed on the federal level in the US, as well in Australia and Japan only few bilateral links can be expected in the coming years. If links to sectoral mechanisms in developing countries are established that have no national cap the sectors that link may play a role. As sectoral crediting mechanisms in developing countries may provide low cost credits to industrial countries, production may expand and leakage may be the consequence unless developing countries implement absolute caps. Without absolute caps developing countries may also see country internal leakage from the capped sector to other sectors.

The establishment of new market based mechanisms in developing countries is an important topic in the UN negotiations this year. Currently it is unclear to what extent new, possibly sector based, mechanisms will be developed within the UN, what would guarantee a certain level of standardisation and comparability, and therefore enable the creation of a global carbon market. Regardless of how sectoral credits will be created, within the UN or outside, credits that could be used in the EU ETS still are several years ahead, and bilateral links between EU ETS and developing countries' ETS cannot be expected before 2020. Thus, the uncertainties for European companies on the amount and price of international credits and possible implications on the European carbon price and as a consequence on leakage will remain.

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