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INTERNATIONAL EMISSIONS TRADING ASSOCIATION

ANALYSIS GROUP
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

Linking Tradable Permit Systems for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges

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With tradable permit systems for greenhouse gas (GHG) emissions in place in some parts of the world and actively being considered in others, increasing attention has been given to the opportunity to link these systems. Linking occurs when the government that maintains one system allows regulated entities to use allowances or credits from another system to meet domestic compliance obligations.

Linking creates opportunities for inter-system trading that can reduce the aggregate cost of meeting emission targets by broadening allowance and credit markets, and by permitting emission reduction efforts to be redistributed across linked systems. In principle, this flexibility can be offered to regulated entities without compromising the effectiveness of climate change mitigation efforts because emission reductions have the same effect on atmospheric GHG concentrations no matter where in the world they occur.

While linking can reduce the long-run cost of mitigating climate change, it also has other implications. In particular, linking can have distributional and (in some cases) emissions implications, and can reduce a government's control over the impacts of its tradable permit system. Thus, in considering linkages, governments may have to weigh linking's implications for potentially competing policy objectives, much as will be required in developing other elements of climate policy. Because linking's implications depend on the type of link that is established and the specific characteristics and design of the linked systems, in the near-term, some links will be more attractive and easier to establish than others. Importantly, those links that may be the easiest to establish — links between cap-and-trade systems and emission-reduction credit systems such as the Clean Development Mechanism — likely can provide much of the near-term cost-saving and risk-diversifying advantages that linking can offer.

This report explores the opportunities, implications, and necessary foundations for linkages.

Categories of Tradable Permit Systems That Can Be Linked

Tradable permit systems that can be linked fall into two categories: cap-and-trade systems and emission reduction credit systems (credit systems). Under a cap-and-trade system, the total emissions of a group of regulated sources are capped by creating a limited number of tradable emission allowances and requiring those sources to secure and surrender a quantity of allowances equal to their emissions. The European Union's Emissions Trading Scheme is an example of such a system. Under a credit system, entities that voluntarily undertake particular emission reduction projects are awarded credits that can be sold to participants in cap-and-trade systems. The Clean Development Mechanism (CDM) is an example of such a system.

Types of Linkages

Several types of links can be established between systems. Depending on whether only one or both linked systems recognize the other's allowances,[i] direct links between systems can be either "one-way" (unilateral), in which allowances can flow in only one direction, or "two-

[i] Throughout this report, we use "allowances" to refer collectively to allowances and credits, except where a distinction between allowances and credits is necessary.

way," in which allowances can flow in either direction.[ii] Two-way links can be bilateral, when established between just two systems, or multilateral, when established among multiple systems.

If a system establishes a one-way link by recognizing another system's allowances, and the former system's allowance price is the higher of the two, inter-system trading will occur until the systems' prices converge at an intermediate level. If the former system's price is the lower of the two, there will be no incentive for inter-system trading. If systems establish a two-way link, allowances will be sold from the system with the lower allowance price to that with the higher price until prices converge. Along with affecting each system's allowance price, this trading alters the distribution of emission reductions across the systems.

Even if two systems are not directly linked, they can be indirectly linked through separate links with a common third system. 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.

Implications of Linkages

By broadening markets for allowances and credits, linking increases the liquidity and improves the functioning of those markets. Linking also can reduce the costs of the linked systems by making it possible to shift where emission reductions occur across the systems. Just as allowance trading *within* a system allows higher-cost emission reductions to be replaced by lower-cost reductions within that system, trading *across* systems allows higher-cost reductions in one system to be replaced by lower-cost reductions *in another system*. While the cost savings from linking are valuable in their own right, in the context of global climate change mitigation efforts, a particularly important benefit of linking is the opportunity it offers to establish "common but differentiated responsibilities" across tradable permit systems without increasing the cost of achieving global emission targets.

Along with the cost savings that it can offer, linking carries with it other implications that warrant consideration. In particular, under some circumstances, linked systems collectively will not achieve the same level of emission reductions as they would absent linking. This can result either from a link's impact on emissions under the linked systems, or from its impact on emissions leakage from those systems. Linking also has distributional impacts across and within systems. As with other international trade, even if linking offers cost savings to each system on the whole, through its effect on allowance prices, linking can create both winners and losers within the linked systems. Moreover, linking leads to capital flows between linked systems. Finally, linking reduces the control that a country has over the impacts of its tradable permit system. Once a domestic system is linked with another system, decisions by the government overseeing that other system can begin to influence the domestic system's allowance price, distributional impacts, and emissions implications. Importantly, linking's implications and the tradeoffs it presents depend fundamentally on the type of link that is established, and the characteristics and design of the linked systems.

[ii] The only link that can be established with a credit system is a one-way link in which the system's credits can be used in a cap-and-trade system. Both one-way and two-way links can be established between cap-and-trade systems.

One-Way Linkage between a Cap-and-Trade System and a Credit System

A one-way link between a cap-and-trade system and a credit system can offer potentially significant cost savings by giving the cap-and-trade system's participants access to low-cost emission reductions, such as emission reduction opportunities in developing countries and opportunities to reduce net emissions that are challenging to incorporate directly in a cap-and-trade system (e.g., biological sequestration). In addition, such a link's distributional impacts ought to elicit broad support because the link can only serve to reduce the cap-and-trade system's allowance price, and increase the price that entities in the credit system receive for their credits.

While it offers potentially significant cost savings, the main concern regarding such a one-way link is that some of the traded credits will overstate the amount of emission reductions associated with their generation in the credit system. If this occurs, the use of credits in a cap-and-trade system will lead to increased emissions that are not fully offset by reductions in the credit system. The primary reason for this concern is the challenge of verifying that projects awarded credits in a credit system represent additional emission reductions beyond what would occur if they were not granted credits — the so-called additionality problem.

The key tradeoff presented by a link with a credit system is between the cost savings it can offer and its emissions implications. In addressing this tradeoff, a balance can be struck through the standards that are established to award credits in the credit system or to allow their use in the cap-and-trade system. Also, this tradeoff is affected by the cap-and-trade system's characteristics and design. If the system employs a "safety valve," any emissions impacts of linking with a credit system would be mitigated if the link limits the use of that safety valve, and the associated increase in emissions. Likewise, the emissions impacts of such a link would be mitigated if it reduces emissions leakage from the cap-and-trade system.

While some credit systems may be linked with only one cap-and-trade system, others, such as the CDM, may be linked with multiple systems. Pre-existing links between a credit system and other cap-and-trade systems significantly affect the implications of establishing a new link with that credit system. Because participants in the newly-linked cap-and-trade system must compete with other cap-and-trade systems for credits, pre-existing links can reduce the cost savings from the new link if the newly-linked system has a relatively low allowance price. Pre-existing links also can mitigate the possible emissions implications of linking with a credit system. This is because some of the offsetting emission reductions associated with the use of credits in the newly-linked system will not occur in the credit system itself, but rather in other cap-and-trade systems from which the credits are bid away. The fact that some of the credits used in the newly-linked system otherwise would be used in another cap-and-trade system renders moot any additionality concerns associated with the use of those credits. The new link would only influence which cap-and-trade system uses those credits, not whether they are used.

Through the indirect links that they create, one-way links between multiple cap-and-trade systems and a common credit system can achieve some and perhaps much of the cost savings that would be realized from direct links among those cap-and-trade systems. Competition for credits will cause credits to be used in the system(s) with the highest allowance price, reducing differences in the indirectly linked cap-and-trade systems' allowance prices, and thereby reducing the remaining cost savings from directly linking those systems.

Two-Way Linkage between Cap-and-Trade Systems

A primary determinant of the cost savings from a two-way link between cap-and-trade systems is the difference between the systems allowance prices. The greater the difference, the greater are the cost savings. At the same time, the greater the difference, the more the allowance price in at least one of the linked systems will adjust as a result of the link; and such adjustments can have other implications that merit consideration in assessing a link. For example, a link's distributional impacts and its effect on emissions leakage from the linked systems depends on how linking affects each system's allowance price.

Along with differences in their allowance prices, various aspects of the design of the linked systems can influence the implications of linking. For example, by influencing who gains and who loses as a result of allowance price adjustments that result from linking, each system's allowance allocation approach will at the very least affect the domestic distributional impacts of linking. Certain allocation approaches (in particular, the use of relative emissions caps and "updating allocations") also can affect the emissions implications and even the cost savings from linking. A cap-and-trade system's monitoring, reporting, and enforcement provisions are another element of its design that influences the implications of linking. While the importance of these provisions for the link's environmental integrity is readily apparent, these provisions also can influence a link's implications for allowance price volatility in the linked systems.

Although several aspects of the design of linked systems affect the implications of a linkage, they will not themselves be affected by that linkage. For example, linking will not affect who is regulated under a domestic cap-and-trade system, allowance allocation methods, or monitoring and penalty regimes. Each linked system maintains control over those decisions.

On the other hand, trading opportunities presented by an unrestricted link will lead to the automatic propagation (*de facto* harmonization) of certain design elements, including: offset provisions and linkages with other systems; banking and borrowing provisions; and safety valve provisions. If these provisions, sometimes referred to as cost-containment measures, are present in one of the linked systems, they will be made available to participants in the other system regardless of whether or not that other system has those provisions.

This automatic propagation can be limited by placing restrictions on a link. But short of prohibiting any net sales of allowances from the system with the more generous cost-containment measures, no restriction can ensure that a link will not increase the use of those measures. Moreover, any restriction that limits the propagation of those measures will present a tradeoff, as it also will reduce the cost savings from the linkage.

Prospects for Linkages

Linkages will be an important element of any cost-effective, long-run effort to reduce GHG emissions in which tradable permit systems feature prominently. Linking opportunities are not limited by any meaningful technical barriers. Therefore, the various implications of linking described above likely will be the primary determinants of whether and how quickly governments adopt particular linkages.

At least in the near-term, some links will be more attractive and easier to establish than others. For example, one-way links between cap-and-trade systems and credit systems may be more readily established than two-way links between cap-and-trade systems. Given the implications of two-way links between cap-and-trade systems, to facilitate such links between some systems, it may be necessary to harmonize certain elements of the design of those systems. In some cases, it may even be necessary to establish broader international agreements governing aspects of the design of linked cap-and-trade systems beyond mutual recognition of allowances.

Necessary Foundations for Future Two-Way Linkages

Mutually beneficial two-way links can be established between cap-and-trade systems whose designs differ in many important respects, but some harmonization of their design may be necessary to facilitate links between them. A system's use of particular allocation approaches (namely, relative caps and updating allocations), and its monitoring, reporting, and enforcement provisions can affect the desirability of linking for potential partners. However, the extent to which these design elements would need to be harmonized to facilitate linkage depends on circumstances specific to each system and linkage; and differences between systems can remain without undermining the case for linking. In contrast, agreement on a unified set of cost-containment measures likely will be a necessary pre-condition for an unrestricted two-way link between systems, given the propagation of those measures that results from such a link.

In principle, two-way links can be established simply by mutual recognition of each system's allowances. Yet, because linking reduces a government's control over the impacts of its system, more encompassing international agreements may be necessary to facilitate some links. Some governments may willingly become "price-takers" in the international allowance market, effectively ceding control to governments that oversee larger systems with which they link. On the other hand, before linking their systems, other governments may wish to reach agreement on a particular process for making future material changes to their respective systems, given the effects that such changes can have on each other's systems.

Near-Term Opportunities for One-Way Linkages with Credit Systems

While some two-way links between cap-and-trade systems may take more time to establish, in the near-term, one-way links between cap-and-trade and credit systems likely will be more attractive and easier to establish. A one-way link with a credit system may offer a cap-and-trade system greater cost savings than a two-way link with another cap-and-trade system. Also, such one-way links can only reduce allowance prices in the cap-and-trade system, giving a government greater control over its system than if it established a two-way link with another cap-and-trade system. The additionality problem is an important concern associated with such links, but it can be managed through the criteria established for awarding or recognizing credits.

If emerging cap-and-trade systems link with a common credit system, such as the CDM, this will create indirect links among the cap-and-trade systems. Through the indirect links that they create, such one-way linkages can achieve some and perhaps much of the near-term cost savings and risk diversification that direct two-way links among cap-and-trade system would achieve. Moreover, they can do so without requiring the same foundation that likely would be needed to establish direct two-way links, such as harmonization of cost-containment measures.

INTRODUCTION

As momentum builds toward a meaningful global effort to address climate change, it is apparent that tradable permit systems will play an important role in reducing greenhouse gas (GHG) emissions. Indeed, two of the most significant institutions for reducing GHG emissions implemented to date — the European Union's Emissions Trading Scheme and the Clean Development Mechanism — are tradable permit systems. Tradable permit systems also are being considered as a primary policy instrument for reducing GHG emissions in Australia, Canada, and the United States, among other countries.

Increasingly, attention has been given to the prospect of linking existing and emerging tradable permit systems for GHG emissions. Linking occurs when the regulatory authority that maintains a tradable permit system allows regulated entities to use emission allowances or emission reduction credits from another system to meet their domestic compliance obligations. Such recognition of allowances or credits from another system creates incentives that otherwise would not exist for inter-system allowance or credit trading.

This inter-system trading can reduce the aggregate cost of meeting the linked systems' collective emissions targets. Just as allowance trading *within* a tradable permit system allows higher-cost emission reductions to be replaced by lower-cost reductions within that system, trading *across* systems allows higher-cost reductions in one system to be replaced by lower-cost reductions *in another system.* In principle, such flexibility to trade across systems can be offered to regulated entities without compromising a GHG tradable permit system's environmental effectiveness because emission reductions have the same impact on atmospheric GHG concentrations no matter where in the world they occur.

Linking can offer significant benefits, as it broadens allowance and credit markets and can reduce the cost of meeting the collective emissions target of linked systems. But there are also reasonable concerns about linking that merit attention. Under some circumstances, linked systems collectively will not achieve the same level of emission reductions as they would absent linking. Also, linking can lead to distributional impacts across and within systems that may be deemed undesirable. Finally, linking can reduce the control that a country has over the impacts of its tradable permit system. Thus, in evaluating the case for linking, careful consideration needs to be given to both the advantages and disadvantages of such action.

This report examines the environmental and economic impacts of linking tradable permit systems, and examines how such impacts are affected by the type of linkage that is established and the characteristics and design of the linked systems.[1] In so doing, this report identifies

[1] While we focus on the environmental and economic impacts of linking, other issues also may deserve attention. For example, technical issues may need to be resolved to facilitate linking the infrastructures that support trading in different countries' systems, and the compatibility of linkages with international trade law needs to be considered.

tradeoffs among competing policy objectives that can be presented by linkage, potential obstacles to future linkage, and steps that can facilitate linkage.[2]

Section 2 of this report provides a basic introduction to the two general categories of tradable permit systems, cap-and-trade systems and emission reduction credit systems. Section 3 briefly reviews GHG tradable permit systems that have been implemented, are soon to be implemented, or have been proposed.

Section 4 describes the types of linkages that can be established between tradable permit systems, and Section 5 offers examples of such linkages. Section 6 discusses the primary benefits of linkage, and puts those benefits in the context of the broader set of policy implications that should be considered in assessing linking opportunities.

Because the implications of linking depend fundamentally on the type of linkage that is established and the characteristics of the linked systems, Sections 7 and 8 offer more detailed assessments of the implications of two types of linkages. Section 7 examines the implications of a "one-way" link between a cap-and-trade system and an emission reduction credit system, in which credits from the latter system can be used for compliance in the former system. Section 8 discusses the implications of a "two-way" link between cap-and-trade systems, in which the two systems mutually recognize each other's allowances.

Based on the findings of the preceding sections, Section 9 examines future prospects for linkages and evaluates the conditions that can foster their establishment. In so doing, it identifies those elements of the design of tradable permit systems that may need to be adjusted or harmonized to facilitate linkage, and considers the role of international agreements in facilitating linkage. Finally, Section 10 concludes.

[2] This report summarizes and builds on the evolving understanding of the implications of linking, to which many prior studies contributed, including Haites and Mullins (2001), Baron and Bygrave (2002), Blyth and Bosi (2004), Baron and Philibert (2005), Ellis and Tirpak (2006), and Kruger et al. (2007).

CATEGORIES OF TRADABLE PERMIT SYSTEMS

Because the implications of linking depend on the type of tradable permit systems that are linked, it is important to distinguish between two categories of systems: cap-and-trade systems and emission reduction credit systems (credit systems). This section describes the defining features of cap-and-trade systems and credit systems.

2.1. Cap-and-Trade Systems

A cap-and-trade system constrains the aggregate emissions of regulated sources by creating a limited number of tradable emission allowances — equal to the level of the overall cap — and requiring those sources to secure and surrender a quantity of allowances equal to their emissions. Faced with the choice between surrendering an allowance or reducing their emissions, firms place a value on an allowance that reflects the cost of the emission reductions that can be avoided by surrendering an allowance. Therefore, regardless of how allowances are initially distributed, allowance trading can lead allowances to be put toward their highest-valued use: covering those emissions that are the most costly to reduce. Conversely, the opportunity to trade allowances ensures that the emissions reductions undertaken to meet the cap are those that are the least costly to achieve.

In developing a cap-and-trade system, policymakers must decide on several elements of the system's design. Policymakers must determine the scope of the cap's coverage, or what sources will be subjected to the overall cap and what types of GHG emissions will be covered. This scope of coverage decision determines the level of demand for allowances. A related decision is that regarding the cap's point of regulation. A cap on energy-related carbon dioxide (CO_2) emissions can be enforced either by requiring that fossil fuel suppliers surrender allowances for the carbon content of their fuel sales ("upstream regulation"), or by requiring that final emitters surrender allowances for their emissions ("downstream regulation").

Policymakers also must determine how many allowances to issue and how to distribute them, decisions that are characterized as allowance allocation decisions. The choice regarding how many allowances to issue defines the level of the emissions cap. Policymakers may choose to establish a pre-determined trajectory of absolute caps, or to allow the level of the cap (and, hence, the number of allowances issued) to adjust over time in response to changes in economic activity.[3] We refer to the latter type of arrangement as a relative cap, although specific variants are often described as intensity- or rate-based caps. A relative cap could tie the number of allowances issued in a given year to a national indicator of economic activity, such as gross domestic product, or to production levels of particular emission sources or sectors.

[3] The level of a cap also may be adjusted to reflect changes in the sources that are covered by the cap. For example, if sources can opt-in to the system, there may be a corresponding change in the aggregate cap when a source opts-in.

Allowances can be freely distributed or auctioned, or a combination of the two approaches can be employed. If allowances are freely distributed, the possible methods for determining who receives them, and how many allowances each recipient receives, are limitless. In evaluating the implications of linking tradable permit systems, it is important to distinguish between methods in which the distribution of allowances is updated over time in response to future developments (so-called updating allocations), and methods in which the distribution of allowances for future years is determined at the time the cap-and-trade system is implemented.

Finally, policymakers must decide on a number of features of the cap-and-trade system relating to monitoring and reporting, as well as enforcement of compliance with the cap. Decisions also must be made regarding the length of the compliance period.

A key concern in many countries developing mandatory climate policies is uncertainty regarding the costs of such policies. In the context of a cap-and-trade system, costs are reflected in the price of emission allowances, which reflects the most costly incremental emission reduction necessary to meet the cap. Thus, concern about cost uncertainty is often expressed as concern about the level and volatility of allowance prices.

In response to concerns about cost uncertainty, much attention has been given to the opportunity to include "cost-containment" measures in cap-and-trade systems, including offset provisions, allowance banking and borrowing, and a safety valve provision. An offset provision allows regulated entities to offset some of their emissions with credits from emission reduction measures that are outside the cap-and-trade system's scope of coverage. While often viewed as a part of a cap-and-trade system, an offset provision also can be viewed as a link between the cap-and-trade system and a credit system.

Banking allows firms to use allowances to demonstrate compliance with the cap in any year after the allowances are issued. Borrowing allows firms to borrow allowances that will be issued in future years to demonstrate compliance in an earlier year. Thus, banking and borrowing allow firms flexibility to shift emission reduction efforts over time to minimize costs. Systems that allow banking and borrowing effectively redefine the emissions cap as a cap on cumulative emissions over a period of years, rather than a cap on emissions in specific years.

A safety valve puts an upper bound on the costs that firms will incur to meet an emissions cap by offering them the option of paying a predetermined fee (the safety-valve "trigger price") to purchase additional allowances. The same effect can be achieved by allowing firms to pay a predetermined fee to cover those emissions for which they do not surrender allowances. Firms facing a choice between reducing emissions further, buying allowances in the market, or paying the safety-valve fee will only reduce their emissions further or buy allowances in the market if doing so costs less than the fee.

In its simplest form, a safety valve introduces a tradeoff between avoiding unexpectedly high costs and achieving a system's emissions target. When a safety valve is exercised, firms' emissions exceed the number of allowances that were initially distributed. However, modifications to a safety valve can mitigate (or potentially eliminate) this tradeoff through provisions such as reducing subsequent years' caps in response to use of the safety valve.

2.2. Emission Reduction Credit Systems

Rather than achieving emission reductions by creating a limited number of emission allowances, an emission reduction credit system brings about emission reductions by awarding tradable credits for certified reductions. Some programs that are described as credit systems can be quite similar to a cap-and-trade system.[4] Therefore, in this report, when we refer to credit systems, we are describing a subset of systems that have a few key differentiating characteristics. First, the systems to which we refer are those for which participation is entirely voluntary. Second, the systems to which we refer are those that serve only as a source of credits that can be used by entities facing compliance obligations in *other* systems. They do not themselves impose any obligations on entities to hold or surrender credits. Third, the systems to which we refer grant credits for particular projects based on an estimate of how those projects reduce emissions from some agreed-upon baseline level of what emissions would have been if the projects had not been carried out.[5] Thus, in determining how many credits to grant an entity for a project, calculation of the appropriate baseline is as important as measuring emissions.

In designing a credit system, policymakers must determine what types of emission sources and actions can be awarded credits. For example, certain emission reduction projects may be excluded from consideration due to concern about the feasibility of accurately measuring results. In addition, policymakers must decide on a method for calculating the number of credits that are awarded. These calculations could be performed on a project-by-project basis, they could be based on standards applied to all projects of a particular type, or some combination of these approaches could be employed. Regardless of which approach is used, decisions must be made about how to measure baseline emissions, and about whether and how other considerations are accounted for in determining the number of credits to award for a project. For example, policymakers must decide whether and how to account for emissions leakage — the fact that emission reductions from a given project may lead to offsetting increases in emissions elsewhere.

[4] For example, a credit system may set individual emissions limits for firms, and allow them to generate tradable credits if they reduce their emissions below their assigned limit. Such a system would be essentially identical to a cap-and-trade system where each firm is allocated a quantity of allowances that reflects its specific emissions limit.

[5] By contrast, one of the earliest tradable permit systems, the U.S. Environmental Protection Agency's Emissions Trading Program, granted tradable credits to firms that reduced their emissions below a mandatory limit. Such a credit system does not raise the same challenges associated with determining the appropriate baseline as do the credit systems that we discuss in this report.

GREENHOUSE GAS TRADABLE PERMIT SYSTEMS

This section briefly reviews existing, planned, and prospective GHG tradable permit systems. Rather than providing a comprehensive review of these systems, this section is intended to familiarize the reader with systems discussed in later sections to illustrate points related to linking.[6]

3.1. Cap-and-Trade Systems

3.1.1. European Union Emissions Trading Scheme

The European Union's Emissions Trading Scheme (EU ETS) is the largest existing GHG cap-and-trade system. Phase I of the EU ETS, from 2005 to 2007, capped aggregate CO_2 emissions from more than 11,000 industrial facilities and electricity generators in 25 European countries.[7] Those sources collectively emitted approximately two billion metric tons of CO_2 in 2005, about 45 percent of the EU's CO_2 emissions.[8] The EU ETS cap has been tightened for Phase II, which runs from 2008 to 2012. Also, the scope of the EU ETS has been expanded to cover new sources in countries that participated in Phase I, and to include sources in Bulgaria and Romania, which acceded to the EU in 2007.

3.1.2. Norwegian Emissions Trading System

A Norwegian emissions trading system began operation at the same time as the EU ETS. From 2005 to 2007, it covered a relatively small set of industrial sources accounting for just 10 to 15 percent of Norway's GHG emissions.[9] Norway has since agreed to adjust its system to conform to the rules and procedures of the EU ETS, with which it will be linked. These adjustments include broadening the scope of sources covered, such that Norway's system will cover approximately 40 percent of its GHG emissions.[10] In response to this expansion, Norway will remove some of the CO_2 taxes that the newly-included sources had been required to pay in prior years. Norway has recognized that the design of those taxes, which covered 68 percent of Norway's CO_2 emissions, should take into account the design of any emissions trading system.[11]

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[6] Others have surveyed existing and prospective GHG tradable permit systems, or have offered in-depth examinations of particular systems. For example, see Baron and Philibert (2005), Ellis and Tirpak (2006), Capoor and Ambrosi (2007), and the symposium on the European Union's Emissions Trading Scheme in the *Review of Environmental Economics and Policy*, Volume 1, Number 1, Winter 2007.
[7] European Commission (2005).
[8] *Id.* and European Commission (2007b).
[9] Ministry of the Environment (2005).
[10] Euractiv.com (2007).
[11] Ministry of the Environment (2005).

3.1.3. Swiss Emissions Trading System

Under its CO_2 Act, in 2008, Switzerland will introduce a fee of 12 francs per ton of CO_2 emissions from industrial fossil fuel use, which accounts for about one-half of Switzerland's energy-related CO_2 emissions.[12] Depending on trends in emissions over the coming years, this fee could rise as high as 36 francs by 2010. As an alternative to this fee, companies can adopt legally binding emission targets for 2008 to 2012 that would be translated into an allocation of allowances in a Swiss cap-and-trade system.

3.1.4. Japan's Voluntary Emissions Trading System

Japan's Voluntary Emissions Trading System (JVETS) has been in operation since April 2006. Facilities bid for subsidies from the government by pledging emission reductions, and corresponding emission targets. Based on a limited pool of funding for these subsidies, thus far, the Japanese government has selected 89 facilities to receive subsidies and take on emissions targets, thereby joining JVETS.[13] These facilities account for no more than a few million tons of Japan's annual GHG emissions, which exceeded 1.3 billion metric tons in 2004.[14] The selected facilities were allocated tradable allowances commensurate with their pledged emission targets. If a facility fails to surrender a sufficient number of allowances to cover its emissions, it must return the subsidies that it originally received, but faces no other penalties.

3.1.5. Australia's Existing and Proposed Systems

In 2003, New South Wales (NSW) began operation of its Greenhouse Gas Reduction Scheme. This scheme is effectively a credit system in which all electricity retailers in NSW and other selected electricity market participants are required to obtain and surrender a specified number of emission reduction credits each year.[15] These requirements were established with a goal of achieving an aggregate target for per-capita emissions from NSW electricity generation.

Recently, there has been movement in Australia toward the development of a nationwide cap-and-trade system. In 2004, the States and Territories of Australia established the National Emissions Trading Taskforce (NETT) to develop a proposal for such a system, which was released in August 2006.[16] While the original proposal suggested that, at least initially, the system should cover only emissions from the stationary energy sector, the NETT has since begun considering whether a system should have broader coverage. In December 2006, Prime Minister Howard established his own Task Group on Emissions Trading, which issued a report in May 2007 proposing a nationwide cap-and-trade system that would have the broadest practicable coverage of Australia's GHG emissions.[17] The States and Territories have indicated that they

[12] Federal Office for the Environment (2007). Nearly all Swiss electricity generation is from hydroelectric and nuclear power plants.
[13] Ninomiya (2007).
[14] Sudo (2006) and Ministry of the Environment (2006).
[15] Independent Pricing and Regulatory Tribunal of New South Wales (2007).
[16] National Emissions Trading Taskforce (2006).
[17] Prime Ministerial Task Group on Emissions Trading (2007).

will introduce a cap-and-trade system by the end of 2010 if the Prime Minister does not commit to such a system. If a nationwide system is implemented, the NSW Greenhouse Gas Reduction Scheme and other existing initiatives to reduce GHG emissions in Australia likely would be phased out.

3.1.6. Chicago Climate Exchange

The Chicago Climate Exchange (CCX) began operation in 2003. Participating companies have voluntarily taken on limits on their global GHG emissions. These limits are defined as percentage reductions from a baseline that is derived from their 1998 to 2001 emissions. Participants are given tradable allowances equal to their agreed-upon limits, and must annually surrender a sufficient number of allowances to cover their emissions. Emissions covered by the CCX were slightly below 200 million metric tons of CO_2 in 2005.[18]

3.1.7. Regional Greenhouse Gas Initiative

In 2005, seven northeastern U.S. states agreed to implement the Regional Greenhouse Gas Initiative (RGGI), which three additional northeastern states subsequently joined.[19] While participating states continue to work on enabling regulations, the program is expected to begin in 2009, and would introduce a cap-and-trade system for electricity generators within the ten states. RGGI would place an aggregate cap on covered generators' emissions equal to nearly 190 million tons of CO_2 per year from 2009 to 2014, a level roughly comparable to those generators' recent emissions.[20] From 2015 to 2018, the cap would be reduced by 2.5 percent per year.

3.1.8. Other Regional Initiatives in the United States

In addition to RGGI, other regional and state efforts to limit GHGs in the United States have begun. One of the most prominent has been California's enactment of its Global Warming Solutions Act of 2006, which set a statewide GHG emissions limit for 2020 equal to California's 1990 emissions level. While California's Air Resources Board has not yet adopted a plan for achieving that target, a cap-and-trade system is one policy instrument being considered.[21]

3.1.9. Proposals for a Federal Cap-and-Trade System in the United States

Several bills proposing a federal GHG cap-and-trade system have been introduced in the 110th U.S. Congress. The proposals differ in many important respects, including the cap's scope of coverage, the level of the cap, and the measures that are proposed to address cost uncertainty. It appears increasingly likely that a federal system will be enacted in 2009 or 2010.

[18] Chicago Climate Exchange (2006).
[19] The participants are: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.
[20] Regional Greenhouse Gas Initiative (2005) and subsequent RGGI announcements at www.rggi.org.
[21] See Market Advisory Committee (2007).

3.1.10. Proposed Canadian System

In April 2007, Canada's Minister of the Environment released a plan that would target GHG emissions from Canada's major industrial sectors, which together account for about half of Canada's GHG emissions.[22] Under this plan, existing large industrial emitters would be required to reduce the GHG emissions intensity of their production by 18 percent by 2010, and achieve further reductions of two percent annually in subsequent years.[23] A cap-and-trade system would be established to achieve this goal.

3.2. Emission Reduction Credit Systems

3.2.1. Clean Development Mechanism

Established as one of the Kyoto Protocol's three "flexibility mechanisms," the Clean Development Mechanism (CDM) is the most significant GHG emission reduction credit system to-date. Under the CDM, certified emission reductions (CERs) are awarded for voluntary emission reduction projects in developing countries that ratified the Protocol, but are not among the Annex I countries subject to the Protocol's emissions limitation commitments. CERs are credits awarded for each ton of CO_2-equivalent (CO_2-e) emission reductions. While CERs can be used by Parties to the Protocol to meet their emissions commitments under the Protocol, they also may be used for compliance purposes by entities covered by various cap-and-trade systems throughout the world, including systems in countries that are not Parties to the Protocol.

An Executive Board established under the United Nations Framework Convention on Climate Change is responsible for supervising the CDM and making determinations about the issuance of CERs for particular projects. To be awarded credits, a project's sponsors must go through an approval process overseen by the Executive Board. From project initiation, it can take two or more years to go through that process, and the cost of the process (not including the cost of the actual emission reduction measures) can be substantial.[24] Nonetheless, as of early November 2007, more than 2,600 projects were in the CDM "project pipeline." These projects are expected to generate more than 2.5 billion CERs by the end of 2012.[25] The Executive Board has already registered more than 800 of these projects, which are expected to yield one billion CERs by 2012. Thus far, projects in China account for 45 percent of the expected CERs from registered projects, projects in India account for 16 percent, Brazil 10 percent, South Korea 8 percent, and projects in 45 other countries collectively account for the remaining 21 percent.

3.2.2. Joint Implementation

Like the CDM, Joint Implementation (JI) was established as a project-based flexibility mechanism under the Kyoto Protocol. However, unlike the CDM, JI applies to emission

[22] Environment Canada (2007).
[23] New facilities would be given a three year grace period, after which they would be required to reduce their emissions intensity by 2 percent per year.
[24] For example, see Nigoff (2006) and Michaelowa and Jotzo (2005).
[25] United Nations Framework Convention on Climate Change (2007).

reduction projects carried out in an Annex I country (the host country) that itself has a national emissions target under the Protocol. JI projects generate credits, referred to as emission reduction units (ERUs), that can be used to cover increased emissions in other countries. When these credits are generated, a corresponding reduction is made in the host country's emissions target under the Protocol. This ensures that the use of ERUs to cover increased emissions in another country is, in fact, offset by a net reduction in the host country's emissions.

ERUs can be awarded in one of two ways. Under the Track 1 approach, if the host country meets specific eligibility requirements under the Protocol, it may verify emission reductions and issue the appropriate quantity of ERUs without the approval of an international body. If the host country does not meet those eligibility requirements, emission reductions must be verified under the Track 2 approach through the Joint Implementation Supervisory Committee (JISC), which accredits an independent entity charged with verifying that the relevant requirements are met.

It appears that JI projects will produce fewer credits than CDM projects. The JISC began accepting documents for proposed projects in October 2005. By November 1, 2007, it had received submissions for only 92 projects, accounting for an estimated 155 million tons of CO_2-e emission reductions over the coming five years.[26]

3.2.3. Domestic Offset Programs

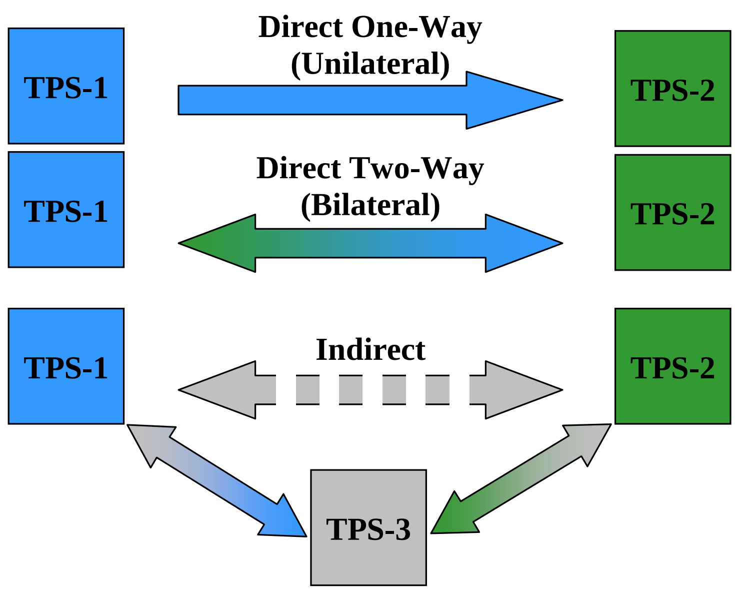
Certain cap-and-trade systems have established (or may establish) their own offset programs for creating emission reduction credits that can be used by regulated entities to meet compliance obligations. For example, electricity generators covered by RGGI can use offset allowances to cover a portion of their emissions. RGGI has established a set of project types that can be implemented to generate offset allowances, and standards for determining the number of allowances that a project will be awarded.[27] Cap-and-trade systems proposed in Australia, Canada, and the United States also include offset programs.

[26] Pointcarbon.com (2007).
[27] RGGI (2007a).

TYPES OF LINKAGES

Several types of linkages can be established between tradable permit systems (Figure 1), and the type of link that is established has important implications for its effects. A linkage can be either one-way (unilateral) or two-way (bilateral or multilateral). While direct links between systems can be established only as a result of explicit decisions to do so, direct links can lead to indirect links between systems even absent explicit decisions to link them.

Figure 1. Types of Linkages between Tradable Permit Systems
(Arrows denote the allowed flow of credits or allowances between systems)



4.1. Direct Linkages

In order for a direct linkage to be established between two systems, either one or both systems must choose to accept the other's allowances or credits as valid for use in demonstrating compliance in its own system.

4.1.1. One-Way (Unilateral) Linkage

In a one-way (or unilateral) direct linkage, allowances (or credits) can flow in only one direction between the linked systems.[28] Such a link may exist either because only one of the linked systems recognizes the other's allowances for compliance purposes, or because one of the

[28] Throughout this report, we use "allowances" to refer collectively to allowances and credits, except where a distinction between allowances and credits is necessary.

systems is a credit system that generates credits but does not place requirements on entities to surrender credits or allowances.

As a result of an unrestricted one-way link in which System A recognizes System B's allowances, if System A's allowance price is higher than that in System B, participants in System A will buy allowances from System B. By increasing the supply of allowances available in System A and increasing demand for System B's allowances, this trading will reduce System A's allowance price and increase System B's price until those prices converge. This trading also will increase emissions in System A and decrease emissions in System B, as higher-cost emission reductions in System A are avoided and replaced by lower-cost reductions in System B.

If System A's allowance price is lower than that in System B, no trading or redistribution of emission reductions will result from the one-way link, as System A participants would have no incentive to purchase System B's allowances. Thus, an unrestricted one-way link in which System A recognizes System B's allowances will ensure that System A's allowance price never exceeds System B's price, but System B's allowance price may still exceed that in System A.

4.1.2. Two-Way (Bilateral or Multilateral) Direct Linkage

In a two-way direct linkage, the governments maintaining the linked systems recognize allowances from each other's system for compliance purposes, making it possible for allowances to flow in either direction between the systems. Two-way links can be bilateral, if agreed upon by just two systems, or multilateral, if agreed upon by more than two systems.

As a result of an unrestricted two-way link between two systems, any difference between the systems' allowance prices will lead to sales of allowances from the lower-price system to the higher-price system until the systems' allowance prices converge at an intermediate level. This inter-system trading will lead to an increase in emissions in the higher-price system and an offsetting reduction in emissions in the lower-price system.

4.1.3. Restrictions on Direct Linkages

Various restrictions or conditions could be placed on links that would limit inter-system trading, and may thereby limit the allowance price convergence described above. For example, a government may limit the quantity of allowances from another system that can be used to demonstrate compliance in its own system.[29] Alternatively, participants in a system may be allowed unrestricted use of another system's allowances, but an "exchange rate" might be applied to their use. That is, participants could be required to surrender a different number of another system's allowances to cover each ton of their emissions than would be the case if they used their own system's allowances. Such a requirement could serve as a simple fix to ensure the environmental integrity of a link if the linked systems' allowances or credits represent different amounts of emissions or emission reductions (e.g., short tons versus metric tons). Such a requirement also may be intended to reduce inter-system trading, or to ensure that any trading

[29] The effects of quantity restrictions depend on whether they are, in fact, binding constraints on the level of inter-system trading that otherwise would occur.

leads to a net reduction in emissions. Finally, in linking with a credit system, a cap-and-trade system might condition the acceptance of credits on the type of emission reduction measure that generated the credits.

4.2. Indirect Linkages

Even if neither system recognizes the other's allowances, two systems can become indirectly linked through a direct link that each has with a common third system. As a result of trading between each of the two systems and the common system, developments in one of the indirectly linked systems can affect the supply and demand for allowances in the other system. Hence, changes in the allowance price and emissions level in one system can affect the allowance price and emissions level in a system with which it is indirectly linked.

Box 1. Can Linkages Emerge Absent Government Decisions to Allow Them?

Markets often emerge to facilitate the trading of goods and services even when a government seeks to prevent or control such trading. Thus, questions have been raised about whether links between tradable permit systems can emerge even without government decisions to create them. For example, some have raised the possibility that financial markets might facilitate trading across systems even if governments do not take steps to link those systems. However, because of a fundamental difference between allowances and other commodities, inter-system trading and the resulting cost savings depend on government decisions to create links.

Most commodities have intrinsic value to trading participants. As a result, incentives to trade those commodities exist even if governments seek to control or discourage trading. On the other hand, the value of an allowance to participants in a tradable permit system depends on that allowance being recognized as a valid means of demonstrating compliance in that system. Therefore, the incentive that a tradable permit system participant has to purchase another system's allowances depends on a government decision to recognize those allowances for use in the participant's system. Absent this decision, there is no incentive for inter-system trades.[30]

Also, the cost savings from linking depend on the redistribution of emission reduction efforts across systems that occurs when one system's allowances are used to cover emissions in another system. This redistribution of emission reductions can occur only if the government that maintains the latter system recognizes the former system's allowances for use in its system.

[30] If a participant in a tradable permit system cannot use allowances from another system for compliance purposes in its own system, that participant would only have an incentive to buy allowances from the other system if the participant believed it could later profitably sell the allowances back into that other system. Such activity would not represent meaningful inter-system trading because all traded allowances ultimately would be sold back to participants in the system in which the allowances were originally issued. That is, there would be no net flow of allowances from one system to another.

Thus, while they can play an important role in facilitating the inter-system trading that results from links between systems, financial market participants cannot themselves create such links. The creation of links depends on government policies.

A series of bilateral links among several systems can create indirect links among those systems that are identical in their effects to a direct, multilateral link among them. For example, if System A has a two-way link with System B, which has a two-way link with System C, trading between Systems B and A and between Systems B and C will cause allowance prices to converge across all three systems even though Systems A and C are not directly linked. Thus, developments that affect System C's allowance price will indirectly affect System A's allowance price. Likewise, through its effect on the supply and demand for allowances in System B, an increase in System C's emissions can lead to a reduction in System A's emissions.

Indirect links also can be created between two systems if they both have a one-way link with a common third system, whereby both systems recognize allowances from that third system. As a result of such one-way links, the two indirectly linked systems will compete for allowances from the third system. Therefore, changes in one system's demand for the third system's allowances will affect the supply of allowances available to the other system.

EXAMPLES OF LINKAGES AMONG GREENHOUSE GAS TRADABLE PERMIT SYSTEMS

While there has been much discussion of the potential for linkages among tradable permit systems, some links already have been established among systems that are in place, or are soon to be implemented. This section briefly reviews some notable existing and planned linkages.

5.1. One-Way Linkages

5.1.1. EU Linking Directive

Through its Directive 2004/101/EC, commonly referred to as the Linking Directive, the European Commission established a link between the EU ETS and the Kyoto Protocol's CDM and JI programs.[31] The Directive allows EU ETS participants to use CERs in meeting their compliance obligations beginning in 2005, and to use ERUs beginning in 2008.

The Directive places restrictions on this linkage. For example, CERs and ERUs generated from nuclear facilities, land use, land use change, and forestry activities are not recognized in the EU ETS. Also, the Directive provides Member States the flexibility to set their own quantitative limits on the use of CERs and ERUs by EU ETS participants under their jurisdiction. However, the Directive stipulates that those limits should be consistent with the Protocol's requirement that the use of such credits be supplemental to domestic action. The Commission has interpreted and enforced this requirement as implying that limits on the use of CERs and ERUs should be set so that the total use of CERs and ERUs by each Member State — including, but not limited to use in the EU ETS — constitutes no more than half of the reductions necessary to meet the Member State's Kyoto target.[32] In total, it appears that this requirement will allow for the annual use of more than 250 million metric tons of CERs and ERUs during Phase II of the EU ETS.[33]

The effects of this linkage are already apparent in markets for CERs, which are more developed than markets for ERUs. In recent months, secondary market prices for CERs have closely tracked prices for Phase II EU ETS allowances.[34]

[31] European Commission (2004).
[32] European Commission (2007a).
[33] Calculations based on information provided in European Commission (2007b).
[34] Carbonpositive (2007). While movements in secondary market CER prices have closely tracked movements in Phase II EU ETS allowance prices, CERs have sold at a slight discount. This may reflect remaining uncertainty about whether quantitative restrictions on the use of CERs in the EU ETS will have a binding effect, which would cause EU ETS allowance prices to exceed CER prices.

5.1.2. RGGI Linkages

The Model Rule governing the implementation of RGGI allows for several types of one-way links. Covered sources may use emission reduction credits from qualified domestic offset projects specified in the Model Rule, subject to quantitative limits that depend on the prevailing RGGI allowance price.[35] At most, no more than 10 percent of a source's emissions can be covered by credits from offsets. If the RGGI allowance price exceeds a particular threshold, which increases over time, sources also have the option to use CERs and allowances from other countries' cap-and-trade systems, such as the EU ETS, in meeting their compliance obligations.[36] However, under such circumstances, sources are still required to cover at least 90 percent of their emissions with RGGI allowances.

5.2. The EU ETS as an Example of a Multilateral Two-Way Linkage

The EU ETS can itself be viewed as a multilateral two-way linkage among individual cap-and-trade systems of each EU Member State. The European Commission has dictated certain aspects of the design of the EU ETS, such as designating the sectors that are covered by the system. However, while subject to some common requirements, the Member States have significant autonomy and responsibility with respect to many aspects of the system within their jurisdiction, such as: determining how many allowances to allocate; determining how to allocate allowances; and overseeing the monitoring, verification, and reporting of emissions. Thus, the EU ETS can be viewed as a multilateral linkage among the Member States' own systems, where a central authority enforces the harmonization of certain characteristics of each system. Importantly, allowances issued by any Member State under the EU ETS are recognized by all other Member States. As a result, facilities in each Member State participate in the same allowance market and can trade with facilities in any other Member State. In addition to these linkages among EU Member States, in 2008 two-way linkages will be established between the EU ETS and Norway's emissions trading system, and between the EU ETS and systems that will be established in Iceland and Liechtenstein.

[35] Regional Greenhouse Gas Initiative (2007a).
[36] This threshold price is an inflation-adjusted amount that begins slightly below $11 per ton of CO_2 (in 2005 U.S. dollars) and increases by 2 percent per year in real terms.

FRAMEWORK FOR ASSESSING LINKING OPPORTUNITIES

Linking tradable permit systems leads to a number of effects that need to be considered in assessing the merits of a particular linkage. This section begins by describing the primary benefits of linking, and then places these benefits in the context of the broader set of policy implications associated with linking. While this section provides an overview of the implications of linking, Sections 7 and 8 examine how these implications are influenced by the type of linkage that is established and the characteristics and design of the linked systems.

6.1. The Primary Benefits of Linking

By broadening the market in which allowances and credits are traded, linking increases the liquidity and functioning of allowance and credit markets. If one or both of the linked systems is small, this benefit of linking can be quite important. For example, absent linking, certain markets may be too small to foster the development of exchanges and other institutions that reduce transaction costs and facilitate trading. Linking also can reduce concerns about market power that otherwise might exist in one of the linked allowance markets.

The most significant benefit of linking results from the opportunity it offers to shift where emission reductions occur across linked systems in ways that reduce the cost of meeting the systems' collective emissions target.

Absent linkages among tradable permit systems, the total cost of achieving their collective emissions target can be minimized only if three conditions are met. First, policymakers would have to know the emissions targets for each system that would achieve the cost-minimizing distribution of emission reduction responsibilities across those systems. Second, this cost-minimizing distribution would have to be adopted by the tradable permit systems. Third, each system's emissions target would have to be adjusted periodically to reflect changes in the cost of emission reductions in each system. It is unlikely that any, let alone all, of these conditions could be met.

Linking makes it possible to minimize the total cost of meeting the collective emissions target of linked systems without meeting any of these three conditions. Regardless of what emissions target each system adopts, as a result of linkages, inter-system allowance trading will occur until the least costly distribution of emission reductions is achieved across the systems.

While the cost savings that linking can achieve are valuable in their own right, in the context of global climate change mitigation efforts, another important benefit of linking is the opportunity it offers to establish "common but differentiated responsibilities" across tradable permit systems without increasing the cost of achieving global emission targets. This benefit of linking likely will make it an important element of any cost-effective, long-run effort to reduce GHG emissions in which tradable permit systems feature prominently.

6.2. Implications of Linkages for the Achievement of Policy Objectives

In implementing a tradable permit system, a government creates a new market whose characteristics and design likely will reflect a desired balance among several policy objectives. Although the system's cost undoubtedly will be a key concern, this likely will be balanced with other considerations, including the system's environmental effectiveness and distributional impacts. While the primary motivation for linking may be to reduce a tradable permit system's cost, linking also can affect the achievement of other policy objectives, as we describe below.

6.2.1. Implications for Costs and Volatility of Costs

By broadening the scope of trading opportunities and improving the liquidity of allowance and credit markets, linking generally reduces the aggregate cost of meeting the linked systems' collective emissions target.[37] Each system benefits from these savings, though the magnitude of the cost savings will depend on the specific circumstances of each linkage.

Along with reducing aggregate costs, linking can affect the volatility of those costs, which is reflected in allowance price volatility. Allowance price volatility will be present in a tradable permit system regardless of whether or not the system links with others. However, linkages can dampen the effects of unanticipated cost shocks in a given system by giving that system's participants access to a broader pool of emission reduction opportunities. At the same time, linkages expose participants in a tradable permit system to a new source of allowance price volatility — that arising from cost shocks in linked systems.

6.2.2. Implications for Environmental Effectiveness

In many cases, linking offers the opportunity to achieve cost savings simply by redistributing where emission reductions occur across linked systems without affecting the aggregate level of remaining emissions under those systems. The sale of an allowance by a participant in one system to a participant in another system leads to an increase in emissions in the latter system and an offsetting reduction in emissions in the former system — leaving total emissions under the two systems unchanged.

However, there are some circumstances (described in later sections) in which linking can increase *or decrease* total GHG emissions under the linked systems. Also, even if it leaves total emissions under the linked systems unchanged, linking can affect global emissions through its effect on emissions outside of those systems. Each system likely will bring about some emissions leakage, whereby market adjustments in response to the system increase emissions outside its scope of coverage. Linking can affect the level of leakage from each system, with a net effect that either increases or decreases total leakage from the linked systems.

[37] There are some limited circumstances in which linking can increase costs (see Sections 8.4.4 and 9.1).

Box 2. Implications of Linkages for Emissions of Correlated Pollutants

In evaluating linking opportunities, some have expressed concern about effects that inter-system GHG allowance trading may have on emissions of regional and local pollutants, such as ozone precursors and air toxics, that often are released along with GHGs.[38] Because they often are emitted along with GHGs, we refer to these pollutants as correlated pollutants. Several considerations suggest that potential linkages among GHG tradable permit systems should not be limited based on concerns about emissions of correlated pollutants.

First, linking will not necessarily increase correlated pollutant emissions. If a tradable permit system becomes a net seller of GHG allowances as a result of linking, this will result in further reductions in GHG and correlated pollutant emissions in that system.

Second, with or without linking, a GHG tradable permit system will be overlaid on top of existing environmental laws that establish standards for emissions of those other pollutants. These laws would prevent firms from undertaking any GHG allowance trades that would cause them to violate standards for correlated pollutants.

Third, even if a link leads to fewer reductions in regional or local GHG emissions (offset by more reductions in another system), the magnitude of its effect on correlated pollutant emissions and the associated health and environmental impacts would be highly uncertain. The amount and the impacts of correlated pollutant emissions associated with each ton of GHG emissions vary widely across emission sources. Thus, a link's effect on the health and environmental impacts of correlated pollutant emissions depends fundamentally on which emission sources adjust their GHG emissions as a result of the link.

If concerns exist about correlated pollutant emissions, separate regulations can be devised that specifically target the sources and correlated pollutant emissions of concern. Compared with restricting links among GHG tradable permit systems, such an approach will be far more certain to achieve the desired aims, and will only reduce the flexibility offered by linking in those cases where the environmental benefits warrant it.

6.2.3. Implications for Distributional Impacts

As with other interregional or international trade, although linking offers net gains to each linked system, it can have both positive and negative distributional effects within each system. Allowance trading resulting from linking raises the allowance price in one of the linked systems, and reduces the other system's allowance price. Consequently, linking's impact on any given participant in one of the linked systems depends on the change in that system's allowance price, and on whether the participant is a net buyer or seller of allowances. Moreover, changes in allowance prices in each linked system affect the prices of energy and other emissions-intensive goods, with those prices rising in the system whose allowance price rises, and falling in the

[38] For example, see Section 2.4 of Market Advisory Committee (2007).

system whose allowance price falls. Therefore, changes in allowance prices resulting from linking also affect firms and households that do not directly participate in the linked systems.

The effect of linking on the competitiveness of firms within the linked systems is another important element of linking's distributional impacts. By placing a cost on emissions equal to the allowance price, cap-and-trade systems can significantly affect the production costs of firms in emissions-intensive industries, and firms that rely on emissions-intensive inputs. As a result, these firms will be concerned with the effect of linking on their competitiveness. The main effect of linking on the competitiveness of firms results from linking's effect on allowance prices in a cap-and-trade system. However, as Section 8.4.3 describes, some allowance allocation methods can influence linking's competitiveness impacts.

Along with its distributional impacts within each linked system, linking leads to capital flows between systems associated with inter-system allowance trading. Because any inter-system trading is voluntary, these capital flows necessarily are beneficial to the entities involved in that trading. However, others may object to some of these potentially large capital flows.[39]

6.2.4. Implications for Control over a Tradable Permit System's Impacts

Underlying some of the effects of linking on a tradable permit system's environmental effectiveness and distributional impacts is a more fundamental effect of linking. Specifically, linking reduces a government's control over the impacts of its tradable permit system. Once a system establishes a linkage, its allowance price will begin to be influenced by developments in the linked system and by decisions made by the government overseeing that linked system. Likewise, the system's effect on emissions will begin to be influenced by decisions made by the government overseeing the linked system.

The degree to which linking reduces a government's control over its tradable permit system depends on the characteristics of the linked systems. For example, while the post-link allowance price in linked systems will be between their pre-link prices, all else equal, it will tend to be closer to the larger system's pre-link price. The link between Norway's emissions trading system and the EU ETS demonstrates this point. Given the relative size of the two systems, by linking with the EU ETS, Norway will become a price-taker, whereby its allowance price will rise or fall to the level of the EU ETS allowance price. Prior to linking, Norway could influence the allowance price in its system through its decisions about how many allowances to issue and what sources to include under its cap. However, once a link with the EU ETS is established, those decisions will have effectively no impact on the allowance price that participants in its system face. Indeed, given Germany's relative size within the EU ETS, Germany's decisions about how many allowances it issues will have a far more significant effect on the allowance price faced by Norwegian facilities than will any decisions by the Norwegian government.

Even if a system is relatively small, however, certain characteristics of that system can have significant effects on much larger systems with which it might link. For example, the

[39] For example, see Bradsher (2007).

presence of a safety valve in one of the linked systems can significantly affect allowance prices in the other system even if the former system is much smaller than the latter (see Section 8.6).

The degree to which linking reduces a government's control over its system also depends on the type of linkage. For example, when a system establishes a one-way link in which it accepts another system's allowances, that link can only lower the former system's allowance price. By contrast, a two-way link can either increase or decrease a system's allowance price.

Although linking can reduce a government's control over its tradable permit system's impacts, in some cases that control already may be limited by connections with other systems through trade in emissions-intensive products. Thus, the reduced control resulting from linking may be of less concern in some circumstances than in others. For example, if two cap-and-trade systems that are not linked cover emissions-intensive sources that compete in the same product market, competition among those sources will cause economic activity and associated emissions to shift toward the system with the lower allowance price. Emissions-generating activity will increase in that system and decline in the system with the higher allowance price. As long as both systems have an absolute emissions cap, this shift ultimately will not increase total emissions in either system, but it will alter the amount of emission reductions that must be achieved to meet each system's cap. Less emission reductions will be needed to meet the cap in the system with the higher allowance price, reducing that system's price. More reductions will be needed to meet the cap in the system with the lower allowance price, increasing that system's price. Thus, tradable permit systems may exert influences on one another even if they are not explicitly linked.

The extent of such influences depends, among other factors, on the ease with which emissions-generating activity can shift between systems in response to differences between them. For example, if the European Union's Member States had pursued separate, unlinked cap-and-trade systems instead of creating the EU ETS, those systems nonetheless would have had a significant influence on one another as a result of competition in emissions-intensive product markets within Europe. This would have tended to make the reduction in control associated with linking a lesser concern. On the other hand, if cap-and-trade systems are established in Australia and the United States, absent a direct or indirect link between them, these systems likely would have very little influence on one another. In such a case, the implications of linking for the control that each government has over its own system would be more important.

6.3. Summary

The decision to link tradable permit systems may require weighing tradeoffs among linking's many effects. These tradeoffs depend on the type of linkage and the characteristics and design of the linked systems, which has two implications. First, the specific circumstances associated with each potential linkage need to be considered in assessing the merits of linking. Second, governments contemplating linking have the opportunity to influence the tradeoffs associated with linking by adjusting their tradable permit system's design.

ONE-WAY LINKAGE BETWEEN A CAP-AND-TRADE SYSTEM AND A CREDIT SYSTEM

This section examines the implications of a one-way link between a cap-and-trade system and a credit system.[40] Section 7.1 explores these implications when no other cap-and-trade system is linked with the same credit system. Section 7.2 examines the implications of such a link when there is a pre-existing link between that credit system and another cap-and-trade system. Section 7.3 describes how indirect links among cap-and-trade systems created by one-way links with a common credit system affect the incremental impacts of direct links among those systems.

7.1. One-Way Linkage in the Absence of Pre-Existing Linkages with a Credit System

A one-way link between a cap-and-trade system and a credit system can offer potentially significant cost savings. As in the case of a link with the CDM, such a link can allow cap-and-trade system participants access to credits from emission reductions in developing countries, which are believed to have a disproportionate share of low-cost reduction opportunities.[41] Moreover, a credit system may be the best policy instrument for encouraging biological sequestration, which can offer significant low-cost opportunities to reduce net emissions, but is challenging to incorporate under a cap-and-trade system.[42]

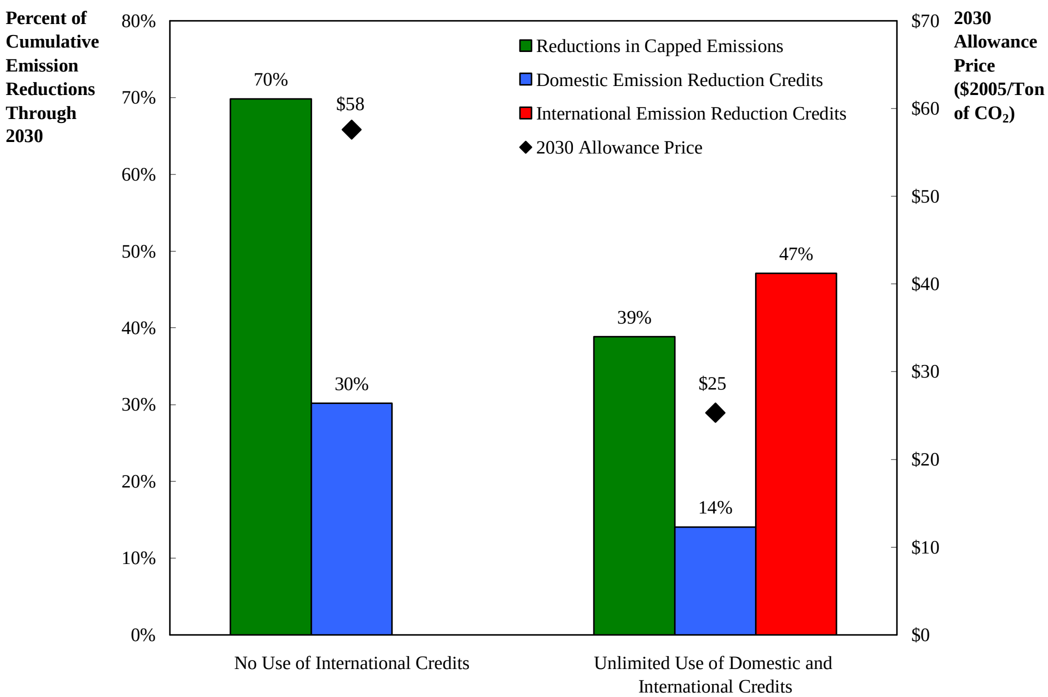
Cost savings from a link between a cap-and-trade system and a credit system result both from the opportunities for low-cost emission reductions under the credit system, and from the fact that, absent that link, *all* of those opportunities would remain untapped. Absent linkage with at least one cap-and-trade system, there would be no demand for credits from the credit system, and hence no incentive for emission reductions under that system. That is, linkage introduces a price signal for emission reductions in the credit system that otherwise would not exist.[43]

A recent U.S. Energy Information Administration (EIA) analysis highlights the significant potential for cost savings from linkages with credit systems.[44] EIA examined the

[40] This is the only type of link that can involve a credit system, which serves only as a source of credits. We do not separately discuss the implications of a one-way link between two cap-and-trade systems, though the key issues that such a link raises are similar to those associated with a two-way link between cap-and-trade systems.
[41] Intergovernmental Panel on Climate Change (2007).
[42] For example, see Stavins and Richards (2005).
[43] By comparison, even before two cap-and-trade systems link, the least costly emission reductions in each system already are undertaken up to the point necessary to meet each system's cap. So, cost savings from linking the systems depend on the difference between the costs of *remaining* untapped reductions in one system, and the costs of the most costly reductions necessary to meet the other system's cap. This difference is reflected in the difference between the systems' allowance prices (see Section 8.1).
[44] U.S. Energy Information Administration (2007).

impacts of the Climate Stewardship and Innovation Act of 2007, a bill introduced in the U.S. Senate that would establish a cap-and-trade system for emissions from sources that accounted for about 80 percent of 2005 U.S. GHG emissions. EIA found that, absent restrictions on the use of emission reduction credits from domestic and international sources, such credits could account for more than 60 percent of the least-cost reductions necessary to meet the Act's caps through 2030 (Figure 2).[45] More than three-quarters of the credits would be from international sources. Compared with a scenario in which international credits would not be recognized in the U.S. system, EIA found that unrestricted use of international and domestic credits would reduce the predicted 2030 allowance price from nearly $60 per ton of CO_2 to just $25.

Figure 2. Effect of Links with Credit Systems on the Allowance Price and Distribution of Emission Reductions under the U.S. Climate Stewardship and Innovation Act of 2007



Source: U.S. Department of Energy, Energy Information Administration (2007)

Linkage with a credit system also will tend to reduce the allowance price volatility in a cap-and-trade system that otherwise would result from unexpected shocks within that system.[46] On the other hand, if facilities under a cap-and-trade system rely heavily on emission reduction credits, new sources of allowance price volatility can be introduced if regulatory developments or other factors suddenly reduce the available supply of credits, or increase their cost. However,

[45] This finding is based on the assumption that the necessary institutions would emerge to award credits for domestic and international projects, and accounts for competition with other countries for credits. The percentage would be higher (lower) if other countries' demand for credits were lower (higher) (see Section 7.2).

[46] The extent to which such a link reduces short-term volatility will be limited if credit-generating projects require significant lead-time to be approved and implemented.

an important characteristic of a one-way linkage is that the link can only reduce the cap-and-trade system's allowance price, relative to what it would be without the linkage.

The distributional impacts of a linkage between a cap-and-trade system and a credit system ought to elicit relatively broad support within the two systems. This is because the only entities made worse off by such a linkage are net sellers of allowances in the cap-and-trade system, and other entities that indirectly benefit from higher allowance prices in that system, such as renewable electricity generators. Of course, even with such link, these entities are likely better off than they would be without a cap-and-trade system.[47]

The key concern regarding a link between a cap-and-trade system and a credit system is that some of the resulting trades may lead to a net increase in overall emissions. This could occur if the number of credits granted for certain projects under the credit system exceed the net reduction in emissions that those projects actually achieve. In such a case, the increase in emissions from the use of those credits in a cap-and-trade system would not be fully offset by reductions in the credit system, leading to a net increase in total emissions.

One possible cause of this phenomenon is the so-called additionality problem. In a credit system, credits are awarded for reductions in emissions from a baseline level that is not and cannot be observed. Rather, an assumption must be made regarding an appropriate baseline of what emissions would have been if a particular project were not awarded credits. If an inappropriate baseline assumption is made, some credits may be awarded for emission reductions that would have occurred even if the credits had not been granted. Because the emission reductions associated with those credits would have occurred regardless of whether or not they were granted credits (i.e., they are not "additional"), the use of those credits to allow for increased emissions under a cap-and-trade system would lead to a net increase in emissions.

Linking with a credit system also can lead to increased emissions because of emissions leakage associated with emission reductions under the credit system. That is, even if a project's direct emission reductions are additional and correctly estimated, that project may lead to increased emissions elsewhere that partly (or even fully) offset its direct reductions. Therefore, the number of credits awarded for a project may overstate the *net* reductions achieved if leakage is not appropriately taken into account. Leakage is typically a greater concern in a credit system than in a cap-and-trade system because a credit system has no means of preventing offsetting increases in other sources' emissions in response to reductions from a given source. By contrast, leakage from emission reductions under a cap-and-trade system only occurs if the sources whose emissions increase are outside of the cap's scope of coverage.[48]

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[47] However, the introduction of a one-way link several years into the life of a cap-and-trade system may be resisted by some if the resulting reduction in the system's allowance price reduces their ability to recoup the cost of emission reduction investments previously made in response to that system.

[48] In addition to additionality and leakage concerns, certain types of emission reductions that may be included under a credit system can raise other concerns. For example, efforts to grant credits for biological sequestration raise more challenging measurement issues than are involved in measuring reductions in energy-related CO_2 emissions.

The extent to which a credit system may award credits in excess of the actual emission reductions achieved under the system depends fundamentally on the standards and procedures that are applied to determine how many credits, if any, should be awarded for particular projects. A balance must be struck in setting such standards and procedures. On the one hand, it is clearly undesirable to award credits in excess of the net emission reductions actually achieved by a project. On the other hand, more stringent standards and procedures may fail to award credits for some real reductions, and may discourage some low-cost reduction measures by imposing substantial transaction costs on efforts to receive credits.

Although a link between a cap-and-trade system and a credit system may lead to an increase in emissions under the linked systems due to the factors described above, linking also reduces the cap-and-trade system's allowance price. In turn, the reduction in the cap-and-trade system's allowance price can reduce emissions leakage from that system, thereby reducing the link's net effect on global emissions. In fact, in some cases, a link between a cap-and-trade system and a credit system could *reduce* global emissions. The magnitude of this offsetting effect depends on how prone the particular cap-and-trade system is to leakage.

The RGGI system in the northeastern United States is an example where leakage is a serious concern. Analyses have found that nearly half of the projected emission reductions at covered plants could be offset by leakage.[49] Thus, by reducing leakage from the RGGI system, a link between that system and a credit system could reduce global emissions even if credits used in the RGGI system overstate the net reductions that credited activities achieve.

The potentially problematic emissions implications of a link between a cap-and-trade system and a credit system also would be mitigated, and possibly reversed, if the cap-and-trade system has a safety-valve provision. In this case, the use of credits in the cap-and-trade system may make it possible to avoid or limit the use of the safety valve, thereby avoiding or limiting the associated increase in emissions.

In summary, a one-way link between a cap-and-trade system and a credit system may yield substantial cost savings by providing sources in the cap-and-trade system access to low-cost emission reduction opportunities. The distributional implications of such a link are unlikely to raise significant concerns in either system. But because of problems inherent in measuring emission reductions in credit systems, linking with such systems can lead to an increase in emissions. At the same time, it is possible that such a linkage can reduce global emissions if the cap-and-trade system is prone to emissions leakage or has a safety valve.

If there are concerns about the emissions implications of such a linkage, a balance can be struck between the desire for cost savings and concern about emissions implications through the standards and procedures established to award credits, or to recognize them for use in a cap-and-trade system. Moreover, linkage with a credit system could be tied to a corresponding tightening of the cap-and-trade system's cap. If the cost savings from the linkage are sufficiently large,

[49] This estimate is based on cumulative projected emission reductions from 2009 to 2024. Regional Greenhouse Gas Initiative (2007b)

despite increasing the cap's stringency, such an approach can yield cost savings while protecting against a net increase in emissions.

7.2. Implications of Pre-Existing Linkages with a Credit System

A credit system may be linked with multiple cap-and-trade systems. For example, while entities covered by the EU ETS can use the CDM's CERs to meet their compliance obligations, other existing and planned systems allow the use of CERs, and future Australian, Canadian, and U.S. systems may recognize CERs.[50] In such a case, the presence of pre-existing links between a credit system and other cap-and-trade systems can significantly alter the implications of establishing a new link with that credit system.[51]

A link between a cap-and-trade system (System A) and a credit system will cause the price of the latter system's credits to rise toward the level of System A's allowance price, eliciting those emission reductions in the credit system that are less costly than the credit price, and increasing System A's emissions by the number of credits used in System A.[52] Given this pre-existing link, if another cap-and-trade system (System B) links with the same credit system, System B participants must compete with System A participants for credits. That is, the two separate one-way links create an indirect link between Systems A and B, whereby the supply of credits available for use in each system depends on the other system's demand for credits.

System B participants will only be able to bid credits away from use in System A if they are willing to pay more for those credits than are System A participants. This will be the case only if System B's pre-link allowance price is greater than System A's allowance price. Thus, linking with a credit system only yields cost savings and only affects emissions in a cap-and-trade system if that system's pre-link allowance price is greater than the allowance prices in all other systems with which the credit system is linked.[53] Hence, policymakers should be cautious in relying on linkage with a credit system to limit a cap-and-trade system's cost if that credit system is (or may become) linked with other systems.

The proposed link between RGGI and the CDM offers an example of how a pre-existing link can limit the impact of a new link with a credit system. Because of the demand for CERs resulting from the link between the EU ETS and the CDM, secondary market CER prices

[50] Also, some governments of Parties to the Kyoto Protocol will compete in the market for CERs.

[51] While the below discussion focuses on a case in which multiple cap-and-trade systems are linked with a common credit system, the key insights are also applicable in a case in which the cap-and-trade systems are linked with different credit systems that draw from a common pool of emission reduction measures.

[52] If there are transaction costs associated with generating and trading credits, these costs can prevent the realization of some emission reductions in the credit system that are less costly than the credit price.

[53] This assumes that there are no binding restrictions on the use of credits in the other systems. If there are such restrictions, some credits may remain available for use in a cap-and-trade system even if its allowance price is lower than those in other systems that are linked with the credit system. Also, in the example described above, even if System B's allowance price is initially less than System A's price, a link between System B and the credit system still offers protection against increases in System B's price. If System B's allowance price increases, access to credits from the credit system can dampen any increase in System B's price if that price reaches System A's price.

recently were quoted at nearly €18, or about $26.[54] At the same time, the RGGI Model Rule allows power plants covered by RGGI to use CERs to cover up to 10 percent of their emissions if the RGGI allowance price exceeds a threshold price, which begins at nearly $11 (2005 U.S. dollars) in 2009 and increases thereafter. If expectations prove correct, power plants covered by RGGI would have to pay $26 or more to bid CERs away from the EU ETS, far more than expected RGGI allowance prices. Thus, the existing link between the EU ETS and the CDM significantly limits the potential cost savings from a link between RGGI and the CDM.

Returning to the previous example, if System B's pre-link allowance price is higher than System A's allowance price, System B participants will bid credits away from System A. Hence, the link with the credit system will, in fact, have an impact on System B's emissions and allowance price. However, because some of the credits used in System B otherwise would have been used in System A, there is an important difference between the emissions implications associated with this scenario and the implications associated with a scenario where System B is the *only* system linked with the credit system.

If System B were the only system linked with the credit system, the increase in System B's emissions associated with its use of credits would be directly offset by the emission reduction measures that generated those credits in the credit system. Therefore, the use of credits in System B would increase total emissions under the linked systems if there is any difference between the number of credits generated in the credit system and the amount of emission reductions actually associated with those credits.

On the other hand, if the credit system is already linked with System A, some of the credits used in System B would have been used in System A. Likewise, the emission reduction measures that generate those credits would have occurred regardless of whether the credits are used in System A or B. Thus, if the credits that otherwise would have been used in System A overstate the actual emission reductions that led to their creation, the increase in global emissions resulting from their use in a cap-and-trade system would occur regardless of whether or not System B links with the credit system. In effect, System A's decision to link with the credit system renders moot concerns about the additionality of emission reductions associated with some of the credits that could be used in System B. System B's linkage with the credit system only affects where those credits are used, not whether they are used.

The use of credits to cover increased emissions in System B has two primary effects that bring about offsetting emission reductions. It increases demand for credits, raising their price and eliciting additional reductions in the credit system. System B's use of credits also reduces the supply of credits that is available to System A participants. To meet their emissions cap, System A participants therefore must rely on some combination of additional domestic emission reductions and more expensive credits. Thus, the increase in System B's emissions associated with its use of credits is offset by emission reductions in System A and additional emission reductions in the credit system. Therefore, the emissions implications associated with System B linking with the credit system are quite different than would be the case if System B were the only system linked with the credit system.

[54] Carbonpositive (2007).

While pre-existing linkages can mitigate the emissions implications of linking with a credit system, they also can reduce the effectiveness of adopting unique standards for the types of credits that are recognized in a cap-and-trade system. Absent pre-existing links, through the standards it adopts for recognizing credits, a government can control the types of emission reductions that are undertaken in a credit system to offset increased emissions in its own cap-and-trade system (System B). However, the efficacy of those standards can be reduced if another cap-and-trade system with less stringent standards (System A) is also linked with that credit system, or with a system that draws from a common pool of emission reduction measures. If System B participants bid certain "higher quality" credits away from use in System A, the reduced availability of those credits in System A will lead to both additional emission reductions in System A and increased use of *other* credits in System A. Those other credits will be subject to System A's standards and will not necessarily meet System B's more stringent standards. Thus, the incremental emission reduction measures in the credit system that would be brought about by System B's use of the "higher quality" credits would be determined, at least in part, by System A's standards, not by System B's more stringent standards.

In summary, from the standpoint of a cap-and-trade system contemplating a link with a credit system, a pre-existing link between that credit system and another cap-and-trade system can significantly affect the implications of linking with that credit system. Unlike in the case where a cap-and-trade system is the only one linked with a credit system, the linkage's implications depend not only on the characteristics of the credit system, but also on the characteristics of the other cap-and-trade system from which credits may be bid away. Indeed, the effects of such a link result, in part, from the fact that it can reduce the availability of credits in the other cap-and-trade system, and thereby increase that system's allowance price. Through this effect on the other system's allowance price, such a link can raise many of the same issues that are discussed in Section 8 in the context of assessing two-way links between cap-and-trade systems. Thus, even when assessing a one-way link with a credit system, consideration should be given to any indirect links that the one-way link creates with other systems.

7.3. Implications of Linkages with a Common Credit System for Remaining Cost Savings from Two-Way Linkages among Cap-and-Trade Systems

Many of the emerging cap-and-trade systems may be linked with a common credit system, such as the CDM. Competition among cap-and-trade systems for credits will lead credits to be used in the system or systems with the highest allowance prices, as participants in those systems will willingly pay the most for credits. Use of credits in those cap-and-trade systems with the highest allowance prices will reduce allowance prices in those systems, and will thereby reduce remaining differences in the allowance prices of the systems that are linked with the common credit system. In fact, if there is a sufficient supply of credits at a price below the least stringent cap-and-trade system's allowance price, links between cap-and-trade systems and a common credit system can cause allowance prices of all of the linked systems to converge even though the systems are not directly linked with one another.

By reducing differences in allowance prices among cap-and-trade systems, one-way links with a common credit system can achieve some and perhaps much of the cost savings and risk diversification that can be achieved by establishing direct two-way links among those systems. Thus, in evaluating the merits of direct links among cap-and-trade systems, it is important to focus on the incremental effects of such links, taking into account the effects of any indirect links among those systems that result from links with a common credit system.

TWO-WAY LINKAGE BETWEEN CAP-AND-TRADE SYSTEMS

Allowance trading resulting from an unrestricted two-way link between two cap-and-trade systems causes those systems' allowance prices to converge. While inter-system allowance trading and the resulting price convergence are what bring about the cost savings from a two-way link, that trading and price convergence also can have other implications, including emissions and distributional impacts. The extent of the cost savings and significance of these other impacts depend fundamentally on the characteristics and design of the linked systems.

8.1. Implications of Differences in Allowance Prices

For each linked system, the magnitude of the cost savings resulting from linking depends on the net amount of inter-system trading and on the difference between its pre-link and post-link allowance price. All else equal, the greater the difference between a system's pre-link and post-link allowance price, the greater are the cost savings from linking. Thus, links between systems with larger differences in allowance prices tend to offer greater cost savings than links between systems with similar prices.

While they offer greater cost savings, links that lead to larger allowance price adjustments also are more likely to bring about other effects that may need to be weighed against cost savings. In some cases, in order to achieve certain policy objectives, a system may be designed to bring about an allowance price that falls within a particular range. Consequently, adjustments in its allowance price that would result from linking may adversely affect the achievement of that system's policy objectives. For example, some systems may be designed to have high allowance prices in order to spur technological changes that would not occur at lower prices. Links that reduce the allowance price in such systems would run counter to this policy objective. Indeed, some participants in the California climate policy debate have suggested that links between any future California cap-and-trade system and other systems should be limited "to ensure that regulated sectors begin to make the transformative investments that will be needed to meet the state's long-term GHG reduction goals."[55]

Even if a system's allowance price is not a specifically targeted outcome of the system's design, significant changes in allowance prices resulting from linking can lead to emissions and distributional impacts that warrant consideration. Linking's effect on emissions leakage is one such impact that can be more significant the greater the change in allowance prices. As linking leads one system's allowance price to increase and the other's to decline, it will tend to increase leakage in the former system and reduce leakage in the latter system. Thus, through its net effect on leakage, linking can increase or decrease global emissions.

The significance and direction of linking's net effect on emissions leakage depend on the extent to which each system's allowance price changes, and on the sensitivity of leakage from

[55] Market Advisory Committee (2007), p. 64.

each system to changes in that price. For example, the potential for leakage from the RGGI system is substantial. If it establishes a two-way link with the EU ETS, given each system's relative size and current allowance price expectations, that link would lead to a significant increase in RGGI's allowance price and to a relatively small decrease in the EU ETS allowance price. Therefore, such a link likely would bring about a net increase in global emissions by increasing leakage from the RGGI system more than it reduces leakage from the EU ETS.

The difference between the pre-link allowance prices of linked systems also will influence linking's distributional consequences within those systems and capital flows between them. When two systems link, even if each system realizes net gains on the whole, some entities covered by or indirectly affected by the system whose allowance price rises will bear increased costs. For example, if a link increases the allowance price in an economy-wide cap-and-trade system, while net sellers of allowances within that system stand to benefit, this increase in allowance prices increases costs for net buyers of allowances and increases gasoline, natural gas, and electricity prices. These distributional impacts are greater the greater is the difference between the system's pre-link and post-link allowance price.

The direction and magnitude of the capital flows between linked cap-and-trade systems that result from inter-system allowance trading depend on the two system's pre-link allowance prices. While differences in these prices depend, in part, on differences in the cost of emission reduction opportunities in each system, they also depend on each government's decision about the stringency of its system's cap. The less stringent a system's cap, the lower its allowance price, as less emission reductions are necessary to meet the cap.

If differences in pre-link allowance prices and resulting capital flows between linked systems are perceived to result largely from differences in the stringency of the systems' caps, there may be resistance to those capital flows. For example, if the United States adopts a cap-and-trade system and the U.S allowance price is lower than that in the EU ETS, a link between those systems would result in EU ETS participants purchasing allowances from the U.S. system. While such capital flows would reduce the net cost of the EU ETS, some nonetheless may object to those flows if the U.S. system is considered less stringent than the EU ETS.

In summary, differences in linked systems' pre-link allowance prices and the resulting magnitude of adjustments in those prices will be a key determinant of the cost savings from a link, as well as the link's emissions and distributional implications. However, the impact of a particular allowance price adjustment depends, in part, on other elements of the design of linked systems, which are discussed next.

8.2. Implications of the Scope of Coverage Decision

Existing, planned, and proposed cap-and-trade systems differ with respect to the scope of emission sources and GHGs that they cover. For example, while RGGI will cover only electricity generators, the EU ETS has a broader scope of coverage, including refineries, pulp and paper manufacturers, iron and steel plants, and other industrial facilities. Furthermore, in the United States and Australia, some proposed systems would adopt even broader coverage, including transportation emissions and emissions from residential and commercial buildings.

While linked systems do not need to cover the same types of emission sources, or even the same types of GHGs, the implications of changes in allowance prices resulting from linking depend, in part, on each system's scope of coverage. For example, the effect that linking has on emissions leakage depends, in part, on the sources that each system covers, as some types of emissions-generating activity are more prone to leakage than are others. Also, linking's effect on allowance prices may pose greater distributional concerns if a system's pre-link allowance price reflects distributional considerations associated with its scope of coverage. For example, it may be politically necessary for a future U.S. system to begin with a relatively low allowance price if that system is to be economy-wide in scope, given that allowance prices would be reflected in the price of gasoline and home heating fuels. Thus, if a U.S. system is economy-wide in scope, links that tend to increase the system's allowance price may not be politically acceptable, at least initially, even if such links would yield net gains to the U.S. economy as a whole.

Although linking can yield cost savings regardless of what emission sources the linked systems cover, the scope of coverage of each system can affect the ability to realize another potential benefit of linking — eliminating competitive distortions that would exist absent linking. If two unlinked systems both cover firms that compete with one another in interregional or international markets, any difference in those systems' allowance prices can introduce a competitive distortion, whereby firms under the system with the lower allowance price gain an advantage over firms under the system with the higher allowance price. This distortion can be eliminated by linking the systems, as such a linkage would ensure that firms in both systems face the same allowance price. Thus, in this respect, the benefits of a link can be increased if the linked systems both cover sources that compete with one another. Of course, such a link may not be favored by those firms in the system with the lower pre-link allowance price.

8.3. Implications of the Point of Regulation Decision

Greenhouse gas cap-and-trade systems may differ with respect to their point of regulation. While the EU ETS employs downstream regulation in which emitters are subject to the allowance requirement, several bills in the U.S. Congress propose the use of upstream regulation in which suppliers of fossil fuel products must surrender allowances for the carbon content of the fuel they sell.[56] While some have expressed concern that differences in the point of regulation of linked systems can lead to "double counting" of emission reductions when systems link, this concern is misplaced.[57]

The concern about double counting is associated with a scenario in which one system employs upstream regulation and another system employs downstream regulation. In such a scenario, if sources covered by the downstream system receive some of their fuel from suppliers subject to the upstream system (that is, if some inter-system fuel transactions occur), emission reductions that reduce inter-system fuel transactions will be counted twice, once in each system.

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[56] See, for example, the Low Carbon Economy Act of 2007 (S.1766). For an examination of the merits of upstream versus downstream CO_2 regulation in a cap-and-trade system, see Stavins (2007).
[57] See Blyth and Bosi (2004), and Market Advisory Committee (2007).

For example, consider a situation in which a source subject to downstream regulation reduces its emissions by one ton by reducing its fuel consumption. As a result of undertaking this emission reduction measure, it sells its unused allowance to another entity in its system. If the source that reduced its emissions receives fuel from a supplier that is subject to the upstream system, that source's emission reduction measure also will allow the fuel supplier to sell one of its allowances, because its fuel sales will have declined. Thus, although the measure only reduces emissions by one ton, it frees up two allowances (one in each system), leading to an offsetting two ton increase in emissions. Because of this double counting, allowance trading resulting from this emission reduction measure would lead to a net increase in emissions.

While such a scenario would be problematic, it could arise only if sources under the downstream system receive some of their fuel from suppliers covered by the upstream system. Moreover, were this the case, the double-counting problem would exist regardless of whether or not the systems link. The fundamental problem is that the source's emission reduction measure frees up two allowances (one in each system) even though it only reduces emissions by one ton. This problem does not depend on the two systems being linked. Thus, the potential for double counting would need to be addressed whether or not the systems are linked.[58]

Fortunately, in designing an upstream system, the potential for such double counting can be avoided simply by excluding exported fuel from the allowance requirement. So, differences in the point of regulation employed by two systems *need not* lead to double counting, and such differences need not affect the implications of linking. Indeed, the double-counting problem described above does not even result from differences in each system's point of regulation *per se*. Rather, it results from two systems overlapping in the scope of emissions-generating activity that they directly or indirectly cover. In the above example, this overlap happened to result from poor design of the upstream system, but such overlap could occur for other reasons (see Box 3).

8.4. Implications of Allowance Allocation Decisions

Mutually beneficial linkages can be established between cap-and-trade systems even if they adopt different allocation approaches. However, certain elements of each system's allocation approach can affect the emissions and distributional implications of linking, and even the cost savings from linking.

8.4.1. Implications of a Relative Cap for the Emissions Impacts of Linking

A link between two cap-and-trade systems with absolute emissions caps will not affect total emissions under those systems as long as each system is well-enforced and adopts a cap that is below business-as-usual emission levels. Regardless of where the allowances are used — that

[58] If double counting were a possibility, linking the upstream and downstream system could either compound or mitigate the problem. The incentive that sources in the downstream system face to undertake those emission reductions that would be double counted is equal to the sum of the two systems' allowance prices. The greater that sum, the greater is the incentive to undertake such reductions. Because linking the two systems can cause this sum either to increase or decrease, linking can either increase or decrease the amount of double-counted emission reductions in the downstream system.

is, regardless of whether or not the systems are linked — total emissions under the two systems will equal the total number of allowances issued under those systems. This is the case regardless of how each system distributes the fixed number of allowances.

Box 3. Emissions Implications of Linkages with Sub-National Cap-and-Trade Systems when a National Cap-and-Trade System also Exists

The discussion about potential double counting of emission reductions highlights a problem that emerges when cap-and-trade systems unintentionally overlap in the emissions-generating activity that they directly or indirectly cover. It is also possible that a system may intentionally cover a subset of the emissions-generating activity that is covered by a broader cap-and-trade system. For example, while a federal cap-and-trade system likely will emerge in the United States, California may implement its own cap-and-trade system for some Californian emission sources. Therefore, it is possible that certain Californian emission sources will be subject to two allowance requirements. For each ton of their emissions, they might have to surrender a U.S. allowance and a Californian allowance.

Such a policy regime would significantly affect the emissions implications of any link between a Californian and foreign cap-and-trade system. If all sources subject to California's cap are also subject to the federal cap, any change in Californian emissions resulting from allowance trades between the Californian and foreign system would be fully offset by a corresponding change in emissions elsewhere under the federal cap. That is, once the federal cap is in place, any change in Californian emissions will change the number of U.S. allowances that are available for use elsewhere in the United States. As a result, changes in California's emissions will have no net effect on nationwide emissions, which will remain at the level of the federal cap.[59] Therefore, the effect on global emissions of a link between a Californian and foreign system will depend entirely on how the link affects emissions in the foreign system. If California becomes a net buyer of foreign allowances, its use of those allowances will lead to a reduction in emissions in the foreign system and a corresponding reduction in global emissions. On the other hand, if California becomes a net seller of allowances, such that Californian allowances are used to cover increased emissions in the foreign system, this will increase global emissions. Thus, if a foreign system is concerned about the emissions impacts of links, it likely would not allow its regulated sources to use Californian allowances to cover their emissions.

However, linking can lead to a change in total emissions under the linked systems if one of the systems has a relative emissions cap that adjusts the total number of allowances it issues in response to changes in economic activity. In particular, linking will affect total emissions under the linked systems if it affects the economic activity that determines the number of allowances issued under the relative cap. For example, if a system with an absolute cap links with a system that has an intensity-based cap for electricity generators, the link's effect on allowance prices in the latter system can affect the level of electricity generation in that system. Therefore, the link can affect the number of allowances issued under the latter system, and thereby total emissions under the linked systems. The extent to which linking affects total emissions under the linked

[59] It is for this reason that there is a compelling argument for sunsetting any sub-national cap-and-trade systems once a national cap-and-trade system is established. Doing so increases the flexibility offered to regulated entities without affecting nationwide emissions, which would be subject to the national cap.

systems depends on the extent to which linking affects the level of the relevant economic activity under the relative cap, and on how sensitive the relative cap is to changes in that activity.

While a link between a system with an absolute cap and one with a relative cap can increase total emissions under the two systems, it also can reduce total emissions. The net effect depends on whether linking increases or decreases the relevant economic activity that determines the number of allowances issued under the relative cap. Both outcomes are possible.

Concerns about the emissions impacts of linking an absolute cap and a relative cap have arisen in the context of the United Kingdom's Emissions Trading Scheme (UK ETS) for GHG emissions, which was terminated in 2006. While some UK ETS participants faced absolute emissions targets (the "absolute sector"), others faced intensity-based targets (the "relative sector"). In an attempt to prevent any increase in emissions that might result from trading between the sectors, a "gateway" was established between the sectors to ensure that there was no net flow of allowances from the relative sector to the absolute sector.[60] Allowances could only be traded from the relative sector to the absolute sector if the total flow of allowances in that direction was less than the total flow of allowances from the absolute sector to the relative sector.

This gateway restriction has been criticized on several grounds, including the fact that it imposes additional transaction costs and foregoes potentially cost-saving trades from the system with the relative cap to that with the absolute cap.[61] However, the most significant criticism of this restriction is the fact that it cannot guarantee achievement of its apparent objective: to keep total emissions from increasing as a result of the linkage. This is because a link between a system with a relative cap and one with an absolute cap can increase total emissions under the linked systems even if allowances are only traded from the absolute system to the relative system.[62] For example, by lowering allowance prices in the relative system, such allowance trades can reduce the production costs of sources covered by that system, which could bring about an increase in their production and a corresponding increase in the allowances issued under that system. Short of the system with the relative cap adopting an absolute cap, no practical trading restriction or adjustment to either system can ensure that a link between a relative and an absolute cap-and-trade system will leave total emissions under those systems unchanged.

8.4.2. Implications of Allocation Decisions for the Domestic Distributional Impacts of Linking

Each system's decision about how to distribute allowances will influence the distributional impacts within its own system that result from linking. As was previously noted, linking two systems increases the allowance price in one of the systems and reduces the allowance price in the other. Through these effects, linking makes net sellers of allowances in the former system and net buyers of allowances in the latter system better off. Likewise, linking makes net buyers of allowances in the former system and net sellers of allowances in the latter

[60] U.K. Department for Environment, Food and Rural Affairs (2001), and Baron and Bygrave (2002).
[61] Baron and Bygrave (2002).
[62] See Fischer (2003). Likewise, trades from the system with a relative cap to that with an absolute cap could lead to a reduction in total emissions in some cases.

system worse off. By determining who these net buyers and sellers are, allowance allocation decisions in each system significantly influence linking's domestic distributional implications. Consequently, these allocation decisions may affect the ability to garner support for linking. For example, if a high proportion of allowances are auctioned, rather than freely distributed, regulated sources may be more likely to resist linkages that are expected to increase allowance prices, even if such linkages would benefit the economy as a whole.

8.4.3. Implications of Allocation Decisions for the Competitiveness Impacts of Linking

If firms in one of the linked systems compete with firms in the other system, differences in the two systems' allocation approaches may raise concerns about the competitiveness impacts of linking. However, in many cases, differences in allocation approaches employed by linked systems will not meaningfully affect the competitiveness of covered firms either before or after linking. In particular, as long as a firm cannot influence the number of allowances it receives by changing its operations or production level, its production costs will be unaffected by the number of allowances it receives. In such a case, a firm will treat its allowance allocation as a one-time gain, and will make production and pricing decisions in the same way that it would if it had to purchase those allowances.[63] Therefore, under such an allocation approach, even if a firm receives far fewer or far more allowances than competitors in another system, that difference in allocations will not affect the firm's competitiveness.[64] That difference also will not affect the impact of linking on the firm's competitiveness. Rather, the firm's competitiveness will be affected by the allowance price and any changes therein that result from linking.

While a wide variety of allocation approaches do not influence linking's competitiveness impacts, these impacts can be affected by allocation approaches that are updated over time. Under an "updating allocation," allowance allocations in future years are adjusted to reflect changes in the activity of allowance recipients. For example, the number of allowances that a firm receives each year may be tied to its production level in that year or in prior years. The free allocation of allowances to new facilities and the stripping of existing facilities' allocations upon closure are another example of updating allocations, as firms' decisions to open new facilities or to close existing facilities affect the number of allowances they receive.

By tying the number of allowances a firm receives to activity that the firm can influence, such as its production level, updating allocations effectively subsidize that activity. The more of that activity the firm undertakes, the more valuable allowances it receives. As a result, such updating allocations can affect the production costs of firms covered by a system. The magnitude of this effect depends on the specific characteristics of the updating allocation.

[63] For example, if allowance allocations are based on a firm's emissions prior to the implementation of a cap-and-trade system, the allocations would not affect allowance recipients' on-going production costs.
[64] However, if a firm faces constraints on its ability to raise capital at typical market rates, differences in allocation approaches can competitively disadvantage a firm that must purchase more allowances than its competitors.

Although updating allocations can increase a cap-and-trade system's cost by distorting emission reduction incentives,[65] one reason why they are proposed is to address concerns about a system's competitiveness impacts.[66] For example, if allocations to iron and steel manufacturers under a cap-and-trade system are tied to their production level, this would mitigate the system's effect on their production costs, and therefore on their international competitiveness.[67]

Regardless of whether a cap-and-trade system is linked with other systems, the use of updating allocations can affect the competitiveness of firms under that system, and can thereby affect the relative competitiveness of those firms' competitors. However, updating allocations also can influence the competitiveness impacts of linking. This is because the change in a system's allowance price resulting from linking alters the size of the effective subsidy created by updating allocations. Thus, under some circumstances, the use of updating allocations in one or both of the linked cap-and-trade systems may affect support for linking among some firms.

For example, consider a case in which two systems cover firms that compete with one another in international markets, and the system with the higher allowance price employs an updating allocation approach, whereas the system with the lower price does not. In such a case, firms in the system with the lower allowance price may object to a link because it would cause them to face the same allowance price as competitors in the other system, without receiving the benefit of the updating allocation that their competitors enjoy.

The significance of the use of updating allocations for the competitiveness impacts of linking depends on the specific updating allocations employed, and on other circumstances specific to each linkage. Moreover, while the use of updating allocations could pose an obstacle for some linkages, in some cases it is possible that the opportunity to establish a linkage could eliminate the need for the use of an updating allocation approach. Updating allocations may be adopted because of concerns about a cap-and-trade system's impact on the competitiveness of covered firms, relative to competitors outside of the system's scope of coverage. If such concerns are spurred by the fact that those competitors are subject to another cap-and-trade system with lower allowance prices, establishing a link with that system would put the covered firms and their competitors on a level playing field by equilibrating the systems' allowance prices. Thus, linking could offer opportunities to reduce or eliminate the need for updating allocations. This example also demonstrates the more general principle that linking can alter the optimal design of each linked system through its effect on each system's allowance price.

[65] For example, see Burtraw et al. (2001).
[66] For example, see Grubb and Neuhoff (2006).
[67] Competitiveness impacts also can be addressed by other aspects of a cap-and-trade system's design. For example, tariffs or allowance requirements could be placed on imports of emissions-intensive products to ensure that domestic manufacturers subject to a cap-and-trade system are not disadvantaged relative to those that import emissions-intensive products from abroad. Similarly, border tax adjustments could be applied to exports of products from manufacturers subject to a cap-and-trade system. See Stavins (2007), and Grubb and Neuhoff (2006).

8.4.4. Implications of Updating Allocations for the Cost Savings from Linking

Updating allocations also can affect the cost savings from linking cap-and-trade systems. Indeed, in some cases, if a system employs updating allocations, a link involving that system could increase (rather than reduce) total emission reduction costs. However, like their effect on linking's competitiveness impacts, the effect of updating allocations on the cost savings from linking depends on the specific updating allocations employed, and on other circumstances specific to each linkage.

By definition, when an allowance is traded within or across cap-and-trade systems, the buyer places a higher value on the traded allowance than does the seller. Under most conditions, allowance trading reduces aggregate emission reduction costs because the value that each party places on an allowance reflects the cost of the emission reductions that each would have to undertake without that allowance. The fact that the buyer places a higher value on an allowance than does the seller implies that the buyer faces higher emission reduction costs. Therefore, the transfer of an allowance from the seller to the buyer allows the buyer's higher-cost emission reductions to be replaced by the seller's lower-cost reductions, reducing aggregate costs.

However, under some circumstances, the value that buyers and sellers place on allowances may deviate from their emission reduction costs. Consequently, the fact that the buyer places a higher value on an allowance than does the seller would not necessarily mean that the buyer faces higher emission reduction costs; and resulting allowance trading would not necessarily reduce aggregate emission reduction costs.

The use of updating allocations in a cap-and-trade system can cause the value that a buyer or seller places on allowances to deviate from its emission reduction costs, such that allowance trades involving that buyer or seller will not necessarily reduce aggregate emission reduction costs. Thus, if a cap-and-trade system employs an updating allocation, a link involving that system will not necessarily reduce aggregate emission reduction costs.

To be specific, if an updating allocation directly or indirectly ties a firm's future allocations to its current emissions, such that the less it emits the fewer allowances it receives in the future, then the firm will place a value on an allowance that exceeds its direct emission reduction costs. In particular, that value will equal the cost of the emission reductions that it would have to undertake without the allowance, *plus* the value of future allocations that would be foregone by undertaking those reductions. A firm therefore would buy an allowance at prices above its emission reduction costs, and would be unwilling to sell an allowance until prices exceed its emission reduction costs by a sufficient amount. As a result, updating allocations can drive up allowance prices in a cap-and-trade system. Some have suggested that the higher-than-expected Phase I EU ETS allowance prices during 2005 and early 2006 were at least partly due to firms' expectations that their Phase I emissions would influence their Phase II allocations.[68] While some EU Member States have avoided directly or indirectly tying firms' Phase II

[68] Reilly and Paltsev (2006).

allocations to their Phase I emissions, not all have. Under France's National Allocation Plan (NAP), some firms' Phase II allocations will be affected by their Phase I emissions.[69]

If a cap-and-trade system (System A) employs updating allocations, the inter-system trading that results from linking with another system (System B) will not necessarily yield cost savings, even though it will be mutually beneficial to the firms involved. For example, participants in System A may place a higher value on allowances than do participants in System B even if System A participants have lower emission reduction costs. This could occur if the value of future allocations that System A participants would forego by reducing their emissions more than offsets their lower emission reduction costs. If this were the case, System A participants would become net buyers of allowances from System B, shifting emission reduction efforts from the system with lower emission reduction costs to that with higher costs. On the other hand, if System A's updating allocation has a less substantial effect on the value that System A participants place on allowances, System A participants may become net sellers of allowances to System B participants, preserving — though perhaps reducing — the cost savings from linking. Case-specific analysis is needed to assess the extent to which a system's updating allocation may compromise the cost savings from linking.

8.4.5. Summary of the Implications of Allowance Allocation Decisions

By influencing who gains and who loses within its system as a result of allowance price adjustments resulting from linking, each system's allowance allocation approach at the very least affects the domestic distributional impacts of linking. However, certain types of allocation approaches can influence the emissions impacts, competitiveness impacts, and even the cost savings realized by linking. Thus, the implications of the use of these approaches in either system will be of interest to both systems contemplating a linkage. In particular, if at least one of the systems adopts a relative emissions cap, linking can either increase or decrease total emissions under the linked systems. Also, if one of the systems employs updating allocations, this can alter linking's competitiveness impacts, and can reduce the cost savings from linking.

While the above discussion indicates that the allocation approaches adopted both domestically and by potential linking partners should be considered in evaluating linkages, mutually beneficial links can be established between systems despite significant differences in their allocation approaches. Indeed, even the use of a relative cap or updating allocation will not

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[69] France's Phase II NAP first determines each sector's share of the nationwide allocation, and then determines each facility's share of its sector's allocation. Each sector's share depends, in part, on the its 2005 emissions. Therefore, even if a facility's share of its sector's allocation were fixed, the facility's allocation would depend, in part, on its 2005 emissions, which contribute to its sector's 2005 emissions. Also, in the cement and glass sectors, the relationship between a facility's 2005 emissions and its allocation is strengthened by the fact that its share of its sector's allocation depends, in part, on its 2005 emissions. Ministère de l'Écologie et du Développement Durable (2006). While the *total* number of Phase II allowances issued by each Member State depends, in part, on the Member State's Phase I emissions, the effect of updating allocations on allowance prices only occurs if the allocation approach creates a meaningful relationship between a facility's own emissions and its future allocations.

necessarily compromise the net gains from linking. Case-specific analysis is needed to determine how each system's allocation approach influences the implications of linking.

8.5. Implications of Monitoring, Reporting, and Enforcement Provisions

A cap-and-trade system's environmental integrity depends on the effectiveness of emissions monitoring and enforcement provisions. Likewise, a link's effect on total emissions under the linked systems depends on the effectiveness of those provisions in each system.

If monitoring and enforcement in one system is less effective than that in another, trading resulting from linking the systems can affect total emissions under the two systems. While it is easy to imagine how trading could increase total emissions under the linked systems, it could, in fact, also reduce total emissions. Firms' compliance with a cap-and-trade system will depend, in part, on the allowance price. The higher the price, the greater is the incentive for noncompliance. Therefore, if a link reduces the allowance price in the system with poorer monitoring and enforcement, such a link could actually reduce noncompliance in that system, and thereby reduce total emissions under the linked systems.[70]

Nonetheless, to maintain confidence in a cap-and-trade system's environmental integrity, linkages likely will gain support only if they are with systems deemed to have equally effective monitoring and enforcement provisions. This does not, however, mean that the specific monitoring methods or enforcement provisions must be identical to facilitate linkage. Rather, the methods and provisions must simply be viewed as comparably reliable and stringent.

Most attention given to monitoring and reporting of emissions in cap-and-trade systems relates to concerns about a cap's environmental integrity. But experience with the EU ETS highlighted that emissions monitoring and reporting provisions also have important implications for a system's cost-effectiveness through their effect on allowance price discovery.

A cap-and-trade system's ability to direct emission reduction efforts toward the least costly means of meeting an emissions cap depends on the quality of information about market conditions that is reflected in the allowance price. In turn, this depends, in part, on the quality and frequency of emissions reporting. If market participants lack adequate information about the amount of emission reductions that is necessary to meet a cap, until that information emerges, allowance prices may be too high or too low. As a result, those prices may encourage unnecessarily costly emission reductions, or may fail to encourage reductions that are cost-effective. The EU ETS offers an example of this problem.

[70] A link also can affect emissions through its effect on a government's incentive to enforce a cap-and-trade system. If that enforcement incentive is driven, in part, by a desire to maintain the value of the system's allowances, linking can reduce that incentive. By making additional allowances available, non-compliant behavior reduces a system's allowance price and thereby reduces the value of allowances. However, by increasing the demand for a system's allowances, linking reduces the negative effect that a given amount of non-compliant behavior has on a system's allowance price. Therefore, poorer enforcement has a lesser impact on the value of a system's allowances when the system is linked with other systems than when it is not linked — potentially reducing a government's enforcement incentive.

While the EU ETS began in January 2005, the first verified emissions data for covered sources were not released until the spring of 2006.[71] Prior to that data release, allowance prices had risen to almost €30. Following the data release, allowance prices fell more than 50 percent in just one week, suggesting that the data fundamentally altered perceptions regarding the amount, and thereby cost, of reductions necessary to achieve the cap. Phase I allowance prices never again exceeded €20, a level that was consistently exceeded from July 2005 through most of April 2006. Given the sharp drop in prices following the data release, some of the emission reductions undertaken before that release undoubtedly were more costly than opportunities that remained unexploited after the release because of the lower prices. Had emissions data been released earlier, allowances prices likely would not have climbed to the level that they did. As a result, some emission reductions undertaken in 2005 and early 2006 likely could have been avoided and replaced by less costly reductions that remained unexploited later in Phase I.

By contributing to allowance price volatility, poorly designed emissions monitoring and reporting provisions can have additional adverse impacts on the costs of achieving emissions targets. Unanticipated changes in allowance prices can render emission reduction investments uneconomic, such that firms cannot recoup the cost of their investments. The possibility that future changes in allowance prices might render some investments uneconomic will make firms reluctant to invest in certain potentially cost-effective, but capital-intensive emission reduction measures. As a result, there will be greater reliance on higher-cost measures that are less capital-intensive, and thereby do not bear the same investment risks. While this reluctance — and the resulting increase in emission reduction costs — is desirable when allowance price volatility reflects real, irreducible uncertainties, it is undesirable and imposes unnecessary costs when that volatility results from poorly designed emissions monitoring and reporting provisions.

Because linking leads allowance prices in the linked systems to converge, each system's emissions monitoring and reporting provisions will have implications for allowance price volatility in the other system. Therefore, differences in the monitoring and reporting provisions employed by two systems contemplating a linkage need to be evaluated not only with respect to their effect on the emissions implications of a link, but also with respect to their implications for allowance price volatility in the linked systems.

8.6. Automatic Propagation of Certain Design Elements Due to Linking

When two cap-and-trade systems link, some design elements will affect the linkage's implications, but will not themselves be affected by the linkage. Linking will not affect who is regulated under a domestic system (the point and scope of regulation), allowance allocation methods, or monitoring and penalty regimes. Each system maintains control over those design decisions.

On the other hand, the inter-system trading that results from an unrestricted link will lead to automatic propagation (or *de facto* harmonization) of particular design elements that are often referred to as cost-containment measures. These include offset provisions, linkages with other systems, banking and borrowing provisions, and safety-valve provisions. If these provisions are

[71] Convery and Redmond (2007).

present in one of the linked systems, they will be made available to participants in the other system regardless of whether the other system has the same provisions (and regardless of whether it wishes to have them). Likewise, future changes in the use of these provisions in one system can directly affect the functioning of the other system.

In the following subsections, we discuss how linking leads to the automatic propagation of these provisions.[72] We also consider the efficacy of trading restrictions that might be implemented with the goal of limiting the propagation of these provisions across systems.

8.6.1. Propagation of Offset Provisions and Other Linkages

When two cap-and-trade systems link, each becomes indirectly linked with any cap-and-trade or credit system with which the other is linked. Thus, by linking with another system, each system effectively adopts the other system's offset provisions and linkages.

For example, if System A links with and becomes a net buyer of allowances from System B, even if System A does not recognize offsets that are recognized by System B, the linkage will lead System B's participants to purchase more offsets, as they compensate for the reduced availability and increased price of System B's allowances.[73] Consequently, if a link between Systems A and B increases emissions in System A, some of that increase will be mitigated through increased use of offsets in System B, even if System A does not recognize those offsets. Likewise, if Systems A and B link, and System B is linked with another cap-and-trade system (System C), System A will become indirectly linked with System C.

Given the indirect links that can result from linking two cap-and-trade systems, in contemplating a direct link with another system, consideration should be given to the implications of all the indirect links with offset programs and other systems that will result. Similarly, once a link between two systems is established, any new links or offset provisions that either system adopts will have implications for the other system.

8.6.2. Propagation of Banking and Borrowing Provisions

If either linked system permits allowance banking or borrowing, linking makes those provisions available to the other system's participants. Contracts can be structured between participants in linked systems to make banking or borrowing available to participants in the system that does not directly allow banking or borrowing.[74] For example, consider a case in which System A does not allow borrowing, but it is linked with System B, which allows

[72] While this section discusses the propagation of cost-containment measures that results from a direct link, it should be noted that one system can indirectly affect the use of cost-containment measures in another system, and can be influenced by the use of those measures, even if the two systems are only indirectly linked, such as through linkages with a common credit system. However, any such effects would be less pervasive than the propagation that results from a direct two-way link between the systems.
[73] This assumes that System B participants are not prevented from purchasing additional offsets, such as might be the case if System B has a binding limit on the use of offsets. Also, if System A becomes a net seller of allowances to System B, the link will reduce (rather than increase) the use of offsets in System B.
[74] For example, see Electric Power Research Institute (2006).

borrowing. In this case, a System A participant could enter into a swap contract with a System B participant, where it agrees to give the System B participant an allowance in two years in return for receiving an allowance from the System B participant today. Knowing that it will receive an allowance from the System A participant in two years, the System B participant could then borrow an allowance and use that borrowed allowance in place of a current-year allowance, making the latter allowance available to be transferred to the System A participant. Thus, in effect, System B's borrowing provision would be made available to System A participants.

While such contracts could be developed, the benefits of banking and borrowing would still be available to System A participants without them. For example, if System B participants believe that allowance prices will be higher in the present than in the future as a result of the link with System A, they will have an incentive to borrow more allowances than they would absent the linkage. Thus, even without explicit contracts motivating them to do so, System B participants effectively would borrow allowances on behalf of System A participants, increasing the supply of allowances available to participants in both systems in the present, while reducing the supply that will be available to cover future emissions.

Banking enjoys broad support because the opportunity to bank allowances causes firms to achieve some emission reductions earlier than they would if they could not bank unused allowances. Unrestricted banking will be allowed within the EU ETS beginning in 2008, and also in RGGI, and it likely will be allowed in all other GHG cap-and-trade systems.[75] Therefore, the propagation of banking provisions resulting from linking is likely to be of little concern.

On the other hand, despite the benefits that borrowing can offer, some oppose it because of a concern that requirements to "return" borrowed allowances in future years will not be adequately enforced.[76] As a result, borrowing may be prohibited or at least restricted in some systems, as is the case in the EU ETS and RGGI.[77] At the same time, other systems may institute more generous borrowing provisions. Therefore, consideration should be given to differences in the borrowing provisions of systems considering linking, and to the propagation of those provisions that results from linking.

8.6.3. Propagation of Safety-Valve Provisions

When a system without a safety valve (System A) links with a system that has a safety valve (System B), that safety valve effectively becomes available to participants in the former system. As a result of the link, allowance prices in the two systems will converge. If conditions in either system cause the common allowance price to reach System B's safety-valve trigger price, System B participants will exercise the safety valve, increasing the number of allowances

[75] Banking between Phase I and II of the EU ETS was restricted because, among other reasons, the use of banked allowances in Phase II could affect a Member State's ability to achieve its Kyoto commitments.
[76] For example, see Market Advisory Committee (2007).
[77] By issuing allowances for the next year before allowances must be surrendered for the prior year's emissions, the EU ETS effectively allows limited borrowing. Likewise, RGGI has three-year compliance periods that can be extended to four years under certain circumstances. Such multi-year compliance periods effectively allow borrowing of allowances from future years within a given compliance period.

in circulation, and therefore increasing total emissions under both systems. In turn, this increase in the supply of allowances will prevent the common allowance price from exceeding System B's trigger price.[78] Thus, while System A participants would not have direct access to the safety valve, the supply of allowances available to them, the allowance price they face, and their resulting emissions all will be affected by the use of the safety valve in System B.

If two systems each have a safety valve but their trigger prices differ, linking will lead to the *de facto* harmonization of the trigger price in both systems at the lower of the two prices. Before the common allowance price in both systems can reach the higher trigger price, the safety valve in the system with the lower trigger price will be exercised, increasing the number of allowances in circulation and limiting any further price increase.

Therefore, if two systems with different trigger prices decide to establish an unrestricted link, they might wish to adopt a harmonized trigger price. Absent explicit harmonization of the trigger price, each government would have an incentive to set its own trigger price marginally below the other's trigger price. By doing so, it could capture all of the revenue associated with participants exercising the safety valve; and it could do so without meaningfully affecting the allowance price or emissions under the linked systems, relative to what would result if the other system's trigger price were the lower one.

It appears likely that different systems will adopt different approaches to the use of a safety valve. Whereas the EU ETS does not have a safety valve, one cap-and-trade system proposed in the U.S. Congress does, as does the Canadian proposal, and discussions in Australia suggest that it may adopt a safety valve if it implements a cap-and-trade system. These differences in whether and how each system incorporates a safety valve may pose an obstacle to linking, given the propagation of safety-valve provisions that results from linking.

While a system without a safety valve may be reluctant to link with a system that has a safety valve even if that safety valve's trigger price is relatively high, such a link would be even more problematic if the trigger price is below the actual or expected allowance price in the former system.[79] For example, Phase II EU ETS allowances recently have been trading above

[78] Kruger et al. (2007) note that the design of System B's safety valve can influence the extent of its effect on System A's allowance price and emissions. Instead of selling an unlimited number of allowances at a particular price, a safety valve might allow regulated sources to make a fixed per-ton payment in lieu of surrendering allowances. This latter design is used in U.S. Senator Bingaman's proposal for a U.S. system, and is being considered in Canada and Australia. Rather than increasing the supply of allowances, such a design would reduce System B participants' demand for allowances once allowance prices reach the level of the fixed payment. With that design, at most, the number of System B allowances that would become available for use in System A would be equal to System B's initial supply of allowances. Therefore, if System B is significantly smaller than System A, the use of a safety valve in System B and the resulting sale of allowances to System A may dampen any increase in System A's allowance price, but it may not fully cap System A's allowance price.

[79] However, such a link would not necessarily trigger the safety valve. Inter-system trading could bring about an allowance price below the safety valve's trigger price if the system with the safety valve is sufficiently large relative to the system with which it links, and if it has a pre-link allowance price that is sufficiently below the trigger price.

€20. This expected price is well above the initial level of the safety-valve trigger prices incorporated in the Canadian proposal and in Senator Bingaman's proposal for a U.S. cap-and-trade system.[80] Therefore, were these proposals to be implemented in their current form, it is less likely that a link could be established between the EU ETS and either system.

8.6.4. Efficacy of Efforts to Limit Propagation of Cost-Containment Measures through Restrictions on Linkages

Given that the propagation of cost-containment measures resulting from unrestricted linking may pose an obstacle to the development of links, some have explored whether restrictions (or conditions) can be placed on links to avoid such propagation.[81] Potential restrictions include: restrictions on the quantity of allowances that can be sold to or purchased from another system; exchange rates, whereby participants must surrender a different number of another system's allowances to cover each ton of their emissions than would be the case if they used their own system's allowances; and fees that increase the cost of using another system's allowances. These restrictions could be differentiated depending on the participants involved in trading. For example, a system may prohibit the use of any allowances sold by those participants in another system who have used that system's safety valve. Restrictions also could be adjusted in response to certain triggering events. For example, restrictions on the use of another system's allowances may depend on whether the safety valve has been exercised in that system.

In evaluating potential restrictions, it is important to recognize that, no matter what restrictions are employed, any link that still allows for net sales of allowances from the system with the more generous cost-containment measures necessarily will increase the use of those measures, or at least increase the likelihood that they are used. For example, if System A has an offset provision and becomes a net seller of allowances to System B, even if trading with System B is restricted, this trading will increase System A's allowance price, increasing demand for offsets in System A. Likewise, if System A has a safety valve and System B does not, even if System A's allowances cannot be used in System B after that safety valve is triggered, any allowance sales from System A to B prior to that point will reduce the available supply of allowances in System A. As a result, these sales will increase the likelihood that the safety valve is exercised in System A, and will increase the use of the safety valve if and when it is exercised. Hence, the only way to prevent *any* linking-induced increase in the use of cost-containment measures in the system with the more generous measures is to establish restrictions that prevent *any* net sale of allowances from that system, such as by adopting only a one-way link.

Nonetheless, restrictions may be employed to limit the extent to which a link increases the use of cost-containment measures in the system with the more generous measures. Also, to

[80] The proposed Canadian system would allow participants to make contributions to a technology fund in lieu of surrendering allowances. The Canadian proposal would set the required contribution level at $CAN 15 per ton of CO_2 from 2010 to 2012, rising to $CAN 20 in 2013, and increasing annually thereafter. Similarly, Senator Bingaman's Low Carbon Economy Act of 2007 includes a "Technology Accelerator Payment," whereby, in lieu of surrendering an allowance for a ton of their emissions, participants can make a per-ton payment that begins at $US 12 in 2012, and increases annually thereafter.
[81] For a detailed analysis of this issue, see Electric Power Research Institute (2006).

the extent that concerns about a linkage relate to potential emissions impacts of the increased use of cost-containment measures, exchange rates can be employed to offset the increase in emissions that may result from inter-system trading.

Because of the fungibility of allowances within each cap-and-trade system, some restrictions will be entirely ineffective. An example of such a restriction is a prohibition on the use of any allowances obtained from participants in another system if those participants have exercised that system's safety valve. If trading between the systems drives up allowance prices in the system with the safety valve to the point that the safety valve is exercised, this restriction simply would concentrate the use of the safety valve among fewer participants that decide not to engage in inter-system trading. Two groups of participants would emerge in the system with the safety valve: those that rely partly or entirely on the safety valve to cover their emissions, and those that do not use the safety valve so that they can continue trading with the linked system. However, this restriction would not affect the overall extent to which the safety valve is used.

Some restrictions could limit the propagation of cost-containment measures across systems. For example, a restriction on the number of allowances that can be used from a linked system with a safety valve can limit (but cannot eliminate) that safety valve's potential effect on allowance prices in a domestic system. Unfortunately, any restriction on inter-system trading that is effective in limiting the propagation of cost-containment measures resulting from a linkage also will reduce the cost savings from that linkage. Therefore, in evaluating potential restrictions, consideration should be given to the tradeoffs they present. While these tradeoffs will depend on the severity of the restriction, they also will depend on the type of restriction employed, such as quantitative restrictions or exchange rates. Evaluating these tradeoffs will be difficult both because of the difficulty of identifying the incremental effect of a linkage on the use of cost-containment measures (e.g., a link's effect on the likelihood that a linked system's safety valve will be triggered), and because these incremental effects will change over time.

PROSPECTS AND NECESSARY FOUNDATIONS FOR LINKAGES

Links among emerging tradable permit systems have the potential to significantly reduce the long-run cost of mitigating climate change. Moreover, links make it possible to allow for differentiated emission reduction responsibilities across tradable permit systems without compromising the cost-effectiveness or environmental effectiveness of global climate change mitigation efforts. Therefore, linkages will be an important element of any cost-effective, long-run effort to reduce GHG emissions in which tradable permit systems feature prominently.

But, along with the cost savings that it can offer, linking carries with it other implications that merit consideration. In particular, linking can have emissions and distributional implications, and can reduce the control that a government has over the impacts of its tradable permit system. Given that linking opportunities are not limited by any meaningful technical barriers, it is these implications — together with the opportunities for cost savings — that will determine whether and how quickly governments choose to link tradable permit systems.

Because the full implications of a particular linkage depend on the type of link that is established and the specific characteristics and design of the linked systems, in the near-term, some links will be more attractive and easier to establish than others. For example, one-way links between cap-and-trade systems and credit systems may be more readily established than some two-way links between cap-and-trade systems.

Given the implications of two-way linkages, more may need to be done to set the foundation for such links. In particular, to facilitate two-way links between some cap-and-trade systems, it may be necessary to harmonize certain elements of each system's design. In some cases, it may even be necessary to develop international agreements that govern aspects of the design of linked cap-and-trade systems beyond simply mutual recognition of allowances.

This section first discusses the implications of two-way linking opportunities for the design of domestic cap-and-trade systems, highlighting those elements of a system's design that may need to be adjusted or harmonized to facilitate linkages. It then considers the role that international agreements may need to play in facilitating some two-way linkages. It concludes by discussing the near-term role that one-way links between cap-and-trade systems and credit systems can play in both directly and indirectly linking emerging tradable permit systems.

9.1. Implications of Linking Opportunities for the Design of Cap-and-Trade Systems

Mutually beneficial two-way links can be established between cap-and-trade systems whose designs differ in many respects. However, given the effects of certain design elements on the implications of linking, some harmonization of the design of cap-and-trade systems may be necessary to facilitate links between them.

A system's use of particular allocation approaches — namely, relative emissions caps and updating allocations — and its monitoring, reporting, and enforcement provisions can affect the desirability of linking for potential partners. But the extent to which these design elements need to be harmonized to facilitate linkage will depend on circumstances specific to each system and linkage. Differences between systems can remain without undermining the case for linking.

On the other hand, agreement on a unified set of cost-containment measures is likely to be a necessary pre-condition for any unrestricted two-way link between cap-and-trade systems. If either system employs an offset provision (or other linkages), banking or borrowing provisions, or a safety valve, an unrestricted link will lead to the propagation of those provisions into the linked system. As a result, meaningful differences in the cost-containment measures employed by two systems could present a substantial obstacle to linking. Although restrictions could be placed on a linkage to reduce this propagation, such restrictions also would reduce the cost savings from linking.

Of course, in considering a potential linkage, a government will have to weigh the linkage's benefits against the domestic implications of any adjustments to its system that are necessary to facilitate the linkage. Also, while some adjustments to a cap-and-trade system's design could be motivated by a desire to make linking more attractive to potential partners, design changes also may be motivated by a link's effect on the system's domestic implications. By altering allowance prices in the domestic system and in the system with which it is linked, a link can alter a system's optimal design for achieving domestic policy objectives. For example, changes in allowance prices resulting from linking may alter the optimal approach to allowance allocation, or the need for measures to address emissions leakage.

In some cases, the establishment of linkages also may call for changes to other elements of domestic policy apart from the cap-and-trade system itself. For example, it is possible that some countries may employ both a cap-and-trade system and either direct or indirect emissions taxes,[82] as the United States did to phase out ozone depleting substances under the Montreal Protocol.[83] However, if participants in a cap-and-trade system are also subject to direct or indirect emissions taxes, those taxes can reduce the cost savings from linking. In fact, in some cases, linking can *increase* the cost of climate policy when such taxes are present. Therefore, if a government wishes to link its cap-and-trade system, it may need to adjust its tax policy to ensure that it benefits from linking.

The effect of emissions taxes on the cost savings from linking is made evident by considering an example in which one cap-and-trade system (System A) has an allowance price of $40, and another system (System B) has an allowance price of $30. Moreover, unlike System A participants, System B participants also face a $20 per ton emissions tax. That is, for each ton of their emissions, System B participants must both surrender an allowance and pay a $20 tax.

Prior to linking, System A participants would undertake all emission reductions that cost less than System A's $40 per ton allowance price. Even though System B's allowance price is only $30, System B participants would undertake all emission reductions that cost less than $50 per ton, as the per-ton cost of any remaining emissions in System B would be equal to the $30 allowance price plus the $20 tax. Thus, prior to linking, some of the emission reduction

[82] Taxes on fossil fuels are an example of an indirect emissions tax.
[83] See Stavins (2003).

opportunities that remain untapped in System A (those that cost more than $40 per ton) would be less costly than some of the emission reductions that would be undertaken in System B. To achieve cost savings from linking these systems, emission reduction efforts would therefore have to shift from System B to System A, implying that allowances would have to be sold from System A to System B.

However, given the relative allowance prices in the two systems, linking would lead to allowance sales in the opposite direction — from System B to System A. Consequently, as a result of inter-system allowance trading, emission reduction efforts would shift from System A, where they are less costly, to System B, where they are more costly. While System A would benefit from this inter-system trading, that trading would increase global emission reduction costs and would increase the cost of System B's climate policy.[84] As is the case with updating allocations (see Section 8.4.4), emissions taxes affect the cost savings from inter-system allowance trading because they cause participants in a cap-and-trade system to place a value on allowances that deviates from their true emission reduction costs.

9.2. The Role of International Climate Agreements

To establish a direct two-way link between their systems, governments need only agree to mutually recognize each other's allowances. Nonetheless, there are several reasons why broader international agreements governing aspects of the design of linked systems may play an important role in facilitating linkage, and may, in fact, be a necessary foundation for some links.

9.2.1. Agreements on Emissions Caps

Prior to linking their systems, governments may wish to establish formal agreements regarding either the level of their systems' future emissions caps, or at least procedures for setting future caps. There are three reasons why this is the case.

First, as Section 8.1 described, direct links between cap-and-trade systems can result in significant inter-system capital flows that depend, in part, on the stringency of each system's cap. Therefore, an agreement that effectively gives each system's cap some form of international approval could reduce any potential objections to those capital flows.

Second, agreements on the emissions caps selected by each system may play an important role in facilitating linkages because of linking's effect on the incentives that a government faces in setting future caps. This effect can be illustrated by considering Norway's linkage with the EU ETS. If Norway's system were not linked with any other system and Norway were to reduce the number of allowances that it issues, this would lead to a one-for-one reduction in emissions under Norway's system. Moreover, given the demand for allowances in Norway, this reduction in the number of allowances issued would increase Norway's allowance price, and likely would increase the total value of Norway's allowances. On the other hand, once Norway links with the EU ETS, any reduction in the number of allowances that Norway issues

[84] In some cases, such taxes may just reduce the cost savings from linking. Babiker et al. (2004) provide a more technical discussion of the implications of taxes for the cost savings from linking.

would have a far smaller (perhaps imperceptible) effect on the price of its allowances, which would be determined by the supply and demand for allowances across the entire EU ETS. Therefore, by reducing the total number of allowances that it issues, Norway would be reducing the total value of its allowances. Likewise, emissions from sources covered by Norway's system would be essentially unchanged, as the reduction in the number of allowances issued would lead to a corresponding reduction in emissions that is dispersed throughout the EU ETS.

As the above example demonstrates, linking changes the incentives that governments face in setting future emissions caps for their systems. Therefore, agreements among governments about the future caps of their systems may provide valuable assurances that links will not cause governments to set less stringent caps than they would absent those linkages.

Finally, governments may wish to agree upon a trajectory of future caps with linking partners in order to provide greater regulatory certainty for those covered by their system. Many promising emission reduction measures involve significant capital investments. A cap-and-trade system's ability to bring about such investments depends on the level of certainty that it can provide firms regarding the long-run trajectory of allowance prices. The more uncertainty there is about this long-run trajectory, the less inclined firms will be to invest in capital-intensive emission reduction measures. As a result, emission reductions will have to be achieved through more costly, but less capital-intensive measures.

While uncertainty about future allowance prices cannot be eliminated, a cap-and-trade system can be designed to reduce this uncertainty. For example, in addition to setting the caps for the first few years of a cap-and-trade system's operation, a government can establish a trajectory of future caps (or ranges of potential caps) extending more than a decade into the future. However, a government's efforts to reduce uncertainty about future allowance prices in its own system can be undermined if the system is linked with a system that has only established near-term caps. Uncertainty about future caps in the latter system will contribute to uncertainty about future allowance prices in both systems.

9.2.2. Agreements on Processes for Making Future Changes to Linked Systems

In addition to its immediate effects, a link between two cap-and-trade systems reduces each government's control over the future impacts of its system. Just as a cap-and-trade system's initial design affects the desirability of linking with that system, future changes in a system's design can have consequences for linked systems. Some governments may willingly become "price-takers" in the international allowance market, effectively ceding control to governments that oversee larger systems with which they link. Moreover, the control that some governments have over the impacts of their system already may be limited by connections with other systems through trade in emissions-intensive products (see Section 6.2.4). Under these circumstances, such as may be the case with regional trading partners, two-way links may be more readily established. However, the reduced control that comes with linking may be an obstacle to establishing other two-way links.

While governments always have the option to terminate a link in response to undesirable changes in the design of a linking partner's system, such an action could itself have undesirable consequences. For example, terminating a link may significantly change future allowance prices in a cap-and-trade system, leaving some existing investments stranded and causing other undesirable distributional impacts. Therefore, before establishing a link between their systems, governments may wish to agree to a particular process for making future material changes to their respective systems. Any such agreement would have to strike a difficult balance between the competing objectives of leaving each government with sovereignty over its own system while providing linking partners adequate authority to influence those changes in linked systems that would materially affect their own system.

9.3. Near-Term Opportunities for One-Way Linkages between Cap-and-Trade Systems and Credit Systems

In the near-term, one-way links between cap-and-trade systems and credit systems likely will be more attractive and easier to establish than some two-way links between cap-and-trade systems. Such one-way links may offer greater cost savings. Also, because they can only reduce allowance prices in the linked cap-and-trade system, such one-way links give a government greater control over its system than would be the case if it established a two-way link with another cap-and-trade system.[85] Moreover, whereas links with other cap-and-trade systems may require harmonization of certain aspects of the linking systems' designs — such as their cost-containment measures — this would not be necessary when linking with a credit system.

While some two-way links between cap-and-trade systems may take more time to establish, if these cap-and-trade systems link with a common credit system, such as the CDM (or even with different systems that draw on a common pool of emission reduction measures), this will create indirect links among the cap-and-trade systems. In turn, through the indirect links that they create, such one-way linkages can achieve some and perhaps much of the near-term cost savings and risk diversification that direct two-way links among cap-and-trade systems could achieve.

[85] For similar reasons, some governments may establish one-way links with other cap-and-trade systems.

CONCLUSIONS

By broadening the market in which emission allowances and emission reduction credits are traded, linking increases the liquidity and improves the functioning of markets for those allowances and credits. Through the inter-system allowance and credit trading that it facilitates, linking allows emission reduction efforts to be redistributed across systems in ways that lower the aggregate cost of reducing global GHG emissions. Therefore, linkages will be an important element of any cost-effective, long-run effort to reduce GHG emissions in which tradable permit systems feature prominently.

However, along with the potential cost savings that it offers, linking has other implications that warrant consideration. In particular, under certain circumstances, linked systems collectively will not achieve the same level of emission reductions as they would in the absence of linking. Linking also can lead to distributional impacts across and within tradable permit systems that may be deemed undesirable in some cases. Finally, linking reduces a government's control over the impacts of its tradable permit systems. Thus, in considering linkages, governments may have to weigh linking's implications for potentially competing policy objectives, much as will be required in developing other elements of climate policy.

As this report has described, linking's implications and the tradeoffs it presents depend fundamentally on the type of linkage that is established, and the characteristics and design of the linked systems. Therefore, case-specific analysis is necessary to assess the merits of individual linking opportunities. For the same reason, whereas the implications of some linkages may make them attractive in the near-term, the case for other linkages may take time to emerge, as changing conditions alter the tradeoffs that those linkages present.

While mutually beneficial links can be established between cap-and-trade systems whose designs differ in many respects, some harmonization of the design of systems may be necessary to facilitate links between them. A system's allocation approach — in particular, its use of relative emissions caps and updating allocations — as well as its monitoring, reporting, and enforcement provisions can affect the desirability of linking for potential linking partners. However, the extent to which these elements need to be harmonized to facilitate linking will depend on circumstances specific to each system and linkage, and differences can remain without undermining the case for linking. On the other hand, agreement on a unified set of cost-containment measures likely will be a necessary pre-condition for any unrestricted two-way link between cap-and-trade systems, given the propagation of those measures that results from such a link. Of course, any necessary adjustments to a system's design will have domestic implications that may influence a government's willingness to establish particular linkages.

Although some adjustments to the design of a cap-and-trade system may be motivated by a desire to make linking more attractive to potential linking partners, linking opportunities also may call for changes to a system's design to address the domestic implications of a linkage. By altering allowance prices in the domestic system and in the system with which it is linked, a linkage can alter a system's optimal design for achieving domestic policy objectives.

Because linking reduces a government's control over the impacts of its cap-and-trade system, some two-way links between cap-and-trade systems likely will take more time to emerge than others. Some governments may choose to become "price-takers" in linking with other systems. Other links — such as between regional trading partners — may pose lesser concerns about impacts on a government's control over its system, given the influence that the systems would have on one another even if they were not linked. But, in other cases, in order to establish a two-way link between their systems, the linking governments may need to establish agreements governing the design of their systems that are broader in scope than simply mutual recognition of one another's allowances. Such agreements would need to strike a difficult balance between the competing aims of leaving each government with sovereignty over its own system while providing linking partners adequate authority to influence those changes in linked systems that would materially affect their own system.

In the meantime, it is important to recognize that one-way links between cap-and-trade systems and a common credit system, such as the CDM, can create indirect links among the cap-and-trade systems. Through these indirect links, such one-way linkages can provide some and perhaps much of the near-term cost savings and risk diversification that would be achieved through two-way links among cap-and-trade systems; and they can do so without much of the foundation that would be needed to establish some two-way linkages.

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