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Linking a U.S. Cap-and-Trade System for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges

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Working Paper 08-01

January 2008

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Executive Summary

The long-run cost of a U.S. cap-and-trade system for greenhouse gas (GHG) emissions could be significantly reduced by linking that system with other existing and emerging tradable permit systems for GHG emissions. However, along with the cost savings that it offers, linking carries with it other implications. For example, linking has distributional consequences and, under some circumstances, linked systems collectively will not achieve the same level of emission reductions as they would absent linking. Also, linking can reduce a government's control over the impacts of its tradable permit system. Thus, in considering linkages, the United States and potential linking partners may have to weigh linking's implications for potentially competing policy objectives, much as will be required in developing other elements of their respective domestic climate policies.

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 with 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.

Given the implications of links with other cap-and-trade systems, to facilitate such links, it may be necessary to harmonize certain elements of the design of the U.S. system and any system(s) with which it links. In particular, agreement on a unified set of measures to address cost uncertainty likely will be a necessary pre-condition for an unrestricted link with another cap-and-trade system. Also, in order to link with other cap-and-trade systems, it may be necessary to establish broader international agreements governing aspects of the design of the U.S. and linked systems beyond simply mutual recognition of allowances.

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1. Introduction

It is increasingly likely that the United States will adopt a nationwide cap-and-trade system for greenhouse gas (GHG) emissions. As the debate about a potential U.S. cap-and-trade system has developed, one issue that has received attention is the possibility of linking a U.S. system with cap-and-trade or emission reduction credit systems in other countries (hereafter collectively referred to as tradable permit systems). A link between two tradable permit systems is established when the government overseeing one (or both) of the systems recognizes the other system's emission allowances or emission reduction credits as valid for use in meeting compliance obligations under its domestic system.

The primary motivation for linking is that it can reduce the cost of meeting the linked systems' emission targets. Just as trading within a tradable permit system allows higher-cost emission reductions to be replaced by lower-cost reductions within that system, trading across systems made possible by linking 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 the environmental effectiveness of the linked systems, as reductions in GHG emissions have the same impact on atmospheric GHG concentrations no matter where in the world they occur.

While linking can reduce the cost of a U.S. cap-and-trade system, linking also has other implications that merit consideration. In particular, under some circumstances, linked systems collectively will not achieve the same level of emission reductions as they would absent linking. Linking also can lead to distributional impacts across and within the linked systems. Finally, linking can reduce the control that the U.S. government and its linking partners have over the impacts of their respective cap-and-trade systems. Thus, in evaluating the case for linking, careful consideration needs to be given to both the advantages and disadvantages of such action.

Importantly, the tradeoffs presented by linking depend fundamentally on the types of linkages that are established and the characteristics and design of the linked systems. This has two implications for U.S. climate policy. First, in the near-term, certain linkages may be more attractive to establish than others. Second, in developing a U.S. cap-and-trade system, along with the various other factors that will influence the system's design, consideration should be given to the implications of the system's design for linking opportunities.

This paper examines linking's environmental and economic impacts, and examines how such impacts are affected by the type of linkages that are established and the characteristics and design of the linked systems.[1] In so doing, it identifies tradeoffs among competing policy objectives that can be presented by linkages, potential obstacles to future linkages, and steps that can facilitate linkages.

Section 2 of this paper provides an introduction to the two categories of tradable permit systems with which a U.S. system could be linked, cap-and-trade systems and emission reduction credit systems. Section 3 describes the types of linkages that can be established. Section 4 provides an overview of how linking can affect the achievement of various policy objectives that likely will underlie a U.S. cap-and-trade system and any systems with which it may link.

Because linking's implications depend fundamentally on the type of linkage that is established and the characteristics and design of the linked systems, sections 5 and 6 offer more detailed assessments of the implications of two types of links that a U.S. system could establish. Section 5 examines the implications of links with emission reduction credit systems. Section 6 discusses the implications of links with other cap-and-trade systems.

Based on the insights from the preceding sections, section 7 examines the prospects for linkages and evaluates the conditions that can foster their establishment. In so doing, it identifies elements of the design of cap-and-trade systems that may need to be adjusted or harmonized to facilitate links between them, and considers the role of international agreements in facilitating linkage. Section 8 concludes.

2. Categories of Tradable Permit Systems with which a U.S. System Could Link

A U.S. cap-and-trade system could link with other cap-and-trade systems, and it also could link with emission reduction credit systems (credit systems). Because the implications of linking depend on the type of system with which a link is established, before discussing the

[1] This paper summarizes and builds on the evolving understanding of linking's implications, 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). While we focus on linking's environmental and economic impacts, other issues also may deserve attention, such as technical issues associated with linking the infrastructures that support trading in each linked system, and the compatibility of linkages with international trade law.

implications of linking, it is important to distinguish between these two categories of tradable permit systems and to identify the characteristics that define each type of system.

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 emissions 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. Given differences in firms' emission reduction costs and the corresponding differences in the value they place on allowances, trading can lead allowances to be put toward their highest-valued use: covering those emissions that are the most costly to reduce. Conversely, allowance trading ensures that the emissions reductions undertaken to meet the cap are those that are the least costly to achieve.

While several countries are considering adopting a GHG cap-and-trade system, the most prominent existing system with which a U.S. system could link is the European Union's Emissions Trading Scheme (EU ETS). During Phase I of the EU ETS, which lasted from 2005 to 2007, the EU ETS capped carbon dioxide (CO_2) emissions from more than 11,000 industrial facilities and electricity generators in 25 countries.[2] In 2005, those sources collectively emitted approximately two billion metric tons of CO_2, about 45 percent of the EU's CO_2 emissions.[3] 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 sources in Bulgaria and Romania, which joined the EU in 2007.

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 subject 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 CO_2 emissions can be enforced either by requiring that fossil fuel suppliers surrender allowances for the carbon

[2] European Commission (2005).
[3] *Id.* and European Commission (2007).

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. 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.

Allowances can be freely distributed or auctioned, or a combination of these 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. However, 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 in future years is determined at the time the cap-and-trade system is implemented.

Finally, policymakers must decide on emissions monitoring, reporting, and enforcement provisions. For example, decisions must be made regarding how frequently emission levels will be reported, and regarding the length of each compliance period.

A key concern in many countries developing mandatory climate policies, including the United States, 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. 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 an offset provision, 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 separate 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 per-ton 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 opportunities exist to do so at a cost that is 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 allowances, a credit system brings about emission reductions by awarding tradable credits for certified reductions. Some credit systems can be quite similar to cap-and-trade systems.[4] So, when we refer to credit systems in this paper, we are describing a subset of systems that have a few key differentiating characteristics. First, the credit systems to which we refer are those for which participation is 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 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 an 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 award a project, calculation of the appropriate baseline is as important as measuring emissions.

The most prominent existing GHG credit system is the Clean Development Mechanism (CDM), which was established under the Kyoto Protocol. The CDM awards credits, referred to as certified emission reductions (CERs), for voluntary emission reduction projects in developing countries that ratified the Protocol but are not subject to the Protocol's emissions limitation commitments. An Executive Board established under the Protocol supervises the CDM and makes determinations about the issuance of CERs. To be awarded credits, a project's sponsors must go through an approval process overseen by the Board. It can take several months to complete that process, and the cost of the process (not including the cost of the actual emission reduction measures) can be substantial.[6] Nonetheless, by December 2007, the Executive Board had registered nearly 900 projects, which are expected to yield more than 1.1 billion CERs by 2012.[7] Projects in China account for 48 percent of the expected CERs from registered projects, projects in India account for 15 percent, Brazil 9 percent, South Korea 8 percent, and projects in 45 other countries account for the remaining 20 percent.

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 establish baseline emissions, and about whether and how other considerations

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[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 limit. Such a system would be essentially identical to a cap-and-trade in which each firm is allocated a quantity of allowances equal to its 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 system does not raise the same challenges associated with determining the appropriate baseline as do the credit systems discussed in this paper.

[6] For example, see Nigoff (2006) and Michaelowa and Jotzo (2005).

are accounted for in determining the number of credits to award 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.

3. Types of Linkages

Several types of linkages can be established between tradable permit systems (Figure 1). A link can be either one-way or two-way. Also, while direct links between systems can be established only through explicit decisions to do so, direct links can lead to indirect links between systems even absent explicit decisions to link them.

3.1. Direct linkages

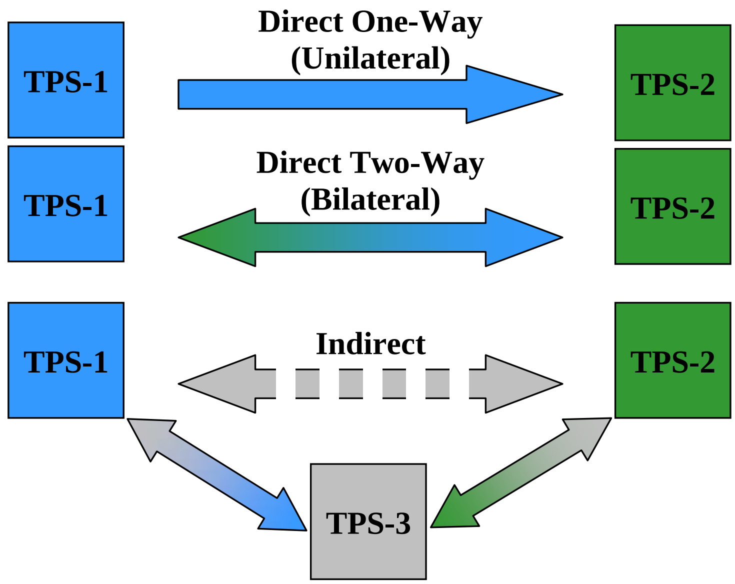
In order for a direct link to be established between two systems, either one or both systems must choose to accept the other's allowances (or credits) as valid for use in demonstrating compliance in its own system.[8,9]

[7] United Nations Framework Convention on Climate Change (2007).

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

[9] International trading of other goods and services often can emerge even absent explicit decisions by governments to allow it. However, because of a fundamental difference between allowances and other tradable commodities, inter-system allowance trading and the resulting cost savings depend on government decisions to create linkages. This is because the incentive for participants in one system to purchase allowances from another system depends on those allowances being recognized as valid for use in the former system. Also, the cost savings from linking depend on the redistribution of emission reductions across systems that occurs when one system's allowances are used to cover emissions in another system. This redistribution can occur only if the government maintaining the latter system recognizes the former system's allowances for use in its system.

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



3.1.1. One-way linkage

In a one-way (or unilateral) direct linkage, allowances can flow in only one direction between the linked systems. Such a link may exist because only one of the linked systems recognizes the other's allowances, or because one of the 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 a foreign system's allowances can be used in a U.S. system, if the U.S. system's allowance price is higher than that in the linked system, participants in the U.S. system will buy allowances from participants in the linked system. By increasing the supply of allowances available in the U.S. system and increasing demand for the linked system's allowances, this trading will reduce the U.S. system's allowance price and increase the linked system's price until those prices converge. This trading also will increase emissions in the U.S. system and reduce emissions in the linked system, as higher-cost emission reductions in the U.S. system are replaced by lower-cost reductions in the linked system.

If the U.S. system's allowance price is lower than that in the linked system, no trading or redistribution of emission reductions will result from the one-way link, as participants in the U.S. system would have no incentive to purchase allowances from the linked system. Thus, an unrestricted one-way link in which another system's allowances can be used in a U.S. cap-and-trade system will ensure that the U.S. system's allowance price never exceeds that in the linked system, but the linked system's allowance price may still exceed that in the U.S. system.

3.1.2. Two-way linkage

In a two-way direct link between cap-and-trade systems, the governments maintaining the linked systems recognize allowances from each other's system, making it possible for allowances to flow in either direction between the systems.[10] 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 a U.S. system and a foreign system, 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.

3.1.3. Restrictions on linkages

Various restrictions or conditions could be placed on links that would limit inter-system trading, and may thereby limit the allowance price convergence and redistribution of emission reductions 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.[11] Alternatively, an "exchange rate" might be applied to another system's allowances. 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. Exchange rates could serve as a simple fix to ensure the environmental integrity of a link if the linked systems' allowances represent different amounts of emissions or emission reductions (e.g., short versus metric tons). Exchange rates also may be intended to reduce inter-system trading, or to ensure that any trading leads to a net reduction in emissions. Finally, in a link with a credit system, the acceptance of credits for use in a cap-and-trade system may be conditioned on the type of emission reduction measure that generated the credits.

[10] While a one-way link can be established either between a cap-and-trade and credit system or between two cap-and-trade systems, a two-way link only can be established between cap-and-trade systems.
[11] 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.

3.2. 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.

A series of bilateral links among several cap-and-trade 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 the third system's allowances. Therefore, changes in one system's demand for the third system's allowances will affect the supply of allowances available to the other system.

4. Overview of the Implications of Linking

The design of a U.S. cap-and-trade system — and any cap-and-trade system with which it may link — likely will reflect a balance among several (sometimes competing) considerations, including the system's environmental effectiveness, cost, and distributional consequences. While the primary motivation for linking systems is to reduce each system's cost, linking also can have implications for the achievement of other policy objectives that merit consideration in evaluating linking opportunities. In some cases, the decision to link may require weighing tradeoffs among linking's various effects.

This section provides an overview of linking's implications. However, these implications depend on the type of link that is established and the characteristics and design of the linked systems. Therefore, sections 5 and 6 explore in more detail the implications of links between a U.S. system and credit systems, and between a U.S. system and other cap-and-trade systems.

4.1. Implications for a system's costs and volatility of costs

By broadening the scope of trading opportunities and improving the liquidity of allowance markets, linking generally reduces the cost of meeting the linked systems' collective emissions target.[12] Each system benefits from these savings. For example, if emission reduction costs in the U.S. system are higher than untapped opportunities in a linked system, the United States will become a net buyer of allowances from that system, and linking will allow U.S. system participants to displace higher-cost domestic reductions with lower-cost reductions in the linked system. On the other hand, if the United States becomes a net seller of allowances, while U.S. system participants will incur increased costs associated with achieving additional emission reductions, these costs will be more than offset by the associated revenue from allowance sales to participants in the linked system. While linking generally yields cost savings for both linked systems, the magnitude of these savings depend on the specific circumstances of each linkage.

Along with reducing costs, linking can affect the volatility of those costs, which is reflected in allowance price volatility. Allowance price volatility will be present in a cap-and-trade system regardless of whether or not it is linked with other systems. However, linkages can dampen the effects of unanticipated cost shocks in a 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 system to a new source of allowance price volatility — that arising from cost shocks in linked systems.

4.2. Implications for a system's environmental effectiveness

In many cases, linking offers the opportunity to achieve cost savings simply by redistributing where GHG emission reductions occur across linked systems without affecting the aggregate level of remaining emissions. The sale of an allowance by a participant in one system

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[12] Linking can increase costs under some limited circumstances. For example, see section 6.4.4.

to a participant in another system leads to an increase in emissions in the latter system and an offsetting reduction in the former system, leaving the total remaining emissions 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 GHG 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.

While a GHG tradable permit system's primary purpose is to reduce GHG emissions, in evaluating linking opportunities, some have also expressed concern about effects that linking may have on emissions of regional and local pollutants that often are released along with GHGs.[13] Examples of such pollutants include ozone precursors and air toxics. Because they often are emitted along with GHGs, we refer to these pollutants as correlated pollutants.

Even though correlated pollutants are an important focus of environmental policy, several considerations suggest that links with other GHG systems should not be limited by concerns about impacts on these pollutants. First, linking will not necessarily increase correlated pollutant emissions. If a U.S. system becomes a net seller of allowances as a result of linking, this will result in further domestic reductions in GHG and correlated pollutant emissions. Second, with or without linking, a U.S. system will be overlaid on top of existing 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. Finally, even if linking leads some domestic sources to achieve fewer GHG emission reductions than they would absent linking (offset by more reductions abroad), the magnitude of the resulting effects on correlated pollutants and the associated health and environmental impacts would be highly uncertain. This is the case because the amount and the impacts of correlated pollutant emissions associated with each ton of GHG emissions vary widely across emission sources.

If concerns exist about correlated pollutant emissions, separate regulations can be devised to target the sources and emissions of concern. Compared with restricting links among GHG

[13] For example, see Market Advisory Committee (2007).

systems, such an approach will be far more certain to achieve the desired aims, and will only reduce the flexibility offered by linking in cases where the environmental benefits warrant it.

4.3. Implications for a system's distributional impacts

As with other 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 cap-and-trade systems can 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 system whose allowance price falls. Therefore, changes in allowance prices resulting from linking also can affect firms and households that do not directly participate in the linked systems.

Linking's effect on the competitiveness of firms covered by the linked systems is another important element of its distributional impacts. By placing a cost on emissions equal to the allowance price, cap-and-trade systems can significantly alter 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 linking's effect on their competitiveness. While linking's competitiveness impacts result primarily from its effect on allowance prices, as section 6.4.3 describes, some allowance allocation methods can influence linking's competitiveness impacts.

Along with affecting distributional impacts within each linked system, linking also leads to capital flows between systems associated with inter-system allowance trading. Because such 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.[14]

4.4. Implications for control over a system's impacts

Underlying the implications of linking described above is a more fundamental effect of linking. Specifically, linking reduces a government's control over the impacts of its tradable permit system. Once a linkage is established, a system's allowance price will begin to be

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

influenced by conditions and developments in the linked system, and by decisions made by the government overseeing that linked system. Likewise, a 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 system depends on the characteristics of that system and the system(s) with which it links. For example, the larger the system with which a link is established, the more conditions in that system will affect the domestic system's allowance price. If the United States were to establish a link with the EU ETS and with a future Australian system, all else equal, conditions in the EU ETS would have a far greater influence on U.S. allowance prices than would conditions in the Australian system.

Even if a system is relatively small, however, certain characteristics of that system can still have significant effects on much larger systems with which it might link. For example, the presence of a safety valve in one system can significantly affect allowance prices in a linked system even if the former system is much smaller than the latter (see section 6.6).

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 recognizes 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. 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. Fewer 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 price, increasing that system's price. Thus, tradable permit systems may exert influences on one another even if they are not 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 EU 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 in 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.

5. Linkages between a U.S. Cap-and-Trade System and Credit Systems

A U.S. cap-and-trade system could be linked with a domestic credit system that covers emission sources and activities that are neither directly nor indirectly covered by the cap-and-trade system (e.g., biological carbon sequestration). Such a link is sometimes referred to as a domestic offset program. Also, a U.S. system could be linked with a foreign credit system, such as the CDM.

Section 5.1 examines the implications of linking a U.S. cap-and-trade system with a credit system. While some credit systems, such as a domestic offset program, may only be linked with a U.S. cap-and-trade system, others, such as the CDM, also may be linked with other cap-and-trade systems. As section 5.2 describes, pre-existing links between a credit system and other cap-and-trade systems can significantly affect the implications of linking with that credit system. Moreover, if a U.S. cap-and-trade system and other cap-and-trade systems are linked with a common credit system, this leads to indirect linkages among the cap-and-trade systems. Such indirect links affect the incremental impacts of establishing direct links between the U.S. system and those other cap-and-trade systems, as is described in section 5.3.

5.1. Implications of linking with a credit system

A link between a U.S. 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 provide access to emission reductions in developing countries, which are believed to have a disproportionate share of low-cost reduction opportunities.[15] Also, a credit system may be the best policy instrument for encouraging biological sequestration of carbon and for targeting certain non-CO_2 GHG emissions, which can offer significant low-cost opportunities to reduce net emissions, but are challenging to include directly under a cap-and-trade system.[16]

Cost savings from a link with a credit system result both from the credit system's low-cost emission reduction opportunities, and from the fact that *all* those opportunities would remain untapped absent at least one link with a cap-and-trade system. That is, absent at least one such link, there would be no demand for credits from a credit system, and hence no incentive for emission reductions under that system. Linkage introduces a price signal for emission reductions in a credit system that otherwise would not exist. By contrast, even before two cap-and-trade systems link, the least costly emission reductions in each system are already undertaken up to the point necessary to meet each system's cap. So, cost savings from linking cap-and-trade systems depend on the difference between the costs of the *remaining* untapped reductions in one system, and the costs of the most costly reductions necessary to meet the other's cap.

A recent Energy Information Administration (EIA) analysis of the Climate Stewardship and Innovation Act of 2007 highlights the significant potential for cost savings from links with credit systems.[17] Introduced in the Senate in January 2007, that bill would establish a cap-and-trade system for GHG emissions from sources that accounted for about 80 percent of 2005 U.S. GHG emissions.[18] EIA found that, if the Act allowed unrestricted use of credits from domestic and international sources, such credits could account for more than 60 percent of the least-cost emission reductions necessary to meet the Act's caps through 2030 (Figure 2).[19] 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.

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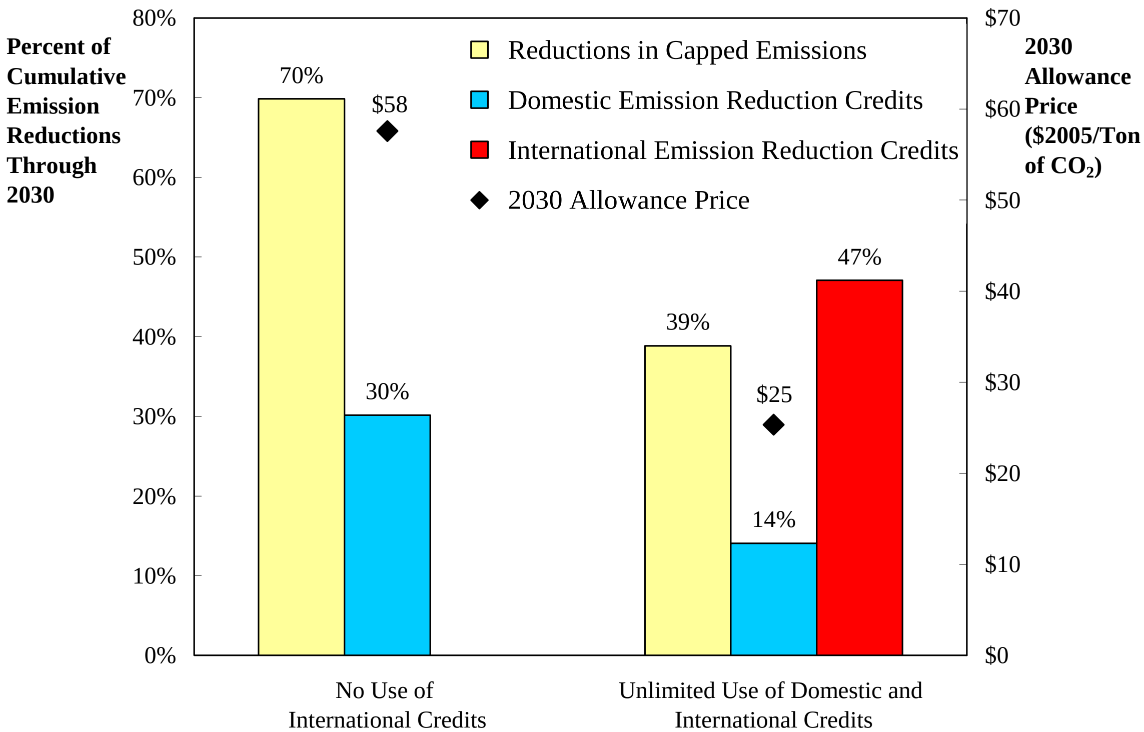
[15] Intergovernmental Panel on Climate Change (2007).
[16] For example, see Stavins and Richards (2005).
[17] United States Energy Information Administration (2007).
[18] In its current form (as of December 2007), the Lieberman-Warner Climate Security Act of 2007 (S. 2191) imposes more stringent emission caps than the Climate Stewardship and Innovation Act. This suggests that the cost savings from links with credit systems under the Lieberman-Warner bill would be even greater than those projected in EIA's analysis of the Climate Stewardship and Innovation Act.
[19] This finding is based on the assumption that the necessary institutions would emerge to generate these credits, and it 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 5.2).

Along with reducing the level of the U.S. allowance price, links with credit systems can reduce the price volatility that would result from unexpected shocks in the U.S. system.[20] On the other hand, if U.S. system participants rely heavily on credits, new sources of volatility can be introduced if regulatory developments or other factors suddenly alter the supply or cost of credits. However, an important feature of a link with a credit system is that it can only reduce a cap-and-trade system's allowance price, relative to what that price would be without the link.

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



Source: U.S. Energy Information Administration (2007)

The distributional impacts of a link between a U.S. 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 link 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 non-

[20] The extent to which such links reduce short-term volatility will be limited if credit-generating projects require significant lead-time to be approved and implemented.

emitting electricity generators. But, even with such link, these entities likely would be better off than they would be without a cap-and-trade system.[21]

The key concern regarding links with 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 a 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 U.S. cap-and-trade system would not be fully offset by reductions in the credit system.[22]

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 were not granted. Because the reductions associated with those credits would have occurred regardless of whether or not they were granted credits (i.e., the reductions 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 credit systems also can lead to increased emissions because of emissions leakage associated with emission reductions under a credit system.[23] 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.

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[21] However, the introduction of such a 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.

[22] This concern would be mitigated if another cap-and-trade system is already linked with the credit system (see section 5.2).

[23] In addition to leakage and additionality concerns, some emission reduction measures that may be included under a credit system can raise other concerns. For example, efforts to grant credits for biological sequestration raise challenging measurement issues.

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. In setting such standards and procedures, a balance must be struck. On the one hand, it is clearly undesirable to award credits in excess of the 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 with a credit system may lead to an increase in emissions under the linked systems due to the factors described above, it also can reduce the U.S. system's allowance price. This reduction in the U.S. system's allowance price can reduce emissions leakage from that system, reducing the link's net effect on global emissions. The magnitude of this offsetting effect depends on how prone the U.S. system is to leakage. However, consideration of leakage from the U.S. system suggests that such a link can still be neutral with respect to its effect on global emissions even if there is some difference between the number of credits generated in the credit system and the associated emission reductions achieved in that credit system.

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

5.2. Implications of pre-existing linkages with a credit system

A credit system can be linked with more than one cap-and-trade system, and a pre-existing link between a credit system and another cap-and-trade system can significantly affect the implications of linking with that credit system.[24] This is made apparent by considering a link between a U.S. system and the CDM, which is already linked with the EU ETS.

Given the existing link between the EU ETS and the CDM, if a U.S. cap-and-trade system were to link with the CDM, the U.S. system's participants would have to compete with EU ETS participants for CERs. That is, the two separate links with the CDM would create an

[24] While we focus on a case in which multiple cap-and-trade systems are linked with a common credit system, the key insights are also applicable to 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.

indirect link between the U.S. system and the EU ETS whereby the supply of credits available for use in each system would depend on the other system's demand for credits. This has implications for both the cost savings and emissions impacts of linking with the CDM.

Demand for CERs from EU ETS participants has caused secondary market CER prices to rise to about €18 in recent months, slightly below EU ETS allowance prices.[25] As a result, if a U.S. system were in place today, its allowance price would have to exceed $26 (€18 at current exchange rates) before a link with the CDM would offer any cost savings to participants in the U.S. system. Likewise, if EU ETS allowance prices were to increase from their current level and drive up CER prices, U.S. allowance prices would have to rise to even higher levels before a link with the CDM would offer any cost savings. Hence, as this example demonstrates, policymakers should be cautious in relying on a link with a credit system to limit a U.S. system's cost if that credit system is (or may become) linked with other cap-and-trade systems.

If U.S. allowance prices were sufficiently high such that CERs would be purchased and used in the U.S. system, the fact that the EU ETS is already linked with the CDM would affect the emissions implications associated with the use of CERs in the U.S. system. In particular, some of the CERs used in the U.S. system otherwise would have been used in EU ETS.[26] Thus, if those CERs overstate the 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 they are used in the U.S. system. In effect, the existing link between the EU ETS and the CDM renders moot concerns about the additionality of emission reductions associated with some (but not all) of the CERs that would be used in the U.S. system. The U.S. system's link with the CDM would only affect where those CERs are used, not whether they are used.

The use of CERs to cover increased emissions in the U.S. system would have two effects that bring about offsetting emission reductions. First, it would increase demand for CERs, raising their price and eliciting additional reductions under the CDM. Second, it would reduce the supply of credits available for use in the EU ETS. To meet their emissions cap, EU ETS participants therefore would have to rely on some combination of additional domestic emission

[25] Carbonpositive (2007). The discount at which CERs are selling relative to EU ETS allowances may reflect uncertainty about whether quantitative restrictions on the use of CERs in the EU ETS will have a binding effect, which would cause EU ETS allowances to be more valuable than CERs.

[26] Under limited circumstances, CERs may be used in the U.S. system without reducing the number of CERs used in the EU ETS. Specifically, if restrictions on the use of CERs in the EU ETS are binding (such that the EU ETS

reductions and more expensive CERs. Thus, the increase in the U.S. system's emissions associated with its use of CERs would be offset by emission reductions in the EU ETS and by additional emission reductions under the CDM. Therefore, the emissions implications associated with a link between a U.S. system and the CDM are quite different than would be the case if the U.S. system were the only system linked with the CDM.

While pre-existing links 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, the U.S. government could control the types of emission reductions that are undertaken in a credit system to offset increased emissions in its own cap-and-trade system. 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. If U.S. system 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 the U.S. system's standards. Thus, the incremental emission reduction measures under the credit system that would be brought about by the U.S. system's use of the higher quality credits would be determined, at least in part, by System A's standards, not by the U.S. system's standards.

In summary, a pre-existing link between a credit system and another cap-and-trade system can significantly affect the implications of linking a U.S. system with that credit system. Unlike in the case where a U.S. system is the only one linked with a credit system, the link'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 its effect on the other system's allowance price, such a link can raise many of the same issues that are discussed in section 6 in the context of assessing links between cap-and-trade systems.

allowance price exceeds the CER price) and demand for CERs in the U.S. system is sufficiently limited, use of CERs in the U.S. system may not reduce the use of CERs in the EU ETS.

Thus, even when assessing a link with a credit system, consideration should be given to any indirect links that such a link creates with other systems.

5.3. Implications of linkages with a common credit system for remaining cost savings from direct linkages with other cap-and-trade systems

Many of the emerging cap-and-trade systems may be linked with a common credit system, such as the CDM, and the competition for credits will lead them to be used in the system or systems with the highest allowance prices. In turn, use of credits in those systems will reduce their allowance prices, thereby reducing remaining differences in the allowance prices of the systems that are linked with the 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 the allowance prices of all those cap-and-trade systems to converge even though they are not directly linked with each other. By reducing differences in allowance prices among cap-and-trade systems, 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 links among those cap-and-trade systems. Therefore, in evaluating the merits of direct links between a U.S. system and other cap-and-trade systems, it is important to focus on the incremental effects of such links, given the indirect links that will exist between those systems if they are linked with a common credit system.

6. Linkages between a U.S. System and Foreign Cap-and-Trade Systems

The United States could establish either a one-way link or a two-way link between its cap-and-trade system and a foreign cap-and-trade system, depending on whether the system with which it links also recognizes U.S. allowances for use in its own system. Regardless of which system's allowance price is higher prior to linking, a two-way link would lead to inter-system allowance trading until the linked systems' allowance prices converge. On the other hand, if the United States establishes a one-way link with another system, the link will only lead to inter-system trading and allowance price convergence if the U.S. allowance price would be higher than the linked system's price absent the linkage. Such a link would have no effect if the U.S. allowance price would be lower than the linked system's price absent the linkage.

While the inter-system allowance trading and resulting allowance price convergence are what bring about the cost savings from linking, that trading and the resulting price convergence also can have other implications, including emissions and distributional impacts. As we describe below, the extent of the cost savings and the significance of these other impacts depend on the characteristics and design of both the U.S. system and the system with which it links.

6.1. Implications of differences in the linked systems' allowance prices

For each linked system, the cost savings from linking depend on the net amount of inter-system trading and the difference between the system's pre-link and post-link allowance price. All else equal, the greater that difference, the greater are the cost savings from linking. Thus, links between systems with larger differences in allowance prices, which thereby bring about larger price adjustments, tend to offer greater savings than links between systems with similar prices. However, while they offer greater cost savings, links that lead to larger allowance price adjustments in one or both of the linked systems also are more likely to bring about other effects that may need to be weighed against those savings.

In some cases, 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 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.

Even if a system's allowance price is not a specifically targeted outcome of its design, significant changes in allowance prices resulting from linking can lead to emissions and distributional impacts that merit consideration. Linking's effect on emissions leakage is one such impact that can be more significant the greater the change in allowance prices resulting from linking. As linking leads one system's allowance price to rise and the other's to fall, it will tend to increase leakage in the former system and reduce leakage in the latter system, with a net effect that may either increase or decrease global emissions. The significance and direction of linking's net effect on leakage depend on the extent to which each system's allowance price changes, and on the sensitivity of leakage from each system to changes in that price.

The difference between the linked systems' allowance prices prior to linking also influences linking's distributional consequences. 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 the United States adopts an economy-wide cap-and-trade system and establishes a two-way link with another system that has a higher allowance price, this link will increase U.S. allowance prices. While net sellers of allowances in the U.S. system would stand to benefit from this link, the resulting increase in U.S. allowance prices would increase costs for net buyers of allowances and would increase the cost of electricity, gasoline, and natural gas. Such distributional impacts would be greater the greater is the difference between the U.S. system's pre-link and post-link allowance price.

The direction and magnitude of capital flows between linked systems that result from inter-system trading also depend on the two system's allowance prices prior to linking. 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 the cap, the lower the allowance price, as less emission reductions are necessary to meet the cap.

If differences in allowance prices and resulting capital flows between systems are perceived to result largely from differences in the stringency of their caps, there may be resistance to the capital flows. For example, if a U.S. system's allowance price were lower than that in the EU ETS, a link between those systems would result in EU ETS participants buying U.S. allowances. While the resulting capital flows would reduce the cost of the EU ETS, some may object to those flows if the U.S. system is considered less stringent than the EU ETS.

In summary, differences between the allowance prices of a U.S. system and any system with which it may link will be a key determinant of the cost savings from linking, and of linking's emissions and distributional impacts. However, the impacts of particular allowance price adjustments resulting from linking depend, in part, on elements of the design of a U.S. system and of any system with which it may link, as is discussed next.

6.2. Implications of the scope of coverage of the linked systems

The scope of emission sources and GHGs covered by a U.S. system may differ from that of other systems with which it could link. For example, while the EU ETS currently covers only CO_2 emissions from electric power plants and certain industrial facilities, some bills in the U.S. Congress propose systems that would have broader coverage, including CO_2 emissions from transportation and commercial and residential buildings, and some non-CO_2 GHG emissions.

Linked systems do not need to cover the same types of emission sources, or even the same types of GHGs to realize gains from linking. However, the implications of allowance price adjustments resulting from linking depend, in part, on each system's scope of coverage. For example, linking's effect 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. Each system's scope of coverage also can influence the distributional concerns associated with linking. For example, it may be politically necessary for a 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, links that tend to increase such a system's allowance price may not be politically acceptable, at least initially, even if they would yield net gains to the U.S. economy as a whole.

Although linking can yield cost savings regardless of what emission sources are covered by the linked systems, 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 a U.S. and foreign system both cover firms that compete with one another, any difference between those systems' allowance prices can introduce a competitive distortion whereby firms under the system with the lower price gain an advantage over firms under the system with the higher price. This distortion could be eliminated by linking the systems, as firms in both systems would then face the same allowance price. In this respect, the benefits of linking can be increased if the linked systems cover sources that compete with one another. Of course, such a link may not be favored by firms in the system with the lower allowance price.

6.3. Implications of the point of regulation employed by the linked systems

Greenhouse gas cap-and-trade systems also 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, some bills in the U.S. Congress propose the use of upstream regulation in which fossil fuel suppliers must surrender allowances for the carbon content of the fuel they sell.[27] As long as each system is well-designed, differences in the point of regulation employed by two systems should not affect the implications of linking them.

[27] 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).

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.[28] The double counting concern is associated with a scenario in which one system employs upstream regulation and another 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.

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 covered by the downstream system receive some of their fuel from suppliers covered by the upstream system. Moreover, if this were the case, the double-counting problem would exist whether or not the systems link. In the above example, the double-counting problem arises because the source's emission reduction measure frees up two allowances (one in each system) even though it reduces emissions by only one ton. This problem does not depend on the systems being linked. Thus, the potential for double counting would need to be addressed whether or not the systems link.[29]

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 need not affect the implications of linking. Indeed, the double-counting problem described above does not result

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[28] See Blyth and Bosi (2004), and Market Advisory Committee (2007).

[29] If double counting were a possibility, linking an 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 can cause this sum either to increase

from differences in each system's point of regulation *per se*. Rather, it results from the two systems overlapping in the scope of emissions that they directly or indirectly cover.[30]

6.4. Implications of allowance allocation methods in the linked systems

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

6.4.1. Implications of a relative cap for linking's emissions impacts

A link between a U.S. system and a foreign cap-and-trade system will not affect total emissions under those systems as long as each system is well-enforced and adopts an absolute emissions cap that is below business-as-usual emission levels. Regardless of where each system's allowances are used — that is, regardless of whether or not the systems are linked — total emissions under the systems will equal the total number of allowances issued under those systems. This is the case regardless of how each system distributes those allowances.

However, linking can lead to a change in total emissions under the linked systems if one of the systems employs 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 one of the linked systems has an intensity-based cap for electricity generators, the link's effect on allowance prices in that system can affect the level of electricity generation in that system. In turn, this will affect the number of allowances issued under that system and total emissions under the linked systems.

The extent to which linking an absolute and relative cap affects total emissions under the linked systems depends on the extent to which linking affects the relevant economic activity under the relative cap, and on how sensitive the level of the relative cap is to changes in that activity. Moreover, such a link can either increase or decrease total emissions under the linked

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or decrease, linking can either increase or decrease the amount of double-counted emission reductions in the downstream system.

[30] This double-counting problem is a form of regulatory-induced emissions leakage. Because of the overlapping regulations, some emission reductions in the downstream system will be offset by increased emissions outside that system. In evaluating how a system's scope of coverage may influence linking's implications for emissions leakage,

systems. The net effect depends on whether linking increases or decreases the relevant economic activity that determines the level of the relative cap. Both outcomes are possible. Finally, the impact of inter-system trading on total emissions under the linked systems does not depend in any direct way on the direction of that trading. For example, even if allowances are only sold from the system with the absolute cap to that with the relative cap, the resulting reduction in the latter system's allowance price could lead to an increase in the relevant economic activity under that cap, and thus to an increase in the number of allowances issued under that cap.[31]

6.4.2. Implications of allocation decisions for linking's distributional impacts

As was previously noted, linking two systems increases one system's allowance price and reduces the other's allowance price. Thus, linking makes net sellers of allowances in the former system and net buyers of allowances in the latter system better off; and it makes net buyers of allowances in the former system and net sellers of allowances in the latter 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. Therefore, these decisions may affect the ability to garner support for linking. For example, if a high proportion of allowances are auctioned in a U.S. system, there may be more resistance to linkages that are expected to increase allowance prices, even if such links would benefit the economy as a whole. On the other hand, if allocation decisions make particular entities significant net sellers of allowances, those entities may resist links that would tend to reduce domestic allowance prices.

6.4.3. Implications of allocation decisions for linking's competitiveness impacts

If firms covered by a cap-and-trade system compete with firms in a linked system, differences in the systems' allocation approaches may raise concerns about linking's competitiveness impacts. However, in many cases, such differences 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

consideration should be given to the potential for such regulatory-induced leakage, along with traditional forms of leakage.

[31] Fischer (2003).

production and pricing decisions in the same way that it would if it had to purchase those allowances.[32] Therefore, under such an allocation approach, even if a firm receives far fewer or far more allowances than competitors in a linked system, that difference will not affect the firm's competitiveness, or linking's impact on its competitiveness.[33] Rather, the firm's competitiveness will be affected by the allowance price it faces, the allowance price its competitors face, and any changes in those prices resulting from linking.

While many allocation approaches do not influence linking's competitiveness impacts, these impacts can be affected by approaches in which allocations 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, a firm's allowance allocation in 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 stripping of allocations upon a facility's closure are also examples of updating allocations, as firms' decisions to open or close facilities affect their allowance allocation.

By tying the number of allowances a firm receives to activity that it can influence, such as its production, an updating allocation effectively subsidizes that activity. The more of that activity the firm undertakes, the more valuable allowances it receives. As a result, an updating allocation 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.

Although they can increase a system's cost by distorting emission reduction incentives, one reason why updating allocations are proposed is to address concerns about competitiveness impacts.[34] For example, if allocations to iron and steel manufacturers are tied to their production level, this would mitigate a cap-and-trade system's effect on their production costs.

Regardless of whether a cap-and-trade system is linked with other systems, the use of an updating allocation can affect the competitiveness of firms under that system, and can thereby affect the relative competitiveness of those firms' competitors. However, an updating allocation also can influence linking's competitiveness impacts because the change in a system's allowance

[32] For example, if allocations are based on a firm's emissions prior to the cap-and-trade system's implementation, the allocations would not affect the firm's on-going production costs.
[33] However, if a firm faces constraints on its ability to raise capital at typical market rates, it can be competitively disadvantaged if it is required to purchase more allowances than its competitors.
[34] Competitiveness impacts also can be addressed in other ways. Tariffs or allowance requirements could be placed on imports of emissions-intensive products to ensure that domestic manufacturers are not disadvantaged relative to importers of such products. Similarly, border tax adjustments could be applied to exports of emissions-intensive products. See Grubb and Neuhoff (2006) and Stavins (2007).

price resulting from linking alters the size of the effective subsidy created by an updating allocation. Thus, the use of an updating allocation in one or both of the linked systems may affect the support for linking among some firms. For example, consider a case in which two systems cover firms that compete with each other, and the system with the higher allowance price employs an updating allocation, but the system with the lower price does not. In such a case, firms in the system with the lower 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 an updating allocation for linking's competitiveness impacts depends on the specific allocation employed and other circumstances specific to each link. Moreover, while the use of an updating allocation could pose an obstacle for certain links, the opportunity to establish a link might eliminate the need for an updating allocation in some cases. An updating allocation may be adopted because of concerns about a system's impact on the competitiveness of covered firms, relative to competitors outside of the system's coverage. If those competitors are subject to another cap-and-trade system with a lower allowance price, linking 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 reduce or eliminate the need for an updating allocation. This example demonstrates the more general principle that linking can alter the optimal design of a system through its effect on allowance prices.

6.4.4. Implications of updating allocations for the cost savings from linking

Updating allocations also can affect the cost savings from linking. Indeed, in some cases, if a system employs an updating allocation, a link involving that system could increase (instead of 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 allocation employed, and on other circumstances specific to each linkage.

By definition, when an allowance is traded, the buyer places a higher value on the 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 costs.

The use of an updating allocation 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, a firm would place a value on an allowance that exceeds its emission reduction costs if an updating allocation directly or indirectly ties the firm's future allocations to its current emissions, such that the less it emits the fewer allowances it receives. That value would equal the cost of the emission reductions that the firm would have to undertake without the allowance, *plus* the value of future allocations that would be foregone by undertaking those reductions. The firm therefore would buy an allowance at prices above its emission reduction costs, and would not 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. Indeed, 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.[35]

If a cap-and-trade system (System A) employs an updating allocation, 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 they 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

[35] Reilly and Paltsev (2006). Some EU Member States avoided tying firms' Phase II allocations to their Phase I emissions, but not all have. For example, some French firms' Phase II allocations will be affected by their Phase I emissions. Ministère de l'Écologie et du Développement Durable (2006).

offsets their lower emission reduction costs. Were this 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 the updating allocation has a less substantial effect on the value that System A participants place on allowances, they may become net sellers of allowances to System B participants, preserving — but perhaps reducing — the cost savings from linking. Case-specific analysis is needed to assess the extent to which an updating allocation may compromise the cost savings from linking.

6.4.5. Summary of the implications of allowance allocation decisions

By influencing who gains and who loses in its system as a result of allowance price adjustments resulting from linking, each system's allowance allocation approach at the very least affects linking's domestic distributional impacts. Certain types of allocation approaches also can influence the emissions impacts, competitiveness impacts, and even the cost savings from 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. If one of the systems employs an updating allocation, 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. Even the use of a relative cap or an updating allocation will not 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.

6.5. Implications of monitoring, reporting, and enforcement provisions of the linked systems

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 are less effective than that in another, inter-system trading can affect total emissions under those 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, the link could actually reduce noncompliance in that system, and thereby reduce total emissions under the linked systems.[36]

Nonetheless, to maintain confidence in a 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 emissions monitoring and reporting provisions in cap-and-trade systems relates to concerns about a cap's environmental integrity. But experience with the EU ETS highlighted that these 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.

While the EU ETS began in January 2005, the first verified emissions data for covered sources were not released until the spring of 2006.[37] Prior to that data release, allowance prices had risen to almost €30. Following the release, prices fell more than 50 percent in just one week, suggesting that the data fundamentally altered perceptions of the amount, and thereby cost, of

[36] A link also can affect emissions by affecting a government's incentive to enforce a system. If that 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-compliance reduces a system's allowance price and thereby reduces the value of allowances. However, by expanding the allowance market, linking reduces the negative effect that a given amount of non-compliance has on allowance prices. Therefore, linking reduces the negative impact that poor enforcement has on the value of a system's allowances, potentially reducing a government's enforcement incentive.

reductions necessary to achieve the cap. Phase I allowance prices never again exceeded €20, a level they consistently exceeded from July 2005 until early 2006. Given the sharp drop in prices after the data release, some emission reductions undertaken before that release undoubtedly were more costly than opportunities that remained unexploited after the release. Had emissions data been released earlier, allowances prices likely would not have climbed to the level 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.

6.6. Automatic propagation of certain design elements due to linking

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

[37] Convery and Redmond (2007).

On the other hand, as we describe below, inter-system trading resulting from an unrestricted two-way link between two systems will lead to the automatic propagation (or *de facto* harmonization) of particular design elements that are often referred to as cost-containment measures.[38] These include offset provisions, links with other systems, banking and borrowing provisions, and safety-valve provisions. If these provisions are present in one system, 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).[39] Also, future changes in one system's use of these provisions can directly affect the functioning of the other system.

6.6.1. Propagation of offset provisions and other linkages

When two cap-and-trade systems link, each becomes indirectly linked with any 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 link will lead System B's participants to purchase more offsets, as they compensate for the link's effect on the price of their allowances.[40] Consequently, if a link between Systems A and B increases emissions in System A, some of that increase will be counterbalanced by increased use of offsets in System B.

6.6.2. 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. For example, if one system allows banking and borrowing and the other does not, contracts can be structured between participants in the linked systems to make banking or borrowing available to participants in the latter system.[41] However, even without such contracts, the opportunity to bank or borrow allowances

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[38] As we describe below, these measures may not be propagated if only a one-way link is established.

[39] Electric Power Research Institute (2006) provides a detailed discussion of this issue. While this section discusses the propagation of cost-containment measures resulting from a direct link, it should be noted that one system can indirectly affect, and be affected by, the use of those measures in another system even if the systems are only indirectly linked through links with a common credit system. However, any such effects would be less pervasive than the propagation resulting from a direct link between the systems.

[40] This assumes that System B participants are not restricted from purchasing more offsets. Also, if System A becomes a net seller of allowances to System B, the link will reduce offset use in System B.

[41] Consider a case in which System A, which does not allow borrowing, links with System B, which allows borrowing. In this case, a System A participant could enter into a swap contract with a System B participant, where

in one system would affect the allowance supply and price in the other system because each system recognizes the other's allowances, and each system faces the same allowance price.[42]

6.6.3. 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 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.[43] 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 have safety valves with different trigger prices, 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 may wish to adopt a harmonized trigger price. Absent explicit harmonization of the trigger price, each government would have an

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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 in two years, the System B participant could then borrow an allowance and use that borrowed allowance in place of a current-year allowance, which could be transferred to the System A participant. Thus, in effect, System B's borrowing provision would be made available to System A participants.

[42] Returning to the example in the above footnote, if developments in System A cause the common allowance price to increase relative to expected future prices, this would increase the incentive that System B participants face to borrow allowances. Thus, even without explicit contracts motivating them to do so, System B participants effectively would borrow allowances on behalf of System A participants.

[43] 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. Rather than increasing the allowance supply, such a design would reduce System B participants' demand for allowances once 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. Thus, if System B is significantly smaller than System A, the use of a safety valve in System B and

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.

6.6.4. Efficacy of efforts to limit propagation of cost-containment measures through restrictions on linkages

While allowance banking likely will be allowed in all GHG cap-and-trade systems, the adoption of and preferences for the other cost-containment measures likely will differ across systems. For example, while some cap-and-trade proposals in the United States, Australia, and Canada include a safety-valve provision, the EU ETS does not have such a provision. Therefore, the propagation of these other cost-containment measures that would result from unrestricted linking may pose an obstacle to the development of some links. As a result, some have explored whether restrictions (or conditions) can be placed on links to avoid that propagation.[44]

A few different types of restrictions could be placed on linkages, including: 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. Such restrictions could be differentiated depending on the participants involved in trading. For example, a system may prohibit the use of allowances sold by those participants in another system who have used that system's safety valve. Restrictions also could depend on certain triggering events, such as the first use of a safety valve in the linked 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 will 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

the resulting sale of allowances to System A may dampen an increase in System A's allowance price, but it may not fully cap that price.

[44] See Electric Power Research Institute (2006).

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 a restriction that prevents *any* net sale of allowances from that system. This could be achieved by adopting only a one-way link in which the system with the more generous measures could purchase allowances from a linked system, but could not sell allowances to that system.

Because of the fungibility of allowances within each 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 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, but it would not affect the overall extent to which the safety valve is used.

Some restrictions can limit, but not eliminate 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 that safety valve's potential effect on a domestic system's allowance prices. Also, to the extent that concerns about a linkage relate to potential emissions impacts of the increased use of cost-containment measures, the use of exchange rates can offset the increase in emissions that may result from inter-system trading.

Unfortunately, any restriction on a linkage that is effective in limiting or offsetting the propagation of cost-containment measures 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 link on the use of cost-containment measures (e.g., a link's effect on the likelihood that a safety valve will be triggered), and because these effects will change over time.

7. Prospects and Necessary Foundations for Linkages

Links between a U.S. cap-and-trade system and other tradable permit systems have the potential to reduce significantly the long-run cost of the U.S. system and any systems with which it links. But, along with the cost savings that it can offer, linking carries with it other implications. In particular, linking can have emissions and distributional implications, and can reduce the control that the U.S. government and its linking partners have over the impacts of their respective systems. 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 particular linkages are established.

Because the implications of a 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, links with credit systems may be more readily established than some links with other cap-and-trade systems.

In light of the implications of two-way links with other cap-and-trade systems, more may need to be done to set the foundation for such links. In particular, in order for each party to agree to such linkages, it may be necessary to harmonize certain elements of the design of the U.S. system and the systems with which it links. It may even be necessary to develop international agreements that govern aspects of the design of the U.S. and linked systems beyond simply mutual recognition of allowances. While the United States could unilaterally establish a one-way link with another cap-and-trade system without such an agreement, the government overseeing that system may object to and resist the linkage if it is expected to meaningfully affect allowance prices in its system.

This section first discusses elements of a U.S. system's design that may need to be adjusted or harmonized with other cap-and-trade systems to facilitate links with those systems. It then considers the role that international agreements may need to play in facilitating some linkages. It concludes by discussing the near-term role that links with credit systems can play in directly and indirectly linking a U.S. system with existing and emerging tradable permit systems.

7.1. Implications of linking opportunities for the design of a U.S. system

Mutually beneficial links can be established between 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 both for the system itself and 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 likely will 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 a U.S. system and potential linking partners could present a substantial obstacle to linking.[45] Although restrictions could be placed on a linkage to reduce this propagation, such restrictions also would reduce the cost savings from linking.

While governments may be able to agree to a unified set of cost-containment measures in order to facilitate linkages, a method of addressing cost uncertainty that has recently been proposed in the U.S. climate policy debate may present a less surmountable obstacle to linking. The Lieberman-Warner Climate Security Act of 2007 (S. 2191) proposes to establish a Carbon Market Efficiency Board that would be authorized to manage the U.S. allowance market. Among other powers, the Board would have the discretion to adjust offset and borrowing provisions in the U.S. system, and to increase the total supply of allowances allocated in a given year (though it would be required to make offsetting reductions in future years). If such board is established, by linking its cap-and-trade system with the U.S. system, a foreign government would cede to this board's discretion the control over its system's allowance price and emissions implications. Thus, such an approach to addressing cost uncertainty likely would present a far greater obstacle to linking than would measures that establish well-defined and pre-determined rules to which the linking parties could agree prior to linking.

Of course, implications for linking opportunities are just one of many factors that should be considered in designing a U.S. cap-and-trade system. In some cases, even if certain design decisions would foreclose particular linking opportunities, at least in the near-term, they may be justified by their domestic implications. Moreover, over time, the design of the U.S. system — and of the systems with which it could link — could be adjusted to facilitate linkages as the gains from linking change and as experience provides a better understanding of the implications of those design decisions. Finally, while some adjustments to a system's design could be motivated by a desire to make linking more attractive to potential partners, other changes may be motivated by a link's effect on the system's domestic implications. By altering allowance prices in the U.S. system and in the system(s) with which it is linked, a link can alter the optimal design of the U.S. system. 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.

7.2. The Role of international climate agreements

To establish a direct 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 the linked systems may play an important role in facilitating linkages between a U.S. system and other cap-and-trade systems. In fact, such agreements may be a necessary foundation for some links.

7.2.1. 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 6.1 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.

[45] As was described in section 6.6.4, differences in cost-containment measures may not pose an obstacle to establishing a one-way link in which allowances can only be sold from the system with the less generous cost-containment measures to the system with the more generous measures.

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 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 caps. This effect can be illustrated by considering a recently agreed-upon linkage between the EU ETS and Norway's GHG cap-and-trade system. If Norway's system were not linked with other systems 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.[46] On the other hand, once Norway links with the EU ETS, any reduction in the number of allowances that Norway issues would have a far smaller (perhaps imperceptible) effect on the price of its allowances, which largely would be determined by the supply and demand for allowances in the EU ETS. Therefore, by reducing the number of allowances that it issues, Norway would be reducing the total value of its allowances. Likewise, the resulting reduction in emissions from Norwegian sources would be far smaller than the reduction in the number of allowances issued by Norway, as the reduction in issued allowances would lead to a corresponding reduction in emissions that is dispersed throughout the EU ETS and Norway.

As this example demonstrates, linking changes the incentives that governments face in setting emissions caps for their systems. Therefore, agreements among governments about future emissions caps may provide valuable assurances that linkages 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 in order to provide greater regulatory certainty for those covered by their system. Many promising emission reduction measures require 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 trajectory, the less inclined firms will be to invest in capital-intensive measures. As a result, emission reductions will have to be achieved through more costly, but less capital-intensive measures.

[46] That is, the change in the allowance price likely would more than offset the effect of the reduction in the number of allowances issued on the total value of Norway's allowances.

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 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.

7.2.2. 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 its system's future impacts. Just as a system's initial design affects the desirability of linking with that system, future changes in its design can have consequences for linked systems. Some governments nonetheless 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 their system's impacts already may be limited by connections with other systems through trade in emissions-intensive products (see section 4.4). Under these circumstances, such as may be the case with regional trading partners, links may be more readily established. However, the reduced control that comes with linking may be an obstacle to establishing other links.

While governments always have the option to terminate a link in response to undesirable changes in a linked system's design, such an action can itself have undesirable consequences. For example, terminating a link may significantly change a system's future allowance prices, leaving some existing investments stranded and causing other undesirable distributional impacts. Therefore, before linking their systems, governments may wish to agree to a particular process for making future material changes to their 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.

7.3. Near-term opportunities for and benefits of links with credit systems

In the near-term, links with credit systems such as the CDM likely will be more attractive and easier to establish than some links with other cap-and-trade systems. Links with credit systems may offer greater cost savings. Also, because they can only reduce allowance prices in the U.S. system, such links may enjoy more support than would two-way links with other cap-and-trade systems, which could lead to increased allowance prices in the United States.[47] 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 links between a U.S. system and other cap-and-trade systems may take time to establish, if the U.S. system and these other systems are linked 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, these linkages with a common credit system can achieve some and perhaps much of the near-term cost savings and risk diversification that could be achieved through direct links between a U.S. system and other cap-and-trade systems.

8. Conclusions

Links with existing and emerging tradable permit systems could significantly reduce the long-run cost of a U.S. cap-and-trade system. However, along with the cost savings that it offers, linking has other implications that warrant consideration. Under certain circumstances, linked systems collectively will not achieve the same level of emission reductions as they would absent linking. Linking also can lead to distributional impacts across and within the systems that may be deemed undesirable in some cases. Finally, linking reduces a government's control over the impacts of its system. Thus, in considering linkages, the United States and potential linking partners may have to weigh linking's implications for potentially competing policy objectives, much as will be required in developing other elements of their domestic climate policies.

Because linking's implications and the tradeoffs it presents depend on the type of link that is established, and the characteristics and design of the linked systems, case-specific analysis is needed to assess the merits of each linking opportunity. For the same reason, whereas the implications of some links 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 a U.S. system and other cap-and-trade systems. 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 partners. However, the extent to which these elements need to be harmonized to facilitate linking 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 desire to establish particular linkages.

Although some adjustments to a U.S. system's design may be motivated by a desire to make linking more attractive to potential partners, linking opportunities also may call for changes to the system's design to address linking's domestic implications. By altering allowance prices in the U.S. system and in the system(s) with which it is linked, a link can alter the U.S. 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, links with some cap-and-trade systems may require agreements governing the design of the linking 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 a link between a U.S. system and a credit system such as the CDM would create indirect links with all other cap-and-trade systems

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[47] For similar reasons, the United States may wish to establish one-way links with other cap-and-trade systems. However, unlike a link with a credit systems, such a link may be resisted by the government overseeing the linked system if it would significantly increase allowance prices in that system.

that are linked with that credit system. Through these indirect links, a link with such a credit system can provide some and perhaps much of the near-term cost savings and risk diversification that would be achieved through direct links with those other cap-and-trade systems; and it can do so without much of the foundation that would be needed to establish direct links with those other systems.

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