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Linking by Degrees

Incremental Alignment of Cap-and-Trade Markets

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RESOURCES FOR THE FUTURE

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Abstract

National and subnational economies have started implementing carbon pricing systems unilaterally, from the bottom up. Therefore, the potential linking of individual cap-and-trade programs to capture efficiency gains and other benefits is of keen interest. This paper introduces a two-tiered framework to guide policymakers, with an interest in North American policy outcomes. One tier discusses program elements that need to be aligned before trading of allowances across programs can occur. The second identifies benefits of incremental alignment of program elements even prior to trading between programs—which we call "linking by degrees." We apply this framework to California's cap-and-trade program and the Regional Greenhouse Gas Initiative. These programs are already linking through cooperation and sharing of information. Many aspects of the program designs are ready for the exchange of allowances within a common market; however, the difference in allowance prices remains an issue to be considered before formal linking could occur.

Key Words: greenhouse gas, climate change, climate policy, policy coordination

JEL Classification Numbers: Q58, H77

Executive Summary

Despite efforts to form a multi-national (top-down) climate policy framework, national and subnational economies have started implementing carbon pricing systems unilaterally, from the bottom up. Therefore, the potential linking of individual cap-and-trade programs to capture efficiency gains and other benefits is of keen interest.

This paper introduces a two-tiered framework to guide policymakers, with an interest in North American policy outcomes. One tier provides technical guidance by discussing which program elements need to be aligned before trading of allowances across programs can occur. Previous studies may overemphasize the importance of comprehensively aligning program elements and underemphasize the opportunity to employ policy levers to adjust allowance flows and retain local control of linked programs. We identify priorities for aligning program elements and the relative importance of doing so.

We argue the process of aligning programs has its own rewards. The second tier of our framework identifies benefits of aligning program elements even prior to the trading of allowances between programs. The incremental alignment of program elements—which we call "linking by degrees"—can capture benefits in program administration, build institutions and political support, and may influence the design of expected rules governing greenhouse gas emissions under the US Clean Air Act.

Finally, we apply this framework to a case study of California's cap-and-trade program with the Regional Greenhouse Gas Initiative (RGGI). These programs are already linking by degrees through cooperation and sharing of information, mutual learning, and borrowing from each other's program design. We identify further opportunities for incremental alignment of these programs, evaluate their readiness for trading emissions allowances within a common market, and model potential economic consequences.

We find many aspects of the program designs are ready for formal linking, that is, the exchange of allowances within a common market. However, the difference in allowance prices remains an issue to be considered before formal linking could occur.

We also find several opportunities for further incremental alignment of the programs may be relatively unimportant for market performance or political economy but are easy to achieve. These easy targets should be pursued because they offer administrative benefits and reinforce the process of cooperation across jurisdictions.

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I. Introduction

Despite international and congressional efforts, comprehensive climate policy that would introduce a price on carbon emissions in the United States has yet to take shape. In this void, 10 states have introduced a price on carbon emissions from the bottom up through the introduction of cap-and-trade programs. Similar initiatives are also springing from the bottom up worldwide. Over a dozen countries, four provinces and five cities have recently established or are actively designing cap-and-trade programs.[1] Every program is composed of a set of elements that makes it unique—sectoral coverage, choices over the emissions cap, allocation or auction of allowances, cost management provisions, the use of offsets, enforcement and other technical issues.

The introduction of a carbon price is expected to provide cost-effective emissions reductions compared with other regulatory approaches. However, any climate policy pursued in isolation has limited potential unless it contributes to a global effort to address the global problem of climate change. This paper examines the opportunities for coordinating efforts across jurisdictions through linking programs.

In common usage, linking refers to the joining of cap-and-trade programs into a common market. In this paper, we refer to this as "formal linking" and expand the definition of the term linking to also describe the incremental alignment of various program elements across trading programs, which may preface trading emissions allowances in a common market. We call this process "linking by degrees."

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[1] http://www.climatechange.gov.au/government/~/media/government/international/CarbonExpo-Combet-Presentation-20121109.pdf.

The benefits from linking cap-and-trade markets generally take four forms.

On a political level, linking of cap-and-trade programs signals a common effort to reduce greenhouse gas emissions. Every effort to reduce emissions yields benefits (Jaffe and Stavins 2007). However, achieving noticeable benefit from reducing emissions requires a significant undertaking that exceeds the reach of any one program especially in light of the fundamental free rider characteristic of the climate policy challenge. Most of the benefits of emissions reductions spill over to other jurisdictions, so each jurisdiction has an incentive to free ride and do less than would be socially efficient from a global perspective. The incremental alignment of program elements and the prospect of formal linking contribute a political benefit because they signal progress toward greater levels of cooperation necessary to achieve significant scale across jurisdictions. Such cooperation among existing programs might ultimately enable additional jurisdictions to also commit to climate mitigation efforts.[2]

On an economic level, formal linking changes the distribution of mitigation activities to identify and realize emissions reductions at the lowest possible cost. Further, it broadens the portfolio of emissions reduction options and thereby helps buffer carbon markets against uncertainties that affect cost, such as patterns of economic activity and weather. Formal linking also allows allowance markets to exploit differences in technology and resource costs across trading programs. In addition, both formal and incremental linking help reduce the costs for regulated business by reducing the uncertainty they face in the development of different trading programs. They also reduce the problem of leakage of economic activity to jurisdictions that do not regulate emissions in the same way. These features contribute to lower overall mitigation costs that might enable individual trading programs to commit to more ambitious emissions reductions.

Linking also has administrative benefits. The process of linking enhances the opportunity for regulators to share best practices in program administration including procedures for

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[2] Flachsland et al. (2009a) suggests that formal linking endows a sense of political responsibility that leads to greater reduction efforts among linked programs. In contrast, Helm (2003)and Bohm (1992) argue that formal linking might lower overall emissions reductions when individual jurisdictions choose their own emissions caps because those with a lower environmental commitment will choose higher caps in the presence of linking. Potentially a net exporter would have an incentive to adopt a less stringent cap to create more exports (surplus allowances) and a net importer will have an incentive to adopt a less stringent cap to reduce the spending on imports. These articles discount the role of coordination in solving what is otherwise a disincentive to reduce emissions due to the free riding problem. Tuerk et al. (2009) and Zetterberg (2012) note that linking alters incentives in cap setting. This academic debate would not apply to incremental alignment of program elements but may apply to a formal link.

measurement, reporting, and verification of emissions and protocols for allowance tracking systems as well as overall program design. Linking, insofar as it leads to alignment in administration and design, might streamline compliance and offer reduced administrative costs for businesses operating in both jurisdictions. It may also streamline the administrative operations for among multiple jurisdictions by collecting those activities in a single operation.

Finally, linking offers policy related benefits as well. The process of linking boosts the influence of state programs in shaping national policy. For example, California's Market Advisory Committee convened by Governor Schwarzenegger in 2006 to lay out ideas for a cap-and-trade program in California included participation from several persons involved in the design of the Regional Greenhouse Gas Initiative (RGGI), and that process (and some of those persons) contributed further to the Western Climate Initiative. The architecture of the RGGI program, with innovations beyond the pre-existing emissions trading program in the European Union, was replicated in the proposed Waxman-Markey legislation (HR 2454) that passed the House of Representatives in 2009. Today the California program reflects the RGGI architecture, and conversely the RGGI program has evolved through its recent program review to assimilate some features of the California program.

In the contemporary context, these state activities are expected to influence the guidelines for implementation of greenhouse gas rules for existing stationary sources under the US Clean Air Act. Those rules, which will be promulgated under Section 111(d) of the act, will require states to develop implementation plans for approval by the US Environmental Protection Agency (EPA). Many observers have noted the apparent opportunity for interstate cooperation, including the possibility of emissions trading as a way to satisfy the regulatory requirements. The prospect for interstate cooperation will depend on guidance given to the states by EPA. The role for state cooperation should be enhanced if states are seen to be working together already to help reduce the costs of their greenhouse gas emissions reduction efforts. Subsequent to the issuance of guidance from the EPA, the states will develop implementation plans and one can expect greater deference to the states if those plans include similar provisions embodied in programs that have already been successful at the state level.[3]

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[3] Deference to the states was one of the two main arguments invoked by the DC Circuit in overturning the Cross State Air Pollution Rule (CSAPR) (EME Homer City Generation, L.P. v. EPA, 696 F.3d 7 (D.C. Circuit 2012)). Section 111 references an implementation plan process similar to the one required for CSAPR.

A premise of this paper is that although the administrative and policy related benefits of linking might appear to be the most pedestrian, they are, in fact, immediately tangible and can be achieved incrementally. Political and economic benefits follow. The prospect of these benefits justifies the initial development of relationships across jurisdictions, which also satisfies a precondition for trading emissions allowances across programs. In sum, distinct cap-and-trade programs can realize immediate benefits by taking concrete, incremental steps toward alignment of program elements—that is, through the process of *linking by degrees.*

In brief, this paper observes that California and RGGI already are linking by degrees through cooperation and sharing of information, mutual learning and borrowing from each other's program design. Further, they are almost ready for formal linking when evaluated based on administrative measures and according to the criterion of creating a functioning market. (The paper focuses on economic implications; legal analysis of how linking might occur is beyond the scope of this paper.) However, the difference in allowance prices remains an issue to be considered before formal linking could occur. If formal linking were to occur, we find it would come with political economy consequences, as some interests will benefit and some will lose. However, further incremental alignment of the programs before formal linking would help anticipate and possibly dissipate the wealth transfers that drive political economy consequences. In addition, substantial alignment would be likely to influence federal policy. We identify several opportunities for further alignment.

The next section describes the types of linking that have emerged around the world. Section III describes the design elements that define trading programs and the opportunities for alignment. Section IV reviews the California and RGGI programs, noting the incremental linking that has already occurred and evaluating their readiness to link formally with inter-program trading of emissions allowances. Section V provides illustrative modeling of the economic and environmental consequences of formal linking those programs. Section VI concludes.

II. Types of Linking

Linking by degrees describes a process rather than an outcome, recognizing that climate policy in general and carbon markets in particular are dynamic. Political leadership at the state and provincial level in North America will retain a strong oversight role regarding their participation in programs that reach across subnational jurisdictions, and that will occur even after they were to formally link. By analogy, this is also true for the role of national governments in multi-national trading programs. Hence, the process of linking does not have a final stage; it will be ongoing.

We dedicate most of this paper to explaining the process of linking by degrees. But first we orient the reader by explaining the way linking has traditionally been described in the policy literature. The term linking traditionally refers to a formal relationship that allows the exchange of emissions allowances or offsets between different trading programs, which we define as "formal linking." Although one can imagine other formal links—for example, links between allowance markets and carbon taxes or even regulatory standards (Metcalf and Weisbach 2012)—we focus on linkage between cap-and-trade markets. In this market context, a formal link may take several forms, depending on the regulators' choice of legal framework and the direction of flow of emissions allowances across trading programs.

Two cap-and-trade programs are directly (formally) linked when one administrator recognizes allowances or credits from another jurisdiction as eligible for compliance. If this recognition is not reciprocated, in other words, if recognition flows in only one direction, a *unilateral link* is formed and trade may occur one way. The use of offsets from another trading program for compliance is an example of a unilateral link. If recognition of allowances is mutual, a *bilateral link* is formed and trade may occur two ways (Jaffe et al. 2007).

Unilateral Linking

Unilateral (formal) links require that legislation or regulation in the importing program explicitly recognize allowances from the exporting program as eligible for compliance—or grants an administrator that authority (Mehling and Haites 2009). Regulators in both programs might desire to control the flow of allowances to manage the price of their allowances. A unilateral link introduces increased demand for allowances from the exporting program that would be expected to cause their price to increase. In practice, a unilateral link requires that the exporting program endorses the ability of regulated firms (or an administrator) in the importing program to hold its allowances because regulators in the exporting economy can implement various rules to control allowance flows under a unilateral link. For example, if allowances are not used for compliance within a specified amount of time, the regulator might withdraw and reissue the allowances. This would invalidate their use in another trading program because it would not represent a permanent retirement of an emissions allowance (Holt et al. 2007). Alternatively, regulators in the exporting program could restrict access to the allowance registry, which in some programs presents a legal barrier that might prevent firms (or an administrator) in other trading programs from determining the exclusive use of allowances. Regulators also have mechanisms to more finely manage the flow of allowances, such as imposing a quota limiting the number that can be brought into the system or an additional charge or tariff on allowances purchased for use outside the jurisdiction (Mehling et al. 2009).

A unilateral link introduces an alternative to mitigation of emissions in the importing program, and therefore, if any import of allowances were to occur, the price for allowances in the importing program would be expected to decline. Similar options to control allowance flows are available. The importing program administrator could cease recognition of allowances from other programs or impose an import quota or fee on their use. Alternatively, regulators in the importing program can unilaterally place a discount rate that requires each firm to retire more than one imported allowance for every ton emitted by the firm (Jaffe et al. 2007). These various rules provide a level of flexibility that significantly limits the risk of either program involuntarily losing control over allowance prices under a unilateral link (Mehling et al. 2009).

Under any kind of linking, policies unique to one program can be propagated to the other. For example, if a program with a price ceiling linked unilaterally to a program without one and if allowances were to flow into the program with the price ceiling the absence of the ceiling in the exporting program becomes operative in both allowance markets. This de facto harmonization of architecture, in the case the absence of a price ceiling in one program, can affect aggregate emissions thereby changing the environmental benefits of linking (Haites and Wang 2009).

Although unilateral linking between a cap-and-trade program and offset credit markets is a common practice (see discussion in text box), unilateral links between two cap-and-trade programs are less common and have been used less extensively. One example is Norway's cap-and-trade program, which was unilaterally linked to the European Union's Emissions Trading System (EU ETS) from 2005 to 2007. Emissions allowances from the EU ETS were recognized as eligible for compliance in Norway's cap-and-trade program, but emissions allowances from Norway's program were not recognized as eligible for compliance in the EU ETS. However, Norway's unilateral link to the EU ETS did not result in extensive use of EU allowances because of an oversupply of Norwegian allowances (Mehling et al. 2009). Similarly, RGGI's initial memorandum of understanding (MOU) allowed for a unilateral link to EU ETS allowance markets conditional on the triggering of a price ceiling for RGGI allowances, but prices have never reached this ceiling, so the option has never been used. Looking forward, Australia's Carbon Pricing Mechanism (ACPR) is slated to unilaterally recognize allowances from the EU ETS from July 2015 to July 2018, after which it is anticipated that the relationship will become bilateral and trade may occur both ways.

Unilateral Linking through Emissions Offsets

Unilateral linking between a cap-and-trade program and offset credit market is a common practice. The main intent of these links is to reduce compliance costs.

Although the Kyoto Protocol established two offset credit programs, the Clean Development Mechanism (CDM) and Joint Implementation (JI), only CDM offset credits have been used extensively. The CDM allows firms (or administrators) in developed countries to offset their emissions reduction obligations under the Kyoto Protocol by subsidizing projects that reduce emissions in developing countries; it offers each developed country the option to unilaterally link to an offset credit market. Firms participating in the European Union's Emissions Trading System (EU ETS) almost entirely drive the demand of CDM offset credits (Kossoy and Guigon 2012). To date, over one billion of these offset credits, each representing a ton of CO_2-equivalent reductions, have been issued.

The Regional Greenhouse Gas Initiative (RGGI), which comprises nine participating northeastern states, allows for the use of domestic offset credits from certain project types. However, low allowance prices have stifled the demand for domestic offset credits. The program review completed in 2013 changes the rules for offset use and proposes the adoption of a forest offset based on California's protocol. Firms regulated by California's new cap-and-trade program are expected to use offset credits to partially meet the program's first compliance requirements in 2014. Internationally, Australia's Carbon Pricing Mechanism (ACPR)—initiated in 2012—and New Zealand's Emissions Trading Scheme (NZ ETS)—initiated in 2010—allow for unilateral links to offset credit markets. The NZ ETS recognizes all Kyoto Protocol offsets as eligible for compliance, including certified emissions reductions (CERs) from the CDM, emissions reduction units (ERUs) from JI, and removal units (RMUs) for carbon sequestration. The ACPR recognizes certain domestic offset credits—Australia Carbon Credit Units—from the Carbon Farming Initiative as eligible for compliance. Starting in 2015, the ACPR will recognize CERs and ERUs. Given the recent development of these unilateral links, it is unclear whether regulated firms will use them extensively.

Bilateral Linking

Bilateral (formal) linking occurs when two trading programs mutually recognize their allowances as eligible for compliance. Under bilateral linking, political decisions in both programs such as the ambition of emissions reductions along with economic circumstances will influence the flow of allowances between programs and determine which program is a net buyer or seller of allowances. Similar to unilateral linking, but now in a bilateral manner, the previously existing links of each jurisdiction are propagated to the other partner indirectly (Mehling et al. 2009). For example, if one program has a unilateral link to an offset market, that access is indirectly expanded to any other program it links with (Olmstead and Stavins 2012). This automatic propagation has led many authors to call for alignment of policy designs before a bilateral link is established to avoid unanticipated administrative, political, economic, or environmental ramifications. The proposal we introduce of "linking by degrees" embodies the advice that regulators identify the ramifications of linking their cap-and-trade programs, and where negotiations identify it is important to do so, they align their programs prior to linking or identify policy mechanisms that can allow each program to influence the outcome.

A bilateral link can be established in a binding *bilateral agreement*, or through *reciprocal unilateral linking*. The former results from one overarching legal agreement that establishes mutual recognition of allowances, while the latter results from individual legislation in each programs' jurisdiction recognizing allowances from all other programs (Mehling et al. 2009). Both paths can lead to price convergence in the compliance instrument but they embody somewhat different degrees of joint management and decision making and have different political and economic risks. Reciprocal unilateral links are more flexible and perhaps more easily undone by administrators in either program. Nonetheless, any type of bilateral linking broadens the universe of parties affected by the design of program elements and may appear to make it harder to change program rules. This may be viewed as a loss of flexibility from the perspective of a program administrator and the regulated entities, but it also provides some insulation against capture by special interests within each jurisdiction or program. The distinction between binding bilateral linking and reciprocal unilateral linking offers a trade-off between long-term certainty and short-run flexibility, but any type of bilateral linking represents a commitment to what is hopefully an enduring relationship.

The RGGI program grew out of a long-term cooperative relationship among the northeast states including research and regulatory negotiations that addressed conventional air pollutants. That relationship formed a foundation for a common approach to climate policy that was built through reciprocal unilateral links formed under its memorandum of understanding (MOU) signed by the participating states. In signing the MOU each participating state agreed that its cap-and-trade program would recognize allowances from all other participating states' programs.[4] Under the MOU, each participating state committed to proposing for regulatory or legislative approval the cap-and-trade program outlined in the MOU. The integrity of the entire system is secured by the enactment of laws or regulations within each state, wherein each recognizes allowances from every other state, although the states retain the flexibility to act unilaterally without the threat of sanctioned countermeasures. Currently, regulators in California and Quebec

[4] See Regional Greenhouse Gas Initiative, Program Design, http://www.rggi.org/design.

are also following a reciprocal unilateral approach as they work toward a bilateral link of their cap-and-trade programs.

Programs operating under a reciprocal unilateral link have all the various opportunities that are available under a single unilateral link that allow regulators to adjust allowance flows and manage prices (ceasing recognition of allowances, restricting registry access, instituting import and export quotas, applying fees and discount rates, as may be relevant). In addition, a reciprocal unilateral link introduces the possibility of a mutually negotiated exchange rate that might require more than one allowance from another program for every ton of emissions.

Linking by Degrees

Joining cap-and-trade programs to allow the exchange of emissions allowances and offsets has been the focus of most thinking about linking. However, we propose that regulators can capture a significant share of the benefits of linking prior to actually enabling the flow of emissions allowances or offsets between jurisdictions (Zyla 2010).

Linking by degrees refers to the practice of incrementally aligning key program elements of cap-and-trade programs prior to the potential introduction of formal linking enabling the exchange of allowances or offsets. An emphasis on linking by degrees is motivated by two observations. First, policymakers at the state and provincial level require a careful evaluation of the economic impact of formally linking their own regulations with those in other jurisdictions before it can occur. Incremental alignment provides a process through which the implication of differing program designs can be anticipated and addressed. Linkage by degrees allows regulators to celebrate the alignment of each key program element, which may help build support for the policies. Second, many of the benefits of linkage can be captured without introducing allowance trading between jurisdictions. For example, competitiveness and leakage concerns might be ameliorated via an independent and parallel program that introduced a price on emissions either through cap and trade, a tax or some types of regulations. This paper explains the concrete, incremental steps that jurisdictions can follow to link by degrees and describes how this process (1) is useful even if formal linking does not occur and (2) reduces the chance for unanticipated outcomes from formal if it is ultimately does occur.

An example of linking by degrees is illustrated in Table 1 for the program element *Scope and Timing of Coverage*. The table shows a transition from no communication between programs toward alignment across markets. Several interim steps can be taken that provide tangible benefits while generating momentum for fuller cooperation. In the next section, we describe 10 program elements that can be aligned through incremental concrete steps.

Table 1. Illustration of Linking by Degrees for One Program Element

Fragmented Markets → Fully Integrated Market

Element	A	B	C	D	E
Scope and Timing of Coverage	No communication	Discussion on leakage, measurement of emissions from imports	Rules defining covered entity thresholds, compliance periods aligned	Rules defining interim compliance obligations aligned	Covered sectors, regulation of imports aligned

III. Aligning Programs

The concepts of unilateral, reciprocal unilateral and binding bilateral agreements illustrate that linking cap-and-trade programs can take a variety of forms. Nonetheless, many authors have pointed to significant obstacles in moving from the current state of unrelated domestic cap-and-trade programs to a broader cap-and-trade architecture that enables trading across jurisdictions. We present a strategy of incremental program alignment that is intended to help overcome these obstacles but, equally important, has independent justification. Incremental alignment promises to contribute to good administration of existing trading programs and to signal the intent of future cooperation, which can be important in reinforcing program ambitions and in the development of greenhouse gas rules under the Clean Air Act.

This section decomposes cap-and-trade markets into ten program elements which are listed in the first column of Table 2. We evaluate the elements along three criteria. One is to identify elements that provide the administratively easiest opportunities to incrementally align programs.

A second criterion is to identify the elements that are important to be aligned so that a functioning, formally linked market will be established. We describe a function market as one where allowances can be successfully traded without concern over the environmental integrity of trades—that a “ton is a ton”. The alignments required for a functioning market should be considered the *de minimis* amount of alignment that must occur before formal linking. However, further alignment might also be important because if rules in the separate markets varied widely, then it could raise the perceived risk about the stability of the relationship and undermine the confidence of investors.

Even if the linked market may function effectively, program elements that are not aligned could have important distributional or environmental consequences or generally contradict the founding principles of one of the constituent programs. The third criterion we apply to each program element is whether it is important to align for political economy reasons. Again, we base this determination on our own idiosyncratic experience.

These criteria are considered within the context of the California and RGGI programs. The table format does not imply that the steps toward aligning these programs should be sequential; progress along one row may advance at a different pace than progress along another row. The evaluation we provide is admittedly impressionistic, but informed by the idiosyncratic experience of the authors in observing the development of the programs. In some cases elaboration of specific issues identified in the table requires further research.

In a later section, we evaluate the alignment status of the California and RGGI programs. If a program element is not important for market functioning or for political economy reasons, or if it is already aligned, then we conclude that the programs are ready to link with respect to that element. However, if an element is important but not already aligned between these programs, then we conclude that it should earn the attention of regulators for efforts to further align the program. Program alignment also has administrative and policy benefits. Although some of the most immediate opportunities might not be the most important in the long run, they might be relatively easy to achieve and would contribute to the momentum of inter-program cooperation.

Table 2. Evaluation of Program Elements for Alignment of Programs

				Comparing California and RGGI	
	Difficulty to Align?	Important for Functioning of Markets?	Important for Political Economy?	Already Aligned	Ready to Link?
Technical Issues					
1. Measurement, Reporting, and Verification					
a. Measurement methods	Easy	Yes	Yes	Yes	Yes
b. Reporting of process emissions	Medium	No	Maybe	Yes*	Yes
c. Reporting of emissions from imported power	Medium	No	Yes	No	Maybe
2. Allowance Tracking System					
a. Registries (serial number systems)	Easy	Yes	Yes	Yes	Yes
b. Identification of compliance instruments (type, origin)	Easy	No	Yes	Yes	Yes
c. Data collection on transactions	Medium	No	Maybe	Yes	Yes
d. Public access to data	Easy	Maybe	Yes	Yes	Yes
Emissions Reduction Goal					
3. Emissions Cap					
a. Are caps absolute or intensity based?	Medium	Maybe	Yes	Yes	Yes
b. Coordination of stringency (marginal costs, other metrics)	Hard	Maybe	Maybe	No	No

	Difficulty to Align?	Important for Functioning of Markets?	Important for Political Economy?	Comparing California and RGGI: Already Aligned	Comparing California and RGGI: Ready to Link?
c. Accounting for associated programs (RPS, efficiency, etc.) in baseline	Medium	Maybe	Maybe	No	Maybe
d. Aggregate goal across programs	Hard	No	Maybe	No	Yes
4. Scope and Timing of Coverage					
a. Covered sectors	Hard	No	Maybe	No	Yes
b. Point of regulation	Easy	Maybe	Maybe	Yes	Yes
c. Thresholds for compliance	Easy	No	Maybe	No	Yes
d. Are process/import emissions covered?	Hard	No	Maybe	No	Yes
e. Compliance periods	Easy	No	No	No	Yes
f. Interim obligations to surrender allowances	Easy	Maybe	Maybe	No	Yes
Allocation of Emissions Allowances					
5. Allocation					
a. Method of allocation	Hard	Maybe	Yes	Yes*	Yes
b. Treatment of entrants and exits	Easy	No	Maybe	Yes*	Yes
c. Measures to address leakage	Hard	No	Maybe	No	Yes
d. Use of revenue from auctions	Hard	No	Maybe	No	Yes
6. Auction Coordination					
a. Third-party participation	Medium	No	Maybe	Yes	Yes

	Difficulty to Align?	Important for Functioning of Markets?	Important for Political Economy?	Comparing California and RGGI: Already Aligned	Comparing California and RGGI: Ready to Link?
(noncompliance entities)					
b. Purchase limit	Medium	No	Maybe	No	Yes
c. Public reporting of auction results	Easy	No	Yes	Yes	Yes
d. Auction format (i.e., sealed bid)	Easy	No	No	Yes	Yes
e. Frequency and timing	Easy	No	No	Yes	Yes
f. Common auction platform	Medium	No	No	No	Yes
Cost Management					
7. Banking (borrowing)					
a. Banking provisions	Medium	No	Yes	No	Yes
b. Quantitative restrictions (holding limits)	Medium	No	Maybe	No	Yes
c. Qualitative restrictions (Is value preserved across periods?)	Medium	Maybe	Maybe	No	Yes
8. Offsets					
a. Qualitative limits (types allowed)	Medium	No	Yes	Partly	Maybe
b. Certification protocols	Medium	Maybe	Yes	Partly	Maybe
c. Quantitative limits	Medium	No	Yes	No	Probably
d. Ex post invalidation rules	Medium	Maybe	Yes	No	Maybe
e. Liability (buyer or seller)	Medium	No	Yes	No	Maybe

	Difficulty to Align?	Important for Functioning of Markets?	Important for Political Economy?	Comparing California and RGGI: Already Aligned	Comparing California and RGGI: Ready to Link?
9. Price Collars					
a. Price floor and rate of change	Hard	Maybe	Maybe	No	Maybe
b. Price ceiling and rate of change	Hard	Maybe	Maybe	No	Maybe
c. Implementation (e.g., use of unsold allowances, sale from the reserve)	Medium	Maybe	No	No	Yes
d. Do additional allowances come from inside or outside the cap?	Hard	Yes	Yes	No	No
Enforcement and Contingencies					
10. Legal Contingencies					
a. Penalties for noncompliance	Easy	Yes	Yes	Sufficiently	Yes
b. Market oversight	Easy	Yes	Yes	Sufficiently	Yes
c. Maintaining compatibility; provisions for amending program	Hard	Maybe	Maybe	No	Probably
d. Provisions for delinking	Medium	Maybe	Yes	Yes	Yes

* Policies are aligned in the electricity sectors.

Technical Issues

The first two elements in Table 2 involve technical issues that primarily require expertise of staff. Alignment of one of these issues may be important to the functioning of a linked market, but fortunately most can be addressed administratively and are not politically contentious (Zyla 2010). Therefore, we recommend alignment of some of these elements before a link is formed.

Measurement, Reporting, and Verification

Measurement, reporting, and verification (MRV) of carbon emissions is a core element in developing an allowance market. In this domain, the easiest activity for administrators to align is the development of consistent methodologies for measuring emissions and other variables, and it may be the most important if a common, functional and politically acceptable allowance market is to take shape. In contrast, accounting for emissions from imported power may be relatively difficult to align. One technical reason this may be difficult is that control areas in the electricity system may not be congruent with the geographic borders of the trading program. On the other hand, consistent accounting of emissions from imported power is not crucial to enable trading between programs if parties accept that some leakage of emissions may occur.

Allowance Tracking System

The transparency and consistency of registries that record allowance data are essential features that need to be aligned before a functional market can be developed and trading can occur. The format of the serial number for compliance instruments can seem benign and administrative, but it carries significance because it can provide the ability to discriminate among specific types of compliance instruments. In Europe, the trading program was shaken by a stolen allowance event that disrupted the market and halted trading. As a security measure, the EU ETS is planning to adjust the serial number format so that the unique serial number associated with the allowance will no longer be visible to buyers and sellers. On the other hand, market participants may need to know important distinguishing characteristics of compliance instruments, for example to distinguish different types of offsets if they carry different risks of default. Participants might also have a reason to identify the originating jurisdiction, for instance because liability rules may differ. For example, in California offsets may sell at a lower price than those issued by other potential linking partners such as RGGI or Quebec because of buyer liability provisions in California - where if they are invalidated the buyer of the offset is held liable and is responsible for replacing the offsets. Useful guidance would seem to be that alignment involves comparable administrative designs even if separate administrative systems are maintained.

One feature of the allowance tracking system that is important to align if trading across markets is to occur is the extent of public access to data. If jurisdictions have different rules about public access to data, then the privacy concerns motivating the policy in the more restrictive jurisdiction may be undermined by the less restrictive policy in the other. Alternatively, a firm seeking to conceal strategic information associated with its trading activity may be reluctant to exchange allowances with firms in the less restrictive jurisdiction, which would limit market liquidity and potential cost savings.

To conclude, technical issues surrounding program implementation have significant policy ramifications. The perspective that implementation is purely administrative and less politically contentious can be leveraged to bring stakeholders from prospective linking partners into a conversation that improves communication and builds capacity among the regulators and stakeholders. This conversation is a preliminary step toward solving other, more politically contentious issues. As with other program elements, however, fully aligning the technical implementation processes is no small feat and does require navigating various legal and technical hurdles.[5] As such, steps toward alignment should be viewed on a continuum from less complex to more complex legal and policy issues.

Emissions Reduction Goal

Identification of the emissions reduction goals for each program addresses the central motivation of the environmental benefit from the program. However, the related issue of cost makes it one of the most difficult elements to align.

Emissions Cap

How the emissions caps are initially determined (that is, whether the methodology is based on absolute emissions or emissions intensity) may be difficult to align but it may be relatively unimportant after the level of the cap (defined as emissions) is established. However, it is both difficult and important to consider how the cap will evolve over time. Moreover, if one of the programs that would be linked has a pre-determined cap for a future year and the other

[5] The California Air Resources Board’s Initial Statement of Reasons (May 9, 2012) describes why and what technical and legal changes were made in drafting its regulatory amendments for linkage.

program has a cap that is based on an intensity target, then there may be incentives affecting the behavior of firms in the market, with efficiency and environmental consequences (Marschinski 2008).

One reason that coordination with respect to stringency may be difficult stems from the difficulty of defining stringency. It might be thought of as the number of allowed emissions or the required emissions reductions; however, because the size and nature of economies differ, the number of emissions by itself is not very telling. For example, in the Western Climate Initiative negotiations the targets in various states and provinces would have been very different. An alternative and arguably better method for evaluating stringency is to think about industry responses to different cap levels. Under a given cap, how much investment is required? What is the total resource cost associated with achieving an emissions reduction target? These questions were implicit in the dialogues that led to the formation of the RGGI program.

From an efficiency perspective, the level of stringency might be defined as the marginal cost of emissions reductions. A tool that provides insights on this cost-based measure of stringency is the market's marginal abatement cost curve, which can be estimated using observational data from the two separate allowance markets. The familiar observation in the economics literature is that allowances and emissions would flow from the less stringent program (with lower marginal cost) to the more stringent program, and prices would be equalized between the two (Zetterberg 2012).

If trading across jurisdictions is desired but different levels of marginal cost are politically necessary, an incremental step could involve an exchange ratio. For example, suppose Market A allowances currently sell at $18 per metric ton and Market B allowances sell at $6, and full linkage between the markets would lead to a price of $12 in each. Suppose that this price of compliance is not politically acceptable for either jurisdiction. Markets A and B could directly link without changing their anticipated relative marginal costs with a program design that required covered entities in Market A to surrender three allowances for every metric ton of emissions, but entities in Market B would surrender only one allowance. We examine this type of linking in the modeling section of this paper.

Another crucial element is the broader policy setting in which carbon markets are situated. For example, in the electricity sector, the incentives for investment and the distribution of costs among electricity suppliers and consumers will be influenced by the market regulatory structure in the jurisdiction. In fact, if two jurisdictions with different regulatory structures were to link their cap-and-trade programs, the producers and consumers in one could be advantaged or disadvantaged simply because of the regulatory structure in the other. These differences are not likely to be reconciled in order to enable linking of carbon markets, but recognition of their relevance is important.

In addition, the presence of associated energy and/or climate change policies impacts the marginal abatement opportunities that are available. For example, a renewable portfolio standard (RPS) in one program may mandate investments that are not mandated in the other program. Similar effects result from other policies, such as limits on coal emissions rates, incentives for nuclear power or energy efficiency standards, demand response programs, and low-carbon fuel standards. Consider specifically the impact of an RPS on the market for emissions allowances. The RPS is intended to bring into service non-emitting sources that otherwise would not be selected by the electricity market. Emissions are likely to be lower than they would be in the absence of the RPS. If some of those investments would not have occurred otherwise, the marginal cost to achieve emissions reductions in the cap-and-trade program is likely to be lower.

Alignment of ancillary policies can start with technical discussions of how and what associated policies are included in the emissions and compliance instrument price forecasting methodology. A next step involves an examination of the results and sensitivities of emissions forecasts and forecast compliance costs with the goal of understanding the relationship between other policies and the predicted emissions and compliance costs.

The value of considering other policies highlights our guidance that the activities listed in Table 2 are not sequential. For example, elements such as market design, emissions cap stringencies, or relative sector coverage may be politically contentious. Taking a step back to examine how related energy policies impact the emissions intensities of the respective energy portfolios and the resulting compliance cost may enable the linking partners to have a more constructive discussion about the cost of compliance and other program design questions.

The interests of different constituencies within a jurisdiction with respect to stringency of the cap and the effect of linking are likely to diverge. Whether a constituency would prefer higher costs is dependent on the details of the allocation and program design. For example, consumers in a market that exports allowances may support increased stringency if they are recipients of allowance revenue. We explore this issue further in the modeling section of this paper.

In summary, linkage can create contrasting incentives depending on the specific market and its relationship with its linking partner. Given this, rather than focus on aligning relative stringency, a key initial step might be to focus instead on aligning the methodology for setting the cap and other policies related to determination of the cap. In this way, the discussion can focus on more technical elements, such as reporting and monitoring, methods for forecasting projected business-as-usual emissions across different industries, and methods and considerations in emissions cap setting to reflect respective political and economic preferences. Starting from this technical approach to alignment can build expertise and consensus, paving the way to a consensus-based approach to emissions cap setting.

Scope and Timing of Coverage

One of the most basic features of any regulatory program is the identification of the parties that will have responsibility for compliance. Sector coverage describes the portion of the economy that is regulated and the point of regulation identifies the entity with a compliance obligation. For example, under the sulfur dioxide trading program in the United States it is power plant operators who have the responsibility for compliance, but it might make sense in some cases to locate the point of compliance elsewhere in the fuel cycle, such as at the mine mouth or wellhead, if administrative costs would be lower and the emissions can be reliably predicted from the use of fuel.

Ultimately, most of the impacts of a cap-and-trade program will be borne at the household level (Stavins 2007).[6] Consequently, the point of regulation may be relatively unimportant in terms of any need to align prior to linking (Sterk and Kruger 2009), as indicated in Table 2. Nonetheless, this element of program design has implications for the ability to align program-related activities other than the trading of emissions allowances and for transparency in comparing the performance of programs. The point of regulation also affects which stakeholders are engaged in policy discussions. In addition, this program design element is a key factor influencing other elements, such as enforcement provisions, allowance allocation, leakage potential, and demonstration of compliance. Alignment of these elements can reduce administrative costs and promote learning across programs, but seemingly this would have to occur before a program is in operation. As such, we find sector coverage and point of regulation to be useful program design elements in discussions of linkage, even if they are not essential for exchanging allowances across programs.

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[6] Exceptions to this general rule can occur when allowances are allocated for free to electricity generators in regions with regulated electricity markets. In those cases, the opportunity costs of allowances are not passed on to consumers. Approaches to allocation of allowances are discussed in the next section.

The scope of the regulation also includes thresholds for coverage in the compliance program. California has a threshold based on emissions, while RGGI uses megawatts (MW) of installed capacity as the unit of measurement. The distinction might not effectively lead to different populations of sources being covered under the regulation, so alignment may not be a challenge but also may not be necessary.

California requires an annual compliance obligation of 30 percent of the prior year's emissions obligation each November. In the November following the final year in a compliance period, compliance must be demonstrated for the entire compliance period when true-up occurs. In RGGI, no comparable annual surrender requirement exists; rather, compliance must be demonstrated by March 1 following a multiyear control period. Clearly both the California and RGGI program designs recognize a value in using a multiyear compliance period and place the bulk of the compliance obligation after the full compliance period. The administrative value of streamlining the compliance timing and the relatively narrow difference in policy design in this area may open the door for California and RGGI regulators to meet halfway with respect to compliance surrender deadlines.

By way of example, the incremental alignment of program scope and timing can range from communication among linking partners about sector coverage and alternative points of regulation and the implications thereof to complete harmonization. Along that continuum, a middle point could include the determination of common annual emissions thresholds by source to use in identifying the population of covered entities. The timing of compliance periods is another opportunity for alignment.

Allocation of Emissions Allowances

An important element of market design that is not commonly discussed in the literature on linking is the initial distribution of allowances, that is, the question of "allocation."

Allocation

The value of emissions allowances can be initially distributed in several ways. Allowances might be purchased at a fixed price by a set of covered entities, auctioned, distributed for free to regulated entities based on historical emissions or a forecast of future emissions, or distributed on the basis of output using an emissions rate benchmark. Although most of the program costs will flow through to the consumers regardless of the program's allocation design, allocation plays a key role in determining which parties benefit from revenue generated from the issuance of allowances. In turn, this feature informs which parties and sectors will look to pursue or oppose linkage plans because linkage may change the price of allowances. Parties that receive the value of emissions allowances have a vested interest in supporting linkage with a market with higher allowance prices because the linkage is likely to increase the flow or value to these parties, and in contrast, they have a disincentive to support linkage with a market with lower abatement costs. We explore these incentives in our illustrative modeling of linked programs.

Although the emissions caps may be established in advance of linking, the relative ex post stringency of two programs can be affected by the approach of each to allocation. For example, a common form of allocation used in the industrial sectors in the EU and California is based on economic output (economic production) of the regulated sector, where an emissions rate benchmark (e.g., tons CO_2/tons of product) multiplied by output (tons of product) is applied to calculate the allocation to the firms. The share of the total allocation will be updated according to the change in output of the regulated firm at the end of the eight-year compliance period in the EU and more often in California. Output-based allocation with updating provides an incentive to increase production in order to earn a larger allocation in the future. Updating can be a useful strategy to mitigate the leakage of economic activity and emissions, because the allocation serves as a subsidy to output, but only as long as output is maintained inside the regulated jurisdiction.

However, an ancillary effect of output-based allocation is that it suppresses the change in the price of final goods and services in the economy, which may be relevance from a competitiveness perspective. This effect also leads to more consumption of the good or service and thereby drives up the market price of emissions allowances. Hence, if a program with this type of allocation is linked with another using a different approach to allocation, one might expect to see allowances and emissions flow to the program using output-based allocation even if the two programs are in every other way identical. Understanding and measuring the effects of allocation on distributional outcomes and leakage are important to any cap-and-trade program, and they are especially important if two programs are to be linked. However, alignment of this element may be difficult.

Other aspects of allocation indicated in Table 2 may be less important to the performance of linking. Treatment of entrants and exits is relevant where some portion of allowances is given away for free, and it should be relatively easy to align. However, it is noteworthy that is one practice that states often do differently in their criteria pollutant trading programs. Measures to address the leakage of emissions to outside the regulated jurisdictions may be diverse and hard to align. Our modeling illustrates that the amount of leakage can be affected by linking, but it would not seem to disrupt the functioning of the markets. The use of revenues from an auction can be important because it can act like other associated policies. For example, if a jurisdiction directs revenue to support investments in energy efficiency, that would be expected to reduce emissions and allowance prices in that jurisdiction.

Auction Coordination

Auction design is an element where alignment may be relatively easy to attain. However, some issues, such as the participation by noncompliance entities or purchase limits in the auction, raise political issues that may be difficult to resolve. Neither of these features is expected to play an important role in the performance of a linked market. However, policies in the more lenient jurisdiction could be expected to propagate in the linked market. For example, a noncompliance entity wishing to enter the market could participate in an auction in the jurisdiction that allows it to do so.

The introduction of a common auction is unlikely to precede direct linking of the programs, but two programs might use the same auction process, computer algorithm and bidder evaluation process before actually linking. The adoption of a common auction may be achieved at the time that trading between programs begins or may be added subsequently.

Cost Management

This category includes three program elements that are designed to control the range of allowance prices, including their level and volatility.

Banking

Banking is a common feature that is expected to rationalize investment decisions for firms and lower overall compliance costs. Banking provisions are typically central to the program design and hence may be relatively difficult to align if a change in the provisions is necessary. Quantitative restrictions such as holding limits constrain the size of the bank, and qualitative restrictions address whether the value of banked allowances is preserved across compliance periods or decays over time. If these elements are not aligned, it will affect strategic decisions about what allowances to hold in one’s portfolio. For example, if one jurisdiction has a restriction on banking, then compliance entities in both jurisdictions will substitute for allowances from the other jurisdiction in their banks, and the intent of the limiting jurisdiction may be undermined. However, unaligned banking policies may have relatively little effect on overall performance of the market.

Offsets

Several authors cite harmonization of offset credit rules and protocols as a critical element that must be aligned before linking (Sterk et al. 2009; Tuerk et al. 2009; Tuerk et al. 2009; Flachsland et al. 2009b). This criterion might not be essential, but it would seem important that the programs have comparable stringency even if they restrict eligible offsets according to specific sectors or geography. Suppose Market A accepts offset credits only from forestry projects, whereas Market B accepts offset credits from both forestry and ozone depleting substances (ODS). A degree of linkage occurs when Market B participants purchase forestry credits supplied by Market A. Alternatively, Markets A and B could indirectly link via accessing supply from a third market, Market C, which supplies both forestry and ODS offsets. In these cases, multiple compliance instruments emerge; that is, each product has unique characteristics and price because each has its unique profile of risk of potential outcomes, such as ex post invalidation. The implementation process can support distinct products and the exclusion or inclusion of different types of offsets for compliance in a given program. For example, unique serial numbers for compliance instruments can include an identifier that indicates the type of offset, project location, and so on. In this way, Markets A and B can retain their preference to include or exclude specific types of offsets.

Some authors (Sterk et al. 2009; Zetterberg 2012) have pointed to another issue regarding the "freeing up" of domestic allowances that occurs with linked markets with un-aligned offset protocols. Suppose Markets A and B are directly and bilaterally linked via acceptance of Market B allowances for Market A compliance and vice versa. Also suppose Market A accepts offset credits for compliance but Market B does not. Covered entities in Market A may go to the market to purchase offset credits for compliance, "freeing up" allowances they otherwise would have purchased in the linked Markets A and B allowance market. Essentially, the un-aligned rules regarding usage of offset credits lead to an injection of supply, conflicting with objectives and priorities that led Market B to exclude offset usage from its domestic program design. We previously identified several examples where policies in one program would propagate into the other if the programs were not aligned, but in most cases we do not anticipate that this phenomenon would disrupt the market. It would be likely to have a small effect on price and investment decisions. However, because offsets may constitute an important share of the market and their quality may vary significantly, we identify alignment of offset rules to be crucially important in affecting the performance of a linked market.

If alignment of offset rules and protocols seems unattainable, a more rudimentary approach such as quantitative usage limits on certain types of compliance instruments might be applied. For example, Market A could set a quantitative limit on Market B allowances or approved offsets that would be eligible for Market A, such as a certain percentage of an entity's annual compliance obligation. Similarly, Markets A and B could set limits on usage of Market C compliance instruments. The value (price) of an environmental commodity embeds the ability and degree to which regulated entities can use the commodity for compliance. As such, quantitative limits on usage of offset credits for compliance will impact their market value.

Price Collars

Perhaps the most discussed element in the academic literature about linking programs is the presence of a price floor or cap or other cost-containment measures (Stavins 2007; Sterk et al. 2009; Tuerk et al. 2009). The key consideration is that the cost-containment measures in one market will be propagated to the other market. For example, if one program automatically restricts the supply of allowances if their auction price falls below a price floor, the supply of allowances and the market price in a linked program would be affected as well. Related features such as the escalation factors for associated price floor or price cap also will be exported, and these market design features will impact market dynamics in any linked partner.

The manner in which a price floor would be implemented involves a decision about what to do with unsold allowances. For example, they may be carried over to be available for sale in a future auction, they may be added to a reserve that would be sold at the price ceiling, or they may be retired. However, whenever a floor has been implemented previously it has always been linked to a reserve price in an auction.

However, implementation of a price ceiling can vary more widely. Different features of price collars are difficult to align because they reflect the politically acceptable objectives and priorities of the domestic program and regulatory institution. They also reflect characteristics of the regulatory setting, such as the propensity for leakage of economic activity or emissions. However, an explicit dialogue and fact finding between programs can contribute to the identification of best practice that could be beneficial for both programs. In addition, as we have argued elsewhere in this paper, this dialogue would contribute to transparency and comparability of the distinct programs that may be important for a variety of reasons, including ultimate compliance by state programs with federal regulations under the Clean Air Act.

Enforcement and Contingencies

The final design element in Table 2 describes aspects of governance, including provisions for enforcement, amending the program, or delinking.

Enforcement and Legal Contingencies

Certainty of enforcement for noncompliance usually involving penalties plus surrender of allowances has been widely recognized to be an important aspect of the success of cap-and-trade programs, compared with many other environmental regulations where noncompliance triggers legal proceedings and regulatory negotiations. Certain enforcement lowers administrative costs and boosts the confidence of environmental advocates in the performance of the program. When in place, in fact, it has led to very high levels of compliance. It should be administratively easy to align these enforcement regulations. Enforcement provisions do not have to be identical, but they do need to be similarly rigorous.

Another important issue is market oversight, including reviewing auction outcomes and market activity for strategic influences on prices. It also is important that the registries be immune to manipulation, and it is important that there is mutual confidence of this.

The appearance of shared governance may convey legal consistency, which can play a key role in establishing confidence with respect to the permanence of a link between programs. Nonetheless, programs may desire to change their rules and potentially may want to delink in the future. A central concern about potential delinking is how market participants would be compensated for taking inventory positions in products that are subsequently revalued by changes in regulations. All purchase decisions involve a risk assessment of the commodity, and while risk assessment for compliance instruments in a cap-and-trade market can be likened to purchase of other regulated commodities, a high degree of regulatory uncertainty regarding this new commodity can stifle the market, preventing the realization of the expected economic benefits of linkage. Incremental alignment as we have described it may help build confidence in the decision to link and help ensure market participants of the long-term stability of a set of compliance instruments because it reduces the prospect of unanticipated difficulties in the linked market.

We note some other precautions around governance and linking. First, announcing a time frame for linkage will have a market impact. For example, a commitment to linking over a specified compliance period will lead market participants to take inventory and financial positions consistent with that compliance period. Second, the issue of potential delinking is likely to surface. In the summer of 2012, some stakeholders encouraged the California Air Resources Board to ensure the permanence of an allowance from a linked jurisdiction and establish that it would still be eligible for compliance even if delinking were to occur, or to state explicitly in the regulation what would occur with delinking. The regulators countered that if delinking were contemplated, a new regulatory proceeding would begin to delineate the steps to delink.

IV. Comparing California and RGGI for Readiness to Formally Link Programs

Evaluating the readiness of California and RGGI to formally link their programs is made somewhat easier because the RGGI program is limited to the electricity sector, and many features of both programs are similar in this sector. We base an evaluation of the readiness for linking on two tests. One is whether the program elements are already aligned, which is indicated in column 4 of Table 2. Second, we ask whether alignment of a given element is important for the functioning of the new enlarged market (column 2) or for political reasons stemming from economic or environmental preferences (column 3). If an element is important for the first reason, then alignment is a prerequisite and necessary for a functioning market to emerge that combines both programs. If an element is important for the second reason, however, alignment is not a prerequisite for a functioning market but is prudent to avoid politically undesirable outcomes from linking, which could prevent linking from moving forward. Thus, if an element is important for either reason, alignment may be necessary before the programs are ready to link formally (column 5).

Other elements may be relatively unimportant, so they are not a barrier to formal linking but nonetheless may be relatively easy to align and thus should also be prioritized. Aligning these elements brings benefits we have previously described: improving administration, building the momentum of cooperation, and influencing the development of policy at the national level.

The discussion below focuses on those elements that should be a priority for efforts to align the programs. We identify four priorities. Finally, we identify additional priorities that are of less importance but nonetheless are opportunities that should be easy targets and would contribute to the momentum of cooperation.

Comparability of the Emissions Cap

A technical issue distinguishing the programs is that RGGI currently works in short tons while California works in metric tons. This distinction is not a barrier to linking the markets but it implies that, unless one of the programs changes its unit of measurement, linking will require an exchange rate between the programs to achieve equivalent tons.

The main determinant of the stringency of the program and of allowance prices is the choice of how many allowances to issue (the cap). While a large difference in stringency between programs does not provide a technical barrier to linking or to the functioning of a market, it might pose a political barrier. Linking cap-and-trade programs with widely varying allowance prices offers an opportunity for high gains of trade given current RGGI allowance prices (near $3 per ton) and California allowance prices (about $14 per ton). This indicates large potential gains in the efficiency of overall emissions reductions. However, linking also implies potential flows of allowances between regions. Generally, the region with lower stringency is expected to export allowances (and import wealth) from the region with higher stringency. This is a political and economic challenge but not a technical one. Nonetheless, the choice of stringency in a linked market must be balanced against the distributional outcome.

One solution for regulators sensitive to wealth transfers would be the implementation of an exchange rate in order to control allowance flows. As described above, an exchange rate mandates that one allowance currency is worth more or less than another. For example, an exchange rate might specify that two RGGI allowances are equivalent to one California allowance—meaning a California entity could retire one California allowance or two RGGI allowances for one ton of emissions, and a RGGI entity could retire one California allowance or two RGGI allowances for two tons of emissions. A well-designed exchange rate allows a jurisdiction to tap into some benefits of linkage—including cost savings—while retaining the localized preferences for allowance prices, but at the expense of some efficiency improvements achieved by gains of trade.

As programs evolve, the political acceptability of compliance costs may change, enabling an adjustment in the exchange rate. This adjustment can be achieved by a mandated, periodic reevaluation of the exchange rates. Alternatively, this adjustment can be achieved through automatic adjustments of the exchange rate via a pre-specified adjustment schedule or indexed to an economic or environmental indicator.

Some of the consequences of linking markets with disparate stringency and the possible role of an exchange rate are illustrated in the modeling results in the next section. Other mechanisms to control allowance flows include import quotas and fees imposed on using allowances from other programs for compliance.

Offsets

If linked jurisdictions have different restrictions placed on the use or eligibility of offset credits, the price of offset credits will be communicated between jurisdictions through the linked allowance market. This is known as the “free-up effect” and is expected to occur if offset rules are not aligned across jurisdictions (Sterk et al. 2009, p. 396). The free-up effect results in rules in one jurisdiction unilaterally increasing the supply of compliance instruments in the linked market; for example, if one program allowed the use of a particular type of offset while the other program intended to preclude its use. Reasons to preclude its use might include preferences for a high carbon price or risk aversion to environmentally suspicious offset credits. These preferences are subverted if programs are not aligned, leading some authors to identify un-aligned offset rules as a key barrier to linking (Sterk et al. 2009; Tuerk et al. 2009; Flachsland et al. 2009a).

One partial remedy is available if offset credits are differentiable by origin. The discriminating program can impose import quotas, fees, or discount rates on these offsets. This would not solve the free-up effect, because the offsets would still be available in the other program, but it would ensure that they are not used for compliance in the discriminating program, which may help achieve political objectives.

Because the free-up effect cannot be completely mitigated, regulators should place a high priority on aligning policies about offsets. The development of common offset protocols is an opportunity to save administrative resources and take advantage of specialized expertise across the jurisdictions. Ideally, RGGI and California would adopt the same offset protocols.

Price Collars

Price collars provide a method of managing costs, which are determined primarily by the relative stringency (cap) of the individual programs. Different trigger prices for the floor and ceiling will influence allowance flows and prices and there also is a strong potential for differing floors to erode the environmentally integrity of the linked programs. If they are not aligned, linking could undermine the value of previous investments and thereby the confidence of investors going forward. Hence, the alignment of price floors and ceilings pose a technical requirement for the functioning of the market.

One element of price collars poses a political challenge, whether additional allowances that might be available at a price ceiling come from inside or outside the cap. In California, additional allowances come from under the cumulative cap through 2020. The RGGI program review recommends allowances come from outside the cap. From a design standpoint, some advocates in California are likely to feel that environmental integrity, in the form of emissions reductions, can be guaranteed only if allowances come from under the cap (Harrison 2006).

Legal Contingencies

Provisions for changing the program design or for delinking are difficult to align and potentially important. Within RGGI, each state retains the ability to leave the program, leading to a strong emphasis on finding consensus on policy decisions. This process within RGGI places it on a different decision making schedule than that of California. Consequently, if formal linking were to occur, future changes to the program might be made unilaterally and on inconsistent time schedules.

The California Air Resources Board staff anticipates that if delinking were to occur, it would trigger a program review, as would be likely in RGGI as well. As predictable as the triggering of a review might be, the outcome is not. This means compliance entities will recognize some risk associated with compliance instruments issued by the other jurisdiction. In particular, one is not likely to see banking of compliance instruments from the other jurisdiction. This failure to bank might imply a price difference in the market due to the different convenience yield that each instrument provides an investor, with some loss of market efficiency as a result.

The technical issues associated with potential delinking are not likely to be fatal to the market. For example, on the date the decision to delink is announced, holdings of allowances from outside a given program are noted and those allowances assigned legitimacy for compliance (possibly within a limited period) or sold to the originating program (Haites et al. 2009). Newell et al. (2012) suggest a for linking is a pegged currency system with separate currencies rather than a currency union. As long as linked trading systems maintain distinct units of account, which we interpret to include distinct registries, then they argue delinking should not be a problem.

Nonetheless, the political optic associated with potential delinking is important. The contingencies should be anticipated by each jurisdiction to provide reassurance to investors and legislatures.

Easy Targets

There are several opportunities for alignment of programs that may be relatively unimportant for market performance or political economy but are easy to achieve. These easy targets should be pursued because they offer administrative benefits and reinforce the process of cooperation across jurisdictions.

Allocation Rules for new Entrants and Exits

The rules for new entrants are not relevant for California and RGGI linking because both programs rely heavily on auctions in the electricity sector. These issues will remain irrelevant if and until the RGGI program expands to include other sectors. However, this makes it a relatively easy point for negotiation that could be discussed even in the absence of a commitment by RGGI as to how allowances would be distributed if additional sectors were added to the program.

Implementation of the Price Ceiling

The California program implements its price ceiling through a fixed-price sale six weeks after each auction. Unfortunately, this design introduces a rationing problem if the allowance reserve is oversubscribed, and it introduces an opportunity for strategic behavior in subscribing to the reserve. RGGI has not determined its policy at the time of this writing, but discussions have centered on a more elegant design that would involve a reserve price for the supplemental reserve set at the price ceiling, and the reserve would be available in the same auction as other allowances. Linking negotiations provide an opportunity to reconcile these rules.

Thresholds

California determines a minimum threshold for a compliance obligation based on emissions, but RGGI uses the size of installed capacity. This issue is not especially contentious and involves fewer stakeholders than the broader topic of sector coverage, so it serves as a more politically approachable element for alignment.

Compliance periods

California and RGGI have adopted the organizing principle of three-year compliance periods, but the timing is not aligned. Compliance periods could be aligned beginning in 2015. This would appear to be an obvious opportunity for incremental cooperation, even if linking of programs does not begin that year.

Interim Obligations

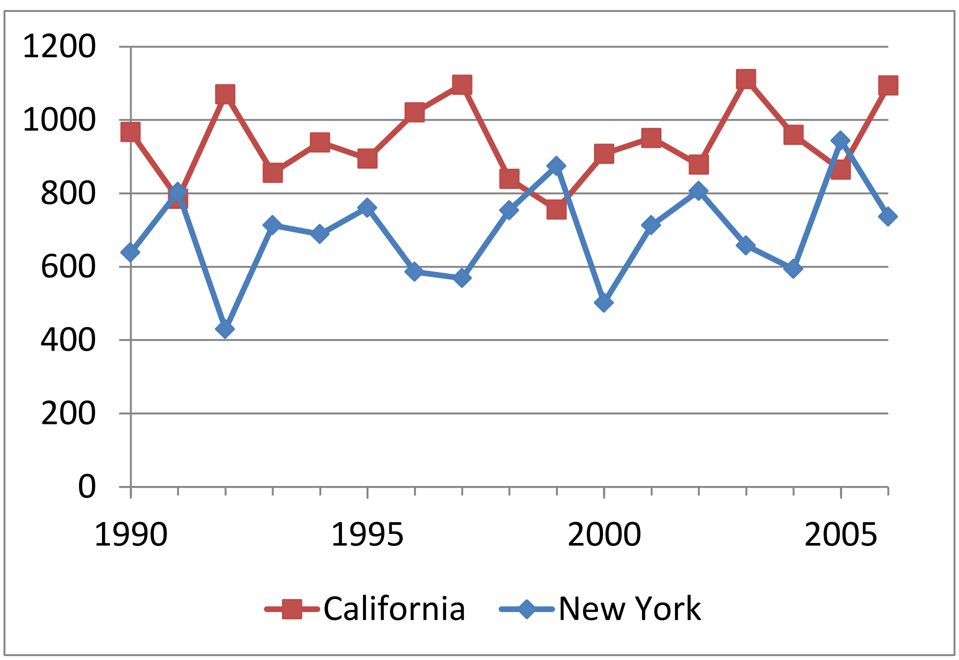
California requires that compliance entities move allowances into their compliance account sufficient to cover 30 percent of their obligation in each year before finally truing up the account at the end of the compliance period. RGGI does not have a similar interim obligation. This would be a transparent technical requirement that might easily be aligned.

V. Modeling Analysis of Linking RGGI and California

Bilateral linking of cap-and-trade programs offers potential efficiency gains through lower-cost emissions reductions. A linked program allows for allowances to flow from regions with low-cost emissions reduction opportunities to those with higher costs. The level of allowance flows resulting from a bilateral link directly depends on differences in program stringencies pre-link, as represented by unlinked allowance prices.

Linking also offers opportunities for sharing of risks related to changing circumstances. One way it achieves this outcome is by dampening the price effects of regional variations in the demand or supply of allowances. For example, annual fluctuations in summer weather, and thus the demand for cooling, may cause unexpected price volatility in unlinked programs. Figure 1 depicts historical data on cooling degree days in California and New York, which is one of the largest states in the RGGI region; the correlation between these two states is –0.64. This suggests that under cap-and-trade programs, linking between these states would reduce the price effects of these annual changes in weather, because demand for allowances would tend to increase in one program while falling in the other.

Figure 1. Cooling Degree Days in California and New York



Opportunities for mutually beneficial interregional allowance trades will depend on how linking agreements are specified, and different specifications could have important consequences for environmental outcomes. An example of a specification that would affect the outcomes of linking, including the flow of allowances and total emissions, is an allowance exchange rate. Linking also would create winners and losers in the different regions. Understanding the impact of linking on these different constituencies provides insight on who might support a bilateral link.

We use RFF's Haiku electricity market model to explore the implications of two simple forms of linking between the California and RGGI trading programs. In this analysis, we consider a linking design that allows for one-for-one trading of allowances between the two programs (an exchange rate of 1:1), as well as a scenario with three-for-one trading (an exchange rate of 3:1) that requires three RGGI allowances for each ton emitted in California and only one-third of a California allowance for each ton emitted in RGGI.

The model solves investment and retirement decisions and system operation in 22 inter-connected regions spanning the continental United States over a 25-year horizon.[7] Our analysis focuses on the electricity sector, so we limit it to the electricity portion of the California program, and we specify a Phase 2 version of the RGGI program that has tighter emissions caps starting in 2015. We consider the effects of linking these two programs on several indicators of allowance market, electricity market, and environmental performance, as well as how different constituencies in the two regions are affected by the linking of the programs. In this analysis we assume no relationship with the Quebec program.

In the next section, we briefly describe how we model the two regional CO_2 cap-and-trade programs and the different scenarios that we consider. In the subsequent section, we describe our findings.

Scenarios Description

The modeling analysis of linking involves comparing the results of linked programs with those from unlinked programs. The first step in modeling the effects of linking is to specify the requirements imposed by the two cap-and-trade programs on electricity generators within each region. In the case of California, the program extends beyond the state border, as those who deliver power to the California market that is generated outside the state also must surrender allowances to cover the associated CO_2 emissions. Throughout this modeling analysis, the central case assumptions regarding fuel prices and underlying electricity demand growth

[7] For more information about the RFF Haiku model, see Paul et al. (2009).

projections are based on assumptions in the US Energy Information Administration's (EIA) 2011 Annual Energy Outlook.[8]

The Haiku model solves for selected simulation years between now and 2035. In this analysis, we select 2015, 2017, and 2020 as the primary simulation years covering the time period for California's cap-and-trade program. The phase-in of emissions caps in California is coincident with a dramatic ramp up in the requirements of the renewable portfolio standard and thus the rapid introduction of renewables, which has important implications for allowance flows between California and RGGI. To capture these effects, we focus on 2020, but for purposes of program planning, the results can be interpreted as roughly accurate for the 2018 time frame.

California

We model an emissions cap in California's electricity sector in order to achieve allowance prices roughly comparable with those anticipated by futures prices in the summer of 2012, about $18 in 2020 (in 2009 dollars). We use the resulting cumulative emissions across all years at these prices to create a trajectory of cap levels, which start at baseline levels at the beginning of the time horizon and decrease linearly each year. We assume that the emissions levels must not exceed the cap in each year, meaning no banking of allowances for future use occurs. There is no explicit offset market, but the cap is calculated taking expected offset use into account.

We include emissions associated with electricity imports into California under the cap to reflect regulators' intent to control emissions leakage. We also assume that no contract shuffling in the imported power market will take place in response to the requirement to surrender allowances on imported power. In our model, the decision at the margin about whether to import power uses the marginal emissions rate for each neighboring region that exports power to California. The volume of allowances required for imported power is based on the average emissions rate for each neighboring region.

RGGI post-2015

The RGGI cap-and-trade program has recently concluded its review of Phase 1. During this process, the RGGI states evaluated all aspects of program performance and design and

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[8] For more information on those assumptions, see the description of the baseline scenario in (Burtraw et al. 2012).

discussed a range of potential future modifications. The updated model rule will tighten the RGGI cap going forward.

In our analysis, we model a cap by simulating a $6 tax (in 2009 dollars) on CO_2 emissions that starts in 2015 and rises at 5 percent per year in real terms.[9] We use the resulting cumulative emissions across all years at these prices to create a trajectory of cap levels, which start at baseline levels at the beginning of the time horizon and decrease linearly each year. We assume that the cap is binding (emissions levels will hit the cap) and that no banking of allowances for future use occurs.

The Unlinked Programs

As modeled, the California program results in emissions reductions from the electricity sector of roughly 10 percent below baseline levels in 2020 with an allowance price of $14.2 per ton, about 12 percent above the price floor. The program raises electricity prices by about 2 percent and lowers REC prices by about 16 percent compared with a baseline with no program.

In our model, the allowance price in 2020 is $7.20 per ton in the RGGI region. Emissions are 22 percent lower than a baseline with Phase 1 RGGI program specifications, under which allowances continue to be sold at the current price floor.[10] The tightening of the RGGI cap results in only a minimal change in electricity price in the region.

Figure 2 depicts estimated marginal abatement cost curves for the two regions and includes box points indicating the allowance price and level of reductions obtained in each of the unlinked programs. Because the curves are estimated from modeling results, points may not fall directly on the curve.

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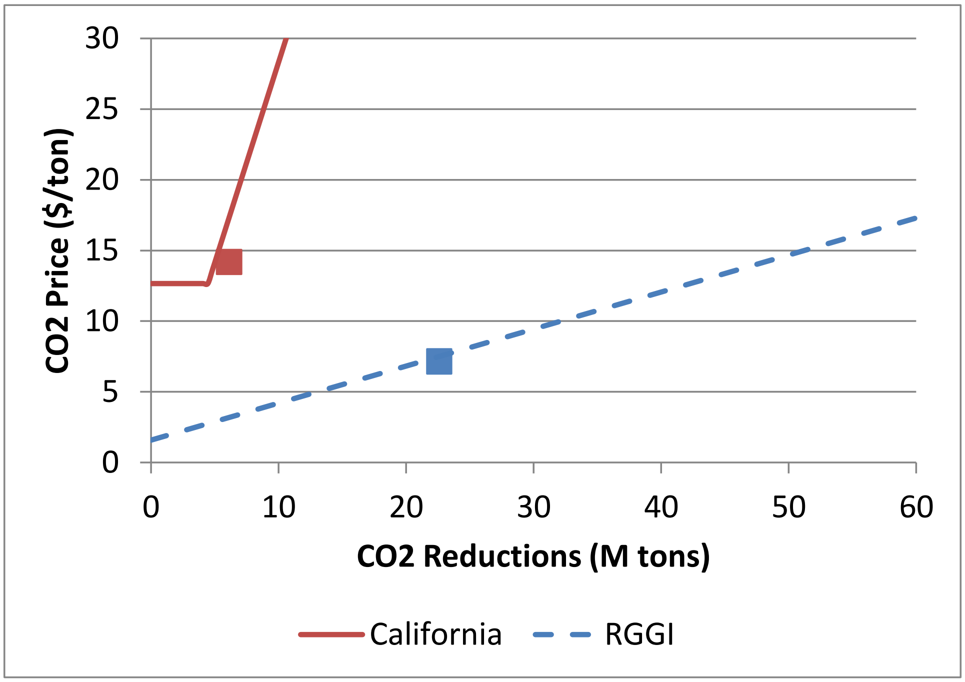
[9] We assume the price floor is unchanged.

[10] All prices are in 2009 dollars.

Figure 2. Marginal Abatement Cost Curves and Results for Unlinked Programs



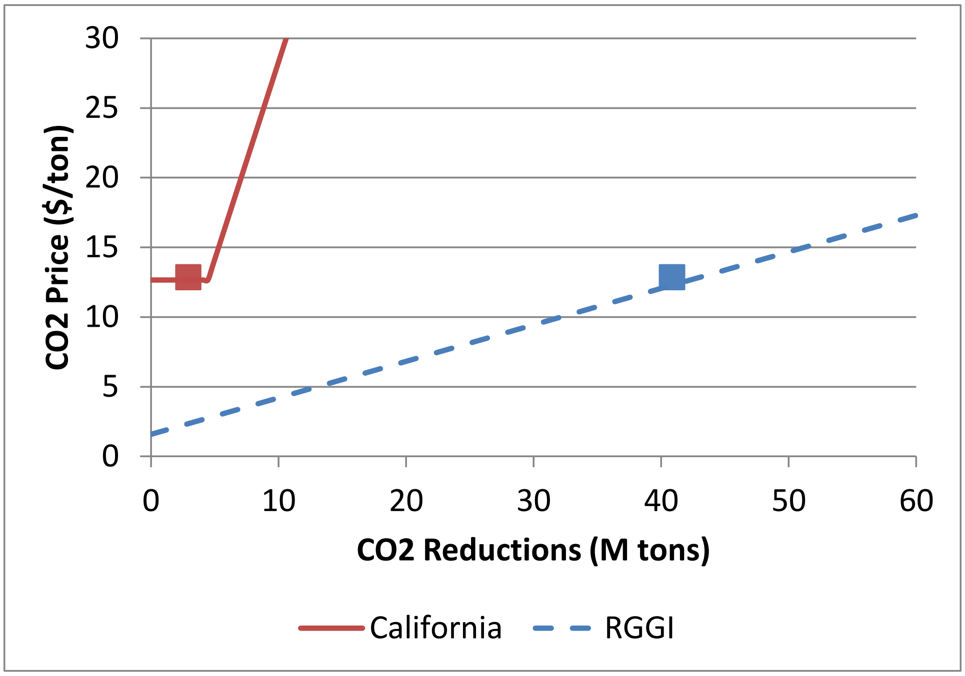
One-for-One Trading

With one-for-one trading of allowances between the two programs, higher California allowance prices suggest that allowances would flow from RGGI to California.[11] The result would cause allowance prices to rise in RGGI and fall in California. As allowance prices in RGGI rise as a result of linking, emissions in RGGI would be expected to exhibit a greater response than in California because the supply of emissions reductions is more elastic in RGGI than it is in California, as illustrated in Figure 3. The extent to which the equilibrium allowance price in California can fall as a result of imports from RGGI is constrained by the California price floor.[12] Linking the programs with one-for-one trading imposes the California price floor on both markets. As a result, allowance prices in RGGI rise by nearly 80 percent, while allowance prices in California fall by only about 10 percent before they reach the floor.

[11] One-for-one trading actually would involve an exchange rate as the programs are currently organized because a California allowance is denominated in metric tons and a RGGI allowance is denominated in short tons. One-for-one trading corresponds to equivalent tons.

[12] If the supply curve for allowances in RGGI were flat and below the California price floor up to quantities that would cover demand for allowances in both regions, then the price would fall below the California price floor, but otherwise the market price of allowances in RGGI will be bid up to the California floor as we find in our modeling.

Figure 3. Marginal Abatement Cost Curves and Results under One-for-One Trading



One-for-one linking has three other important effects:

- *Emissions*. Linking shifts the location of CO_2 emissions from RGGI to California. Emissions from generators covered by the California program rise by 5 percent, while emissions in RGGI fall by 23 percent compared with baseline levels. As a result of the price floor being spread across the two programs, total emissions from the two programs combined are lower than when they are not linked; combined emissions in the two regions are 26 percent below baseline levels with one-for-one linking, compared with 17 percent below baseline when the programs operate separately.
- *Electricity prices*. Linking of the two programs has virtually no effect on electricity price in California because of the allocation of allowance revenues to local distribution companies. The average electricity price in RGGI is roughly 1 percent higher in 2020 as a result of linking. In RGGI, most of the allowance revenues go to energy efficiency programs, which reduce electricity demand and price.[13]

[13] The Haiku model has endogenous representation of the reduction in demand resulting from investments in energy efficiency, but the assumptions in Haiku about the effectiveness of those expenditures in reducing demand are conservative. A less conservative approach would predict that the efficiency investments are more potent in reducing electricity demand.

- *Potential leakage*. As a result of the higher allowance prices in RGGI due to linking, power imports into the region increase by roughly 15 percent (the increase is equivalent to 5 percent of total consumption), suggesting that linking at one for one may contribute to emissions leakage in the RGGI region. Incentives for leakage in California would presumably be reduced because emissions prices fall with linking.

The distributional effects of linking clearly differ across geography and constituencies. For one-for-one trading, these effects are displayed in Table 3. The effects of linking are reported in dollars per megawatt-hour (MWh) and are disaggregated into the effects on allowance value, resource cost, and electricity price. Table 3 shows that one-for-one trading leads to a small electricity price increase in RGGI, which hurts consumers. Because allowance prices rise in RGGI, the government collects more revenue from the allowance auction. This revenue is used to pay for energy efficiency and thus contributes to the low impact on electricity price. Fossil generators in RGGI benefit from the higher electricity price, but this benefit is outweighed by the combination of higher allowance costs and higher operating costs.[14]

In California, one-for-one trading has net positive effects for both consumers and fossil generators. Lower wholesale electricity prices affect consumers positively, but much of that effect is wiped out by the lower allowance revenues going to local distribution companies. Fossil producers are hurt by the lower electricity prices, but reductions in allowance costs and overall resource costs more than compensate.

[14] Note that the net effect indicated in the table is not strictly additive across interest groups, because the use of revenues to the government influences the outcome for consumers and generators.

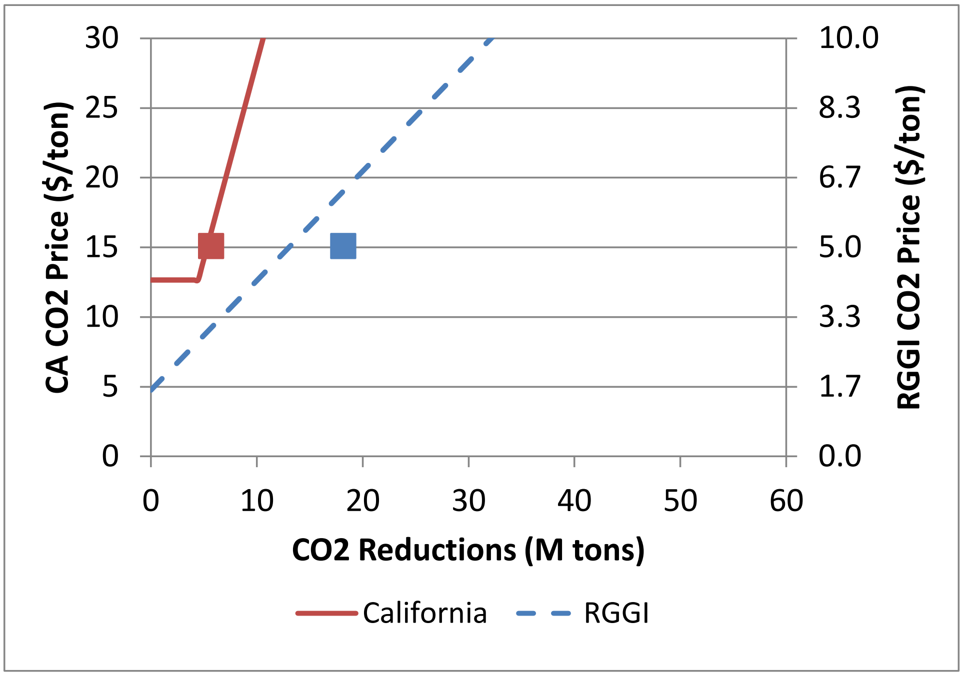
Table 3. Incidence of Costs under One-for-One Trading

$/MWh	RGGI			California		
	Consumers	Government	Fossil Generators	Consumers	Government	Fossil Generators
Allowance Value		1.4	-2.8	-1.1		0.6
Resource Cost/Flow			-6.9			3.8
Electricity Price	-1.0		1.0	1.2		-1.2
Net Effect	**-1.0**	**1.4**	**-8.6**	**0.1**	**n/a**	**3.2**

Three-for-One Trading

Three-for-one trading provides a rough adjustment for the relative stringencies of the two programs but reduces the opportunities for costs savings from shifting CO_2 emissions from RGGI to California because of the requirement that three RGGI allowances be surrendered for every ton of emissions from sources regulated under the California program. The flip side is that regulated sources in RGGI require only one-third of a California allowance to cover one ton of emissions in RGGI. The trading ratio also means that the effective minimum price in RGGI is by construction one-third of the price floor in California. This trading ratio lowers demand for RGGI allowances in California and increases demand for California allowances, both in California and in RGGI. Thus with three-for-one linking, California becomes an allowance exporter, and allowance prices rise in that region and fall in RGGI. Figure 4 shows the resulting allowance prices and emissions reductions from three-for-one trading. Note that the RGGI allowance price is read off the right-hand axis, which is one-third of the California allowance price on the left-hand axis. The dot is away from the line because the dot indicates the outcome from the specific modeling scenario and the line is the linear prediction over this range.

Figure 4. Marginal Abatement Cost Curves and Results under Three-for-One Trading



Linking at three for one compared with an unlinked regime has several other consequences:

- *Emissions*. This program leads to a 6 percent increase in emissions in RGGI relative to the unlinked case and only a small change in emissions in California. As a result, total emissions of CO_2 in the two regions increase to 14 percent below baseline levels, compared with 17 percent below baseline levels when the programs are unlinked.
- *Electricity prices*. With three-for-one trading, linking has only a small effect on retail electricity price in California, but the average retail electricity price in RGGI increases by about 1 percent relative to the unlinked program.
- *Potential leakage*. Power imports into RGGI fall and total generation in RGGI rises as a result of the reduction in allowance cost associated with producing power in the region, suggesting leakage is less of a concern in RGGI under three-for-one trading.

With three-for-one trading, the benefits of linking the RGGI region accrue primarily to fossil generators, which face lower allowance and resource costs. Consumers in the region also see slight benefits from lower electricity prices, while government revenues from allowance sales are lower because of lower allowance prices in RGGI. In California, fossil generators are negatively affected by the higher allowance costs and the lower electricity price. For consumers, higher allowance value results in a direct benefit in the form of allowance revenue rebates, which complements the reduction in wholesale electricity costs relative to the unlinked scenario. Although electricity prices would be expected to increase with an increase in allowance prices, the dynamic nature of capacity investments and electricity consumption in Haiku result in electricity prices in California falling in this scenario.

Table 4. Incidence of Costs under Three-for-One Trading

$/MWh	RGGI			California		
	Consumers	Government	Fossil Generators	Consumers	Government	Fossil Generators
Allowance Value		-0.5	1.2	0.3		-0.4
Resource Cost/Flow			1.2			0.5
Electricity Price	0.2		-0.2	0.5		-0.5
Net Effect	**0.2**	**-0.5**	**2.2**	**0.7**		**-0.4**

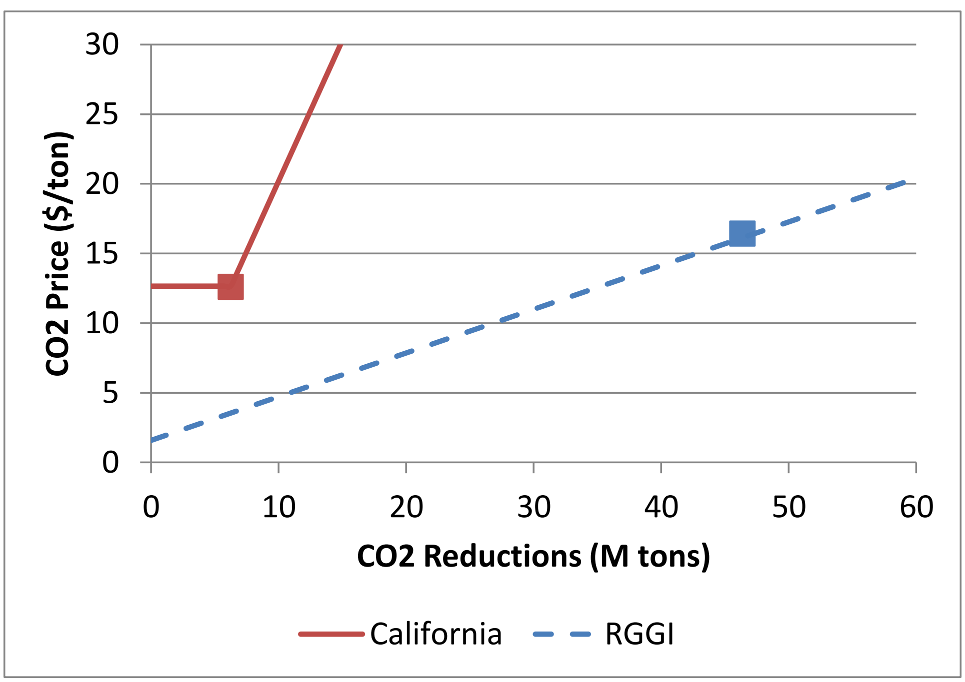
Sensitivities

The consequences of linking the RGGI and California CO_2 markets depend importantly on other factors that affect what is going on in electricity markets in those two regions. The central case scenarios discussed above adopt assumptions that are consistent with the Annual Energy Outlook (AEO) 2011, but several of those assumptions are highly uncertain. In the sensitivity analysis discussed in this section, we analyze the effects of alternative forecasts of natural gas prices and of electricity demand growth on the outcomes in these two regional CO_2 allowance markets and, in particular, on the effects of linking the two markets. In the first sensitivity case, we consider the effects of higher natural gas price projections that mirror those assumed in the AEO 2009. In the second sensitivity case, we explore the effects of combined higher natural gas price projections and higher electricity demand growth.

High Natural Gas Price Sensitivity

In the first sensitivity case, natural gas forecasts track those in AEO 2009, which projects total natural gas consumption in 2020 of 21.53 trillion cubic feet (TCF) at an average wellhead price of $6.84/MMBtu, whereas the AEO 2011 projects total natural gas consumption in 2020 of 25.34 TCF at an average wellhead price of $4.47/MMBtu. Between these two projections, consumption would increase by 18 percent while the price would fall by 35 percent. High gas prices have very different effects on the generation mix in the two regions in the absence of the two new cap-and-trade programs. In RGGI, coal capacity is greater, and thus coal claims a larger share of the generation market than it does with the low gas prices assumed in the central case. Higher gas prices also raise the cost of reducing emissions from the sector, as reflected by the steeper marginal CO_2 abatement cost curve in the region as shown in Figure 5. In California, the main CO_2-emitting electricity capacity is fired by natural gas, but high gas prices discourage its use and encourage the use of non-emitting technologies, thereby lowering the marginal cost of reducing emissions in California as also shown in Figure 5. Total CO_2 emissions in the baseline with high gas prices are much greater than with lower gas prices, so the programs that target a particular cap yield greater reductions relative to the baseline with high gas prices than they do with lower gas prices.

Figure 5. Marginal Abatement Cost Curves and Results without Linking under High Gas Prices



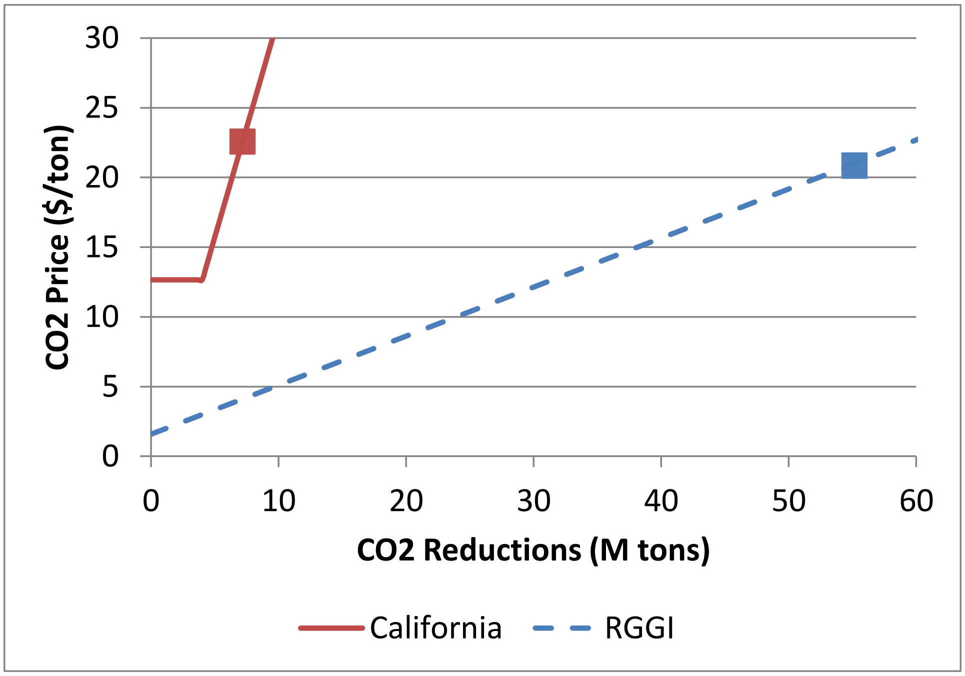
In the high gas price sensitivity case, when the two regional cap-and-trade programs are not linked, the price of CO_2 allowances in California falls to the floor, while the allowance price in RGGI is much higher than in the reference case presented earlier and actually exceeds the allowance price in California. As a consequence, linking the two programs at one for one pulls the allowance price in California up off its floor, and thus emissions in California and across the two regions increase with linking (not depicted). However, linking results in very little allowance trading between RGGI and California.

The switch in relative allowance prices across the two unlinked programs, with RGGI now having higher prices than California, suggests that trading allowances at three for one will not result in aggregate emissions reductions. Indeed, three-for-one trading leads to allowances flowing from California to RGGI and in higher emissions overall, with RGGI emissions increasing by about 18 percent and California emissions remaining unchanged compared with the unlinked scenario. In this scenario, allowance prices in California are twice as high as the floor, while the ability to use one-third of a California allowance to cover a ton of emissions in RGGI results in a substantial reduction in the RGGI allowance prices. Total emissions in the two regions increase by roughly 10 percent compared with the unlinked case. On the other hand, linking at three for one reduces power imports into RGGI by about 4.5 percent relative to the unlinked case and thus would lower the amount of leakage out of RGGI.

Combined High Natural Gas Price and High Electricity Demand Sensitivity

When electricity prices and electricity demand growth are aligned with assumptions in AEO 2009, overall emissions in the absence of the two programs are even higher, and thus the emissions reductions required to reach the program caps established in the two separate programs are substantial. When the two regional programs are in place but not linked, the prices of emissions allowances in the two regions are very close, as shown in Figure 6. In both cases, one emissions allowance costs roughly $21 per ton, substantially above the price floor in California.

Figure 6. Marginal Abatement Cost Curves and Results without Linking under High Gas Prices and High Electricity Demand



Because the prices in the unlinked programs are so similar, linking the two programs at one for one has very little effect in either market (not depicted). Allowances are not traded and total emissions are basically the same. Under three-for-one trading, allowances flow from California to RGGI, and the allowance price in California is bid up to the California price ceiling of $50.6. As a result, total CO_2 emissions in the two programs rise by roughly 5 percent relative to the unlinked case, both because of RGGI buying allowances at the exchange rate and because more allowances are offered in California to help support the allowance price ceiling. However, linking at three for one does reduce the amount of power imports into RGGI relative to the unlinked case, thereby potentially reducing emissions leakage.

VI. Conclusion

California and RGGI, as well as other states and provinces including Quebec (which we have not studied) are already *linking by degrees* through cooperation and sharing of information, mutual learning and borrowing from each other's program design. This paper makes explicit comparison of the readiness for formal linking between California and RGGI allowance markets. We conclude these markets are almost ready for linking when evaluated based on administrative measures and the expected functioning of a common market. However, the difference in allowance prices remains an issue to be considered before formal linking could occur.

We conclude with an observation, a takeaway from our modeling results, and a summary of the benefits of linking by degrees.

From the exercise of evaluating linking readiness, we observe across the program elements that political preferences frequently appear more important than the conditions for developing a functioning market. These political preferences lead to an emphasis on alignment of every program element beyond what would be necessary for a functioning market. This tendency can likely be attributed to a strong political preference for policy certainty. However, there are mechanisms that can dynamically adjust key parameters to influence the flow of allowances and other market outcomes including discount rates, fees, quotas, registry restrictions or mutually negotiated exchange rates. As regulators and stakeholders become more familiar with elements of program design they may cede the goal of aligning every program element in favor of developing adjustment mechanisms that offer considerable adaptability and flexibility.

Second, we note from our modeling results that one suggested adjustment mechanism—an exchange rate—introduces two-way uncertainty to the emissions outcome of linking. That is, emissions can be either lower or higher under a linked market than under a non-linked market. Further research in this area might suggest an exchange rate mechanism that can make positive environmental outcomes more likely. While promising, we do not recommend this approach until it is studied more fully.

Finally, we have built a framework to view linking as a process that yields incremental benefits even before it leads to trading of allowances between jurisdictions. These include administrative benefits that come from improving program design and policy benefits that result from influencing anticipated greenhouse gas rules under the Clean Air Act. Moreover, linking by degrees can contribute to the momentum of further cooperation between states and provinces, which is necessary to achieving meaningful emissions reductions in the current policy setting.

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