NOTA DI LAVORO

26.2015

Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies Through a Future International Agreement

By **Daniel M. Bodansky**, Arizona State University
Seth A. Hoedl, Harvard University
Gilbert E. Metcalf, Tufts University
Robert N. Stavins, Harvard University

Climate Change and Sustainable Development
Series Editor: Carlo Carraro

Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies Through a Future International Agreement

By Daniel M. Bodansky, Arizona State University
Seth A. Hoedl, Harvard University
Gilbert E. Metcalf, Tufts University
Robert N. Stavins, Harvard University

Summary

Negotiations pursuant to the Durban Platform for Enhanced Action appear likely to lead to a 2015 Paris agreement that embodies a hybrid climate policy architecture, combining top-down elements, such as for monitoring, reporting, and verification, with bottom-up elements, including "nationally determined contributions" from each participating country, detailing what it intends to do to reduce emissions, based on its national circumstances. For such a system to be cost-effective—and thus more likely to achieve significant global emissions reductions—a key feature will be linkages among regional, national, and sub-national climate policies. By linkage, we mean a formal recognition by a greenhouse gas mitigation program in one jurisdiction (a regional, national, or sub-national government) of emission reductions undertaken in another jurisdiction for purposes of complying with the first jurisdiction's mitigation program. We examine how a future international policy architecture could help facilitate the growth and operation of a robust system of international linkages of regional, national, and sub-national policies. Several design elements merit serious consideration for inclusion in the Paris agreement, either directly or by establishing a process for subsequent international elaboration. At the same time, including detailed linkage rules in the core agreement is not desirable because this could make it difficult for rules to evolve in light of experience.

Keywords: Climate Policies, International Agreements
JEL Classification: Q5, Q58

This paper was originally published as a Discussion Paper for the Harvard Project on Climate Agreements (HEEP). HEEP develops innovative answers to today's complex environmental issues, by providing a venue to bring together faculty and graduate students from across Harvard University engaged in research, teaching, and outreach in environmental, energy, and natural resource economics and related public policy. The program sponsors research projects, convenes workshops, and supports graduate education to further understanding of critical issues in environmental, natural resource, and energy economics and policy around the world. For more information, see the Program's website: http://heep.hks.harvard.edu/

Address for correspondence:
Robert N. Stavins
John F. Kennedy School of Government - Harvard University
79 John F. Kennedy Street
Room L-306
Cambridge, Massachusetts 02138
USA
Phone: 617-495-1820
E-mail: robert_stavins@hks.harvard.edu

Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies through a Future International Agreement

Daniel M. Bodansky
Arizona State University

Seth A. Hoedl
Harvard University

Gilbert E. Metcalf
Tufts University

Robert N. Stavins
Harvard University

November 2014

THE HARVARD PROJECT ON CLIMATE AGREEMENTS

The goal of the Harvard Project on Climate Agreements is to help identify and advance scientifically sound, economically rational, and politically pragmatic public policy options for addressing global climate change. Drawing upon leading thinkers in Argentina, Australia, China, Europe, India, Japan, and the United States, the Project conducts research on policy architecture, key design elements, and institutional dimensions of domestic climate policy and a post-2015 international climate policy regime. The Project is directed by Robert N. Stavins, Albert Pratt Professor of Business and Government, Harvard Kennedy School. For more information, see the Project's website: http://belfercenter.ksg.harvard.edu/climate.

ACKNOWLEDGEMENTS

The Harvard Project on Climate Agreements collaborated with the International Emissions Trading Association (IETA) in conducting the research that led to this paper. The following IETA members provided financial support for this research: Chevron, GDF-Suez, Global CCS Institute, Rio Tinto, Shell, and TransCanada.

The Harvard Project receives additional support from the Harvard University Center for the Environment; Christopher P. Kaneb (Harvard AB 1990); the James M. and Cathleen D. Stone Foundation; and ClimateWorks Foundation. The Project is very grateful to the Doris Duke Charitable Foundation, which provided major funding during the period July 2007–December 2010. The Project receives ongoing support from the Belfer Center for Science and International Affairs at the Harvard Kennedy School.

The closely affiliated, University-wide Harvard Environmental Economics Program receives additional support from the Enel Endowment for Environmental Economics at Harvard University, the Enel Foundation, the Alfred P. Sloan Foundation, the Mossavar-Rahmani Center for Business and Government at the Harvard Kennedy School, Bank of America, BP, Castleton Commodities International LLC, Chevron Services Company, Duke Energy Corporation, and Shell.

CITATION INFORMATION

Bodansky, Daniel M., Seth A. Hoedl, Gilbert E. Metcalf, and Robert N. Stavins. "Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies through a Future International Agreement." Cambridge, Mass.: Harvard Project on Climate Agreements, November 2014.

ABSTRACT

Negotiations pursuant to the Durban Platform for Enhanced Action appear likely to lead to a 2015 Paris agreement that embodies a hybrid climate policy architecture, combining top-down elements, such as for monitoring, reporting, and verification, with bottom-up elements, including "nationally determined contributions" from each participating country, detailing what it intends to do to reduce emissions, based on its national circumstances. For such a system to be cost-effective—and thus more likely to achieve significant global emissions reductions—a key feature will be linkages among regional, national, and sub-national climate policies. By linkage, we mean a formal recognition by a greenhouse gas mitigation program in one jurisdiction (a regional, national, or sub-national government) of emission reductions undertaken in another jurisdiction for purposes of complying with the first jurisdiction's mitigation program. We examine how a future international policy architecture could help facilitate the growth and operation of a robust system of international linkages of regional, national, and sub-national policies. Several design elements merit serious consideration for inclusion in the Paris agreement, either directly or by establishing a process for subsequent international elaboration. At the same time, including detailed linkage rules in the core agreement is not desirable because this could make it difficult for rules to evolve in light of experience.

Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies through a Future International Agreement[1]

Daniel M. Bodansky
Arizona State University

Seth A. Hoedl
Harvard University

Gilbert E. Metcalf
Tufts University

Robert N. Stavins
Harvard University

1. INTRODUCTION

In the Durban Platform for Enhanced Action, adopted by the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2011, the parties agreed to develop a new legal instrument "under the Convention applicable to all Parties," for adoption at the Twenty-First Conference of the Parties (COP-21) in December 2015, in Paris (UNFCCC, 2012). Although the negotiations are still at a relatively early stage, it appears likely that the 2015 agreement will reflect a hybrid climate policy architecture—one that combines top-down elements, such as for monitoring, reporting, and verification, with bottom-up elements, including "nationally determined contributions," detailing what a country intends to do to reduce emissions, based on domestic political feasibility and other factors (Bodansky and Diringer, 2014).

---

1 Bodansky is Foundation Professor of Law at the Sandra Day O'Connor College of Law, Professor at the School of Sustainability, and Senior Sustainability Scholar at the Global Institute of Sustainability, all at Arizona State University; Hoedl is a J.D. student at Harvard Law School; Metcalf is Professor of Economics, Tufts University, Research Associate of the National Bureau of Economic Research, and Associate Scholar of the Harvard Environmental Economics Program; and Stavins is the Albert Pratt Professor of Business and Government at the Harvard Kennedy School, Research Associate of the National Bureau of Economic Research, and University Fellow of Resources for the Future. The authors gratefully acknowledge excellent research assistance from John Agan; valuable comments on a previous version of the paper from Dallas Burtraw, Mariana Conte Grande, Denny Ellerman, Christian Flachsland, Andrei Marcu, Matthew Ranson, Eswaran Somanathan, Robert Stowe, David Weisbach, and Jonathan Wiener; major contributions to Table 1 by Matthew Ranson; editing support from Marika Tatsutani; and financial support from the following members of the International Emissions Trading Association: Chevron, GDF-Suez, Global CCS Institute, Rio Tinto, Shell, and TransCanada. The authors, however, are fully responsible for any errors and all opinions expressed in this paper.

To enhance the cost-effectiveness of such a system—and thus the likelihood of achieving significant global emissions reductions—a key feature will be linkages among regional, national, and sub-national climate policies. By linkage, we mean a formal recognition by a greenhouse gas (GHG) mitigation program in one jurisdiction (a regional, national, or sub-national government) of emission reductions undertaken in another jurisdiction for purposes of complying with the first jurisdiction's mitigation program.[2] Linkage can be very straightforward, as with the bilateral recognition of allowances under two cap-and-trade regimes, but linkage can also take place among a heterogeneous set of policy instruments, such as between systems of performance standards, carbon taxes, and cap-and-trade. Linkage is a core focus of one key track of the current international climate negotiations, namely the Framework for Various Approaches (FVA), which originated at COP-13 in Bali, Indonesia in 2007 (UNFCCC, 2008, 1(b)(5)), and which seeks to ensure that various types of national mitigation policies meet common standards.

This paper analyzes theoretical issues relating to linkage among heterogeneous climate policy instruments and then applies this analysis concretely to the 2015 Paris agreement. It examines how the agreement could help facilitate the growth and operation of a robust system of international linkages of regional, national, and sub-national policies, as well as how inappropriate or excessive rules could obstruct effective, bottom-up linkage.

The paper is organized as follows. Section 2 summarizes what is known about linkage in its various forms. We identify the key economic and political advantages of and challenges to linkage, and examine sources of interest and pressure from governments and the private sector. The section concludes with an empirical review of existing and proposed climate policy linkages, and a list of key lessons that have been learned to date.

In Section 3, we examine conceptually the role of linkage in a future international climate agreement. Specifically, we postulate a set of generic needs for facilitating and regulating linkage, examine the implications of the Durban Platform, and describe a small set of potential design elements to facilitate linkage in a future international agreement. Section 4 of the paper transitions from concepts to more concrete design issues in the context of international law. Alternative types of international instruments are considered. The section concludes with an examination of how key linkage design elements can be treated in a future international agreement. Section 5 of the paper offers some conclusions.

2 Our use of the term linkage should not be confused with the concept of linkage in the international relations literature, where it refers to negotiated agreements between countries in which multiple issues are negotiated and "linked" for purposes of coming to agreement on the overall package. See, for example, Haas (1980).

2. UNDERSTANDING LINKAGE

Separate and distinct policy instruments in different political jurisdictions may be linked together, essentially through mutual recognition and crediting for compliance. As discussed below (and in greater length in Metcalf and Weisbach [2012]), linkage could occur between cap-and-trade and tax systems, between either of those systems and non-market regulatory systems, or among non-market regulatory systems. Linkage can also be direct or indirect, as we explain below, and bilateral or multilateral. We begin by utilizing the example of direct linkage between two cap-and-trade systems, not because this will necessarily be the most common or important form of linkage in the long term, but because it is the most obvious and easiest to understand.

2.1 Direct and Indirect Linkage

Direct linkage occurs when an agreement is reached between two cap-and-trade systems to accept allowances (or credits) from the other jurisdiction for purposes of compliance with the local cap. This can occur on a one-for-one basis, where an allowance from one jurisdiction is accepted in place of an allowance for the same amount of emissions in another jurisdiction (Ranson and Stavins, 2013a,b), or a trading ratio (exchange rate) can apply to allowance (or credit) transfers between the two systems.[3] Direct linkage can be bilateral (two-way), where both systems accept allowances or credits from the other system for compliance, or unilateral (one-way), where only one of two systems allows credits from the other for compliance (Ranson and Stavins, 2013b).

Indirect linkage occurs when two systems do not accept allowances from each other, but both accept allowances (or credits) from a common third party (Ranson and Stavins, 2013b). For example, cap-and-trade systems in two jurisdictions might both allow firms to comply using offsets purchased from an emission reduction credit system. By accepting credits (or allowances) from a common source (jurisdiction), both cap-and-trade-allowance markets influence the common offset market, and in turn both influence allowance prices (and compliance costs) in each other's markets.

3 If systems wish to preserve different levels of ambition, they can put in place a number of mechanisms to do so. First, they can recognize allowances from the other jurisdiction with an exchange rate. For example, a country with a more aggressive cap might agree to accept allowances from a country with a less aggressive cap but apply an exchange rate so that, for example, three tons of emission allowances from the other country would be required for one ton of compliance domestically (Burtraw *et al.*, 2013). Second, a country can place a limit on the use of allowances from other systems. Third, a country could require a payment to "top up" each foreign allowance approved for compliance purposes. For example, if an allowance from a system with a less ambitious cap (and an allowance price of $10) were used for compliance in a system with a more ambitious cap (and an allowance price of $25), the complying entity in the second system could be required to surrender the foreign allowance together with a payment of $15 to account for the difference. Note that the fee in this type of top-up approach could be set below the difference in allowance value (i.e., at less than $15 in the example given) to preserve some positive incentive for trading.

2.2 Linkage among Homogeneous and Heterogeneous Policy Instruments

Cap-and-trade programs provide the most straightforward opportunity for linkage, by allowing firms (emission sources) in one jurisdiction to comply either with local allowances or equivalent allowances from another, linked system. However, a variety of issues arise even in such straightforward linkages (Jaffe, Ranson, and Stavins, 2009; Ranson and Stavins, 2013b; Burtraw *et al.* 2013). These include technical issues, such as monitoring, reporting, and verification of emissions, and the structure and coordination of allowance tracking systems; emissions reduction targets (for example, stringency of caps, and the scope and timing of coverage); allocation of allowances (in particular, measures to address competitiveness and leakage); cost containment mechanisms (rules for banking and borrowing, use and certification of offsets, price floors and ceilings); and legal frameworks (for example, penalties for non-compliance, market regulation, contingency processes for de-linking).

It is highly unlikely that all countries will employ national cap-and-trade instruments as their means of reducing GHG emissions under the 2015 agreement. Other instruments include, among other options, carbon taxes or fees, emission reduction credit systems (ERCs) such as the Clean Development Mechanism, and emission intensity trading systems. Countries may also rely on more traditional regulatory approaches (for example, mandated technology standards or minimum emission reduction requirements). Hence, it is important to consider options for linking different types of policy instruments (Hahn and Stavins, 1999; Metcalf and Weisbach, 2012). In this context, we think of linkage as a strategy to narrow or eliminate differences in the shadow price of carbon (that is, the marginal cost of abatement) through policies that allow carbon regimes in different political jurisdictions to interact in various ways.

For example, firms that are subject to a carbon tax might be allowed to pay taxes at a higher level than they owe based on their emissions, and sell certified Emission Tax Payment Credits (ETPCs) to firms that are operating under a cap-and-trade program. Within the cap-and-trade program, firms could use ETPCs just as they would the equivalent quantity of allowances for purposes of compliance. Conversely, firms under a cap-and-trade program could sell allowances to firms required to pay a carbon tax, allowing the purchasing firm to lower its tax obligation by the amount of allowances it submits for retirement. Likewise, either a carbon tax or a cap-and-trade system could be linked with policies that provide subsidies for emissions reductions, which could be traded like ERCs to be used in place of allowances to comply with a cap-and-trade program, or as ETPCs for compliance with a carbon tax (Metcalf and Weisbach, 2012).[4]

4 Mexico's recently enacted carbon tax allows the use of offset credits from projects under the Kyoto Protocol's Clean Development Mechanism (CDM) in lieu of tax payments (ICAP, 2014).

In principle, market-based mechanisms[5] (taxes, subsidies, and cap and trade) could be linked with a performance-based regulatory system. If the regulation is in the form of a quantity standard (e.g., tons of carbon-dioxide-equivalent reduction), firms could buy allowances or ETPCs from another market to meet the required quantity of reduction, or to achieve reductions in excess of the regulatory minimum and then sell additional reductions as ERCs. Intensity standards may be translated into quantity standards at the source or firm level (per total output, total sales, or whatever denominator the regulation prescribes), thus allowing for linkage (Metcalf and Weisbach, 2012).

Technology standards present a considerably greater challenge, because it is difficult to verify the additionality of emissions reductions from meeting or exceeding a technology standard. Even a one-way link, which might allow firms facing the technology mandate to purchase offsets or allowances from another system, would be challenging to implement. In principle, credits could be used to attribute reductions to companies that outperform expected emissions from a technology standard; these credits could then be sold to foreign markets (Metcalf and Weisbach, 2012).

2.3 Advantages of Linkage

Linkage offers a variety of economic and political advantages. These advantages have been key motivating forces behind linkages that have already been established or are being planned.

2.3.1 Economics

Linkage allows for voluntary exchanges across systems, and thereby facilitates cost-effectiveness, that is, achievement of the lowest-cost emissions reductions across the set of linked systems, minimizing both the costs for individual countries as well as the overall cost of meeting the collective cap.[6] Perhaps the key argument for allowing linkage in the UN climate change regime is that, by reducing costs, linkage allows countries to adopt more ambitious policies. In addition, linkage has a number of subsidiary benefits. By increasing the number of allowance buyers and/

5 We define market-based mechanisms as policy instruments that alter the price of emitting activities relative to non-emitting activities based on the carbon content of the former. Examples of market-based policies include taxes and cap-and-trade systems that explicitly price emissions. They also include subsidies to clean technologies (for example, feed-in tariffs or Renewable Portfolio Standards) that alter the price of non-emitting energy sources relative to emitting sources. Note that some market-based mechanisms would be classified as economic instruments (for example, taxes). Market-based approaches differ from traditional command-and-control approaches in important ways: these approaches do not prohibit emissions by individual firms (although there may be an economy-wide limit as in the case of a cap-and-trade system); rather they put a price on emissions at the margin. Moreover, that marginal price is common across all emitters in equilibrium. The key advantage of a market-based approach is that it allows firms in the market to determine who will emit greenhouse gases based on the firm-specific value of emissions, rather than dictating who must reduce emissions.

6 Although this is an economic merit of linkage, for political reasons price equalization may not be a near-term goal (Ranson and Stavins, 2013a), as we discuss later.

or sellers across linked cap-and-trade systems, linkage tends to increase market liquidity (Ranson and Stavins, 2013a). To the extent that linkage reduces carbon price differentials across countries or regions, it also reduces the potential for competitive distortions caused by "leakage" (where leakage refers to emissions-generating sources or activities moving to jurisdictions with less stringent climate policies).

Moreover, by expanding the scope and size of the market for carbon allowances, linkage can mitigate allowance price shocks caused by extreme weather or other unexpected events (Burtraw *et al.*, 2013) and thereby reduce price volatility, although in the process, linkage also can transmit price volatility from one system to another. Finally, linkage can reduce the market power of individual market participants. Large buyers or sellers of emissions in a small market may be able to exercise market power, and strategically affect allowance prices (Wiener, 1999, Metcalf and Weisbach, 2012). But this potential is diminished when the overall market is expanded, provided that the same entity is not a significant allowance buyer or seller in both of the linked jurisdictions.

2.3.2 Politics

One possible political motivation for linkage is the ability of a country to demonstrate global leadership, as some jurisdictions may see political benefits from supporting global action on climate change. For example, the European Commission has indicated that linking the European Union Emissions Trading System (EU ETS) with other cap-and-trade systems "offers several potential benefits, including…supporting global cooperation on climate change" (European Commission, 2014c). The prospect of linkage may allow nations to exert greater diplomatic influence on unlinked, free-riding nations, encouraging them to take action on climate change.

Likewise, international linkage agreements can offer domestic political benefits, as leaders can point to linkage as a sign of "momentum" for increasing participation in systems similar to (or at least compatible with) their domestic climate policies. Linked systems may also provide regulatory stability, attractive from the point of view of affected firms, in the sense that it may be more difficult to introduce changes in an emission-reduction scheme when those changes require some sort of coordination with other countries with linked emissions systems.

There are also administrative benefits from linking that come from sharing knowledge about the design and operation of a carbon-pricing system. Quebec may benefit in this way from its linkage with the larger California cap-and-trade system. Also, linkage may reduce administrative costs through the sharing of such costs and the avoidance of duplicative services. Making the combined system run more smoothly can insulate both participating systems from political attacks.

Political support for linkage may also come from the capture of greater local co-benefits, such as reductions of emissions of correlated pollutants (Flachsland *et al.*, 2009). If one jurisdiction has a lower GHG price than another before linkage, linkage may provide a market for additional emissions reductions in the low-price jurisdiction that yields additional co-benefits to that jurisdiction. Conversely, a high-price jurisdiction may resist linking with a low-price system because linkage could mean fewer domestic emissions reductions, with the loss of related co-benefits. This concern was raised during debates in California regarding whether to link with Quebec's cap-and-trade system.

It is possible that linkage and the set of harmonized rules and procedures that accompany linkage may provide cover for politically difficult decisions. Monitoring and verification procedures that are opposed by particular interest groups, for example, can be justified on grounds that these procedures are needed to realize the benefits that accrue from linking with other jurisdictions.

Linking heterogeneous systems can create political flexibility to pursue the domestic policy instrument that is most feasible politically, while retaining the option to link with other types of systems. This may enable greater participation in linking despite diverse political tastes (Metcalf and Weisbach, 2012). Finally, well-designed linkage systems may pave the way for other forms of cooperation among nations.

2.4 Challenges of Linkage

The advantages of linkage are real, but linkage also brings with it a number of challenges. Some of these challenges are economic, others are political.

2.4.1 Economics

First, it is important to recognize that linkage has the potential to improve the cost-effectiveness of a pair of linked policies only if there is sufficient environmental integrity in both systems with respect to their monitoring, reporting, and verification requirements (Ranson and Stavins, 2013a). If one jurisdiction in a linked pair or large set of linked jurisdictions lacks the capacity or motivation to track emissions and emission allowances accurately (and/or the capacity or motivation to measure and verify offset credits), these loopholes will be exploited throughout the system, damaging the cost-effectiveness of the full set of linked policies. This can create significant barriers to linkage between nations with different levels of environmental and financial

management (Metcalf and Weisbach, 2012).[7] On the other hand, linkage could encourage the development of stronger systems: a desire to link between two countries or regions might induce the party with the weaker system to improve the environmental integrity of its system in order to persuade the other party to link.

Linkage itself can undermine environmental integrity. For example, linkage can result in double counting if transfers between countries are not properly accounted for and if, as a result, the same emissions reduction is counted towards compliance in more than one national system.

Strategic behavior could also produce adverse economic consequences in a set of linked systems. In a game-theoretic analysis of two countries setting their emissions caps (and thereby, their reduction targets), Helm (2003) examines the incentives of two countries that wish to link but assign different values to emissions reductions. Suppose that Country A adopts an ambitious emissions cap that leads to high allowance prices, reflecting the high value it places on emissions reductions. Country B may assign a lower value to its emissions reductions, and thus sets a domestic cap on emissions that produces a lower domestic allowance price than Country A. If Country B anticipates linking with Country A, it may have an incentive to loosen its domestic cap even more, so that the post-linkage emissions price more closely reflects its domestic benefits from emissions reductions. This can lead to disparities in ambition that could complicate efforts to link.[8] However, multilateral linkage would reduce the power of one jurisdiction to influence the international price by adjusting its own cap.

Even if a linkage is established, it may not be executed in terms of actual trades if transaction costs inhibit trading. As we discuss later, harmonized or uniform multilateral rules can facilitate effective linkage by lowering transaction costs. This is true of harmonized rules both for national policies, such as emissions trading, and for bilateral linkage agreements. Private actors can trade more easily between different jurisdictions if the traded units are subject to similar or identical rules in the two jurisdictions.

---

7 A nation with high environmental integrity can seek to protect against such risks in its bilateral linkage agreements with other nations by linking only with nations that have comparable standards, by otherwise ensuring the environmental integrity of whatever trades are facilitated under linkage (ensuring that "a ton is a ton"), or by applying an exchange rate to trades. A nation can also seek to protect the integrity of its national system against the risk that nations with which it is linked may seek to link with third nations that have lower standards by reserving the right to cancel its linkage agreements, or by requiring that linkages with third nations obtain its consent. But as more and more nations join a single linked system, these options become increasingly cumbersome. Pizer and Yates (2014) note that how delinking occurs in practice can have significant implications for the overall cost of carbon abatement policies. They discuss the implication of this finding for linkage agreements.

8 In a closely related game-theoretic analysis, Holtsmark and Sommervoll (2012) examine the incentives that nations face when they set their national emissions-reduction targets under a bottom-up pledge-and-review system. They find that if countries anticipate that international emissions trading will be implemented, they have incentives to establish less ambitious reduction targets than if trading were not anticipated.

2.4.2 Politics

While linkage has the potential to improve aggregate cost-effectiveness across linked jurisdictions, it can also have significant distributional implications between and within jurisdictions (Ranson and Stavins, 2013a).[9] Firms that were allowance buyers (firms with high abatement costs) in the jurisdiction with the higher pre-link allowance price will be better off as a result of the allowance price changes brought about by linking, as will allowance sellers (firms with low abatement costs) in the jurisdiction with the lower pre-link allowance price. Conversely, allowance sellers in the jurisdiction with the higher pre-link allowance price and allowance buyers in the jurisdiction with the lower pre-link allowance price will be hurt by the allowance price change that results from the link. For the jurisdiction that faces higher prices post-linkage, this means greater transfers from buyers to sellers (Newell, Pizer, and Raimi, 2013).

An increase in the volume of trades (as a result of linkage) may also have distributional implications and attendant political consequences, depending on the relative influence of buyers and sellers in the jurisdiction (Ranson and Stavins, 2013a). Within jurisdictions, the potential also exists for elites in developing countries to capture allowances from domestic cap-and-trade systems and sell them into linked markets to the detriment of the local economy (Somanathan, 2010).

In some cases, jurisdictions that have established emission-reduction policies may be motivated, at least in part, by a political desire to provide incentives for long-term investment in domestic abatement activities. The carbon price brought about by a cap-and-trade system or carbon tax may be expected to induce greater domestic development of low-carbon technologies, but existing carbon taxes and cap-and-trade systems have had little if any impact on technology innovation, presumably because of relatively low carbon prices (Calel and Dechezlepretre, 2012). If a system with a high allowance price links with a system with a lower allowance price, the firms in the system with higher abatement costs will have less incentive to find innovative ways to reduce their emissions, since they can opt instead to purchase allowances at the new lower price. The result may be less technological innovation than expected under the emissions policy pre-linkage.[10]

Beyond such long-term investment impacts, linkage may raise political concerns by reducing domestic environmental ambition (in the sense that domestic emission reductions will be less than what they would have been without linkage) in the short term. In existing cap-and-trade systems, rules limiting the use of foreign offsets may indicate a desire to ensure domestic emissions

9 Distributional implications across jurisdictions pertain specifically to capital flows from countries with higher prices to those with lower prices. As discussed in section 3.2.1, these flows can create their own political problems for climate policy.

10 This holds if technology innovation is convex in allowance prices or if innovation is a function of the maximum price across systems. The opposite would hold if innovation is concave in prices.

abatement, even when domestic actions are more costly.[11] This concern appears to have motivated the design of the EU ETS in its third commitment period (2013-20), as well as the design of the Regional Greenhouse Gas Initiative (RGGI) in the northeastern United States (RGGI, 2014c), and the cap-and-trade system under California Assembly Bill 32, the Global Warming Solutions Act of 2006 (AB 32) (Ranson and Stavins, 2013a).

In some cases, the desire to ensure a minimum level of domestic mitigation may be motivated by the belief that domestic mitigation provides co-benefits unrelated to climate change, such as reduction of localized air-pollutants (Flachsland *et al.*, 2009). Linkage that reduces abatement in the local system may forfeit such politically important co-benefits. It is also possible, however, that the ability to link to other systems (and so enjoy the opportunity to achieve emission reductions at lower cost) may provide political support for greater ambition in mitigation goals.

Finally, linkage presents the political challenge of ceding some degree of national (or other jurisdictional) autonomy. Before two jurisdictions link, they may need to agree on how to reconcile design features that they have separately established for their respective systems (Ranson and Stavins, 2013b). As those design features may represent a compromise between competing stakeholder interests within a country, any changes could pose political hurdles.

2.5 Interest and Pressure

Interest in linkage and pressure to establish linkages can be expected and have been observed from governments, firms with compliance obligations, and multilateral organizations. The EU, for example, has used participation in the ETS as a precondition for full EU membership (Ellerman and Buchner, 2007). Likewise, the EU has announced that it will delink with developing countries post-2020 by ceasing to accept Clean Development Mechanism (CDM) offset credits until a more robust international emissions reduction market is defined (Lippman, 2014).[12]

Companies with compliance responsibilities have demonstrated their interest in linkage through their membership in the International Emissions Trading Association (IETA), which has publicly supported linkage of emissions trading systems (IETA, 2014a). According to IETA, "linking enables companies to capture a wider range of mitigation opportunities to keep costs down" (IETA 2014b). Firms in a system with relatively high allowance prices will see an advantage in

11 These political considerations are distinct from economic considerations, such as concern about the ability to verify the quality of international offsets. Limiting or disallowing foreign offsets in certain instances may be more cost effective than expending resources to ensure the quality and additionality of foreign offsets.

12 Between now and 2020, the EU in principle accepts CDM offset credits, but credits from projects registered since January 2013 are eligible only if the project is hosted by a Least Developed Country. The current surplus of ETS allowances, however, means that CDM credits are not needed at present.

linking with a system that has lower allowance prices, as access to lower-cost allowances will reduce their compliance costs. Firms in a lower-priced system, however, may be reluctant to link for the same reason (because they would expect to see higher allowance prices), but even these firms might see benefits from linkage in terms of increased liquidity, greater price stability, and reduced opportunities for sellers to exercise market power, as mentioned above.

Offsetting that potential reluctance is the opportunity for firms with low marginal abatement costs to receive rents in the form of payments for emission reductions in excess of their abatement costs. In addition, one-way links with ERC or offset programs are also popular among firms with compliance responsibilities, provided that offset prices are below allowance prices in the relevant existing cap-and-trade system.

Finally, multilateral organizations have shown interest in linkage. The World Bank's Globally Networked Carbon Markets Initiative strives to provide a reliable process for valuing the climate mitigation impact of emission-reduction units from different nations, providing "exchange rates" for allowances or credits to be traded between national or regional markets, even if these markets are not formally linked. As currently conceived, the Initiative would include independent rating agencies, an International Carbon Reserve, and an International Settlement Platform (World Bank, 2014b). The World Bank has also established a Partnership for Market Readiness to prepare developing countries for implementing market-based systems, as discussed in section 4.3.4.

2.6 Experience

As of early 2014, 20 regional, national, or sub-national cap-and-trade systems were either operating or scheduled to launch in 40 countries (not including emissions trading under the Kyoto Protocol). These include the EU ETS, RGGI, seven regional pilots in China, and emissions trading systems in California, Kazakhstan, New Zealand, Quebec, Switzerland, and Tokyo (World Bank, 2014a). Of these, most had established or proposed at least one international linkage with another cap-and-trade or credit system.

These links fall into four general categories: one-way and two-way linkages between cap-and-trade systems; one-way linkages between cap-and-trade systems and credit systems; implicit linkages via national trading under Article 17 of the Kyoto Protocol; and various types of non-traditional linkage.

The first panel in Table 1 lists former, existing and planned direct linkages between cap-and-trade systems.[13] There have been two cases of planned one-way linkages, both now abandoned. One

13 The two-way linkages described in Table 1 can be bilateral or multilateral. We distinguish them in the table by denoting the former as "Two-way" and the latter as "Multilateral."The multilateral linkages are all two-way.

was Australia's former plan to accept EU ETS allowances beginning in July 2015. Due to the election of a new government in September 2013, Australia rescinded its existing carbon tax and planned cap-and-trade system in July 2014, resulting in the termination of this announced one-way linkage. The other example of one-way linkage was the language in RGGI's 2006 amendment to its MOU that allowed participants to use allowances from foreign cap-and-trade systems when and if RGGI allowance prices exceeded a specified trigger price (the trigger price started at $10 per ton of CO_2 in 2005 and increased by roughly 2 percent each year). Because RGGI prices have remained well below the trigger price, this one-way linkage option was never exercised. The 2013 updates to the RGGI Model Rule ended this conditional linkage (RGGI, 2013b, 3).

Table 1 also lists several proposed bilateral linkages. The most prominent example is the agreement between California and Quebec to link their cap-and-trade systems and hold joint permit auctions beginning in the fall of 2014. Although Australia formerly had plans for a two-way linkage with the EU ETS beginning in 2018, the repeal of Australia's cap-and-trade system ended this link as well (ClimateWire, 2013).[14]

Table 1 includes two examples of multilateral linkage: between the EU ETS nations and between the RGGI states. While these are not technically linkages between independent cap-and-trade systems, both involve countries (in the case of the EU ETS) or sub-national states (in the case of RGGI) negotiating an agreement to merge their carbon markets. Because of the similarities to linkage, it is useful to view such systems as sets of linked cap-and-trade programs (Ellerman and Buchner, 2007).

The second panel in Table 1 lists existing and proposed one-way linkages in which cap-and-trade systems have agreed to accept offsets from ERC systems. By far the most important credit system, in terms of the volume of credits created, is the Kyoto Protocol's CDM. As Table 1 shows, several cap-and-trade systems, including those of the EU, Switzerland, and New Zealand, have established such one-way linkages with the CDM. Of these, the EU has been the dominant purchaser of CDM credits: as of 2011, over 80 percent of issued CERs were surrendered by EU ETS participants or were being held in EU carbon registry accounts (Shishlov and Bellassen, 2012, 16-17).

The third panel in Table 1 lists examples of heterogeneous linkage. Under Mexico's recently established carbon tax on fossil fuels (initially set at $3.50 per ton carbon dioxide equivalent [tCO_2e]), firms may elect to use offset credits from CDM projects developed in Mexico to meet all or part of their tax liability. The precise form of the interaction between these two instruments

14 Less defined, but a potential precursor of a bilateral linkage, is a Memorandum of Understanding signed on July 28, 2014 by the Governor of California and the government of Mexico to coordinate climate policy efforts, including the possible development and implementation of "carbon pricing systems and other market-based instruments" (Kahn, 2014). Also, in 2013, California, Oregon, Washington, and British Columbia established the Pacific Coast Collaborative to coordinate climate policies.

is still being developed (World Bank, 2014a, 81). South Africa also plans to allow offsets to be used in lieu of tax payments when its carbon tax goes into effect, currently planned for 2016 (Bosworth, 2014).

Other proposed offset programs also exist. For example, California has negotiated Memoranda of Understanding with the provinces of Acre, in Brazil, and Chiapas, in Mexico, to work together to develop a framework to allow the use of offsets from those states in California's cap-and-trade system under AB 32.

In addition to the system-level linkages shown in Table 1, some nations' cap-and-trade systems participate in an informal, highly indirect form of linkage via the trading of Assigned Amount Units (AAUs) under the Kyoto Protocol. The Protocol assigns each Annex I Party a quantity of AAUs equal to its GHG emissions target for a given commitment period, measured in metric tons of CO_2-equivalent. The Protocol then requires each Annex I Party, at the end of a commitment period, to surrender enough AAUs to cover its actual emissions over the period. If a country's emissions exceed its AAUs, it is allowed to make up the difference by purchasing AAUs from another country under Article 17 of the Kyoto Protocol (or by obtaining emissions credits under one of the Protocol's project-based mechanisms—Joint Implementation and the CDM) (UNFCCC, 1998).

In principle, AAU trading between nations creates implicit linkages between their domestic carbon abatement policies. For example, consider a transfer of AAUs between two nations with cap-and-trade systems, both of which are committed to meeting their Kyoto Protocol commitments. By buying additional AAUs, the purchasing country would be able to relax the aggregate emissions cap in its domestic cap-and-trade system while still achieving its Kyoto target. Conversely, after the transaction, the selling country would need to tighten its emissions cap in order to meet its Kyoto commitment, holding all else constant.

In practice, the market for AAUs has involved a very limited number of participants. This should not be a surprise, given that governments are not simple cost-minimizing entities and lack necessary information about abatement costs (Hahn and Stavins, 1999). Most AAUs have been purchased by one of three sets of buyers: Japanese firms, the government of Spain, and the World Bank. Other buyers of AAUs have included Austria, Belgium, Ireland, Japan, Luxembourg, the Netherlands, Portugal, and one U.S. firm. Virtually all transactions occurred between 2008 and 2012 and involved sales by economies in transition—specifically, central and eastern European countries. The sole exception was a very small sale of AAUs by New Zealand in 2010 (UNEP Risø Centre, 2013; Ranson and Stavins, 2013a, 6).

There have also been a few instances of partial and unconventional linkage, including some cases of what Burtraw *et al.* (2013) refer to as "linking by degrees." Such linkages have occurred

when jurisdictions have taken actions that fell short of establishing a formal link but nonetheless brought their systems into closer alignment. For example, in 2013, Australia and California signed a memorandum of understanding on sharing information and experience with cap-and-trade systems and with linkage (AGCER & CARB, 2013). Similarly, California and RGGI have engaged in information sharing and have adapted some design elements from each other (Burtraw *et al.*, 2013), while the state of Washington and the United Kingdom have engaged in a partnership to collaborate on carbon-market design, as well as other issues (State of Washington and UK DECC, 2014).

As noted above, linkages among carbon tax systems can be direct or indirect. Carbon taxes are currently in place or planned in British Columbia, Denmark, Finland, Iceland, Ireland, Japan, Mexico, Norway, South Africa, Spain, Sweden, Switzerland, and the United Kingdom. Some of these taxes, particularly those in Europe, appear intended to complement the carbon price established by the EU ETS (World Bank, 2014a, 76-87).

The U.S. federal government has recently proposed CO_2 regulations on existing electricity-generating power plants. These regulations would provide strong incentives and renewed interest in the widespread development of state-level and multi-state market-based policies—in particular, cap-and-trade systems—over the next several years (Chemnick, 2014). While designed as a set of state-specific intensity targets (emissions per megawatt-hour), the proposed rule would allow states to utilize regional cap-and-trade systems, among other approaches, to pursue comparable mass-based targets. It is likely that some of these regional approaches will link with California's AB 32 system and/or the RGGI system.

2.7 Lessons Learned

Experience to date with explicit and implicit linkages of carbon policies across jurisdictions yields some potentially useful lessons (Ranson and Stavins, 2013a). First of all, a number of regions, nations, and sub-national jurisdictions have demonstrated their preference for linkage. Despite evident challenges, the current "bottom-up" trend of bilateral and multilateral linkages has demonstrated significant progress in the context of a potential future hybrid climate agreement. Second, linking carbon markets has proved "powerful and effective," although the risk of linking includes the reality that problems in one market can be transferred via linkage to other systems (World Bank, 2014a, 34).

Third, although there was demonstrable value to firms in Annex I countries from their use of CDM offsets for purposes of cost mitigation, a functioning international market for such offsets does not appear likely to continue under the current political landscape, particularly given changes in the EU ETS. Fourth, the International Transaction Log, part of the Kyoto Protocol process, played an important role by tracking traded units (Marcu, 2014). Fifth, linkages are not

permanent, and are subject to national or sub-national political swings (as occurred in Australia), causing uncertainty for regulated firms (Ranson and Stavins, 2013a).[15]

Finally, the benefits and attraction of linkage are likely to evolve over time. In the short run, the benefits may be more political (developing a sense of momentum and climate leadership) and administrative (learning by sharing, reducing duplicative administrative costs, and coordinating rules and procedures) than economic (this point is also stressed by Burtraw *et al.* [2013]). In the short run, full price harmonization is unlikely, given restrictions on the magnitude of allowance flows observed in current linkage schemes (Table 1). In the absence of full price harmonization, some efficiency-enhancing transactions will not take place. In the long run, however, as carbon markets mature and nations adopt more ambitious mitigation targets, especially in light of the 2-degree-Celsius limit on warming that climate negotiators have embraced, it is reasonable to expect some loosening of constraints on linkage flows, contributing to enhanced price harmonization and increased cost effectiveness of carbon policy.

3. LINKAGE UNDER A FUTURE INTERNATIONAL AGREEMENT

Given that linkage among homogeneous and heterogeneous policy instruments could be brought about through bilateral arrangements, is there a useful role for the multilateral UNFCCC to play in facilitating or regulating linkage in a future climate agreement? To address this question, we examine potential generic needs for facilitating or regulating linkage, and examine, in particular, the implications of the Durban Platform for Enhanced Action. On this basis, we explore the role that linkage might play in a future international climate policy architecture and we identify design elements that could potentially facilitate linkage.

3.1 Generic Needs for Facilitating and Regulating Linkage

As a first step to identifying needs for international governance in regard to linkage, we examine situations in which markets for goods and services of various kinds have been subject to coordination or regulation by national governments and international institutions. We then review rules and oversight that have been provided for existing regional, national, and sub-national GHG cap-and-trade regimes.

3.1.1 National and International Regulation of Markets for Goods and Services

The regulation of markets can be justified by the presence of market failures. For example, a large holder of allowances in a cap-and-trade system may be able to exercise market power, thereby

15 In most cases, however, systems were delinked before linkage came into effect (New Jersey's exit from RGGI being a notable exception). We thank a reviewer for pointing this out.

influencing the market price for allowances and erecting barriers to entry, including in the primary (product) market (Hahn, 1984). While linkage can reduce this impact by enlarging the market, a single entity might still hold a large share of allowances across the linked jurisdictions. In that case, market power could remain a concern.

Regulation could, in principle, limit the propagation of risk from one market to another. In emissions markets, regulation to limit risk could come in the form of price ceilings that trigger the sale of allowances from a reserve to prevent exceptionally costly emissions reductions from being required. Conversely, price floors for emissions allowances can be implemented to ensure financial incentives for a minimal level of emissions reductions.[16]

More broadly, various forms of governance can help play coordinating roles in markets—reducing transaction costs and promoting accountability through definitions, standard setting, or increased transparency. International or cross-jurisdictional institutions can provide several types of support to help facilitate well-functioning markets. One form of support could involve information sharing, such as tracking financial instruments and reporting prices and quantities of transactions to other market participants, thereby reducing information-related transaction costs that might otherwise constitute barriers to trade.[17] A second form of support might focus on developing universal definitions of key terms, thereby promoting a common language for market exchanges. Such universal standards for financial instruments or transactions can facilitate well-functioning markets.

When considering potential market failures, it is important to consider two questions. First, can the market failure be addressed through private-sector engagement without the need for intervention by governments or international organizations? And second, would regulation be welfare improving once politics intrude on the actual design and implementation of regulatory approaches? When considering options for the 2015 Paris agreement, it will be important to keep these questions in mind. Our review of existing linkage mechanisms does, however, suggest the potential for welfare improving regulatory approaches. Even if one takes the position that some form of top-down regulatory oversight of linkage is not necessary, it will still be important to ensure that the Paris agreement does not contain elements that would inadvertently *impede* linkage and reduce the effectiveness of market-based climate policy mechanisms.

16 Murray, Newell, and Pizer (2009) proposed an allowance reserve as an alternative to price caps and floors. This mechanism requires a regulatory and governance structure. The EU has also proposed a Market Stability Reserve to address potential market imbalances (European Commission, 2014d).

17 Some information services may best be provided by private firms. In this case, it may be that the regulatory role is to ensure transparency and open access to market transaction data.

3.1.2 Rules and Oversight in Existing Regional, National, and Sub-National Cap-and-Trade Regimes

Oversight mechanisms are in place in several existing cap-and-trade systems, both in the United States and in Europe. Elements of these existing mechanisms provide insights regarding how responsibilities may be allocated between the UNFCCC and participating nations.

3.1.2.1 Regional Greenhouse Gas Initiative

RGGI is essentially a linked system of separate state-level GHG trading programs. Eight of the original ten RGGI member states[18] established rules and oversight responsibilities through a 2005 Memorandum of Understanding (MOU). The MOU established a Regional Organization with several functions: providing a deliberative forum for member states; developing systems for tracking emissions and allowances; and providing technical assistance for states to develop standards, including for the review of offset certification (RGGI, 2005 and 2014a).

The RGGI MOU also prescribes market rules, including setting the initial emissions cap and establishing the rate of decline of the cap and the quantity of allowances allocated to each member state, as well as rules governing allowable types of offset projects (including a prohibition on the use of offsets from outside the United States unless a price trigger is reached, and a rule that specifies a 2-1 exchange rate for offsets from projects located in U.S. states that are not RGGI members). RGGI allowance auctions are conducted quarterly through a regional auction platform, subject to each state's determination of what portion of its allowance budget to offer at auction (RGGI, 2014b). Finally, the Regional Organization contracts for Market Monitor Reports to independently verify the efficiency and competitiveness of the market and to identify any attempts to manipulate the allowance market (RGGI, 2014d). However, the RGGI MOU is clear that the Regional Organization is "a technical assistance organization only" and "shall have no regulatory or enforcement authority with respect to the program…" (RGGI, 2005). Individual member states retain the lion's share of oversight and enforcement authority in the RGGI system.

One lesson from the RGGI approach is the important distinction between regulation/enforcement and technical assistance. The states reserve enforcement authority to themselves, while the Regional Organization provides important information, coordination, and technical assistance support at a centralized level. This delineation of functions follows from economic principles, given the public good nature of information and coordination activities and suggests a similar potential delineation of responsibilities between the UNFCCC and parties in any oversight of market mechanisms, including linkage. RGGI illustrates that a technical advisory body can serve an effective coordinating function and does not require a formal legal instrument.

18 Massachusetts and Rhode Island were not original signatories to the MOU, but signed before the first compliance period began. New Jersey was an original signatory but withdrew in 2011, leaving RGGI with nine participating states.

3.1.2.2 California's AB 32 System and Its Linkage with Quebec

Before linking with the Quebec emissions trading system (Table 1), California autonomously wrote regulations for its own emissions trading system, established pursuant to AB 32, including: procedures for running auctions and reporting auction results; rules for trading, including holding limits and reporting requirements; and timing and prices for cost containment reserve credit sales (CARB, 2013c).

The 2013 agreement between California and Quebec to link their systems (beginning in 2014) builds on technical work both governments undertook through their membership in the Western Climate Initiative and includes plans to resolve several potential barriers to functioning linked markets (CARB and Quebec, 2013). Specific issues to be resolved include mutually agreed upon definitions of key terms, combined periodic allowance auctions, a common electronic registry platform for trading, and entities for facilitating coordination between the parties. The systems' respective offset protocols continue separately under the agreement, but with the understanding that any changes to one party's system will require consultation with the other jurisdiction.

The experience of California and Quebec highlights the need to coordinate multiple elements of individual programs when linking. It also shows that linkage is made more complicated when it is executed after program design rather than during initial program design. Of course, this experience also makes clear that the barriers to linking pre-existing programs are not insurmountable, though in this case of this linkage the barriers were reduced by California and Quebec's previous engagement in the Western Climate Initiative.

3.1.2.3 Financial Regulation of RGGI and California Allowance Markets

Trading of emissions allowance options and futures contracts in the United States is regulated by the U.S. Commodity Futures Trading Commission (CFTC). The Commission's broadly defined mission is to "protect market participants and the public from fraud, manipulation, abusive practices and systemic risk related to derivatives…and to foster transparent, open, competitive and financially sound markets" (CFTC, 2014). The International Commodity Exchange recently submitted amendments to the U.S. CFTC's exchange rules providing for the trading of options contracts in both the RGGI (2015 and 2016) and California (2017 and 2018) allowance markets (ICE Futures, 2014).

The CFTC's mission to foster transparency in markets indicates the importance of institutions to support the smooth functioning of financial markets and dovetails with a decision of COP-19 in Warsaw in November 2013, which requested the UNFCCC's Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) to identify the information that parties should put forward to facilitate the "clarity, transparency and understanding" of each party's intended nationally determined contribution (UNFCCC, 2014, Decision 1/CP.19 2(b) and (c)).

As discussed in section 3.3.2, oversight related to standards of transparency in reporting emissions data and cross border flows of permits of the type provided by the CFTC could be provided by the UNFCCC or by other organizations that have the technical expertise in place to provide that oversight.

3.1.2.4 European Union Emissions Trading System

The European Union Emissions Trading System (EU ETS) provides a more centralized model of linked trading systems than the examples that currently exist in North America.[19] Emissions monitoring and verification is governed by European Commission guidelines, rather than by plans adopted by member countries (European Commission, 2014a). Following an EU directive change in 2009, allowance tracking is centralized under a single registry, which records lists of covered entities in each country, allocations received, and verified emissions; accounts of all parties holding allowances; transfers of allowances between account holders; and annual reconciliation between allowances and verified emissions (European Commission, 2014b).

The European Commission is in the process of revising its financial-markets rules, and as part of this process has proposed including emissions allowances as fully regulated financial instruments (European Commission 2014e).[20] This would make ETS allowance markets subject to safeguards and monitoring aimed at preventing market manipulation, increasing market transparency in terms of allowance prices and quantity of allowance transactions, and imposing checks on buyers and sellers to prevent money-laundering. The EU's experience addressing issues of tax fraud and cybersecurity will be extremely valuable for any monitoring or regulatory role the UNFCCC or other designated entities might play in overseeing linked carbon markets in the post-2020 period.

3.1.3 International Coordination of National Policies for Regulating Markets

In finance and trade, existing international institutions demonstrate how information-sharing, standard-setting, and model policies can facilitate the harmonization of national policies that regulate markets for various goods and services. The UNFCC or another international institution could likewise facilitate linkage by providing a forum for setting standards, exchanging information, and developing model policies or rules.

---

19 The governance structure of the EU-ETS has evolved over time, from a structure that was highly decentralized in the beginning to one that is increasingly centralized. For a description of the early organization of the ETS, see Kruger *et al.*, (2007).

20 This also marks a transition from national financial regulation towards more centralized EU regulation. In the UK, where most emissions trading to date has occurred, the Financial Services Authority regulated futures and options, but oversight of futures trading has shifted to the UK's Financial Conduct Authority.

3.1.3.1 Coordination of Financial Regulation

Internationally, a number of financial institutions facilitate market operation through information sharing, coordination of laws and regulation, cooperation on enforcement issues, and peer review. These may provide lessons for linkage and for carbon markets more generally.

The Basel Committee, which consists of representatives from 27 central banks and banking regulators, aims to enhance global financial stability by improving the quality of banking supervision worldwide. The Committee is best known for a series of capital adequacy accords, which have influenced national regulators significantly, even though they are not legally-binding (Scott and Gelpern, 2012; BIS, 2013). The Financial Action Task Force (FATF), with representatives from 34 countries, combats money laundering and terrorist financing by developing minimum standards for laws and regulations, by monitoring the implementation of such standards through a peer-review process, and by imposing sanctions on non-complying countries, for example, by prohibiting financial transactions with institutions in non-complying countries (Brummer, 2011).

The International Organization of Securities Commissions, whose members are regulatory agencies that cover more than 95 percent of the world's securities markets, develops and promotes standards for securities regulation, cooperation on enforcement, and information exchange (IOSCO, 2014). The Financial Sector Assessment Program (FSAP), which is jointly implemented by the International Monetary Fund (IMF) and the World Bank, conducts analyses of countries' financial sectors (IMF, 2014a). FSAP was originally a voluntary program for countries to assess and demonstrate the health of their financial systems. After the financial crisis of 2008-09, however, the IMF identified 25 nations with "systemically important financial sectors" that must submit analyses to FSAP at least once every five years (IMF, 2014b). Assessments remain voluntary for other jurisdictions.

The Bank for International Settlements (BIS) acts as a bank for national central banks. It offers a range of financial services to central banks and other official monetary institutions for maintaining monetary and financial stability. The Committee on Payment and Settlement Systems, headquartered at BIS, engages in standard-setting activities for payment and settlement systems, and monitors new developments in cross-jurisdictional settlement systems (BIS, 2014a,b).

The UNFCCC, an organization designated by the UNFCCC, or another organization formed by countries interested in linkage and carbon markets more generally might learn from some of these examples in designing measurement, reporting, and verification systems, as well as in developing default or model rules (discussed further below). The UNFCCC, however, will need to be cautious in not taking on oversight roles for which it does not have the technical expertise. Given the complexity of modern international markets, it will be important for national governments and the UNFCCC to work closely with organizations that have strong expertise in market functioning and coordination.

3.1.3.2 International Harmonization of Standards and Rules to Promote Trade

Several international institutions facilitate international trade, the most prominent among them being the World Trade Organization (WTO) and its General Agreement on Tariffs and Trade (GATT). WTO members receive Most-Favored Nation (MFN) status and national treatment (the equal treatment of imported and locally-produced goods), among other benefits, when engaging in trade with each other (WTO, 2014a). In exchange, members must commit to meet specific requirements with respect to the transparency of trade policies and periodic scrutiny of policy implementation (WTO, 2014b).

Trade in services can be obstructed by the prospect of double taxation, where an entity providing a service across international borders might be taxed both where the income was earned and where the entity is based. There are no general international rules governing the proper method of taxing such income, and thus bilateral agreements between nations are necessary to overcome this barrier. The Organisation for Economic Co-operation and Development (OECD) established a Model Tax Convention for nations interested in adopting bilateral treaties on taxation, which has served as the basis for more than 225 bilateral tax treaties (OECD, 2014). The concept of model rules is one that we discuss further in a later section and one that the Paris agreement could play a role in facilitating.

3.1.3.3 Other Coordination of National Policies

In addition to international efforts to harmonize rules for trade and financial transactions, there are other cases of international organizations that facilitate the harmonization of national policies. One example is the World Health Organization (WHO). WHO's mission includes developing and promoting public health standards, as well as monitoring global health trends that are beyond the scope and capacity of national governments (WHO, 2014a). WHO also develops and enforces "International Health Regulations," legally binding for WHO's member nations, which stipulate conditions under which nations must report public health outbreaks that may have consequences for other countries (World Health Organization, 2014b). Again, there could be much value in sharing experiences and lessons about the harmonization of national policies in discussions with groups such as the WHO to develop best practices to facilitate linkage in the Paris agreement.

3.2 Linkage as Part of Climate Policy Architecture

Existing and planned links among regional, national, and sub-national climate change policies provide preliminary evidence regarding both the near-term and long-term roles that linkage may play in a global climate policy architecture.

3.2.1 Near-Term Role for Linkage

Since the 1997 Kyoto Protocol entered into force, a patchwork system of linkages has evolved among independent regional, national, and sub-national climate policies. This patchwork of existing and planned links hints at the outline of a near-term "system" that would combine several regional, directly linked cap-and-trade systems, with some level of indirect connection via a common credit system, such as the CDM or a sectoral crediting program.

Although linkage can help with market functioning, the near-term cost savings from direct links between cap-and-trade systems may be modest. Because two-way links are currently planned primarily between systems in developed nations, they may not be able to help regulated firms take advantage of very low-cost abatement opportunities (such as those available in developing countries). Furthermore, direct linkages suffer from a climate policy irony: the links that are most attractive for economic reasons—i.e., those between systems with very different allowance prices (such as RGGI and the EU ETS)—may be politically the most difficult to establish because of concerns (real or perceived) about the large international capital flows that such links might generate.[21]

Links with a credit system can also contribute to the near-term goals of cost-minimization and market liquidity. In principle, a near-term set of indirect links could yield much of the cost savings and other advantages of a broad set of direct links, while also preserving a high level of national control over domestic carbon markets. This would allow countries to tailor policies to fit their specific political and economic circumstances.

In practice, the ability of credit systems—in particular, the CDM—to create meaningful indirect links between cap-and-trade systems has been mixed. Despite the potential cost-savings from linking to a credit system, some jurisdictions that have implemented cap-and-trade programs (such as California and Quebec) have chosen to allow only selected credits generated from outside projects. Others have imposed quantity limits on the use of external credits, have designed application procedures that make it difficult to receive approval for new offset projects, or have implemented trigger mechanisms that allow the use of foreign offsets only if domestic allowance prices exceed some pre-determined level.

This general reluctance to allow links with credit systems (in particular, with the CDM) is motivated by concerns about additionality (that is, the concern that credit systems like the CDM allow firms to claim emission reductions that would have happened anyway) and a desire to emphasize domestic reductions. Politically, as we discuss elsewhere, domestic reductions appear

21 However, the inclusion of international offsets in the Waxman-Markey cap-and-trade bill that passed the U.S. House of Representatives in 2009 was viewed as a critical element of the U.S. contribution to the commitment by developed countries in the Copenhagen Accord to mobilize $100 billion annually by 2020 for mitigation, adaptation, and other climate-change-related activities in developing countries.

to be preferred to offsets (controlling for cost). But if the goal is to maximize emission reductions at minimum cost, offset limits are not desirable so long as the environmental integrity of offsets can be assured. Practically speaking, it may be difficult to provide that assurance, in which case limits are applied.

3.2.2 Linkage as a Foundation for a Future International Climate Policy Architecture

By helping to build an institutional framework of coordination among different GHG mitigation systems, linkage could help create a pathway to a more robust long-term international climate policy architecture. In the short term, there will probably be several regional sets of directly linked systems, with some indirect linkage through the CDM or other offset/sectoral crediting programs. This short-term arrangement may transition toward a system with a greater number of direct links. In the same way that the GATT transitioned into the WTO, a bottom-up system of links between national-level climate programs could, in principle, provide the basic institutional framework for a broader agreement (Stewart and Wiener, 2003; Ranson and Stavins, 2013b).[22]

Linkage could help support a future climate agreement in another way: by providing incentives for nations to adopt market-based climate policies. Major developed countries with cap-and-trade systems may be expected to attempt to use offset programs as both a carrot and a stick to stimulate mitigation action in counties without an emissions cap. The best example of this may be the EU ETS policy toward CDM offsets from developing countries. Whereas the EU ETS allowed regulated entities to use CDM credits originating in any developing country between 2008 and 2012, beginning in 2013 new CDM credits are only allowed for projects originating in "Least Developed Countries" (the 48 poorest countries, as defined by the United Nations), thus excluding projects in China and India, among other countries (European Commission, 2011b). This policy shift is deliberate; according to EU documents: "[w]hile initially the use of international credits was allowed for cost-effective compliance, this has been complemented with the objective of actively using the leverage the EU possesses as the by far most important source of demand for international credits" (European Commission, 2011b, 1).

Finally, linkage could support a future climate agreement in the short run by facilitating learning and sharing of ideas about how to implement market based mechanisms, by reducing the administrative costs of meeting nationally determined contributions, and by contributing to a sense of momentum that helps build political support at the national level.

---

22 On the other hand, linkage could also create political and regulatory obstacles to a future agreement. Linking two cap-and-trade systems requires agreement about a variety of design characteristics, including the stringency of the cap in each system. To the extent that linkage makes it difficult for countries to change such design characteristics, it might also become more difficult for countries to make the adjustments necessary to support some future climate agreement. Whether this outweighs the political momentum that linkage can provide is an empirical question.

3.3 Implications of the UNFCCC's Durban Platform for Linkage

It is anticipated that a new international climate agreement will be finalized in December 2015, in Paris, pursuant to the 2011 Durban Platform for Enhanced Action. A number of important issues related to the role of markets and linkage remain to be worked out in the Paris agreement.

3.3.1 Durban Platform Approach

The Durban Platform for Enhanced Action calls for Parties to the UNFCCC to "…develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention." The new agreement is to be adopted at COP-21, in 2015, and will apply from 2020. In contrast to the negotiating mandate for the Kyoto Protocol, which specifically excluded any new commitments for non-Annex I Parties, the Durban Platform is open-ended and specifies that the new agreement will be "applicable to all Parties" (UNFCCC, 2012).

Marcu (2014) has identified three possible scenarios for how carbon markets could evolve under the Paris agreement. One scenario involves a true global carbon market with a centralized regulatory authority to oversee market operation. No one—including Marcu—expects this sort of "super KP" outcome in Paris. Marcu's second scenario is dubbed the "Cartesian" scenario. In this scenario, regional, national, or sub-national carbon-pricing schemes are developed, with the UNFCCC playing a role as certifier of emission reductions for purposes of meeting international obligations. As exists in current linked cap-and-trade systems, domestic factors may limit the amount of trading that occurs between jurisdictions. The UNFCCC would play an oversight role, determining whether an emission reduction can be counted under the international agreement.

Marcu's third scenario is termed "Globally Networked Carbon Markets" and is based in part on the aforementioned World Bank's (2014b) Globally Networked Carbon Markets Initiative. As in the second scenario, it envisions a patchwork of regional, national, and sub-national carbon reduction systems. Unlike the second scenario, however, an independent assessment and rating service (rather than the UNFCCC) would assess the value of emission reduction units. An International Carbon Reserve would serve to maintain liquidity in global trading by buying, selling, banking, and borrowing carbon reduction assets. An essential difference from the second scenario is the delegation of oversight and market facilitation authority to third parties with expertise in these sorts of functions.[23]

Regardless which vision of global carbon markets emerges, linkage will play an important role. How linkage is operationalized depends on the global carbon market approach that evolves and the role of centralized authorities, whether it be the UNFCCC or some other institution(s).

23 Discussions in Paris on the Framework for Various Approaches (FVA) that was initiated in Durban in 2011 may provide an organizing structure for some of these issues. See Marcu (2012) and IETA (2013).

Hints at the form of the future global system may be seen in the ongoing and evolving international negotiations. Over the past several years, these negotiations have gravitated toward a structure for the 2015 agreement that will feature a hybrid policy architecture, namely one that combines top-down elements, such as for monitoring, reporting, and verification (MRV), with a bottom-up set of contributions ("nationally determined contributions" or NDCs), consisting of emissions limitation targets and/or actions specified by individual countries, presumably on the basis of what they judge to be feasible domestically (Höhne, Ellermann, and Li, 2014). As of June, 2014, no parameters had been adopted regarding what countries can offer as contributions (Bodansky and Diringer, 2014); one can expect a mix of market-based mechanisms and non-market regulatory approaches, along with absolute emissions targets as well as emissions-intensity targets.

While COP-19 in Warsaw (November 2013) began to develop the broad outlines of this hybrid architecture, the exact shape of the Paris agreement is unknown and could evolve in a number of ways (Bodansky and Diringer, 2014). It is worth reviewing various elements that might be included, because the necessary elements of a 2015 agreement to facilitate linkage depend critically on the ultimate design of the overall agreement.

For example, the 2015 agreement may articulate a quantitative, long-term goal to make more concrete the Convention's ultimate objective to stabilize "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, 1992, Article 2). At COP-16 in Cancun, the Parties to the UNFCCC adopted a goal of limiting global average warming to less than 2 degrees Celsius from pre-industrial levels. The 2015 agreement could further elaborate the UNFCCC's objective—for example, by articulating a cumulative or medium-term emissions goal. Such a quantitative emissions goal, Bodansky and Diringer (2014) argue, would make it easier to assess the ambition of individual countries' NDCs and their sufficiency in helping achieve the goal.

Identifying cost effectiveness as an element of the long-term goal could provide reassurance that the costs of meeting the goal are not being ignored; it would also remind negotiators of the important role that market-based mechanisms and linkage can play in contributing to economically efficient environmental outcomes. A long-term goal for linkage in a global system might be full price harmonization across country and regional mitigation systems. A short- to medium-term goal might be to limit price differences to bands around some central price—which itself would be expected to rise in conjunction with any quantitative goals on mitigation.

A second key element of the 2015 agreement concerns the formulation, presentation, and inscription of national mitigation contributions (Bodansky and Diringer, 2014). This element involves many issues, including the legal character of NDCs (whether, for example, each country would commit to achieving its NDC), the content of the NDCs (for example, specificity and scope), the time frame of NDCs, accounting rules, participatory and information requirements

(issues of transparency), and *ex ante* review. As Marcu (2014) notes, the sooner details are resolved over the shape of the 2015 agreement and how countries intend to implement their NDCs, the sooner markets can begin to develop and function.

A third element is the process for revising NDCs. Revisions might be left to the discretion of individual parties, they might require collective agreement among all parties, or something in between. How this plays out will have implications for market mechanisms and linked systems.

A fourth element is the degree of transparency and accountability in implementing NDCs. This set of issues parallels existing efforts under the Kyoto Protocol to review compliance with Kyoto emission targets, as well as MRV requirements negotiated in the Cancun Agreements. Transparency and accountability are critical to the success of linkage mechanisms.

Finally, there is the issue of whether and how subsequent rounds of NDCs will be negotiated (Bodansky and Diringer, 2014). The design of linked market-based mechanisms will need to take into account the time frame and level of uncertainty about out-year commitments when addressing such issues as banking and borrowing, sunset provisions for linkage agreements, and other dynamic market-related design issues.

3.3.2 Long-Term Role for Linkage under the Durban Platform

A set of unilateral emissions-limitation contributions that is part of a hybrid policy architecture under the 2015 agreement, combined with a decentralized set of links, could result in a more cost-effective outcome (Jaffe, Ranson, and Stavins, 2010). The near-term outlines of this approach may already be emerging, with regional trading partners choosing to link directly with each other, with broader indirect linkages via the CDM or through new sectoral crediting mechanisms. As more jurisdictions establish cap-and-trade and other systems, this fragmented near-term system could evolve into a broader bottom-up architecture that includes a set of direct linkages.

Whether such a decentralized architecture actually achieves meaningful environmental results in a cost-effective manner depends on several factors. A sufficient number of large emitter countries (industrialized and developing) would have to agree to participate and commit to substantial unilateral emissions reductions. In the case of industrialized countries, commitments would need to be self-motivated—in part driven by internal politics. In some developing countries, and especially in the least developed countries, commitments would likely depend on incentives provided by developed countries. Such incentives could be positive—for example, developed countries could offer financial support for climate abatement policies and the opportunity to sell allowances or offset credits. Developed countries could also create negative incentives for participation, for example by imposing carbon-border-tax adjustments as a condition for the opportunity to sell offset credits. For this type of international policy architecture to be cost-effective would require links among GHG trading systems in industrialized and developing countries.

3.3.3 A Role for the 2015 Agreement to Facilitate Linkage

It will likely be left to the top-down (or centralized, UNFCCC-based) components of the 2015 agreement to provide mechanisms—and institutions—to compare contributions and verify performance, in part to measure progress toward global goals. In addition, preliminary international discussions and negotiations to facilitate the use of markets to enhance the cost effectiveness of approaches to reduce emissions have already commenced under the UNFCCC in the form of the FVA.

The FVA can consist of a set of components and rules designed to increase the likelihood that the various national approaches used for mitigation meet some set of common standards, especially in terms of environmental integrity (Carbon Market Forum, 2012) and accounting rules. The FVA would thereby focus on mitigation actions that produce reductions (units) used for compliance with international obligations by a jurisdiction other than the one where they were created or issued. Such actions can be market or non-market based. In other words, the FVA could facilitate linkage of heterogeneous national climate policies under the 2015 Agreement.

Key objectives of the FVA might include helping to ensure that internationally traded units used for compliance under the Paris agreement are reported, reviewed, and tracked to avoid double-counting. FVA rules and standards might be informed by, or build upon, Kyoto Protocol flexible-mechanism resources, such as the International Transaction Log, and on the resources of jurisdictions with existing market systems, such as the European Union's central registry (Marcu, 2014).

It is clear that, under the umbrella of the FVA, UNFCCC Parties and observers are considering how emissions reductions under a 2015 agreement, including reductions achieved with non-market mechanisms, can be transferred between and among governments—that is, to a close approximation, how such mitigation-reduction systems might be linked. Parties and observers are also considering how the FVA could be used to link existing or future market-based mechanisms that provide for emissions trading between private parties.

3.4 Potential Design Elements in an International Agreement to Facilitate Linkage

Specific elements of a future international policy architecture under the 2015 agreement could help facilitate the growth and operation of a robust system of international linkages between regional, national, and sub-national policies. On the other hand, other potential elements of a new agreement could get in the way of effective, bottom-up linkage.

3.4.1 Elements That Would Inhibit Effective Linkage

One design element that would have the effect of inhibiting international linkage would be overly prescriptive or restrictive rules on allowable trading across linked systems. A clear example would be a requirement (or even a preference) for domestic actions to achieve national commitments. Such a "supplementarity principle" can render cross-border linkage difficult or impossible, and thereby drive up compliance costs, decrease international ambition, and reduce the feasibility of reaching an agreement.

For example, several provisions of the Kyoto Protocol suggest that internal emissions abatement should take precedence over compliance through the Protocol's flexibility mechanisms (International Emissions Trading, Joint Implementation, and the CDM),[24] but the precise meaning of this principle of supplementarity has been debated since the adoption of the Protocol. Also, as noted previously, limits on the use of foreign offsets for compliance are common in existing regional, national, and sub-national cap-and-trade systems.

A second (and related) issue is the confusion that can arise from competing and conflicting objectives and rules between the UNFCCC and regional or national trading systems. An example is the controversy over CDM credits issued for projects that target industrial gases such as HFC-23 and nitrous oxide (N2O) from adipic acid production. Responding to concerns that access to CDM credits was creating perverse incentives to continue or even increase production of these gases, the EU ETS disallowed the use of CDM credits from industrial gas projects for purposes of ETS compliance after 2012 (European Commission, 2011a). The CDM Executive Board, however, continued to issue credits for these projects (albeit with greater restrictions on their use). The controversy sowed confusion and damaged perceptions of carbon trading in general (Marcu, 2014).

The potential for conflicting rules relates to a broader issue about how national or regional carbon mitigation systems become recognized as valid for purposes of meeting international commitments under the Paris agreement. Marcu (2014) notes two possible approaches (approval and transparency) by which reductions under domestic systems might become eligible for counting in the UNFCCC context. The former approach would require explicit COP approval of domestic systems, while the latter would involve the development of model rules through COP negotiations. Domestic systems would then demonstrate how they conform to internationally

24 Article 6.1 of the Kyoto Protocol states that: "The acquisition of emission reduction units [through trading] shall be supplemental to domestic actions for the purposes of meeting commitments under Article 3." Likewise, Article 17 states that: "Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that article." Article 12.3.b states that: "Parties included in Annex I may use the certified emission reductions accruing from such project activities [under the Clean Development Mechanism] to contribute to compliance with part of their quantified emission limitation and reduction commitments under Article 3 …" (UNFCCC, 1998).

agreed templates. The latter approach could be combined with a peer review process but would not require explicit COP approval.[25]

A third area of potential concern stems from a lack of clarity (or confusion) over objectives. For example, adding a "sustainable development condition" to CDM projects can create confusion in markets (Marcu 2014). This in turn undermines trading across systems, an essential role of linkage.

Finally, rules that restrict which countries can link (for example, allowing linkage only among Annex I countries), or that make it difficult for countries to join the category of countries that can link, would inhibit effective linkage.

3.4.2 Elements That Could Facilitate Effective Linkage

If linkage is to play a significant role in executing a hybrid international policy architecture, then several categories of design elements merit consideration for inclusion in the Paris agreement, either directly or by establishing a process for subsequent international negotiations. These elements include: definition of compliance units; registries and tracking; monitoring, verification, and reporting of individual trades; interaction with cost-containment instruments; and oversight and monitoring of the market in aggregate.

Effective linkage requires common definitions of key terms, particularly with respect to the units that are used for compliance purposes. This will be especially important for links between heterogeneous systems, such as between a carbon tax and a cap-and-trade system. A model rule for linkage could be particularly helpful in this area.[26]

Registries and tracking are necessary with linked systems, whether the links bring together a homogeneous or heterogeneous set of policies.[27] Indeed, a key role for the top-down part of a hybrid architecture that allows for international linkage of national policy instruments will be tracking, reporting, and recording allowance unit transactions. A centralized institution could maintain the accounts of parties that hold allowances, record transfers of allowances between

25 Variations on these two approaches could build on the flexibility mechanisms described in Bodansky and Diringer (2014). These include offering alternatives under which different states may operate to comply with overarching rules, offering default and opt-out clauses, offering opt-in procedures, providing contextual standards to provide flexibility where needed, and using guidelines that serve to set expectations (but not requirements) for behavior and mechanism design.

26 In regard to market coverage, even a (homogeneous) set of national cap-and-trade systems will differ in many design elements, but not all of these elements will require coordination or harmonization. For example, systems may differ in their scope—that is, in the sectors of their respective economies that are included under an emissions cap—but this difference need not create a barrier to linkage and trading.

27 This could be particularly important to avoid double counting in overlapping jurisdictions.

account holders, and annually reconcile allowances and verified emissions. This is particularly important because of the likely omission of AAUs from the post 2020 regime (Marcu, 2014). Some form of international compliance unit would contribute to more effective and efficient registry operation and would help avoid double-counting problems.

International compliance units would make the functioning of an international transaction log more straightforward and reduce the administrative burden of reconciling international registries with national registries (Marcu, 2014).[28] There is also a possible role for the UNFCCC to provide centralized registry services for countries that lack the capacity to develop national registries on their own (Marcu 2014). Finally, there may be economies of scale in regionalizing registries for certain developing countries under the auspices of the UNFCCC or some other multilateral institution (for example, the World Bank or a regional development bank).

More broadly, any system, with or without linkage, will require monitoring, verification, and reporting of emissions. Likewise, compliance and enforcement mechanisms are of generic need in any effective agreement.

The interaction of linked systems with cost-containment elements (banking, borrowing, offsets, and price-stabilization mechanisms) raises particular issues in the context of linkage, because in some cases these mechanisms automatically propagate from one linked system to another. Common rules for approving and measuring offsets may be important, and—more broadly—a tiered system of offset categories could be helpful, with jurisdictions choosing their own "exchange rates" for each category.

Finally, market oversight and monitoring, together with various safeguards against market manipulation such as by large holders of allowances who may be able to exercise market power, may increase confidence in the system. In some cases, national and international institutions may already exist, or need only relatively minor additional capacity, to provide these functions.

4. FROM THE CONCEPTUAL TO THE CONCRETE: INTERNATIONAL LAW AND LINKAGE

4.1 Possible Functions of the UNFCCC Regime with Respect to Linkage

The 2015 Paris agreement could play at least four different roles with respect to linkage of heterogeneous policy instruments. First, it could discourage linkage, either by not allowing countries to count international transfers toward their mitigation contributions, or by limiting

28 Prag *et al.* (2013) argue that mandating a standard type of international compliance unit type may not improve accountability and could add complexity as domestic mitigation schemes evolve over time. While their argument is framed specifically in the context of international units as a feature of the FVA, they make the useful general point that what is especially important is that standards underlie the creation of any units that are designed to comply with commitments made under the Paris agreement.

the number or types of transferred units that can be counted for compliance purposes. Second, the agreement could be silent on the topic of linkage, creating legal and regulatory uncertainty about whether international transfers are allowed. Third, it could expressly authorize linkage but not provide any further details about how linkage should occur, leaving it up either to future UNFCCC negotiating sessions to work out the details or to national governments to develop bilateral or multilateral linkage arrangements. Finally, the Paris agreement could establish institutional arrangements and rules that facilitate and promote linkage.

In pursuing this last role—namely, facilitating and promoting linkage—the UNFCCC regime could serve three related functions. First, it could provide an international infrastructure for linkage—for example, an international system for MRV, an international transaction log to register transfers between national systems and prevent double counting, and an international compliance mechanism. Second, it could play a regulatory function, for example by establishing minimum standards to ensure that linkage arrangements do not undermine the environmental integrity of international and domestic climate change efforts or by requiring international certification for linkage arrangements that will be used for international compliance. Third, the UNFCCC could also play a coordinating function, providing harmonized or model rules for national trading systems and/or international linkages in order to reduce the transaction costs of linkage.

4.2 Key Variables

Rules relating to linkage could be formulated in many different ways in the 2015 outcome. They could be mandatory or optional; uniform or harmonized; and formalized in a legally binding, hard-law instrument, such as a treaty, or in a non-binding instrument, such as a COP decision, model rule, or guidelines.

International trade and finance instruments, such as those outlined in section 3.1, provide illustrations of these different options, as well as insights into how GHG linkage could be governed. Presently, a wide range of different types of agreements and organizations govern international trade and finance. An analysis of these approaches shows how different governance functions relating to linkage can be legally implemented, demonstrates that different governance approaches are preferred for different objectives, and suggests that some types of legal instruments are better suited to implementing a particular governance function.

4.2.1 Mandatory vs. Optional

Rules for multilateral linkage in the 2015 outcome could be mandatory or optional. International instruments relating to finance and trade provide illustrations of these different options. The GATT, for example, sets mandatory rules limiting barriers to trade such as quotas. In contrast, the Convention on the International Sale of Goods (CISG) sets default rules, which parties are free

to depart from in negotiating sales contracts. The OECD Model Tax Convention (OECDMTC) is even less directive than the CISG—it merely serves as a template that nations can choose to use as a starting point for bilateral negotiations.

In general, mandatory rules are appropriate to address "cooperation" problems, where each nation has an incentive to cooperate only if it has an assurance that other nations will reciprocate. In contrast, optional rules—such as the CISG or OECDMTC rules—are useful in addressing "coordination" problems, where harmonized rules help to lower transaction costs.

The 2015 outcome could include a mixture of mandatory and optional elements. For example, it could commit parties undertaking linkage to a system of international tracking and review, but leave issues related to market coverage, cost containment, and treatment of new emitters and emitter closures to be addressed through informal coordination among national regulators or through the development of a model rule or guidelines by the COP, the Subsidiary Body for Implementation (SBI), or a non-UNFCCC institution.

4.2.2 Uniform vs. Harmonized

Multilateral linkage rules could provide for greater or less uniformity among national policies or linkage arrangements. Some international instruments specify highly detailed rules, which produce uniform results. The Kyoto Protocol and Marrakesh Accords, for example, prescribe precise rules to track and account for transfers of compliance units between parties. Other instruments prescribe more general standards, which harmonize national approaches (i.e., ensure some level of similarity), but give parties flexibility to take into account their particular circumstances. The IPCC inventory guidelines, for example, provide methodologies for estimating GHG emissions, but allow nations to choose among different tiers, so that officials can use methods appropriate for their resources and can focus on those emissions that are most significant to their national totals (IPCC, 2006).

Uniformity and harmonization each have their advantages. Uniformity reduces transaction costs and creates greater policy certainty. But harmonization allows nations to take into account their particular circumstances and values, and therefore tends to be easier to achieve. Moreover, harmonization leaves some room for nations to experiment and may thus promote more dynamic systems that have a greater capacity to evolve over time.

From the perspective of market participants, international carbon trading would be easiest if every nation adopted the same linkage rules, so that trade between any two countries occurred in exactly the same way. However, this level of uniformity is unlikely to be achieved in the near term (if ever), and is unnecessary for linkage to be widely adopted. While some elements of linkage may require uniform rules, most can be addressed by harmonized rules—in other words, rules that are

similar but not identical. For example, uniform rules may be needed to define the units of trade and to track units to avoid double counting internationally (Tuerk, *et al.*, 2009). But procedures for MRV and crediting may require only broad adherence to minimum standards, to ensure that emission reductions actually occur, while leaving countries free to adopt more stringent rules that limit the use of emissions credits.

Importantly, some issues relevant to linkage can be addressed through local, non-harmonized rules. For example, national cap-and-trade systems could adopt different allocation methods and yet still be effectively linked. Insisting on uniform rules for all elements of linkage in the 2015 outcome would thus be unnecessary and counter-productive. It would not yield more linkage activity, and it would delay the adoption of international legal instruments to facilitate linkage. A mixture of more and less uniform rules, providing for a spectrum of harmonization, is best for facilitating linkage.

4.2.3 Hard vs. Soft

Multilateral linkage rules could be contained in international instruments that are either "hard" or "soft" (Shelton, 2003). Treaties such as the UNFCCC, the Kyoto Protocol, the GATT, and the CISG represent hard law, and are legally-binding as a matter of international law. In contrast, political agreements, guidelines, model rules, and recommendations serve a prescriptive function but are not legal instruments—hence they represent soft law.

Because hard legal instruments provide a stronger signal of commitment than soft-law instruments and are potentially applicable directly in domestic courts, they are useful for addressing issues where reciprocity or domestic enforcement is important (Tuerk *et al.*, 2009). Hard-law instruments provide greater certainty, but are generally more difficult to negotiate and revise. For example, the WTO Uruguay Round agreements took eight years to negotiate, and the Doha Round of revisions to the WTO is still underway after thirteen years.

In contrast, soft-law instruments are typically easier to adopt and amend, thus making them useful for addressing issues in their early phases, when there may not be sufficient political will to adopt a treaty or when it may be necessary to revise the rules on a regular basis in response to new information and circumstances. The Basel Capital Accords, for example, were quickly revised in response to the 2008 financial crisis, with Basel III being adopted in 2010.

A number of soft law standards have already been adopted to harmonize national climate mitigation systems, outside of the UNFCCC. For example, the International Standards Organization (ISO) has promulgated standards for monitoring and reporting GHG emissions and emissions reductions at the organization and project level (ISO, 2009a; ISO, 2009b; ISO, 2013a); ISO standards also exist for validating or verifying GHG reduction claims (ISO, 2009c; ISO, 2011; ISO, 2013b).

A mixture of hard- and soft-law instruments might be best suited to facilitate linkage. Core elements might be contained in a hard-law instrument that is comparatively difficult to amend. A provision in a hard-law instrument that mitigation-unit transfers can count towards a party's emission-reduction contribution would likely be required for wide-scale linkage to occur.[29] A hard-law instrument might also include model rules defining the units to be used for linkage, as well as a requirement that parties allow international tracking of units in order to engage in linkage.

Other elements of linkage, however, could potentially be addressed in soft-law instruments or through informal coordination among national regulators. Either of these approaches would allow for greater flexibility to make changes in the future. For example, minimum standards for national and international MRV, registries, and crediting mechanisms might be set forth in soft-law instruments. Although soft-law instruments are not legally binding, compliance could be assured by making compliance a condition of linkage, just as national governments have required compliance with the FATF and Basel Committee standards as a condition for granting access to their domestic financial markets.

4.2.4 Relationships among variables

Mandatoriness, uniformity, and legal form are independent variables; they need not co-vary. The capital adequacy requirements in the Basel Accords are phrased in mandatory rather than optional terms, even though the various Basel Accords are soft-law instruments. Similarly, ISO standards may be very precise, even though they are not legally binding. Conversely, the CISG is a legal agreement, and hence qualifies as hard law, even though it sets forth non-mandatory, default rules from which parties may deviate.

Nevertheless, mandatoriness, uniformity, and legal form are related in that they all tend to increase the capacity of a rule to constrain behavior. Thus, rules that address systemic risks or collective action problems are ideally formulated in precise, mandatory, and legally binding terms, all else being equal. In contrast, rules intended to address coordination problems may be optional and soft.

4.3 Linkage in the International Climate Change Regime to Date

From the outset, the UN climate change regime has recognized the potential role of linkage in promoting cost-effective emissions mitigation. Indeed, rules adopted to date as part of that regime illustrate many of the options for addressing linkage in the 2015 agreement.

29 Such an agreement could be conditioned on both linked systems adopting international minimum standards, as discussed below.

4.3.1 UNFCCC

The UNFCCC provides the seed for international linkages by allowing developed countries to implement mitigation policies "jointly with other Parties" (UNFCCC, 1992, Article 4.2(a)). Although countries might decide to link their mitigation policies even in the absence of a multilateral climate change regime like the UNFCCC (for the reasons discussed in sections 2.3 and 2.5), Article 4.2(a) provides an incentive for linkage by implicitly authorizing parties to use transferred units for international compliance purposes.

The history of the Activities Implemented Jointly (AIJ) mechanism under the UNFCCC (not to be confused with Joint Implementation under the Kyoto Protocol), however, illustrates the potential for undermining agreement on a general linkage provision in the process of elaborating more specific rules. The rules adopted by the COP for AIJ severely restricted the use of this mechanism, by providing that developed countries could not count activities implemented jointly with developing countries towards fulfillment of their commitments and by providing that such activities are "supplemental, and should only be treated as a subsidiary means of achieving the objective of the Convention" (UNFCCC, 1995, Decision 5/CP.1, par. c). In practice, comparatively few activities implemented jointly were initiated under the UNFCCC (UNFCCC, 2006).

4.3.2 Kyoto Protocol

The Kyoto Protocol went much further in promoting linkage: it established three linkage mechanisms—International Emissions Trading, Joint Implementation, and the Clean Development Mechanism (CDM)—and by allowing transferred units to count towards international compliance.[30] In contrast to the UNFCCC experience with AIJ, nations ultimately agreed to detailed rules for operationalizing these three linkage mechanisms in the 2001 Marrakesh Accords (UNFCCC, 2001).

The rules elaborated under the Kyoto Protocol illustrate the basic infrastructure required to allow linkages for international compliance purposes. Key elements of this infrastructure include:

- Definition of a common compliance unit, denominated in terms of metric tons of CO_2 equivalent emissions (UNFCCC, 1998, Article 3).
- An international accounting system for tracking transfers and preventing double counting, through the international transaction log (ITL).

30 In addition to promoting international linkage, Article 2.1(a)(v) of the Kyoto Protocol implicitly endorses the use of market instruments at the national level by encouraging participating parties to reduce or phase out "market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors that run counter to the objective of the Convention and application of market instruments" (UNFCCC, 1998).

- Minimum standards regarding MRV, to ensure that all parties participating in the Protocol's market mechanisms achieve a basic level of environmental integrity (UNFCCC 1998, Articles 5, 7, 8; UNFCCC, 2001: Marrakesh decisions on national emissions inventory systems and national registries).[31]
- An international credit system—the CDM—to ensure that emissions credits meet a basic level of environmental integrity (UNFCCC, 2008, Article 12).

Experience with the Kyoto Protocol also illustrates that creating an international infrastructure to allow linkage for international compliance purposes does not ensure that countries will, in fact, link their national mitigation systems. The Protocol permits parties to link their national mitigation policies and addresses some of the key issues raised by bilateral linkage—for example, it establishes common MRV standards, thereby streamlining the linkage process. But the Protocol does not require parties to link, nor does it address all of the issues involved in linkage—and comparatively little linkage has actually occurred. For example, the European Union, from the outset, has imposed more restrictions than the Protocol on the use of international credits and has progressively restricted the use of CDM credits in its emissions trading system over time. In practice, if two Kyoto Protocol Parties wish to link, they must negotiate a bilateral linkage agreement, rather than rely solely on the Kyoto Protocol rules.

4.3.3 Framework for Various Approaches

As discussed in section 3.3.3, although the progress of FVA negotiations has been fitful thus far, the FVA could provide a platform for the elaboration of rules for linking heterogeneous national systems to limit emissions.

4.3.4 Partnership for Market Readiness

The Partnership for Market Readiness (PMR) is a World Bank initiative intended to promote the use of market-based instruments, such as emissions trading, in national mitigation policies. Although the PMR largely focuses on capacity building, it also has a harmonizing effect through its promotion of common approaches to issues such as MRV, baseline setting, and crediting, and thereby could help facilitate linkages among national systems (World Bank, 2014c).

4.3.5 ICAO and IMO

Finally, both the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) are exploring the use of market-based measures (MBMs) to reduce

31 For example, the Marrakesh Accords (UNFCCC, 2001) set forth minimum rules for national systems to inventory greenhouse gas emissions and for national registries of compliance units. Compliance with these minimum standards is a condition for participation in the Protocol's market mechanisms.

emissions from international civil aviation and maritime transport (Van Asselt, 2014). Although these MBMs would serve the same function as linkage—namely, to equalize carbon prices across countries—they are generally being envisioned as uniform international trading systems rather than as linked national systems.

4.4 Elements of a 2015 Paris Agreement

The contents of the Paris outcome are still highly uncertain, so it is difficult to specify in detail how the Paris outcome might address linkage issues. For example, if the Paris outcome makes parties' NDCs legally binding, then linkage could play an important role in enabling countries to comply with their NDCs, through transfers among parties. Conversely, if NDCs are not legally binding, then transfers of contributions among parties would not serve a compliance function, although they could still serve as an indicator of a party's commitment to fulfilling its NDC.

Nevertheless, the broad contours of the 2015 outcome are beginning to come into focus and it is possible to make some preliminary observations about how linkage issues might be addressed. The 2015 outcome is likely to include, at its core, a legally binding agreement that establishes parties' basic commitments as well as the regime's institutional arrangements. Given the difficulties of negotiating a legally-binding agreement in the relatively little time remaining before the Paris COP, as well as the difficulty, for some countries, of ratifying an elaborate agreement, the 2015 agreement is likely to be comparatively brief, addressing only essential issues and doing so in a minimalist manner. More detailed rules addressing issues such as linkage are likely to be put forward in COP decisions. These could be adopted concurrently with the core agreement, as part of the 2015 outcome, or, more likely, the Paris agreement could authorize the COP to adopt rules on linkage at subsequent sessions.

If the Paris agreement leaves the development of rules on linkage to future COP decisions, a key question will be whether these rules must be adopted before linkage can occur. If so, opponents of linkage would have tremendous leverage, since COP decisions require consensus. Alternatively, the Paris agreement could allow parties to move forward with linkage while simply authorizing the COP to adopt additional rules regarding linkage at a future date.

4.4.1 Authorization of linkage

The 2015 agreement may not need to authorize linkage between parties, because linkage is already authorized by Article 4.2(a) of the UNFCCC (discussed in section 4.3.1; UNFCCC, 1992). Nevertheless, an explicit statement that parties may transfer portions of their NDCs to other parties and that parties can use transferred units from other jurisdictions to demonstrate that they have met their NDC commitments would be helpful in providing certainty both to governments and to private market participants. Some statement of this sort is likely a necessary condition for

widespread linkage to occur. In addition, if it were deemed desirable to allow linkages between parties and non-parties to the new agreement, the agreement should explicitly authorize such linkages.[32] Similarly, the core agreement might authorize the use of CDM credits by parties in achieving their NDCs, thereby providing a common crediting platform for the 2015 agreement.

4.4.2 Minimum standards to ensure environmental integrity

Rules aimed at ensuring environmental integrity could, in theory, be contained in the core 2015 agreement itself or in subsequent COP decisions. But it is unlikely that detailed rules for linkage can be developed in time for inclusion in the core agreement. Nor would including such detailed rules in the core agreement be desirable. Given the difficulties of amending a legally binding instrument, including linkage rules in the core agreement would make it difficult for these rules to evolve in light of experience.

For this reason, minimum standards to ensure environmental integrity should be elaborated in COP decisions—this would include, for example, establishing the requirements for national and international MRV, registries, and crediting mechanisms (Hood *et al.*, 2014; Tuerk *et al.*, 2009). In this case, the function of the core agreement with respect to linkage might be confined to articulating general principles related to environmental integrity, while also authorizing the COP, or another organization, to develop more detailed rules. Minimum standards would not require uniformity among national systems or linkage agreements. MRV and crediting procedures only need to be credible in order for linkage to occur and be sustained, not identical (Tuerk *et al.*, 2009). Parties could have some flexibility in designing their national systems for MRV and crediting, so long as their systems satisfied the agreement's minimum requirements.

As noted earlier, most minimum standards for trade and financial linkages have been developed through soft-law instruments, because these instruments are typically easier to negotiate and adopt and can also be revised more easily, allowing them to evolve over time in response to changing needs and circumstances (Brummer, 2011). Rules for multilateral linkage could also be developed outside the UNFCCC process, by institutions that bring together national regulators, market participants, and private experts. The ISO is one possibility (Metcalf and Weisbach, 2012), but a new, informal institution addressing mitigation linkage is another alternative.

Whatever minimum standards are adopted for multilateral linkage, international oversight of compliance would be important, to ensure the integrity both of the 2015 agreement (to the extent transfers are permitted for international compliance purposes) and of the linked national systems (to the extent transfers count towards domestic compliance). Oversight functions could

32 Although allowing linkages with non-parties would enhance cost-effectiveness, it would diminish the incentive of non-parties to join the agreement.

be performed by a UNFCCC institution such as the expert review groups that currently review Annex I inventories, by national authorities in linked systems, or by an outside body.[33]

4.4.3 Default/Model Rules

Many elements of GHG linkage could be addressed through default or model rules, from which states are free to deviate at their discretion. For example, a model rule might define key terms, including the compliance units (e.g., metric tons CO_2 equivalent). Rules that may benefit from this approach are typically concerned with the details of linking two regulatory systems. For example, two nations interested in linking their GHG cap-and-trade systems would have to consider rules regarding market coverage, cost containment, banking and borrowing, compliance periods, allocation methods, and the treatment of new emitters and emitter closures (Tuerk *et al.*, 2009; Metcalf and Weisbach 2012). Additional rules would be desirable for linking heterogeneous systems. For example, efforts to link a tax system and a cap-and-trade system must consider the treatment of emission tax payment credits (Metcalf and Weisbach, 2012).

Developing uniform rules to address all of these issues is unrealistic. Current and planned regulatory systems for GHG mitigation vary significantly in size, design, characteristics, and scope. They are tailored to achieve domestic policy objectives and reflect domestic circumstances and the domestic evolution of climate policy (Tuerk *et al.*, 2009). Thus, rules for linking disparate systems would likely need to be too different to support a uniform or even minimum-standard approach.

Despite the need for local flexibility, a degree of harmonization could be achieved through default rules that facilitate linkage by providing a common framework for governments to use when developing their own bilateral or plurilateral linkage agreements. In other words, countries would not need to develop bilateral agreements from scratch; they could choose to adopt some or all of the default rules and thereby shorten the time needed to develop linkage agreements. In addition, the existence of default rules may encourage efforts to harmonize disparate systems over time. As nations reform and update their linkage agreements, they may choose to match the default rules more closely. Over the long term, such harmonization would reduce transaction costs for market participants by reducing the number of different rules that must be learned and complied with.[34]

---

33 Examples of international oversight procedures intended to limit systemic risks include the IMF's FSAP, the FATF's peer review process to ensure compliance with the FATF's anti-money-laundering standards (see section 3.1.3.1 for FSAP and FATF), and Reports on Observance of Standards and Codes (ROSCs), which are carried out by the IMF (Scott and Gelpern, 2012; Brummer, 2011).

34 The Convention on Contracts for the International Sale of Goods (CISG) and the OECD Model Tax Convention (OECDMTC) illustrate the role of default rules in lowering transaction costs. The CISG provides a set of substantive rules that parties can use to prepare contracts; these have become a lingua franca of international commerce (Kröll *et al.*, 2011) and are enforceable in domestic courts. The OECDMTC serves as a basis for over 225 bilateral tax treaties (Miller and Oats 2014). Although the OECDMTC is not binding on any nation, the terms of the convention are so commonly adopted as part of bilateral treaties that they represent, in effect, default rules for bilateral linkages between tax systems.

Default rules for GHG linkage could be developed by the COP or by an outside institution, and could be adopted via a hard-law multilateral convention or a soft-law approach. The hard-law approach would deliver maximal certainty and likely has the greatest chance of eventually creating de facto uniform rules. However, a hard-law approach also has several disadvantages. Negotiations may be difficult if not impossible given the disparities between existing and planned systems. Furthermore, because linked carbon markets are a relatively recent phenomenon, rules that appear optimal today may not be optimal in the future. A model-law approach would provide flexibility and allow default rules to evolve through an iterative process, just as model tax treaties have evolved over time.[35] Once linked carbon markets are mature—perhaps decades in the future—a multilateral convention might be appropriate to encourage the default rules to evolve into uniform rules that would reduce transaction costs.

5. CONCLUSION

The upcoming Paris agreement is a critical next step in the on-going international process to reduce global GHG emissions. Whether the agreement will be sufficiently ambitious to put the world on a path toward limiting global average warming to 2 degrees Celsius, as Parties to the UNFCCC have called for, remains to be seen. In general, greater ambition is more easily realized when its costs are low. Market-based mechanisms are an important element in the portfolio of potential actions that can lead to cost-effective solutions. Linkage—between and among market and non-market systems for reducing GHG emissions—is another key element. This paper's contribution is to catalog and assess a variety of ways in which the Paris agreement, and more generally the on-going negotiations, can facilitate and advance linked systems.

If linkage is to play a significant role in a hybrid international policy architecture, then several categories of design elements merit serious consideration for inclusion in the Paris agreement, either directly or by establishing a process for subsequent international negotiations. In general, effective linkage requires common definitions of key terms, including particularly the units to be used for compliance purposes. This will be particularly important for links between heterogeneous systems, and it is an area where a model rule could be particularly helpful.

Second, linkage requires registries and tracking mechanisms, whether the systems being linked are homogeneous or heterogeneous. Indeed, a key role for the top-down part of a hybrid architecture that allows for international linkage of national policy instruments will be the tracking, reporting, and recording of allowance unit transactions. International compliance units would make the functioning of an international transaction log more straightforward and reduce the administrative burden of reconciling international registries with national registries. Minimum standards for

35 In the U.S. context, the Clean Air Task Force has proposed that the U.S. Environmental Protection Agency issue a model rule for interstate emissions trading, under its proposed power plant rule under section 111(d) of the Clean Air Act (Clean Air Task Force, 2014).

approving and measuring offsets may be important. And market oversight and monitoring may increase confidence in the system, although in some cases, national and international institutions that can provide oversight may already exist or may need only relatively minor additional capacity to assume these functions.

Including detailed linkage rules in the core Paris agreement is not desirable as this could make it difficult for rules to evolve in light of experience. Instead, minimum standards to ensure environmental integrity should be elaborated in COP decisions—for example, the COP could establish minimum requirements for national MRV, registries, and crediting mechanisms. In terms of linkage, the function of the core Paris agreement might be confined to articulating general principles relating to environmental integrity, while also authorizing the COP or another organization to develop more detailed rules. Whatever minimum standards are adopted, international oversight of compliance will be important to ensure the integrity both of the 2015 agreement and of linked national systems.

Many elements of GHG linkage can be addressed through default or model rules that nations are free to deviate from at their discretion. Rules that may benefit from this approach are typically concerned with the details of linking two regulatory systems. For example, nations interested in linking their cap-and-trade systems would have to consider rules for market coverage, cost containment, banking and borrowing, compliance periods, allocation methods, and the treatment of new emitters and emitter closures. Additional rules may be needed for linking of heterogeneous systems.

Developing uniform rules to address all of these issues is unrealistic. Instead, a degree of harmonization could be achieved through default rules that facilitate linkage by providing a common framework for nations to use when developing their own linkage agreements. Although there is no need for the 2015 agreement itself to elaborate harmonized linkage rules, the agreement might authorize the COP to develop default linkage rules that nations can use in negotiating bilateral linkage agreements.

Ultimately, the most valuable outcome of the Paris agreement regarding linkage might simply be the inclusion of an explicit statement that parties may transfer portions of their NDCs to other parties and that these transferred units may be used by the transferees to meet NDC commitments. From a legal perspective, such a statement would help provide certainty both to governments and private market participants and is likely a necessary condition for widespread linkage to occur. Such a minimalist approach will allow diverse forms of linkage to arise among what will inevitably be heterogeneous NDCs, thereby advancing the dual objectives of cost-effectiveness and environmental integrity in the international climate policy regime.

Table 1: Linkages Between Emissions Trading Systems

System 1	System 2	Type of Linkage	Enact. Date	Effect. Date	Prices at Enactment		Caps ($mtCO_2$)		Notes and References	
					#1	#2	#1	#2		
Linkages among cap-and-trade systems										
27 EU nations	(via the EU ETS)	Multi	2003	2005	none	na	varied	2,299		1, 12
Norway	EU ETS	One-way		2005						10
Norway	EU ETS	Multi	2007	2008	€0	€20	15	2,080		2
Iceland	EU ETS	Multi	2007	2008	none	€20	0	2,080	G	2
Liechtenstein	EU ETS	Multi	2007	2008	none	€20	18	2,080		2
Switzerland	EU ETS	Two-way	*							3
Australia	EU ETS	One-way	2013*	2014	AUD$25	€7-€8	TBD		C	4, 11
Australia	EU ETS	Two-way	*	2018	AUD$25	€7-€8	TBD	1,852		4
Australia	New Zealand	Two-way	*				TBD			5
Australia	EU ETS, NZ	Delinking	2014	2014						24
California	Quebec	Two-way	2012/13	2014	$14	none	160	25		6, 14,15
10 U.S. states	(RGGI)	Multi	2005	2009	none	na	varied	168	A	7
RGGI	Any CAT system	One-way	2005	2009	none	€9/EUA	168	2,299	B	8
RGGI	Any CAT system	Delinking	2013	2014	$3	€5/EUA	91	2,299	B	9
New Jersey	RGGI	Delinking	2011	2012	$2	$2	21	150		13
Linkages from cap-and-trade systems to credit systems										
EU ETS Phase 1	CDM	One-way	2004	2005	€9	$5	2,299	na	D	1, 16, 17
EU ETS Phase 2	CDM	One-way	2004	2008	€9	$5	2,299	na	D	1, 16, 17
EU ETS Phase 3	CDM	One-way	2004	2013	€9	$5	2,299	na	D,E	1, 16, 22
EU ETS Phase 2	JI	One-way	2004	2008	€9	$6	2,299	na	D	1, 16, 18
EU ETS Phase 3	Non-LDC CDM	Delinking	2012	2013	€6	€4	2,084	na		26
Switzerland	CDM	One-way	1999	2008	none	$4-$7	na	na		17, 19
New Zealand	CDM, JI, RMU	One-way	2008	2008	none	€11	na	na		17, 20, 21
Australia	CDM, JI	One-way	2011	2012/15	none	€6	TBD	na		4
RGGI	Any credit system	One-way	2005	2009	none	$5-8	110	na	B	8
RGGI	Any credit system	Delinking	2013	2014	none	$5	165	na	B	9
California	Acre and Chiapas	One-way	*					na		25
Quebec	Acre and Chiapas	One-way	*					na		25
Tokyo ETS	CDM	One-way	2008	2010	$142	$18	13	na	F	23
Linkage from carbon tax to credit systems										
Mexico	CDM	One-Way	2013	2014	none	€.4	na	na	H	27
South Africa	CDM, VCS	One-Way	2013	2016						28

* indicates a proposed linkage.

[A] The RGGI states signed a MOU in 2005, and then each passed authorizing legislation between 2006 and 2008.

[B] The original Model Rule included language (section XX-10.3(b)(1)) allowing the use of allowances from foreign cap-and-trade or credit systems (including Kyoto flexibility mechanisms) if RGGI allowance prices exceeded a "two-stage price trigger event" that began at $10 in 2005 and increased by roughly 2 percent each year. The 2013 amendments to the Model Rule eliminated this linkage.

[C] Participants in Australia's system may use EUAs for up to 50 percent of their compliance obligations.

[D] Credit price reflects pre-compliance offsets for which seller assumes risk.

[E] Under recent proposed rules, EU ETS participants will be entitled to use international credits during the 2012-2020 period up to the higher of two limits: (a) the international credit entitlement specified in the national allocation plan for Phase 2; or (b) 11 percent of the free allocation of EU allowances granted to them in that period.

[F] Use of CDM credits is allowed only if domestic prices exceed a threshold, and if Tokyo-based credits are used as well.

[G] Per EEA Joint Committee decision 146/2007, Iceland did not submit a National Allocation Plan for EU ETS Phase II, since it had no installations large enough to be covered by the cap-and-trade system.

[H] Mexico allows companies to pay with CDM credits in lieu of tax payments equal to the credit market value at the time of paying the tax; however, only CDM projects developed in Mexico can be used in this way. The price shown in the table if from RGGI.

Sources: [1] European Parliament (2004); [2] European Commission (2007b); [3] European Commission (2010); [4] Australia (2013); [5] Combet and Grosner (2011); [6] CARB (2013a); [7] RGGI (2008); [8] RGGI (2013a); [9] RGGI (2013b), Mehling and Haites (2009); [10] Sopher and Mansell (2013a); [11] European Commission (2012, 2013a); [12] European Commission (2007a); [13] NJ.com (2011); [14] CARB (2013b); [15] Quebec MDDEFP (2013); [16] Sijm (2009, 21); [17] UNDP (2006); [18] Allen Consulting Group (2005); [19] Sopher and Mansell (2013b); [20] New Zealand Parliament (2008); [21] New Zealand Ministry of the Environment (2011); [22] European Commission (2013b); [23] EDF and IETA (2013); [24] ClimateWire, 2013; [25] EDF (2010); [26] European Commission (2011b); [27] World Bank (2014a, 81), SendeCO2 (2014). [28] South Africa National Treasury (2014).

SOURCE: Ranson and Stavins 2013a, updated by Ranson October 2014.

References

AGCER (Australian Government Clean Energy Regulator) and CARB (California Air Resources Board). 2013. "Memorandum of Understanding Between the Clean Energy Regulator and the California Air Resources Board." CER/ARB MOU Reference No. 1. July 30. www.arb.ca.gov/newsrel/2013/mou_cer_arb_073013.pdf.

Allen Consulting Group. 2005. "The Cost of Tradeable Emissions Units Under the Kyoto Protocol; Pricing a Potential Future Greenhouse Liability: Report to New Zealand Treasury." June. www.treasury.govt.nz/publications/informationreleases/carbonprice/kp-acg-jun05.pdf.

Australia (Government of). 2013. "Starting Emissions Trading on 1 July 2014: Policy Summary." July. www.climatechange.gov.au/sites/climatechange/files/files/reducing-carbon/carbon-pricing-policy/cef-policy-summary-moving-ets.PDF.

BIS (Bank for International Settlements). 2013. *Basel Committee on Banking Supervision: A Brief History of the Basel Committee*. Basel, Switzerland: Bank for International Settlements. July. www.bis.org/bcbs/history.pdf.

BIS. 2014a. "Fact Sheet: Committee on Payment and Settlement Systems." www.bis.org/about/factcpss.htm, accessed June 20, 2014.

BIS, 2014b. "CPSS: Standard Setting Activities." www.bis.org/cpss/cpssinfo02.htm, accessed June 20, 2014.

Bodansky, Daniel, and Elliot Diringer. 2014. "Building Flexibility and Ambition into a 2015 Climate Agreement." Arlington, Virginia, USA: Center for Climate and Energy Solutions. June. www.c2es.org/docUploads/int-flexibility-06-14.pdf.

Bosworth, Brendon. 2014. "Offsets to Cushion South African Carbon Tax." Inter Press Service News Agency. May 28. www.ipsnews.net/2014/05/offsets-cushion-south-african-carbon-tax.

Brummer, Chris. 2011. *Soft Law and the Global Financial System: Rule Making in the 21st Century*. Cambridge University Press, Cambridge, U.K.

Burtraw, Dallas, Karen L. Palmer, Clayton Munnings, Paige Weber, and Matthew Woerman. 2013. "Linking by Degrees: Incremental Alignment of Cap-and-Trade Markets." Discussion Paper 13-04. Washington, D.C.: Resources for the Future. April. www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=22167.

Calel, Raphael, and Antoine Dechezlepretre. 2012. "Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market." Working Paper 87. London and Leeds, U.K.: Centre for Climate Change Economics and Policy. March. http://personal.lse.ac.uk/calel/Calel%20and%20Dechezlepretre%20(2012).pdf.

CARB (California Air Resources Board). 2013a. "Air Resources Board sets date for linking cap-and-trade program with Québec." Press Release #13-18. April 19. www.arb.ca.gov/newsrel/newsrelease.php?id=430.

CARB. 2013b. "Quarterly Auction 2, February 2013. Summary Results Report; June 5, 2013 Update." www.arb.ca.gov/cc/capandtrade/auction/february_2013/updated_feb_results.pdf.

CARB. 2013c. "Article 5: California cap on greenhouse gas emissions and market-based compliance mechanism to allow for the use of compliance instruments issued by linked jurisdictions." July. www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf.

CARB and Quebec (Government of). 2013. "Agreement between the California Air Resources Board and the *Gouvernement du Québec* concerning the harmonization and integration of cap-and-trade programs for reducing greenhouse gas emissions." September. www.arb.ca.gov/cc/capandtrade/linkage/ca_quebec_linking_agreement_english.pdf.

Carbon Market Forum. 2012. "Submission to the UNFCCC on FVA and NMM." Brussels: Centre for European Policy Studies. http://unfccc.int/resource/docs/2013/smsn/ngo/323.pdf.

CFTC (Commodity Futures Trading Commission). 2014. "Mission and Responsibilities." www.cftc.gov/About/MissionResponsibilities/index.htm, accessed June 19, 2014.

Chemnick, Jean. 2014. "Regional markets take center stage as states weigh EPA proposal." *Greenwire*. June 19. www.eenews.net/greenwire/2014/06/19/stories/1060001616.

Clean Air Task Force. 2014. "Power Switch: An Effective, Affordable Approach to Reducing Carbon Pollution from Existing Fossil Fuel Power Plants." Boston, Massachusetts, USA. February. www.catf.us/resources/publications/view/194.

ClimateWire. 2013. "New Australian government dismantling climate policies." September 12. www.eenews.net/climatewire/2013/09/12/stories/1059987111.

Combet, Greg, and Tim Groser. 2011. "Joint Media Release: Australia and New Zealand Advance Linking of Their Emissions Trading Schemes." December 5. www.climatechange.gov.au/sites/climatechange/files/media/March%202013/MR20111205B.pdf.

EDF (Environmental Defense Fund). 2010. "Tropical Forests Protection Pact Hailed for Protecting Climate." Press release. November 16. www.edf.org/news/tropical-forests-protection-pact-hailed-protecting-climate.

EDF (Environmental Defense Fund) and IETA (International Emissions Trading Association). 2013. "Tokyo: The World's Carbon Markets: A Case Study Guide to Emissions Trading." September. www.ieta.org/assets/Reports/EmissionsTradingAroundTheWorld/edf_ieta_tokyo_case_study_september_2013.pdf.

Ellerman, A. Denny and Barbara Buchner. 2007. "The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results." *Review of Environmental Economics and Policy* 1(1): 66-87. http://dx.doi.org/10.1093/reep/rem003.

European Commission. 2007a. "Emissions trading: EU-wide cap for 2008-2012 set at 2.08 billion allowances after assessment of national plans for Bulgaria." Press Release IP/07/1614. October 26. http://europa.eu/rapid/press-release_IP-07-1614_en.htm.

European Commission. 2007b. "Emissions trading: Commission announces linkage EU ETS with Norway, Iceland and Liechtenstein." Press Release IP/07/1617. October 26. http://europa.eu/rapid/press-release_IP-07-1617_en.htm.

European Commission. 2010. "Opening negotiations with Switzerland on linking Emissions Trading Systems." November 5. http://ec.europa.eu/clima/news/articles/news_2010110501_en.htm.

European Commission. 2011a. "Commission Regulation (EU) No 550/2011…on determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, certain restrictions applicable to the use of international credits from projects involving industrial gases." June 7. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:149:0001:0003:EN:PDF.

European Commission. 2011b. "Questions and Answers on Use of International Credits in the Third Trading Phase of the EU ETS." http://ec.europa.eu/clima/policies/ets/linking/docs/q_a_20111114_en.pdf.

European Commission. 2012. "Australia and European Commission agree on pathway towards fully linking Emissions Trading systems." Joint Press Release. August 28. http://europa.eu/rapid/press-release_IP-12-916_en.htm?locale=en#PR_metaPressRelease_bottom.

European Commission. 2013a. "International Carbon Market." http://ec.europa.eu/clima/policies/ets/linking/index_en.htm, accessed May 28, 2014.

European Commission. 2013b. "Climate Change Committee approves proposed Regulation on international credit entitlements for 2013-2020." July 10. http://ec.europa.eu/clima/news/articles/news_2013071002_en.htm.

European Commission, 2014a. "Monitoring, reporting and verification of EU ETS emissions." http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm, accessed October 17, 2014.

European Commission, 2014b. "Union Registry." http://ec.europa.eu/clima/policies/ets/registry/index_en.htm, accessed June 20, 2014.

European Commission, 2014c. "International Carbon Market." http://ec.europa.eu/clima/policies/ets/linking/index_en.htm, accessed October 16, 2014.

European Commission, 2014d. "Proposal for a Decision of the European Parliament and of the Council Concerning the Establishment and Operation of a Market Stability reserve for the Union Greenhouse Gas Emission Trading Scheme and Amending Directive 2008/87/EC." http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014PC0020&from=EN, accessed August 31, 2014.

European Commission, 2014e. "Ensuring the Integrity of the European Carbon Market." http://ec.europa.eu/clima/policies/ets/oversight/index_en.htm, accessed October 16, 2014.

European Parliament. 2004. "Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004, amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms." Official Journal of the European Union L 338/18. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0101:en:NOT.

Flachsland, Christian, Robert Marschinski, and Ottmar Edenhofer, 2009. "To Link or Not to Link: Benefits and Disadvantages of Linking Cap-and-Trade Systems." *Climate Policy* 9: 358-372. http://dx.doi.org/10.3763/cpol.2009.0626.

Haas, Ernst. 1980. "Why Collaborate? Issue-Linkage and International Regimes." *World Politics* 32: 357-405. www.jstor.org/stable/2010109.

Hahn, Robert W. 1984. "Market Power and Transferable Property Rights." *Quarterly Journal of Economics* 99: 753-765. www.jstor.org/stable/1883124.

Hahn, Robert W. and Robert N. Stavins. 1999. "What Has the Kyoto Protocol Wrought? The Real Architecture of International Tradeable Permit Markets." Washington, D.C.: AEI Press. February. www.hks.harvard.edu/fs/rstavins/Papers/What_Has_Kyoto_Wrought.pdf.

Helm, Carsten. 2003. "International Emissions Trading with Endogenous Allowance Choices." *Journal of Public Economics* 87 (12):2737–47. http://dx.doi.org/10.1016/S0047-2727(02)00138-X.

Höhne Niklas, Christian Ellermann, and Lina Li. 2014. "Intended Nationally Determined Contributions under the UNFCCC." Cologne, Germany: Ecofys. June. www.ecofys.com/files/files/ecofys-giz-2014-intended-nationally-determined-contributions-under-unfccc.pdf.

Holtsmark, Bjart and Dag Einar Sommervoll. 2012. "International Emissions Trading: Good or Bad?" *Economic Letters* 117: 362-364. http://dx.doi.org/10.1016/j.econlet.2012.05.034.

Hood, Christina, Gregory Briner, and Marcelo Rocha. 2014. "GHG or Not GHG: Accounting for Diverse Mitigation Contributions in the Post-2020 Climate Framework."Climate Change Expert Group Paper no. 2014(2). Paris: OECD. May. www.oecd.org/env/cc/GHG%20or%20not%20GHG_CCXGsentout_May2014_REV.pdf.

ICAP (International Carbon Action Partnership). 2014. "Mexico Announces ETS Plans and Introduces a Carbon Tax." ICAP Newsletter, Issue 2, June 12. https://icapcarbonaction.com/index.php?option=com_jnews&act=mailing&task=view&mailingid=9.

ICE Futures. 2014. "New Emissions Options Vintages: Submission Pursuant to Section 5c(c)(1) of the Act and Regulation 40.2 and 40.6(a)." May 21. www.cftc.gov/ucm/groups/public/@rulesandproducts/documents/ifdocs/rul052114iceus002.pdf.

IETA (International Emissions Trading Association). 2013. "Response to the Call for Inputs on FVA, NMM and non-market based approaches." September 2. www.ieta.org/assets/UNFCCC/ieta_fvanmm%20unfccc%20input_020913.pdf.

IETA. 2014a. "About." www.ieta.org/overview, accessed October 16, 2014.

IETA. 2014b. "The Select Committee on Energy and Climate Change's Inquiry on linking emissions trading systems: Written evidence submitted by the International Emissions Trading Association (IETA)." April 21. www.ieta.org/assets/PositionPapers/ieta_ets%20linking_uk%20parliamentary%20inquiry_april%202014%20final.pdf.

IMF (International Monetary Fund). 2014a. "Supporting Documents Country FSAPs." www.imf.org/external/NP/fsap/fsap.aspx, accessed June 20, 2014.

IMF. 2014b. "The Financial Sector Assessment Program (FSAP)." www.imf.org/external/np/exr/facts/fsap.htm, accessed June 20, 2014.

IOSCO (International Organization of Securities Commissions). 2014. "[About]The International Organization of Securities Commissions." www.iosco.org/about, accessed June 21, 2014.

IPCC (Intergovernmental Panel on Climate Change). 2006. "2006 IPCC Guidelines for National Greenhouse Gas Inventories." www.ipcc-nggip.iges.or.jp/public/2006gl.

ISO (International Standards Organization). 2009a. "ISO 14064-1:2006 Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals." www.iso.org/iso/catalogue_detail?csnumber=38381.

ISO. 2009b. "ISO 14064-2:2006 Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements." www.iso.org/iso/catalogue_detail?csnumber=38382.

ISO. 2009c. "ISO 14064-3:2006 Greenhouse gases — Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions." www.iso.org/iso/catalogue_detail?csnumber=38700.

ISO. 2011. "ISO 14066:2011 Greenhouse gases—Competence requirements for greenhouse gas validation teams and verification teams." www.iso.org/iso/catalogue_detail?csnumber=43277.

ISO. 2013a. "ISO/TR 14069:2013 Greenhouse gases — Quantification and reporting of greenhouse gas emissions for organizations — Guidance for the application of ISO 14064-1." www.iso.org/iso/catalogue_detail.htm?csnumber=43280.

ISO. 2013b. "ISO 14065:2013 Greenhouse gases — Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition." www.iso.org/iso/catalogue_detail?csnumber=60168.

Jaffe, Judson, Matthew Ranson, and Robert Stavins. 2009. "Linking Tradable Permit Systems: A Key Element of Emerging International Climate Policy Architecture." *Ecology Law Quarterly* 36:789-808. www.boalt.org/elq/documents/elq36-4-01-jaffe-2009-1209.pdf.

Kahn, Debra. 2014. "Gov. Brown signs pact to work with Mexico on carbon pricing and other climate, environmental programs." *ClimateWire*. July 29. www.eenews.net/climatewire/2014/07/29/stories/1060003675.

Kröll, Stefan, Loukas Mistelis and Pilar Perales Viscasillas. 2011. "Introduction to the CISG," in *The United Nations Convention on Contracts for the International Sale of Goods: Article by Article Commentary*, edited by Stefan Kröll, Loukas Mistelis, and Pilar Perales Viscasillas. Munich: CH Beck/Hart Publishing, pp. 19-20.

Kruger, Joseph, Wallace E. Oates, and William A. Pizer. 2007. "Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy." *Review of Environmental Economics and Policy*. 1(1): 112-133. http://dx.doi.org/10.1093/reep/rem009.

Lippman, Daniel. 2014. "E.U. Climate Plan Includes only Domestic Carbon Cuts." *ClimateWire*. March 14. www.eenews.net/climatewire/2014/03/14/stories/1059996128.

Marcu, Andrei. 2012. "A Framework for Various Approaches under the UNFCCC: Necessity or Luxury? Submission to the Ad-Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)." Brussels: Center for European Policy Studies. October 5. www.ceps.eu/files/MM_FVADoha%20Final.pdf.

Marcu, Andrei. 2014. "The Role of Market Mechanisms in a Post-2020 Climate Change Agreement." Special Report 87. Brussels: Centre for European Policy Studies. May. www.ceps.eu/book/role-market-mechanisms-post-2020-climate-change-agreement.

Mehling, Michael, and Erik Haites. 2009. "Mechanisms for Linking Emissions Trading Schemes." *Climate Policy* 9 (2): 169–184. http://dx.doi.org/10.3763/cpol.2008.0524.

Metcalf, Gilbert, and David Weisbach. 2012. "Linking Policies When Tastes Differ: Global Climate Policy in a Heterogeneous World." *Review of Environmental Economics and Policy* 6 (1): 110-128. http://dx.doi.org/10.1093/reep/rer021.

Miller, Angharad and Lynne Oats. 2014. *Principles of International Taxation*, 4th edition. West Sussex, U.K: Bloomsbury Professional.

Murray, Brian, Richard Newell, and William Pizer. 2009. "Balancing Cost and Emissions Certainty: An Allowance Reserve for Cap-and-Trade." *Review of Environmental Economics and Policy* 3 (1): 84-103. http://dx.doi.org/10.1093/reep/ren016.

New Zealand Ministry of the Environment. 2011. "Emissions Trading Scheme Review 2011: Issues statement and call for written submission." Emissions Trading Scheme Review Panel. March 11. www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/issues-statement.pdf.

New Zealand Parliament. 2008. "Climate Change Response (Emissions Trading) Amendment Act 2008: Public Act 2008 No 85." www.legislation.govt.nz/act/public/2008/0085/latest/DLM1130932.html.

Newell, Richard, William Pizer, and Daniel Raimi. 2013. "Carbon Markets 15 Years after Kyoto: Lessons Learned, New Challenges." *Journal of Economic Perspectives* 27, 123–146. http://dx.doi.org/10.1257/jep.27.1.123.

NJ.com. 2011. "Gov. Christie announces N.J. pulling out of regional environmental initiative." May 28. www.nj.com/politics/index.ssf/2011/05/gov_christie_to_announce_nj_pu.html.

OECD (Organisation for Economic Co-operation and Development). 2014. "OECD Model Tax Convention on Income and on Capital - an overview of available products." http://www.oecd.org/tax/treaties/oecdmtcavailableproducts.htm, accessed June 20, 2014.

Pizer, William and Andrew Yates. 2014. "Terminating Links between Emission Trading Programs." Working Paper No. 20393. Cambridge, Massachusetts, USA: National Bureau for Economic Research. August. www.nber.org/papers/w20393.

Prag, Andrew, Christina Hood, and Pedro Martins Barata. 2013. "Made to Measure: Options for Emissions Accounting under the UNFCCC." Climate Change Expert Group Paper no. 2013(1). Paris: OECD. May. www.oecd-ilibrary.org/environment-and-sustainable-development/made-to-measure-options-for-emissions-accounting-under-the-unfccc_5jzbb2tp8ptg-en.

Quebec MDDEFP (Québec Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs). 2013. "The Québec Cap and Trade System for Greenhouse Gas Emissions Allowances: Regulatory Information." www.mddefp.gouv.qc.ca/changements/carbone/Systeme-plafonnement-droits-GES-en.htm , accessed August 3, 2013.

Ranson, Matthew, and Robert N. Stavins. 2013a. "Linkage of Greenhouse Gas Emissions Trading Systems: Learning from Experience." Discussion Paper ES 2013-2. Cambridge, Massachusetts, USA: Harvard Project on Climate Agreements. November. http://belfercenter.ksg.harvard.edu/publication/23585.

Ranson, Matthew and Robert N. Stavins. 2013b. "Post-Durban Climate Policy Architecture Based on Linkage of Cap-and-Trade Systems." *The Chicago Journal of International Law*, 13:2, 403-438. http://search.proquest.com/docview/1290647348/13D59F9A202577E7152.

RGGI (Regional Greenhouse Gas Initiative). 2005. "Memorandum of Understanding." http://rggi.org/docs/mou_final_12_20_05.pdf.

RGGI. 2008. "Regional Greenhouse Gas Initiative Model Rule: 12/31/08 Final with Corrections. Part XX CO_2 Budget Trading Program." www.rggi.org/docs/Model%20Rule%20Revised%2012.31.08.pdf.

RGGI. 2013a. "State Statutes & Regulations." http://rggi.org/design/regulations.

RGGI. 2013b. "Summary of RGGI Model Rule Changes." February. www.rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Model_Rule_Summary.pdf

RGGI. 2014a. "CO_2 Emissions and Allowance Tracking." http://rggi.org/market/tracking, accessed June 18, 2014.

RGGI. 2014b. "CO_2 Auctions." http://rggi.org/market/co2_auctions, accessed June 18, 2014.

RGGI. 2014c. "State Statutes and Regulations." http://rggi.org/design/regulations, accessed June 18, 2014.

RGGI. 2014d. "Annual Report on the Market for RGGI CO_2 Allowances: 2013." Prepared by Potomac Associates. www.rggi.org/docs/Market/MM_2013_Annual_Report.pdf.

Scott, Hal S. and Anna Gelpern. 2012. *International Finance: Law and Regulation*, 3rd edition. London: Sweet & Maxwell.

SendeCO_2. 2013. "CO_2 Prices: 2008-2013." www.sendeco2.com/uk/precio_co2.asp?ssidi=3, accessed June 19, 2014.

Shelton, Dinah. 2003. *Commitment and Compliance: The Role of Non-binding Norms in the International Legal System*. Oxford: Oxford University Press.

Shishlov, Igor and Valentin Bellassen. 2012. "10 lessons from 10 years of the CDM." Climate Report 37. Paris: CDC Climat. October. www.cdcclimat.com/Climate-Report-no37-10-lessons-from-10-years-of-the-CDM.html?lang=en.

Sijm, J.P.M. 2009. "Tradeable Carbon Allowances: The Experience of the EU and Lessons Learned." Amsterdam: Energy Research Centre of the Netherlands. www.ecn.nl/docs/library/report/2009/e09078.pdf.

Somanathan, E. 2010. "What Do We Expect from an International Climate Agreement? A Perspective from a Low-Income Country." In Joseph E. Aldy and Robert N. Stavins, eds, *Post-Kyoto International Climate Policy: Implementing Architectures for Agreement*. Cambridge, UK: Cambridge University Press, pp. 599-617.

Sopher, Peter and Anthony Mansell. 2013a. "Norway: The World's Carbon Markets: A Case Study Guide to Emissions Trading." New York and Geneva: Environmental Defense Fund and International Emissions Trading Association. May. www.edf.org/sites/default/files/EDF_IETA_Norway_Case_Study_May_2013.pdf,.

Sopher, Peter and Anthony Mansell. 2013b. "Switzerland: The World's Carbon Markets: A Case Study Guide to Emissions Trading." New York and Geneva: Environmental Defense Fund and International Emissions Trading Association. May. www.edf.org/sites/default/files/EDF_IETA_Switzerland_Case_Study_May_2013.pdf.

South Africa National Treasury. 2014 "Carbon Offsets Paper." April. http://www.treasury.gov.za/public%20comments/CarbonOffsets.

State of Washington and UK DECC (United Kingdom Department of Energy and Climate Change). 2014. "Report on the collaboration between Washington State and the UK Government on climate change." July 14. www.governor.wa.gov/documents/Washington_State_collaboration_report.pdf.

Stewart, Richard and Jonathan Wiener. 2003. *Reconstructing Climate Policy*. Washington DC: AEI Press. www.aei.org/wp-content/uploads/2011/10/20040218_book211.pdf

Tuerk, Andreas, Michael Mehling, Christian Flaschland, and Wolfgang Sterk. 2009. "Linking Carbon Markets: Concepts, Case Studies, and Pathways," *Climate Policy* 9(4): 341-357. http://dx.doi.org/10.3763/cpol.2009.0621.

UNDP (United Nations Development Programme). 2006. "The Clean Development Mechanism: An Assessment of Progress." November. http://assets.mediaglobal.org/documents/UNDP_Environment_and_Energy_Group_Report_The_Clean_Development_Mechanism.pdf .

UNEP (United Nations Environment Program) Risø Center. 2013. "JI Projects." http://cdmpipeline.org/ji-projects.htm. Click on Microsoft Excel spreadsheet labeled "JI Pipeline Spreadsheet," then tab "AAU." Accessed May 22, 2013.

UNFCCC (United Nations Framework Convention on Climate Change). 1992. "Text of the Convention." http://unfccc.int/essential_background/convention/items/6036.php.

UNFCCC. 1995. "Report of the Conference of the Parties on Its First Session, Held at Berlin from 28 March to 7 April 1995." FCCC/CP/1995/7/Add.1. June 6. http://unfccc.int/resource/docs/cop1/07a01.pdf.

UNFCCC. 1998. "Kyoto Protocol to the United Nations Framework Convention on Climate Change." http://unfccc.int/resource/docs/convkp/kpeng.pdf.

UNFCCC. 2001. "Report of the Conference of the Parties on Its Seventh Session, Held at Marrakesh from 29 October to 10 November 2001." FCCC/CP/2001/13/Add.3. January 21. http://unfccc.int/resource/docs/cop7/13a03.pdf.

UNFCCC, 2006. "Activities Implemented Jointly under the Pilot Phase: Seventh Synthesis Report: Note by the secretariat," FCCC/SBSTA/2006/8. September 13. http://unfccc.int/resource/docs/2006/sbsta/eng/08.pdf.

UNFCCC. 2008. "Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007." FCCC/CP/2007/6/Add.1, p. 3, Decision 1/CP.13, "Bali Action Plan." March 14. http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf.

UNFCCC. 2012. "Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011." FCCC/CP/2011/9/Add.1, p. 2, Decision 1/CP.17, "Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action." March 15. http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=2.

UNFCCC. 2014. "Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013." FCCC/CP/2013/10/Add.1, p. 3, Decision 1/CP.19, "Further Advancing the Durban Platform." January 31. http://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf#page=3.

Van Asselt, Harro. 2014. "Alongside the UNFCCC: Complementary Venues for Climate Action." Arlington, Virginia, USA: Center for Climate and Energy Solutions. May. www.c2es.org/publications/alongside-unfccc-complementary-venues-climate-action.

Wiener, Jonathan Baert. 1999. "Global Environmental Regulation: Instrument Choice in Legal Context." *Yale Law Journal*. 108: 677-800. www.jstor.org/stable/797394.

World Bank. 2014a. *State and Trends of Carbon Pricing 2014*. Washington, D.C.: World Bank. http://documents.worldbank.org/curated/en/2014/05/19572833/state-trends-carbon-pricing-2014.

World Bank. 2014b. "Globally Networked Carbon Markets." www.worldbank.org/en/topic/climatechange/brief/globally-networked-carbon-markets, accessed May 25, 2014.

World Bank. 2014c. "Partnership for Market Readiness." www.thepmr.org, accessed July 31, 2014.

WHO (World Health Organization). 2014a. "The role of WHO in public health." www.who.int/about/role/en, accessed June 21, 2014.

WHO. 2014b. "International Health Regulations." www.who.int/topics/international_health_regulations/en, accessed June 21, 2014.

WTO (World Trade Organization). 2014a. "Principles of the Trading System." www.wto.org/english/thewto_e/whatis_e/tif_e/fact2_e.htm, accessed June 20, 2014.

WTO. 2014b. "Understanding the WTO: What We Do." www.wto.org/english/thewto_e/whatis_e/what_we_do_e.htm, accessed June 20, 2014.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:

http://www.feem.it/getpage.aspx?id=73&sez=Publications&padre=20&tab=1
http://papers.ssrn.com/sol3/JELJOUR_Results.cfm?form_name=journalbrowse&journal_id=266659
http://ideas.repec.org/s/fem/femwpa.html
http://www.econis.eu/LNG=EN/FAM?PPN=505954494
http://ageconsearch.umn.edu/handle/35978
http://www.bepress.com/feem/

NOTE DI LAVORO PUBLISHED IN 2015

ERM	1.2015	Elena Verdolini, Laura Diaz Anadon, Jiaqi Lu and Gregory F. Nemet: The Effects of Expert Selection, Elicitation Design, and R&D Assumptions on Experts' Estimates of the Future Costs of Photovoltaics
CCSD	2.2015	James Lennox and Ramiro Parrado: Capital-embodied Technologies in CGE Models
CCSD	3.2015	Claire Gavard and Djamel Kirat: Flexibility in the Market for International Carbon Credits and Price Dynamics Difference with European Allowances
CCSD	4.2015	Claire Gavard: Carbon Price and Wind Power Support in Denmark
CCSD	5.2015	Gunnar Luderer, Christoph Bertram, Katherine Calvin, Enrica De Cian and Elmar Kriegler: Implications of Weak Near-term Climate Policies on Long-term Mitigation Pathways
CCSD	6.2015	Francisco J. André and Luis M. de Castro: Incentives for Price Manipulation in Emission Permit Markets with Stackelberg Competition
CCSD	7.2015	C. Dionisio Pérez Blanco and Thomas Thaler: Water Flows in the Economy. An Input-output Framework to Assess Water Productivity in the Castile and León Region (Spain)
CCSD	8.2015	Carlos M. Gómez and C. Dionisio Pérez-Blanco: Simple Myths and Basic Maths about Greening Irrigation
CCSD	9.2015	Elorri Igos, Benedetto Rugani, Sameer Rege, Enrico Benetto, Laurent Drouet, Dan Zachary and Tom Haas: Integrated Environmental Assessment of Future Energy Scenarios Based on Economic Equilibrium Models
ERM	10.2015	Beatriz Martínez and Hipòlit Torró: European Natural Gas Seasonal Effects on Futures Hedging
CCSD	11.2015	Inge van den Bijgaart: The Unilateral Implementation of a Sustainable Growth Path with Directed Technical Change
CCSD	12.2015	Emanuele Massetti, Robert Mendelsohn and Shun Chonabayashi: Using Degree Days to Value Farmland
CCSD	13.2015	Stergios Athanassoglou: Revisiting Worst-case DEA for Composite Indicators
CCSD	14.2015	Francesco Silvestri and Stefano Ghinoi : Municipal Waste Selection and Disposal: Evidences from Lombardy
CCSD	15.2015	Loïc Berger: The Impact of Ambiguity Prudence on Insurance and Prevention
CCSD	16.2015	Vladimir Otrachshenko and Francesco Bosello: Identifying the Link Between Coastal Tourism and Marine Ecosystems in the Baltic, North Sea, and Mediterranean Countries
ERM	17.2015	Charles F. Mason, Lucija A. Muehlenbachs and Sheila M. Olmstead: The Economics of Shale Gas Development
ERM	18.2015	Anna Alberini and Charles Towe: Information v. Energy Efficiency Incentives: Evidence from Residential Electricity Consumption in Maryland
CCSD	19.2015	ZhongXiang Zhang: Crossing the River by Feeling the Stones: The Case of Carbon Trading in China
CCSD	20.2015	Petterson Molina Vale: The Conservation versus Production Trade-off: Does Livestock Intensification Increase Deforestation? The Case of the Brazilian Amazon
CCSD	21.2015	Valentina Bosetti, Melanie Heugues and Alessandro Tavoni: Luring Others into Climate Action: Coalition Formation Games with Threshold and Spillover Effects
CCSD	22.2015	Francesco Bosello, Elisa Delpiazzo, and Fabio Eboli: Macro-economic Impact Assessment of Future Changes in European Marine Ecosystem Services
CCSD	23.2015	Maryse Labriet, Laurent Drouet, Marc Vielle, Richard Loulou, Amit Kanudia and Alain Haurie: Assessment of the Effectiveness of Global Climate Policies Using Coupled Bottom-up and Top-down Models
CCSD	24.2015	Wei Jin and ZhongXiang Zhang: On the Mechanism of International Technology Diffusion for Energy Technological Progress
CCSD	25.2015	Benjamin Michallet, Giuseppe Lucio Gaeta and François Facchini: Greening Up or Not? The Determinants Political Parties' Environmental Concern: An Empirical Analysis Based on European Data (1970-2008)
CCSD	26.2015	Daniel Bodansky, Seth Hoedl, Gilbert Metcalf and Robert Stavins: Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies Through a Future International Agreement