International Carbon Action Partnership

Linking Emissions Trading Systems:

A Summary of Current Research

January 2015, Berlin, Germany

Aki Kachi, Charlotte Unger, Niels Böhm, Kateryna Stelmakh, Constanze Haug, Michel Frerk

Acknowledgements

The authors would like to acknowledge and thank the support, comments and input from a number of ICAP members and external experts. In particular, we would like to thank Michael Mehling, Executive Director of the Center for Energy and Environmental Policy Research (CEEPR), a research center at the Massachusetts Institute of Technology (MIT) and Christian Flachsland, head of the working group Governance at the Mercator Research Institute on Global Commons and Climate Change, Berlin for their thoughts and helpful guidance.

Contents

Introduction

Background

The ICAP Work Program 2014-2015 identifies linking of emissions trading systems (ETS) as the overarching theme for the technical dialog issue among ICAP members. In order to provide a common basis for the first discussion on this issue at the ICAP Meeting in Québec and to help develop an agenda for further work to come, the ICAP Secretariat compiled input paper summarizing the key insights from the academic and grey literature on linking ETS to date. For reasons of space, the paper largely focuses on the technical dimension of linking ETS, to some extent leaving aside reflections on the political challenges and opportunities related to it, which a forum like ICAP may be well placed to discuss. Likewise, the discussion is kept at an abstract level, without reference to specific schemes or experiences with linking (negotiations).

The paper first briefly reviews the rationale for linking, before the following sections examine the existing work on various ETS design elements and their significance for linking. Further, the paper traces the emerging discussion on alternative models including proposed instruments to address barriers without full harmonization, the governance of linking, and several potential research gaps so as to serve as input as to where further work can be done.

Rationale for linking

Carbon trading, as an instrument to reduce carbon emissions efficiently, has recently proliferated around the world. Though a global carbon market would theoretically be the most efficient solution to reduce emissions worldwide (Ranson and Stavins 2013), a multilateral top-down solution has proven elusive and improbable in the short to medium term. In the meantime, linking systems to create larger international markets can help realize many benefits sooner, and help pave the way towards a bigger global market.

There are a number of political, administrative, and economic benefits to creating larger markets through linking. Burtraw et al. (2013) highlight that political benefits center around the signaling of a common effort to address climate change. He refers to the administrative benefits of sharing best practices and – depending on the extent to which practices are aligned - lower compliance and administrative costs. Generally however, the focus is on the potential economic benefits of linking. Flachsland et al. (2008) and IETA (2006) among others, emphasize three main potential economic benefits to larger linked markets: increased efficiency through the cost effective allocation of abatement among a larger number of abatement options, increased market liquidity, and a reduction in competitiveness distortions. Together, these benefits serve as the underlying motivation to link domestic systems.

Linked systems have the potential to be more economically efficient. The extent to which linked systems gain in efficiency depends on the heterogeneity of abatement options. A bigger, more diverse system will likely have more options with different associated abatement costs. A merger of two or more systems expands the number of mitigation options and facilitates those reductions at the least possible overall cost. Linking systems with similar abatement costs will therefore have limited potential for efficiency gains.

Larger linked markets are likely to be more liquid (Ranson and Stavins 2013). Liquidity is the extent to which an allowance can be bought or sold without affecting the market price. This is positively correlated related to market activity which is also tied to the number of market participants. The more active buyers and sellers there are in a market, the weaker the price setting capability of each one individually (Wiener 1999, Metcalf and Weisbach 2012). Theoretically, more liquidity helps markets move towards fundamentals, reduce volatility, and help avoid larger entities from exerting market power and manipulating prices.

Last but not least, competitiveness and so-called leakage concerns may be alleviated when competing industries in other countries face a similar price to pollute. When systems link, their prices converge, giving the

same market price signal to all covered entities. Depending on the industry and its trade exposure, such equalizing of costs faced by the private sector can be an important tool to address leakage, although the benefits of linking systems with similar price levels will also have limited benefits for reduced leakage concerns.

Evolution of the discussion

In view of the potential advantages of linking, much of the literature to date has tended to focus on **"full" bilateral linking,** the best option in order to realize the above benefits. Much of this work examined the economic and environmental compatibility of various design elements and how different provisions may be reconciled in a larger whole. In practice, however, particularly political and administrative barriers have made linking difficult. Given the barriers encountered in practice, studies increasingly explore options to work towards linking despite significantly different policy frameworks or political preferences. These are discussed later in the paper; the following section will first review the compatibility of differing ETS design elements in the context of full bilateral linking, based on the available literature.

ETS Design Elements and Significance

Different jurisdictions have developed their own approaches to emissions trading, including the various design elements of an ETS. Faced with the prospect of linking, policy makers will look to identify differences in their systems' designs, weigh the repercussions of these differences, and judge the extent to which systems must be reconciled in order to link. Design differences can have political, economic, and environmental effects in a larger linked system. We review the necessity of harmonization in these political, economic, and environmental terms, based on the available literature, and note work done on the technical feasibility of their reconciliation. The following sections review these questions for scope and coverage of an ETS; caps and targets; allocation; compliance dates and trading periods; price support and containment measures; monitoring, reporting and verification (MRV), registries and compliance; offsets; and market oversight.

Scope & coverage

Differences between ETS sectors, GHGs and thresholds do not necessarily pose a technical barrier to linking (DEHSt 2013, Burtraw et al. 2013, Goers et al. 2012, Metcalf & Weisbach 2010, Tuerk et al. 2009b, Sterk & Schüle 2009, Ellis & Tirpak 2006, Sterk et al. 2006, Blyth & Bosi 2004, Haites & Mullins 2001). However, differences in the points of regulation in terms of coverage of direct or indirect emissions may lead to potentially problematic accounting discrepancies. Similarly, diverging opt-in and opt-out provisions could result in economic and environmental distortions.

Having a variety of **sectors, GHGs and thresholds** within a linked market may offer potential to increase the economic efficiency of overall mitigation efforts across both systems through the availability of a larger diversity of abatement options stemming from a broader range of sectors and GHGs (Burtraw et al. 2013, Sterk et al. 2006). Differences in scope and coverage do not necessarily have negative environmental consequences, but linking heterogeneous systems will have distributional effects (Ranson & Stavins 2013). If jurisdictions decide to harmonize coverage of sectors, GHGs or thresholds where these were previously excluded as part of a political consensus in one scheme, such changes may undermine previous domestic commitments towards stakeholders (Metcalf & Weisbach 2010).

In economic terms, linking systems with different **points of regulation** and therefore differing indirect or direct emission coverage is technically complex and could pose efficiency concerns of double counting (DEHSt 2013,

Sterk et al. 2006, Haites 2003). Such double counting[1], if not addressed elsewhere, may lead to double payments for end-users (Sterk et al. 2006). Linking direct-coverage emissions systems with those with indirect coverage could also undermine environmental integrity if this leads to undercounting and jeopardizes the "a tonne is a tonne"-principle (Sterk et al. 2006, Mullins & Haites 2001). This could also harm the political goals of a scheme.

Finally, linking systems with different opt-in and opt-out provisions increases the risk of disadvantaged market participants leaving the market and creating an over-allocated ETS with reduced liquidity, although if allowances are cancelled when entities opt-out the effect would be limited (Sterk et al. 2006). Environmental integrity is endangered in the event that linking leads installations to opt out for less effective regulation, resulting in an overall increase in emissions compared to a system without opt-out provision (Blyth & Bosi 2004). While changes in opt-in and opt-out provisions may undermine relevant policy decisions made as a result of a process of stakeholder consultation (Metcalf & Weisbach 2010), the technical harmonization of such provisions is comparatively simple.

Caps & Targets

Linking ETS with different caps – in terms of stringency or nature of the cap – may pose a significant political barrier to linking. As caps represent the environmental target of an ETS, their alignment prior to a link is politically important. Green et al (2014) point out differing ambition levels are perhaps one of the most prominent barriers to linking. To address these concerns, jurisdictions considering linking to each other are likely to aim for comparably ambitious climate policies and share a joint vision of medium and long-term emission trends (Haites 2013, Sterk & Schüle 2009, Edenhofer et al. 2007). Different stringencies and especially types of caps (absolute vs intensity-based caps) are likely to create equity concerns between jurisdictions, at the public/consumer level, and at the sectoral or installation levels (Goers et al. 2012, Blyth & Bosi 2004, Green et al 2014). The level at which a country elects to set a cap for itself may also be affected by the potential opportunity for future trading (Helm, 2003). Bodansky et al (2014) however suggest that the ability to trade may facilitate more ambitious contributions to negotiations on the UN level.

Linking systems with absolute caps and intensity-based targets is technically possible (Ellis & Tirpak 2006), but complex and likely to have negative economic and environmental consequences (Marschinski 2008). Harmonization is therefore likely necessary prior to linking (DEHSt 2013, Burtraw et al. 2013, Sterk & Schüle 2009, Tuerk et al. 2009b, IETA 2006). From an economic perspective, linking a predetermined absolute cap scheme with an ex-post intensity-based scheme would affect the entire system and could lead to liquidity shocks when the latter adjusts its cap (Sterk & Schüle 2009, Sterk et al. 2006, Ellis & Tirpak 2006, Blyth & Bosi 2004), though the linking of any two systems with different price levels will also lead to price shocks. If an intensity-based cap system were a net buyer from an absolute based cap system its effectiveness would be compromised as it would allow more production than otherwise possible (Tuerk et al. 2009b). Alternatively, politically and economically, a system with an absolute cap would be compromised if it were to link with a system with an intensity target if after the link it becomes a net buyer (Tuerk et al. 2009b, Marschinski 2008).

Linking absolute-cap systems with different stringencies also has political, environmental and economic implications. When absolute cap schemes differ in their stringency, resulting in different levels of carbon prices, a link will lower prices in the more stringent system and raise them in the less stringent system. Consequently, the ambitious system would face a financial outflow to the less stringent scheme, which leads to an equalization of prices (Zetterberg 2012, Tuerk et al. 2009b). From an environmental perspective, linking with a system with a comparatively loose (not stringent) cap, for instance set at or above BAU emissions levels, would reduce the environmental performance of the overall scheme by introducing "hot air" into the linked system (Haites and Mullins 2001). In this case, the combined emissions of the linked schemes could be higher than the emissions of

[1] An example of double counting could be a case where a compliance requirement is imposed when fossil fuels are mined or extracted perhaps in one system, and then again at the point of combustion in another system.

the separate schemes (Blyth & Bosi 2004). Politically, Tuerk et al. (2009b) argue that comparable caps are likely to be a precondition for gaining stakeholder support for a link. However, linking systems with similar caps and prices levels will also reduce the potential efficiency gains from linking.

Allocation

Different allocation methodologies do not represent a technical obstacle for linking (Tuerk et al 2009a), but they can have political, competitive and distributional implications. Harmonizing these provisions would weaken such distortions.

Pre-link allocation methods affect who will benefit and hence politically support or oppose linking, to the extent that linking will affect prices . Parties who stand to benefit from the new market price will support linking. With grandfathering, sellers will benefit if the new market price is higher than before the link. Buyers in any system stand to benefit if the market price after the link is lower than it would have been in their system alone. With auctioning, the regulator of the lower pre-link price system stands to gain by generating additional revenues from the auction (Burtraw et al. 2013, Flachsland et al. 2008).

Multiple authors find that competitive or economic distortions take place irrespective of linking and that between systems, different allocation methods do not create additional distortions (Sterk & Schüle 2009, Haites 2003, Tuerk et al. 2009a). However, if a system that distributes its allowances freely links with one that auctions them, allocation in the first system may be seen as a lump-sum subsidy which results in a competitive advantage, often with trade implications. Further, companies which need to buy allowances will be more affected by price changes than those which receive allowances for free (DEHSt 2013).

When future allocations take emissions from previous periods into consideration as is the case when industrial benchmarks are regularly 'updated', there may be further distributional effects when the system links with another with a different allocation method. Blyth and Bosi (2004) and Burtraw et al (2013) point out that diverging approaches may lead to different incentives for efficiency measures and production behavior in both schemes and recommend harmonization to reduce distortions introduced by linking (Blyth & Bosi 2004, Burtraw et al. 2013). Sterk and Schüle (2009) find that when a system with output-based allocation with updating links to a system with another allocation form, the production and emissions will tend to flow to the first system in order to receive a more generous allocation.

The treatment of new entrants and exits can also have distributional implications. For example, companies may have an incentive to start production in a system with free allocation or shut down production where they can still receive allocation (Tuerk et al. 2009a). Treatment of entrants and exits and auction design are relatively easy to align. Other issues, such as purchase limits at auctions, participation by non-compliance entities or measures to address leakage may be politically more sensitive, but are not crucial for the performance of the linked market (Burtraw et al. 2013).

On the whole, although there may be distributional shifts between two systems with different allocation methodologies, the environmental effectiveness of the combined system should not be affected. Benchmarks and free allocation, however, are often used to address leakage concerns. Depending on how the systems are harmonized, this may reduce the risk of leakage between the two systems, but push this risk outside its combined ETS.

Temporal Flexibility

Linking systems with different compliance dates and trading periods may have important distributional and other strategic consequences for the market. While borrowing may pose more technical and political challenges than other aspects, the harmonization of all timing features is not necessarily pre-requisite for linking.

When two or more systems with differing banking and borrowing provisions link, the combined system will indirectly allow for temporal flexibility for all market participants. Systems with historically lax caps could inadvertently carry surpluses on into the future through linking with a system that allows banking. This may undermine the combined price signal and have other political and environmental consequences. However, once concerns of cap setting and surplus allowances are resolved, banking provisions may be comparatively unproblematic, because they likely have little effect on the overall performance of the market and may even incentivize participants to accelerate emission reduction activities (Burtraw et al. 2013, Sterk & Schüle 2009, Jaffe & Stavins 2007). Pizer and Yates (2014) explored the tradeoffs between distinguishing between origins of banked allowances and treating all banked allowances the same in case of the termination of a link between two systems.

More concern has been expressed regarding borrowing. Economically, it may make sense to borrow allowances from the future if mitigation costs are expected to fall (Rubin 1995). However, by putting off mitigation, systems also risk higher future mitigation costs which could have political and environmental consequences affecting all linked systems. The environmental effectiveness of an ETS might also be challenged through linking if climate friendly investments are indefinitely postponed or if a covered entity declares bankruptcy before 'borrowed' allowances must be repaid. A possible solution may be a limit on the amount of borrowing and/or banking (Haites & Mullins: 2001; Baron & Bygrave: 2002; IISD 2007).

Price Support and Containment Measures

Price management measures, both price support and price containment, represent a challenge to linking ETSs for different reasons. A large part of the literature concludes that their harmonization is important prior to linking (Hawkins & Jegou 2014, Burtraw et al. 2013, Haites 2013, Ranson & Stavins 2013, Zetterberg 2012, Edenhofer et al. 2007, Ellis & Tirpak 2006). The linking of two or more ETS with differing cost containment provisions will affect prices in all linked systems. Price collars (floors and ceilings) are regarded as comparatively difficult to align because they reflect the political objectives and priorities an authority has set and negotiated (Burtraw et al. 2013).

A price floor generally restricts added auction volume below a fixed price. If there is a scarcity of allowances in the system without a price floor, the price floor will apply to the whole market by default. If sufficient volume of cheap allowances is available in a system without a price floor and that system links to a system with a higher price floor level, the latter may be undermined with installations buying allowances in the cheaper market until the price floor is reached (DEHSt 2013). If there are sufficient allowances available below the price floor, it may satisfy demand in both systems, resulting in prices below the price floor in both systems. It may be politically important for a government to guarantee a certain minimum price on polluting and Fankhauser and Hepburn (2009) point out the economic advantages of guaranteeing a minimum return on investment in low carbon technology. Wood and Jotzo (2009) reiterate that price floors have significant economic advantages in terms of providing an incentive for and reducing the risk of further technological innovation, limiting price volatility, and managing cost uncertainties. For governments it may also be important to have reliable revenue to support programs funded through auction proceeds. If the expected average market price of a linked system is above either system's price floor, however, it is likely to not pose major concerns.

Price ceilings are equally controversial and also present significant barrier to linking. Depending on how the price ceiling is implemented, two linking systems would by default harmonize with the price ceiling (Burtraw et al 2013). Politically, price ceilings are hard to harmonize because they represent an integral design element introduced by policy makers to seek to enhance credibility of a system and reduce the risk of policy reversal if prices become untenably high (Hepburn 2006). However, the environmental integrity of a scheme may be affected by a price ceiling in that after a certain price the cap may no longer apply (Haites and Wang 2009), with associated environmental and political consequences. One solution to overcome environmental integrity concerns may be the creation of a strategic reserve where allowances under the cap are not initially allocated,

but rather sold off at various tier prices when prices reach set thresholds (Roberts and Spence 1976, Wood and Jotzo 2009).

MRV, Registries and Compliance

Robust and consistent MRV provisions, registries and compliance enforcement are essential for the credible functioning of any emissions trading system. They do not necessarily need to be aligned before linking but harmonization is desirable and represents a "no-regret option" for linking. These elements are relatively easy to align, and because they are generally less politically contentious, they can bring linking partners and stakeholders together, improve their communication and facilitate the further linking process.

MRV standards are important for the environmental integrity and stability of emission trading schemes (Flachsland et al. 2009, Edenhofer et al. 2007). While MRV provisions do not have to be fully aligned, they must be comparable across systems and recognized by the linking partners as robust, credible and transparent (Flachsland et al. 2008, Haites & Wang 2006, Tuerk et al. 2009a). As long as MRV standards ensure that "a tonne is a tonne", do not compromise the confidence of the market players in the validity of the allowances, or create additional errors (DEHSt 2013), slight differences will not significantly impact the environmental effectiveness or the efficiency of the linked market (Sterk & Schüle 2009, Edenhofer et al. 2007). Their harmonization is nonetheless desirable as it increases the comparability and the stability of the market, and improves its operational efficiency (Edenhofer et al. 2007, Flachsland et al. 2008).

Harmonization of registries improves the trackability and transparency of transactions and reduces errors such as double counting and other related risks (Edenhofer et al. 2007). Transparency and consistency of registries is important in that systems must be technically compatible and allow for the transfer and trade of allowances (Edenhofer et al. 2007, Burtraw et al. 2013). The less compatible registries are, the slower and more costly the processing and transfer of allowances (Haites & Mullins 2001, Flachsland 2008). Registry architecture and software can however also be gradually harmonized at a later point in time (Haites & Wang 2006).

Compliance provisions of two systems considering a link need to be at least similarly stringent. Measures do not have to be identical, but they should be comparable and trustworthy. Further, penalties should be significantly higher than the market prices. Otherwise, if linking leads to a market price that exceeds the non-compliance penalty in one of the systems, participants with the low penalty will have an incentive to sell their allowances and pay the resulting penalty (Haites & Mullins 2001), which would effectively function as a price ceiling. Such an event could have negative repercussions for linking environmentally, economically, and politically.

Offsets

Differing offset provisions represent a significant obstacle to linking (Hawkins & Jegou 2014, Burtraw et al. 2013, Zetterberg 2012, Sterk et al. 2006, Tuerk et al. 2009a, Flachsland et al. 2008a, Haites & Mullins 2001), and some degree of harmonization is necessary in order to ensure the integrity of the combined system (Burtraw et al. 2013, Flachsland et al. 2008a). When schemes with differing offset provisions link, the offset credits of all linking partners become at least indirectly available to all participants. Several issues could potentially be of concern when linking systems with different offset systems: the number of offsets that can be used for compliance; the types of eligible offsets, the stringency of standards; and the risk of double counting in the context of international commitments.

The eligibility of different kinds of offsets poses a significant barrier for linking, in economic, political and environmental terms (i.e. Edenhofer et al. 2007 and Hawkins & Jegou 2014). Relevant aspects include the geographic scope, the types of projects accepted, additionality calculations, and how project credits are accounted for in terms of international commitments. The eligibility of offset projects indirectly reflects domestic political objectives in that they represent areas deemed worthy of addressing through potentially lucrative offset development schemes. Differences may become especially controversial when one system has excluded a type

of project from eligibility, but is then confronted with its tacit approval through linking with a scheme that has approved the project type (Jaffe & Stavins 2007). Moreover, if the linking partners' offset rules do not provide for the same degree of stringency, the ETS jurisdiction with the more ambitious evaluation standards may see its environmental integrity undermined (Haites & Mullins 2001 and IISD 2007).

Finally, there is the issue of accounting of offsets, which is complicated by the fact that some jurisdictions have started to develop their own offset standards with diverging scopes and methodologies (Kachi et al 2013). Burtraw et al. (2013) propose the introduction of unique serial numbers for offsets as a possible solution to some of the discussed difficulties. However, this still does not resolve the issue of "freeing up": participants without access to certain types of offsets will still enjoy a larger supply of allowances as these are "freed up" by others using offsets for compliance instead (Sterk et al. 2006; Zetterberg 2012). Tuerk et al. (2009a) point out that because of the freeing up phenomenon, the consequences of different allowable offset quotas also affects the entire system. This does not necessarily require harmonization, but the potential effect of these rules should be carefully evaluated as the sum of the allowable quotas will effectively become the new upper limit of the common market.

Market Oversight

Though there is a fair amount of literature on market oversight in individual systems, the issue of market regulation and has received comparatively little attention in the context of linking. Bodansky et al (2014) underline the importance of oversight for confidence in the joint market, and Diaz-Rainey et al. (2011) touch on the broader interplay between financial and environmental markets and underline the importance of assessing the remit of regulators to ensure that activities leading to risk do not fall between spheres of responsibility. Haites (2013) argues that as long as market oversight provisions are similarly capable of effectively overseeing their own markets, different rules (and associated differing financial market oversight structures) do not necessarily pose a barrier to linking. The harmonization of such provisions is however desirable. If one system's provisions prove to be ineffective at preventing manipulation and fraud, market oversight in the linked combined system will default to the lower standard due to regulatory arbitrage, with negative environmental, economic and political repercussions.

With this, we conclude our review of ETS design compatibility in the context of linking. The next sections briefly touch on options to enable linking without full harmonization of design features and on governance questions in a linked scheme.

Instruments to address barriers without harmonization

The majority of studies on linking to date have focused on "full" bilateral linking in which compliance instruments (allowances, offset units) are fully fungible in all participating systems. Only a few have explored alternative approaches for cases where the benefits of linking are deemed significant enough to warrant the effort, but full harmonization of key design features is not feasible in the short term.

Potential options include quantitative limits or quotas (restricting the volume of traded allowances) and monetary/fiscal instruments, involving the levying of a fee or tax for cross-system trades or the introduction of an exchange rate between certificates between the two systems. Some forms of qualitative restrictions on allowances or compliance units – for instance through a ban on cross-border trades of certain types of certificates or by participants that have used offsets or purchased allowances from a strategic reserve are economically ineffective (Electrical Power Research Institute 2006). Banned certificates free up other types of allowances for trading, and allowances held by participants banned from cross-border trading are still indirectly available to participants in the other system. Restrictions could also be tied to certain triggering events, such as the use of a safety valve or strategic reserve in one system. However, according to Jaffe and Stavins (2007, 46) 'no matter what restrictions are employed, any link that still allows for net sales of allowances from the system with

the more generous cost-containment measures necessarily will increase the use of those measures, or at least increase the likelihood that they are used.' The only option to prevent this entirely is a unilateral link, where one jurisdiction accepts the allowances of another, but the recognition is not reciprocated (Mehling & Haites 2009).

An alternative to such restrictions is the imposition of a levy or tax on cross-border trade of allowances (Jaffe and Stavins, 2007; Marschinski, 2008). Burtraw et al. (2013) further examines the potential of exchange rates (which assign a differing compliance value to allowances from different schemes) to address concerns over wealth transfers in a linked system with substantially different prices levels; he suggests that the rate could be adjusted over time as acceptability of compliance costs rises in the system with the initially lower price level.

Authors agree that the options discussed above may not be ideal as they do not offer the same benefits in terms of liquidity, efficiency, and competitiveness as a full one to one link, and some of them are technically complex to implement. Especially in system with a large pre-link price differential, they may nonetheless be a second best option and help build trust and pave the way for policy makers as an intermediate step in a longer incremental process towards full linking.

Burtraw et al (2013) discuss this in the context of their concept of "linking by degrees", a process which could offer incremental benefits before actual trading of allowances takes place. They argue that an early dialogue between systems may contribute to momentum towards linking and spark cooperation between jurisdictions. Burtraw et al. use the example of scope and timing of coverage. Fragmented markets would start out without any communication on the issue; begin with a discussion on leakage and measuring emissions from imports; followed by defining rules on covered entity thresholds, align compliance periods; defining rules to align interim compliance obligations; followed by harmonization of covered sectors; and the regulation of imports ending up with a fully integrated market.

Governance of the linking process

While compatibility questions of individual ETS design elements have been the focus of attention among scholars in the studies reviewed, the governance of linking is an area of potential further exploration. Authors acknowledge that in the context of linked schemes, a balance needs to be found between "leaving each government with sovereignty over its own system while providing linking partners adequate authority to influence those changes in linked systems that would materially affect their own system" (Jaffe & Stavins 2007). While Mehling (2009) provides a general background on the governance challenges and functions in the carbon market, little has been written to date about the institutional structures and processes required to establish, operate and if necessary, terminate a link (Mehling & Haites 2008). Issues to explore range from the legal form of the link; information and consultation processes to mechanisms for conflict resolution; and how to approach major events such as system reforms or linking with a third scheme. Answers for many of these questions will depend on the context of the link (legal system and tradition of the jurisdictions, subnational vs. national ETS, history of cooperation and trust between the two partners, etc.). An exception to the comparative lack of literature in this area is a recent study on options for delinking a joint system, focusing in particular on the treatment of banked allowances and distinguishing between symmetrical (mutual) and asymmetrical (unilateral) decisions to delink (Pizer & Yates 2014).

Conclusion

Pending a global solution, linking existing and possible future emissions trading systems may offer significant political, administrative and economic benefits. While the discussion on specific provisions of systems and their compatibility continues, a review of the existing literature suggests that ETS design features can be divided into three categories according to the importance of their harmonization for the success of the linked market in

political, economic, or environmental terms. Some features pose a potential barrier to linking and require harmonization, others do not necessarily pose a barrier as long as they are comparably effective, and a final group of design elements does not necessarily require harmonization when linking, although they may be worth harmonizing to facilitate the administrative benefits. A summary table can be found below.

Potential barrier to linking, Harmonization important	**Not necessarily a barrier to linking, though harmonization may facilitate operation of the linked system**	**Not necessarily a barrier to linking**
• Cap nature and stringency • Borrowing provisions • Offset provisions • Price ceilings/floors	• MRV systems (should be comparably robust) • Registry designs • Compliance periods • Banking provisions • Enforcement provisions / Penalties	• Sectoral / Gas coverage • Point of regulation • Opt in / Opt out provisions

Table 1.

The ease with which the various provisions can be harmonized in a linked scheme varies greatly, and different stakeholders and different political cultures will assign different priorities to different issues. Burtraw (2013) notes in practice, political preferences in the linking process may lead to more harmonization of design elements than would be necessary for a functioning market. It is also clear that the political, economic and environmental implications of linking discussed above are inextricably interconnected.

Suggested ways to facilitate linking without the full harmonization of key ETS design elements include restrictions on traded volume and the imposition of levies, taxes or an exchange rate that establishes a different compliance value to allowances from different schemes. However, all options come at the cost of the full potential benefits of linking and are not well understood. They may nonetheless be important as interim measures in an incremental process towards a fully linked system.

In spite of the large body of literature on linking ETS, there are some areas that may merit further examination. One area includes the possible legal aspects of linking subnational, national, supranational, and multilateral instruments, especially within a larger framework that has primarily focused on the national level for implementation and compliance.

Depending on how systems develop and the planning and design of future initiatives, the possible linking of absolute cap and intensity based cap systems may also be of relevance, as well as options for the disentanglement of systems should policies prove to diverge. Other potential research gaps include the potential of regulatory loopholes due to linking of different financial market oversight regimes (especially in an age of increasingly sophisticated financial engineering and a complicated derivative regulation); distributional questions surrounding changes in auctioning revenues due to linking; as well as questions concerning linking with credit schemes and other policies. Finally, as discussed earlier, issues concerning the governance of linking and linked systems will become increasingly pertinent.

Shifting the research perspective away from one-to-one comparison of individual ETS design elements is another promising perspective for future research on linking. Given that ETS design emerges as the output of a complex institutional framework and policy process, as well as their dynamic interplay with a multitude of stakeholders, it is important to take the overall design of a system into account when assessing the compatibility of different of individual design elements, rather than each feature only in isolation. Further, further research

could be done regarding the quantitative effects of linking including expected allowance and revenue flows, and price equilibria.

The future outlook for linking ETS will depend primarily on political will and domestic developments that shape climate policies on the subnational and national levels and how these interact with the international multilateral process. The potential role that international institutional arrangements and fora like ICAP may be able to play to facilitate linking is also relevant in this context. Linking is a complicated, multifaceted endeavor with multiple variables and challenges to be taken into consideration. Yet given its potential benefits it is worth further discussion and effort to provide a concrete contribution to the global effort to fight climate change.

Annex A: Design element overview

Scope and Coverage

Design Element	Implications for linking	Political	Economic	Environmental
Sector	**Does not** necessarily pose a barrier to linking	Acceptance of sectors previously not covered in an unlinked system May undermine policy decisions (i.e. stakeholder consensus)	Distributional effects Potential of increased cost-effectiveness gains through availability of allowances from other sectors	With a robust MRV system in place, linking does not necessarily negative environmental consequences
GHG	**Does not** necessarily pose a barrier to linking Closely related to sectoral coverage implications			
Threshold	**Does not** necessarily pose a barrier to linking			
Direct and Indirect Emissions/Point of Regulation	**Does not** necessarily pose a barrier to linking Danger of double-counting	May undermine policy goals of ETS	Potential efficiency losses through double-payment of indirect and direct emissions for end-users	Potential of undercounting and risk to undermine "tonne is a tonne"-principle
Opt-in/Opt-out	**Does not** necessarily pose a barrier to linking Economic and environmental risks	May undermine previous stakeholder position (i.e. stakeholder consensus)	Opt-out: Potential of disadvantaged participants leaving the market leaving it over-allocated with reduced liquidity	Opt-out: Potential of overall increase of emissions if entities opt for environmentally less effective regulation, depending on alternatives

Cap and Targets

Design Element	Implications for linking	Political	Economic	Environmental
Absolute vs. Intensity-based	**Could** pose a barrier to linking Danger of liquidity shocks	May undermine policy objectives i.e. to reduce absolute emissions, if scheme with absolute link with other scheme becoming a net buyer	Potential to impair the liquidity of the combined system, can lead to liquidity shocks Competitiveness concerns: installations in	Linking an intensity based cap system with one with an absolute cap hast the potential to undermine the environmental effectiveness of the absolute cap.

			scheme with absolute cap face higher costs for output increases	Alternatively a generous absolute cap may also undermine the effectiveness of an intensity based cap.
Stringency	**Could** pose a barrier to linking Risk of equity concerns and danger for environmental integrity	Potential to undermine burden-sharing and raising equity concerns	Potential to lower price in more stringent system and raise them in the less stringent scheme, long-term equalization of prices	Potential to reduce performance of overall scheme if linking with a scheme with non-stringent cap set at/above BAU emission levels

Allocation

Design Element	Implications for linking	Political	Economic	Environmental
Auctioning vs. Free allocation	Does not necessarily pose a barrier to linking	Can raise political concerns when it has competitiveness or other distributional effects	Economic impact of different allocation approaches exists irrespective of linking Possible competitive distortions Using updating approach by one of the systems may distort total system emission reduction costs	Allocation methods do not necessarily have a direct impact on environmental effectiveness – it is solely determined by the overall cap In some cases, however, stringency may be compromised: Depending on the harmonization approach, there may be repercussions on leakage outside of the system

Compliance Dates and Trading Periods

Design Element	Implications for linking	Political	Economic	Environmental
Compliance Periods	Does not necessarily pose a challenge for lining	Generally unproblematic	Generally unproblematic	Generally unproblematic Potential danger of "hot air" leakage
Banking	Does not necessarily pose a challenge to linking.	Generally unproblematic, unless oversupply is banked	Generally unproblematic, unless oversupply is banked	Generally unproblematic, unless oversupply is banked

			A more ambitious system might fear undermining of its prices	A more ambitious system might fear undermining of its prices and therefore environmental efforts
Borrowing	Potentially problematic	Potentially problematic: political targets at risk through change of cap, postponement of mitigation activities	Potentially problematic: risk of future high prices, no or less green investments	Potentially problematic mitigation measures may indefinitely be put off into the future, potentially high allowance prices lead to relaxation of the cap

Price Support Measures and Safety Valves

Design Element	Implications for linking	Political	Economic	Environmental
Price Floor	Likely poses a barrier to linking and should be harmonized	Problematic: high price floor, high minimum price leads to political debate on targets, equity, related policies Price floor can be undermined depending on volumes	Problematic: high price floor, high minimum price	Minimum financial incentive to reduce emissions may be undermined by linking to a system with excessively low prices
Price Ceiling		Potentially problematic from either credibility or environmental perspective	Potentially problematic: through linking prices level on the lowest price ceiling	Potentially problematic: undermines a cap

MRV, Registries, and Compliance

Design Element	Implications for linking	Political	Economic	Environmental
MRV Systems	Complete harmonization not necessary as long as systems are comparable. However, harmonization is desirable as the process can actually	Less sensitive politically Might still include some legal challenges	Slight differences should not affect economic efficiency of the market	Not compromised if MRV provisions are comparable, similarly credible and robust Insufficiently robust MRV process can compromise environmental

	encourage communication between linking partners and facilitate further process			integrity
Registries			The less compatible registries are the higher transaction cost will be	No direct implications from linking for two functioning systems
Compliance Provisions			Slight differences should not affect economic efficiency of the market	Not compromised if systems to be linked have similarly robust and stringent compliance provisions

Offsets

Design Element	Implications for linking	Political	Economic	Environmental
Kinds of offsets	Poses a potential barrier to linking	The eligibility and approval of various kinds offsets often very politicized process, lack of harmonization may undermine existing decisions	Depending on prices, offset quotas, and development potential could undermine system	Depending on offsets, does not necessarily pose an environmental problem
Accounting	Could pose a potential barrier and should be harmonized	An overall consistent strategy for accounting for offsets within the framework of possible international commitments is imperative	Offset markets and the linked ETS systems at large risk being undermined if there is not harmonization of accounting methods for offsets	There may be a risk of double counting with negative repercussions for the environmental integrity of systems without developed without harmonization

Market Oversight

Design Element	Implications for linking	Political	Economic	Environmental
Oversight provisions	Does not necessarily pose a barrier to linking as long as systems are comparably effective Harmonization is still desirable to avoid loopholes	Need not pose a political barrier as long as measures are equally robust and effective (barring potential loopholes)	Need not pose an economic barrier as long as measures are equally robust and effective (barring potential loopholes)	Need not pose an environmental barrier as long as measures are equally robust and effective (barring potential loopholes)

References

Baron, R., & Bygrave, S. (2002). *Towards International Emissions Trading: design Implications for Linkages*. OECD; Information Paper.

Blyth, W., & Bosi, M. (2004). *Linking Non-EU Domestic Emissions Trading Schemes with the EU Emissions Trading Scheme*. OECD/IEA.

Bodansky, D., Hoedl, S., Metcalf, G., & Stavins, R. (2014). *Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies Through a Future International Agreement.* Cambridge, Mass.: Harvard Project on Climate Agreements.

Burtraw, D., Palmer, K. L., Munnings, C., Weber, P., & Woerman, M. (2013). *Linking by Degrees: Incremental Alignment of Cap-and-Trade Markets*. RFF Discussion Paper 13-04. SSRN Electronic Journal. doi:10.2139/ssrn.2249955.

DEHSt, (Ahlberg, M., Arnold, H., Gagelmann, F., Gibis, C., Kruse, M., Kühleis, C., … Zirkel, A.) (2013*). Linking Different Emissions Trading Systems – Current State and Future Perspectives*. *Dehst*. Umweltbundesamt.

Diaz-Rainey, Ivan, Siems, Mathias and Ashton, John (2011) The Financial Regulation of Energy and Environmental Markets. Journal of Financial Regulation and Compliance, 19 (4). pp. 355-369.

Edenhofer, O., Flachsland, C., & Marschinski, R. (2007). *Towards a global CO 2 market - An economic analysis*. Potsdam Institute for Climate Impact Research.

Electric Power Research Institute. (2006). *Interactions of Cost-Containment Measures and Linking of Greenhouse Gas Emissions Cap-and-Trade Programs* (Vol. 3). EPRI, Palo Alto, 1013315.

Ellis, J., & Tirpak, D. (2006). *Linking GHG Emission Trading Schemes and Markets.* OECD/IEA.

Flachsland, C., Edenhofer, O., Jakob, M., & Steckel, J. (2008). *Developing the International Carbon Market . Linking Options for the EU ETS*. Report to the Policy Planning Staff in the Federal Foreign Office. Potsdam Institute for Climate Impact Research.

Flachsland, C., Marschinski, R., & Edenhofer, O. (2009). *To link or not to link: benefits and disadvantages of linking cap-and-trade systems*. Climate Policy, *9*(4), 358–372. doi:10.3763/cpol.2009.0626.

Fankhauser, S., and Hepburn, C. (2009). *Carbon markets in space and time*. Working paper, Centre for Climate Change Economics and Policy, London and Leeds.

Goers, S. R., Pflüglmayer, B., & Luger, M. J. (2012). *Design Issues for Linking Emissions Trading Schemes - a Qualitative Analysis for Schemes from Europe, Asia and North America*. Journal of Environmental Science and Engineering B, *1*(2012), 1322–1334.

Green, J. F., Sterner, T., & Wagner, G. (2014). *A balance of bottom-up and top-down in linking climate policies*. Nature Climate Change, 4(12), 1064-1067.

Haites, E. (2003). *Harmonization between National and International Tradable Permit Schemes: CATEP Synthesis Paper*. OECD Environment Directorate.

Haites, E. (2014). *Lessons Learned from Linking Emissions Trading Systems: General Principles and Applications*. Technical Note 7, Partnership for Market Readiness.

Haites, E., & Mullins, F. (2001). *Linking Domestic and Industry Greenhouse Gas Emission Trading Systems*. International Energy Agency. EPRI. IETA.

Haites, E., & Wang, X. (2006). *Ensuring the Environmental Effectiveness of Linked Emissions Trading Schemes.* Mitigation and Adaptation Strategies for Global Change, *14*(5), 465–476. doi:10.1007/s11027-009-9176-7.

Hawkins, S., & Jegou, I. (2014). *Linking Emissions Trading Schemes. Considerations and Recommendations for a Joint EU-Korean Carbon Market*, (3). ICTSD Global Platform on Climate Change, Trade and Sustainable Energy.

Helm, Carsten, 2003. *International emissions trading with endogenous allowance choices*,Journal of Public Economics, Elsevier, vol. 87(12), pages 2737-2747.

IETA. (2006). *Linking the EU ETS with emerging emissions trading schemes*, 1–13. International Emissions Trading Association Washington, D.C.

Jaffe, J., & Stavins, R. (2007). *Linking Tradable Permit Systems for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges*. International Emissions Trading Association Report on Linking GHG Emissions Trading Systems.

Kachi, A.,Tänzler, D. & Sterk, W. (2014). The Clean Development Mechanism and Emerging Offset Schemes: Options for Reconciliation. Climate Change 06/2014. Umweltbundesamt.

Mace, M. J., Millar, I., Schwarte, C., Anderson, J., Broekhoff, D., Bradley, R., ... & Heilmayr, R. (2008). *Analysis of the legal and organisational issues arising in linking the EU Emissions Trading Scheme to other existing and emerging emissions trading schemes*. London, Brussels, Washington, DC: Foundation for International Environmental Law and Development, Institute for European Environmental Policy, World Resources Institute.

Marschinski, R. (2008). *Efficiency of Emissions Trading between Systems with Absolute and Intensity Targets*. Draft Version Presented at EAERE 2008 Annual Conference, Gothenburg, June 25-28, 2008.

Mehling, M., & Haites, E. (2008). *Mechanisms for linking emissions trading schemes*. Synthesis article, Climate Policy, 8, 1–17. Earthscan., ISSN: 1469-3062 (print), 1752-7457 (online).

Mehling, M. (2009). *Global Carbon Market Institutions: An Assessment of Governance Challenges and Functions in the Carbon Market.* Climate Strategies.

Metcalf, G. E., & Weisbach, D. (2010). *Linking Policies When Tastes Differ: Global Climate Policy in a Heterogeneous World*. Review of Environmental Economics and Policy 6(1): 110-128. doi: 10.3673/cpol.2008.0525

Pershing, J. (2007). *Exploring the Challenges and Opportunities for Establishing a North American Emissions Trading System.* Context Setting: United States, World Resources Institute, Washington, D.C., presentation at IISD-WRI Workshop, November 14-15, 2007.

Pizer, W. A., & Yates, A. J. (2014). *Breaking up May not be Hard to do: Terminating Links between Emission Trading Programs.* Regulatory Policy Program Working Paper RPP-2013-12. Cambridge. Mass: Mossavar-Rahmani Center for Business and Government, Harvard Kennedy School, Harvard University.

Ranson, M., & Stavins, R. N. (2013). *Linkage of Greenhouse Gas Emissions Trading Systems - Learning from Experience,* Discussion Paper ES 2013-2. Cambridge. Mass: Harvard Project on Climate Agreements.

Schüle, R., & Sterk, W. (2007). *Options and Implications of Linking the EU ETS with other Emissions Trading Schemes*. European Parliament.

Sterk, W., Braun, M., Haug, C., Korytarova, K., & Scholten, A. (2006). *Ready to Link Up? Implications of Design Differences for Linking Domestic Emissions Trading Schemes*. German Federal Ministry of Education and Research (BMBF), Jet-Set Cross-Section Project 4.

Sterk, W., & Schüle, R. (2009). *Advancing the climate regime through linking domestic emission trading systems*? Mitigation and Adaptation Strategies for Global Change, *14*(5), 409–431. doi:10.1007/s11027-009-9178-5.

Tuerk, A., Sterk, W., Haites, E., Kimura, H., Flachsland, C., Mehling, M., Jotzo, F. (2009a). *Linking of emissions trading schemes - Synthesis Report*. Climate Strategies.

Tuerk, A., Sterk, W., Haites, E., Mehling, M., Flachsland, C., Kimura, H., Jotzo, F. (2009b). *Linking emission trading systems, Prospects and issues for business.* Climate Strategies and Carbon Trust.