Linking Cap-and-Trade Systems and Green Finance

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Summary: Linking of two or more cap-and-trade systems promises gains in cost effectiveness and signals a strong commitment to carbon policy. Linking is also seen as one possible way of converging from regional climate policy initiatives toward a global climate policy architecture. Moreover, linking may be used to direct investment into low-carbon technology – one form of green finance – to low-abatement cost locations. Two linked systems have been established recently, one in Europe and one in North America. However, linking also comes with challenges, such as increased exposure to shocks originating in other parts of the linked system and a greater need for policy coordination. We first consider the benefits and challenges of linking conceptually, including its incentives for green financial flows. We then present some of the main features of the European and North American linked systems and outline the process that led to their establishment. Finally, we consider preliminary evidence on the workings of each linked system. We conclude that from a green finance perspective linking should be viewed as a long-term option.

Zusammenfassung: Die Verknüpfung von zwei oder mehr Cap-and-Trade-Systemen – „Linking" – verspricht Kostenvorteile und signalisiert ein starkes Engagement für die gemeinsame Klimapolitik. Linking wird auch als eine mögliche Option angesehen, um von vereinzelten regionalen Initiativen zu einer globalen klimapolitischen Architektur zu konvergieren. Darüber hinaus kann Linking genutzt werden, um Investitionen in klimafreundliche Technologien – eine Form von „Green Finance" – in Regionen mit geringen Vermeidungskosten zu lenken. Kürzlich wurden zwei verbundene Systeme eingerichtet, eines in Europa und eines in Nordamerika. Linking ist jedoch auch mit Herausforderungen verbunden. So können Schocks, die von Teilen des verknüpften Systems ausgehen, leichter durch das verbundene System propagieren, so dass ein hoher Bedarf an Politik-Koordination besteht. Wir betrachten zunächst die Vorteile und Herausforderungen von Linking konzeptionell, einschließlich der Anreize für Green Finance. Anschließend betrachten wir einige Hauptmerkmale bestehender Links in Europa und Nordamerika und skizzieren den Prozess, der zu ihrer Einrichtung geführt hat. Schließlich betrachten wir die verfügbare Evidenz zur Wirkungsweise der bestehenden Links. Wir schlussfolgern, dass aus der Perspektive von Green Finance Linking eher als langfristige Option anzusehen ist.

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→ Keywords: Cap-and-trade, emission trading, linking, green finance

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1 Introduction[1]

There is conclusive evidence that anthropogenic greenhouse gas (GHG) emissions cause climate change by increasing global temperatures (e. g. IPCC, 2014; IPCC, 2018). Given the global nature of the climate problem the most effective policy response is also at the global level (e. g. Stern, 2007; Cramton, Ockenfels and Stoft, 2015; Weitzman, 2015). Accordingly, the signatories of the Paris Agreement agreed to limit GHG emissions such that the anthropogenic increase in temperatures remains significantly below 2 degrees centigrade (United Nations, 2015). However, the Paris Agreement is not a binding global agreement.[2] Instead, current climate policy initiatives focus on the regional (e. g. in Europe), national (e. g. China) or sub-national levels (e. g. California). Frequently, these policy initiatives take the form of cap-and-trade schemes.

One way of converging from regional policy responses to climate change toward an international or a global climate regime is by "linking" existing cap-and-trade schemes.[3] In this paper, by linking we mean that allowances from either partner system are recognized for compliance purposes in the other.[4] Linking cap-and-trade systems is also foreseen as one possible way to cooperate under Article 6 of the Paris Agreement (United Nations, 2015). It has several potential advantages: It may increase cost effectiveness, improve liquidity and strengthen policy commitment. Moreover, it may incentivize flows of investment into emission abatement – one manifestation of *green finance* – across national borders within the linked system. However, linking also comes with challenges, e. g. a greater exposure to shocks originating in one part of a linked system, a loss of policy sovereignty, and a potential dilution of the effectiveness of the linked system due to a "race to the bottom" in the quest to attract green financial flows by members of the linked systems.

Two linking projects are currently underway, providing important policy experiments on linking as a means toward extending regional cap-and-trade initiatives in the international dimension. One is a link between the European Union Emissions Trading System (EU ETS) and the Swiss Emissions Trading System (CH ETS). The other is a link between two sub-national ETS in North America; between California and Québec. Studying the features of the linked systems and the policy process involved in creating them helps improve our understanding of the costs and benefits of linking. It is also a first step toward evaluating the potential of linking as a means for converging toward a global climate policy architecture. Linking may also be a path toward channeling climate finance into low-abatement-cost environments – often emerging or developing economies – in the future.

The remainder of this paper is organized as follows: In Section 2 we discuss important conceptional benefits and challenges of linking. In Section 3 we outline some of the main benefits and challenges of linking with respect to directing green finance. Section 4 describes the linking projects

1 This paper is based – in part – on Erdmann, K. and Zaklan, A. (2018): Linking Cap-and-Trade Systems. DIW Roundup 123.

2 The Paris Agreement is binding in terms of international law, but does not contain sanctions. It is implemented through regularly updated National Determined Contributions (NDCs). For more information on the Paris Agreement and its mechanisms, cf. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

3 An introduction to cap-and-trade and an overview of existing schemes can be found e. g. on https://icapcarbonaction.com/en/.

4 Links may also be unilateral, where one system recognizes allowances from the other, while recognition in the other direction does not occur. In principle, linking may take place at the sector level, i. e. between certain sectors within two cap-and-trade schemes, while other sectors are excluded.

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currently in existence – in Europe and North America, while Section 5 presents preliminary evidence on their workings. Section 6 concludes.

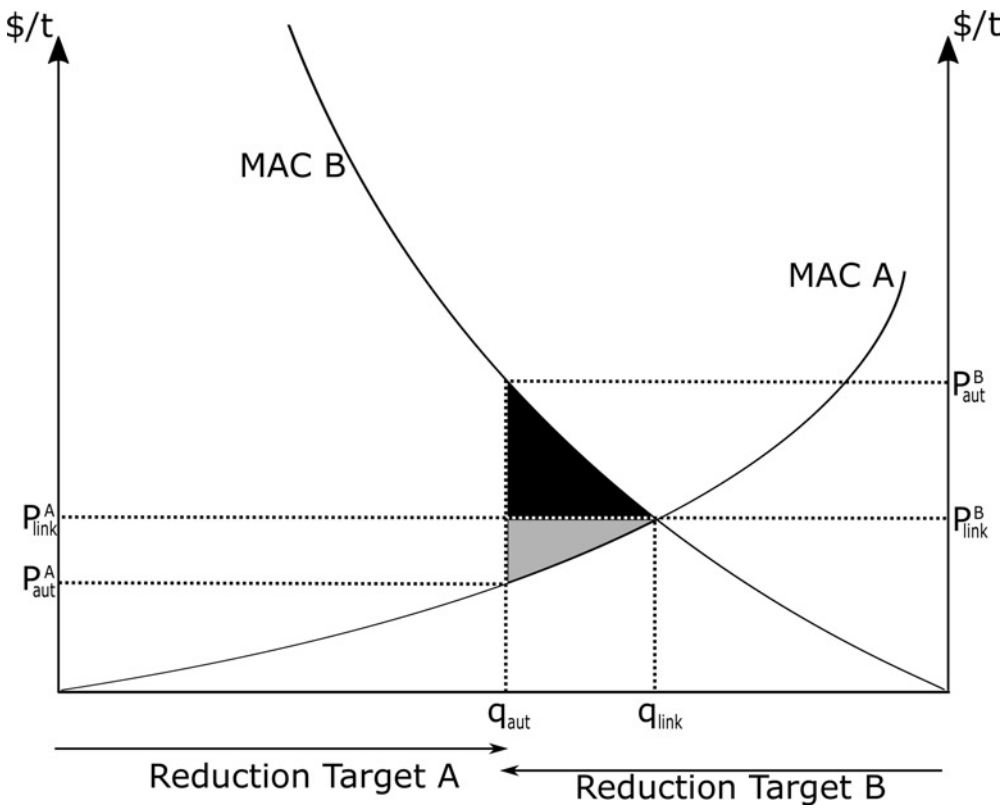
2 The Concept of Linking Cap-and-Trade Schemes

2.1 Advantages of Linking: Greater Cost Effectiveness and Policy Commitment

Linking two cap-and-trade systems with different marginal abatement costs – the costs to reduce an additional unit of GHG emissions – leads to larger potential gains from trade for regulated entities. Figure 1 illustrates the gains from trade in a stylized two-country/two-entity case (cf. also Flachsland, Marschinski and Edenhofer, 2009; Anger, 2008; Carbone, Helm and Rutherford, 2009).

Figure 1

Gains from Trade through Linking



Note: adapted from Flachsland, Marschinski and Edenhofer, 2009.

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The horizontal axis shows the emission reduction and the vertical axis the marginal abatement costs (MAC) per ton of emissions. In Figure 1, the entity in jurisdiction A is assumed to have a less steep MAC than the one in jurisdiction B. This means that for a given amount of emission reduction, the marginal abatement costs for A are lower than for B. We assume that prior to linking both jurisdictions have adopted the same reduction target (q_{aut}). To achieve q_{aut}, jurisdiction A abates such that its equilibrium allowance price in autarky is at P^{A}_{aut}. Due to its steeper MAC entities in jurisdiction B pay the higher autarky price of P^{B}_{aut}. After the link is established, entities in both jurisdictions may trade all certificates in the common market. B gets access to cheaper carbon reduction options in A and shifts part of its abatement abroad to save costs. The entity in jurisdiction A abates more than prior to the link, up to the point q_{link}, and sells its surplus allowances to entities in jurisdiction B. The link therefore involves a financial transfer from jurisdiction B to jurisdiction A. As a result, the post-link equilibrium allowance price converges to $P^{A}_{link} = P^{B}_{link}$. Jurisdiction A benefits from an inflow of trading revenue, while B benefits from less expensive abatement. Total emissions do not change. The blue area indicates the gain in cost effectiveness for jurisdiction B, while the red area shows the cost effectiveness gain for jurisdiction A.

Linking may also increase the liquidity of carbon markets. In a liquid market, individual, participants can purchase and sell allowances without significantly influencing the price. Through linking a larger number of potential buyers and suppliers of allowances are in the market, increasing the potential for trading activity (Flachsland, Marschinski and Edenhofer, 2009). Furthermore, if each jurisdiction auctions allowances, there may also be a higher frequency of auctions in the linked system, with a greater number of potential auction participants (Hepburn et al. 2006). Greater market liquidity enhances the cost effectiveness of the allowance market by reducing market power of individual participants (Wiener, 1999; Hahn, 1984), decreasing trading uncertainty (Kalaitzoglou and Ibrahim, 2015) and lowering transaction costs (Liski, 2001). Cap-and-trade systems with only a small number of participants are vulnerable to losses in cost effectiveness due to illiquidity, while providing scope for strategic behavior.

Linking also demonstrates a long-term commitment to a cap-and-trade system and climate policy in general, as participants in a linked system give up some of their sovereignty with respect to climate policy. Creating a linked system can therefore raise the global acceptance of the policy tool and encourage other jurisdictions to implement emission trading systems and potentially join a linked system (Flachsland, Marschinski and Edenhofer, 2009). Linkages could thus play a role in a bottom-up approach to creating an international climate policy architecture (Sterk and Stuele, 2009).

2.2 Challenges of Linking: Price Risk Shocks and Need for Policy Coordination

Linking also involves challenges. Price shocks in one component of a linked system, e. g. caused by an economic downturn or a boom in one region, will propagate throughout the linked system. A change in demand for allowances in one of the participating schemes will influence the common allowance price (McKibbin, Morris and Wilcoxen, 2008). Such propagation of shocks may be more pronounced when business cycles in each region are very asynchronous. This is especially relevant for smaller systems, which are price takers in the linked market. A link with a larger system with a relatively volatile allowance price will diminish price stability and may decrease investment incentives in the smaller partner system, compared to autarky (Tuerk et al., 2009).

On the policy side, both jurisdictions lose some control over their domestic carbon policy and increase their interdependency. The common allowance price is determined by the caps in both systems, so that cap adjustments in one of the linked systems will have impacts on prices in the linked market. For instance, one of the systems may loosen its cap unilaterally, thus increase the overall supply of allowances in the linked system and cause a decline in the common allowance price. One of the jurisdictions could also start accepting allowances from third parties, e. g. offsets with questionable additionality properties, which may compromise the climate targets in the partner region (Green, Sterner and Wagner, 2014). Due to the increased policy risk as a result of linking, complex negotiations are required to limit unilateral action and avoid such outcomes. The negotiation power of each partner is likely to depend on the relative sizes of the partners' carbon markets. The partner with a larger carbon market will be better able to enforce its interests (Newell, Pizer and Raimi, 2013). Smaller partners may thus lose sovereignty over their climate policy. After a linking agreement goes into force, close policy coordination is required to maintain the integrity of the linked system and the policy targets of all partners.

3 Linking and Green Finance

3.1 Linking May Encourage Green Finance

Both private and public-sector capital play a major role for climate finance. Governments may use linking to direct private climate finance to low-abatement cost regions. E. g. if the cap-and-trade scheme of an advanced economy were linked with that of an emerging or developing economy with lower abatement costs, such a link would lead to climate finance flows from the advanced to the emerging/developing economy. Linking can therefore encourage investments into emission abatement in low-abatement cost regions and thus provide an incentive for green project finance (Brinkman, 2009). In addition to private capital, public capital is also of considerable importance for climate finance. E. g., auctions of emission allowances can generate substantial amounts of financial resources which may then flow into climate funds. For instance, member countries of the EU ETS are obliged to use at least half of the auction revenues for climate and energy related purposes (European Union, 2003). Currently, allowances representing about 57 % of the total cap of the EU ETS are sold at auctions (European Commission 2019). The total revenue from auctioning in the EU ETS amounted to 21 billion euro between 2012 and 2017 – on average 3.5 billion euro per year (European Commission, 2018). Note that during that time the allowance price mostly moved in a corridor between 5 and 10 Euro per ton of CO_2e. The potential for funds that may be available for green finance from EU ETS auctioning proceeds has increased recently, as allowance prices have been between 20 and 25 euro per ton of CO_2e for most of 2019. In principle, public entities such as the EU may use part of these auctioning revenues to purchase and cancel allowances in linked partner-systems, which would lead to lower aggregate emissions in the linked system.

Carbon price stability is an important condition for climate investments, especially in emerging and developing country contexts with greater policy uncertainty. By linking a small system to a larger system with a stable carbon price, investment uncertainty for firms in high-abatement cost countries may be decreased by reducing price fluctuations, and financing low-carbon technologies may be encouraged.

The direction of the financial flows within a linked system depends on whether a jurisdiction is the net buyer or seller of certificates. If jurisdiction A has lower marginal abatement costs and therefore

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a lower carbon price than jurisdiction B prior to linking, entities in B have the incentive to purchase allowances from A after the two systems are linked. Jurisdiction B becomes a net buyer in the linked system, leading to financial flows from B to A. If the two cap-and-trade schemes are of similar size and there is only a small difference in pre-linking equilibrium abatement costs and therefore in each system's allowance price, the value of financial transfers may be expected to be small. The larger the difference in market size and the pre-linking carbon price, the more may we expect financial flows to the low-abatement cost region to be substantial.

3.2 Distributional Aspects

While linking has potential to increase the cost-effectiveness of the linked system compared to a collection of autarkic cap-and-trade schemes and may help channel green finance, linking and the resulting financial flows have distributional impacts. Distributional effects may occur along two dimensions: First, there will be a redistribution of investment into abatement between the linked jurisdictions, due to an inflow of finance into the low-abatement cost region or an outflow from the high-abatement cost jurisdiction. A link and the potential cost-effectiveness gains will only be fully realized if the financial flows between jurisdictions that would result due to linking, e. g. the potential net outflow of capital from one jurisdiction to the other, are accepted politically and not impeded (Green, Sterner and Wagner, 2014).

Second, linking may lead to distributional effects between low-abatement-cost regions that are part of the linked system and those that are not. As explained above, linking can direct climate finance to low-abatement cost regions. However, due to a scarcity of climate finance, capital flows may mainly concentrate on low-abatement-cost regions that are part of the linked systems, leaving other, unlinked regions behind. The unequal distribution of financial flows under the Clean Development Mechanism (CDM) established under the Kyoto Protocol may serve as an example: between 2006 and 2012, more than two thirds of all CDM projects were located in China, India, Brazil and Mexico (UNEP DTU, 2019). Linkages between carbon markets may result in similar regional imbalances.

4 Linking in Practice

This section provides an overview over existing links between established cap-and-trade systems. Currently, links only exist between cap-and-trade schemes in advanced economies. Due to their complexity, establishing links between advanced and emerging or developing economies may be viewed as a medium to longer term perspective. We outline longer-term perspectives on the potential to incentivize green finance through linking between advanced and emerging and/or developing economies in the Conclusion.

4.1 EU ETS and CH ETS

The cap-and-trade scheme of the EU, the EU ETS, is the world's largest cap-and-trade system for GHG emissions. It covers over 11.000 entities and about 2 billion tons of CO_2 equivalents (CO_2e). The Swiss scheme, the CH ETS, is far smaller. Only about 50 entities participate, and more than 5 million tons of greenhouse gases are covered (BAFU, 2019). However, the partner's climate objectives are compatible and the structures of the ETS are very similar. Both are mandatory systems with a cap in absolute terms. Trading cycles are synchronized, as both systems commence their next

trading period in 2021. Cooperation between the partner systems occurs in a Joint Committee consisting of representatives of both parties (cf. European Union, 2017 for details of the linking agreement). The committee is responsible for the administration and the supervision of the implementation of the link, dispute settlement and the discussion of possible future changes in legislation by either party. Auction procedures will remain unchanged after linking: Both parties will conduct their auctions separately. The registries, which record all held and transferred allowances, will also remain independent. To enable the free trade of both EU and Swiss allowances, a link between the two tracking logs EUTL and SSTL,[5] which document all transactions of allowances, will be established (European Union, 2017).

The negotiations between the European Union and Switzerland began in 2010 and were concluded in 2016. The agreement was signed recently (European Commission, 2017b) and will be implemented in January of the year after the ratification by the respective parliaments (European Union, 2017). It is expected that it will come into force in 2020 (BAFU, 2019). Although the design of the CH ETS is based on the structure of the EU ETS, negotiating the necessary adjustments to achieve compatibility with the EU ETS took several years. Important steps were the modification of the CH ETS from a voluntary to a mandatory system for large emitters and the inclusion of the Swiss aviation sector (European Commission, 2017a).

Except for the EU-Swiss link, there are currently no plans to establish further links between third-country cap-and-trade schemes and the EU ETS. However, one possibility is a future link between a UK ETS as a result of the UK leaving the EU. It is to be determined if and how the European carbon market will change as a result of Brexit. Among the available options are that the UK either remains in the EU ETS, establishes a link to it or leaves the EU ETS and introduces an independent carbon pricing policy.

4.2 The North American Carbon Market

In 2007 and 2008, seven western US states[6] and four Canadian provinces[7] joined forces to set up sub-national emission reduction programs and founded the Western Climate Initiative (WCI). The purpose of the WCI is to provide administrative and technical support to its members when implementing cap-and-trade systems. However, except for California, all other US states revoked the collaboration in 2011 and only California and the four Canadian provinces continued to work together (WCI, 2013). Except for Manitoba and British Columbia, the remaining members introduced emission trading systems (WCI, 2017a). Currently, the cap-and-trade systems of California and Québec are linked. In May 2018, Nova Scotia joined the WCI and introduced its cap-and-trade system in January 2019 (Nova Scotia, 2018).

California operates the largest cap-and-trade system in North America. It covers emissions of about 350 million tons CO2e, and is almost six times larger Québec's system (ICAP, 2018). As in Europe, the trading schemes are very similar in their structure. Collaboration takes place in a Consultation Committee and within the WCI. Using the same auction platform, joint auctions are held. Al-

5 EUTL: European Transaction Log, SSTL: Swiss Supplementary Transaction Log.

6 Arizona, California, New Mexico, Oregon, Washington, Montana and Utah.

7 British Columbia, Manitoba, Ontario and Québec.

lowance transactions may be undertaken in U.S. and Canadian dollars, as well as in both English and French (California Air Resources Board, 2017). The WCI also provides a common registry platform and tracking system called CITSS.[8] At auctions, allowances are not differentiated by origin (MDDELCC, 2018). Compared to the European case, there is a higher degree of administrative integration between the linked systems.

The cap and trade systems of California and Québec have been linked since 2014, while Ontario joined the common market in January 2018 (State of California, 2017). Soon after the latest link entered into force, the partners held their first joint auction (California Air Resources Board, 2018a). Unlike in the European case, a comprehensive harmonization process of the three systems was not required prior to linking, because all systems were developed collaboratively following the guidelines of the WCI (WCI, 2017b). This is also in contrast to the European case, where the larger system served as the benchmark, while the smaller system, the CH ETS, adjusted to it. However, a few months after linking, Ontario declared their withdrawal from emission trading, due to a policy shift after provincial elections (Carbon Pulse, 2019b).

Unlike with the European carbon market, further linking opportunities may be available in North America in the short term. In 2016, Québec, Ontario and Mexico signed a joint declaration to collaborate in the area of climate policy. Mexico intends to establish an emissions trading system compatible with the WCI's systems (Ontario, 2016). Oregon also aims to link with the WCI system, although the originally planned linkage date in 2021 is postponed (Carbon Pulse, 2019a). Thus, the North American market is potentially more volatile in terms of the composition of its members than the European one.

5 Preliminary Evidence on the Workings of Linking

5.1 The European Case

Due to the early stages of linking in Europe, it is only possible to evaluate the workings of the link in terms of expectations. We may expect some gains in cost effectiveness, as the marginal abatement cost structures of the EU ETS and CH ETS may be assumed to differ to some extent. Gains for installations regulated under the smaller CH ETS may be expected to be proportionately greater than for those in the EU ETS (Doda and Taschini, 2017). Furthermore, especially Swiss entities will also benefit from greater market liquidity (Oberauner and Krysiak, 2008). In the current unlinked state, Switzerland has the smallest trade volume relatively to its size of all implemented cap and trade systems worldwide (EFK, 2017). Access to the world's largest emission trading market will raise the number of buyers and sellers of allowances and liquidity will thereby increase significantly in the CH ETS.

In exchange, Switzerland loses autonomy in its climate policy and had to adjust the structure of its cap-and-trade scheme to the EU ETS. As the EU ETS is the considerably larger system, it will be the price setter. We may expect that the Swiss allowance price will converge to the EU ETS allowance price. We may also anticipate that price shocks originating in the EU ETS will strongly affect the CH ETS, while the converse effects are expected to be small.

8 CITSS: Compliance Instrument Tracking System Service.

5.2 Linking in North America

As in the European case, there is a lack of ex-post assessments of cost effectiveness effects of linking in North America. We may also assume that marginal abatement cost curves differ somewhat, so that gains in cost effectiveness may be expected. Given the existence of common auctions, more information about price convergence is available for the North American market. The linked system is characterized by a common auction price. As the supply of allowances is currently generous, the common allowance price is determined by the highest floor price of the two systems. Currently, this is the reserve price of California with USD 15.62 in 2019[9] (California Air Resources Board, 2019). The joint price has behaved as outlined in Figure 1. Prior to linking, the auction price was close to the floor price in each component system. After the link was established, the auction price for allowances in Québec increased, while the price in California remained at its floor (California Air Resources Board, 2018b). Especially in the smaller system of Québec, entities benefit from greater liquidity stemming from more trading options and a larger number of auction participants (Purdon, Houle and Lachapelle, 2014).

The linked jurisdictions increased their interdependency, raising their exposure to policy and economic risks. However, these risks appear limited, as even prior to linking they all followed the guidelines developed under the WCI. To our knowledge, there is currently no evidence on the transmission of price volatility or on major negative economic effects due to the link. In this particular case, adding or removing a jurisdiction may be feasible without causing substantial price shocks.

6 **Conclusion**

Linking cap-and-trade systems promises gains in cost effectiveness and provides an opportunity to signal a jurisdiction's commitment to climate policy. It also promises to more fully unlock the finance channel to international abatement investment. The two linked schemes currently implemented show that linking may be a feasible approach to the bottom-up extension of the climate regime beyond a collection of autarkic local approaches. However, considering these policy initiatives closely also reveals that linking is a complex undertaking in practice. In North America and in Europe, as well as in other parts of the world, decision-makers will benefit from the experience gained from creating and operating linked carbon markets. Observing the linked systems over time will provide evidence on whether the links will remain stable and will allow us to draw firmer conclusions on whether entities belonging to the linked systems are able to reap the predicted benefits from linking. The experience operating linked systems in Europe and North America will also help clarify the prospects for including further cap-and-trade schemes to the linked systems or for creating further clusters of linked systems. It will help the global policy community better understand the prospects for building a global climate policy architecture and encourage greater flows of green finance across national borders. If the current more limited initiatives prove to be successful, they may pave the path toward ambitious large-scale linking projects in the more distant future, e. g. the creation of a transatlantic carbon market or linking of the EU ETS with the Chinese ETS.

9 In Québec, the current price floor is CAD 15.31. For example, on 02 April 2019, the exchange rate was 0.749 U.S. dollars for one Canadian dollar. Expressed in U.S. dollars, the carbon price floor in Québec was 11.47 U.S. dollars, respectively.

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Linking with the Chinese ETS or future cap-and-trade schemes from emerging or developing economies may also unlock the potential of linking to direct financial flows targeting abatement investments – one form of green finance – to low-abatement cost locations. In addition to decreasing the aggregate cost of reaching the climate objectives for the linked system, linking may play an important role in bringing green finance to locations currently less able to finance the decarbonization of their economies.

However, given the complex architecture and long time periods required to establish links between cap-and-trade schemes, as well as the urgent need to strengthen international climate action, we believe that linking is not a short-term solution to encouraging green finance. Rather, other measures that may be implemented more easily and more quickly – e. g. public or private funds directly financing abatement in emerging and developing economies – should be pursued in the short run. However – depending on the development of the international climate architecture over the coming decades – linking may become a viable option to encourage climate finance in the medium to long term.

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