学 位 申 請 論 文

Essay on the Political-economy of Linking Heterogeneous Emissions Trading Schemes:

The case of Northeast Asia.

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DOCTORAL THESIS

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"*The only thing we have to fear is fear itself – nameless, unreasoning, unjustified terror which paralyzes needed efforts to convert retreat into advance*".

– Franklyn D. Roosevelt, first inauguration speech.

"The fossil fuel industry has been granted the greatest market subsidy ever: the privilege to dump its waste products into the atmosphere at no charge".

– Bill McKibben, founder of 350.org

"Seen from the viewpoint of politics, truth has a despotic character. It is therefore hated by tyrants, who rightly fear the competition of a coercive force they cannot monopolize".

– Hannah Arendt

"To tell the truth, those who prove incapable of feeling in themselves the smallness of great things cannot recognize in others the greatness of small things. "

– Okura-Sensei, Zen monk

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Essay on the Political-economy of Linking Heterogeneous Emissions Trading Schemes:

The case of Northeast Asia.

Abstract: Linking Emissions Trading Schemes (ETS) of countries with heterogeneous climate policies is the Romeo and Juliet story of carbon pricing instruments. Despite being economically desirable and indispensable to establish a global cooperative climate policy, heterogeneous linkage happens to be politically arduous to establish. But what exactly makes it more challenging for these jurisdictions to agree on ETS linkage? Focusing on Northeast Asia, this doctoral dissertation takes a multidisciplinary political-economic perspective to study the crucial currently unresolved implementation challenges facing ETS linking. This dissertation develops into five chapters. The first chapter introduces the greater purpose of ETS linkage in the international climate policy spectrum, particularly in Northeast Asia, underlining some critical missing political-economic assessments in the literature. *Chapter 1* interrogates the Sustainability of the new Chinese National ETS and its readiness to linking. *Chapter 2* compares ETS design and regulations in China, Japan, and South Korea, studying process and management issues for linking in the region. *Chapter 3* analyzes Political-economic barriers to link ETS in a heterogeneous context using Northeast Asia as a case study and applying an evidence-based approach to investigate stakeholders' influences dynamics. Finally, *chapter 4* considers the potential impact and influence of the COVID-19 global chock on the barrier mechanism to sustainability in ETS implementation, particularly auction allocation. The findings of this doctoral thesis have immediate policy implications by clarifying remaining challenges and providing solutions to overcome barriers to linking not only in Northeast Asia but also across the globe.

Keywords: ETS, Linking, Climate policy, Climate change, Emissions Trading, Political-economy, Carbon pricing

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1. INTRODUCTION

1.1 General Introduction

1.1.a. The defining challenge of the 21st century

Green House Gases (GHG) emissions of anthropogenic origin represent a severe threat to the future of humankind and its environment. By accumulating up in the atmosphere, human-induced GHG emissions change the natural evolution of climate and warm average temperatures at high speed to a level never seen by any human being. In 2018, the *Intergovernmental Panel on Climate Change* (*IPCC) Special Report on the impacts of global warming of 1.5°C* (2018) estimated the remaining carbon budget to stay in line with the Paris Agreement objective of a 1.5°C warming limit to be between 570 $GtCO_2$ (Likely chance to achieve) and 770 $GtCO_2$ (Medium chance to achieve) before 2100. Against this background, the world must achieve a global transition from fossil-fuel reliant economies to carbon-neutrality in record time.

Pathways to stay on the 1.5°C limit would signify to keep GHG emissions to 25-30 $GtCO_2yr^{-1}$ in 2030 and reaching net-zero CO_2 emissions globally for 2050. These targets contrast with the current Nationally Determined Contributions (NDC) to the Paris Agreement forecasting 52-58 $GtCO_2yr^{-1}$ in 2030. Such an unprecedented challenge requires creating a technical revolution in energy generation and revolutionizing our current lifestyles. In turn, these revolutions bear high costs that are susceptible to seriously impacting countries' economic development, necessitate shifting investment patterns, and the emergence of a cooperative global climate policy (IPCC, 2014; IPCC, 2018).

1.1.b How to put a price Carbon?

The *Fifth Assessment Report* of the IPCC emphasizes the necessity to pair technology policy with mitigation policy to address market failure related to innovation and technology diffusion (IPCC, 2014). In 2018, the IPCC affirmed that finding mitigation pathways compatible with the 1.5°C Paris Agreement objective implies putting a price on GHG emissions (IPCC, 2018). So, the question in tackling climate change is not "To price or not to price carbon?" but relatively "What price?" and ultimately "How to price carbon?". Economists have approached this debate by developing the concept of *Social Cost of Carbon* (SCC)[1], intending to evaluate in monetary value the total – present and future – cost of inaction. Based on a range of factors and assumptions, the literature gives a value of SCC above \$100 tCO_2^{-1} globally (Mundaca et al., 2018). The growing accumulation of Social Cost of Carbon conveys that GHG emissions pricing mechanisms are necessary to induce emissions reductions and enhance changes in Energy and Land uses consistent with the climate goals (IPCC, 2018). The extent of the economic coverage of carbon pricing mechanisms and their timing of implementation will affect the ability to stay in line with the Paris objectives.

Carbon Taxation and Emissions Trading Schemes (ETS) are both fiscal instruments dedicated to pricing GHG emissions. Like other Pigovian tax, a carbon tax comprises top-down direct taxation of a negative externality not already included in the market price (Pigou, 1920; Coase, 1960). Emissions Trading Scheme – Alternatively called Cap-and-Trade or Carbon market – on the other hand, are government-mandated market-based instruments that price GHG emissions via a government-engineered scarcity of emissions allowances (Tietenberg, 2006). Carbon tax enables direct governmental control of the carbon price, whereas ETS enables control of the number of

[1] The Social Cost of Carbon is the indicator mentioned here, but it is not the only indicator valuable; the related Shadow Price of Carbon is also essential and indicates changes for each domestic situation. *The SCC is essentially exogenous – that is, determined purely by our understanding of the damage caused and the way we value it; the SPC is endogenous, in the sense that it can adjust to reflect the policy and technological environment*. See: (Price et al., 2007)

emissions reduced annually. Both instruments aim to incite economic agents to internalize carbon costs and reduce their emissions as cost-containment measures. By doing that, these instruments help reduce the social and environmental impact associated with polluting activities. Countries can either decide to implement one of the two instruments or a combination of both (Neuhoff, 2008).

Carbon tax and Emissions Trading Schemes theoretically provide an equivalent solution to price carbon. Thus, choosing the appropriate carbon pricing instrument and finding the proper implementation process remains a critical question for governments. Specific literature considers these questions from the economic perspective, beginning with the prominent original contribution of Weitzman (1974) on instrument choice. In the same vein, pieces like Newell & Pizer (2003), Hepburn (2006), Neuhoff (September 2008), Weisbach (2010), or Goulder & Schein (2013) provide comprehensive answers on choosing the right instrument.

Both the Social Cost of Carbon and Carbon Pricing concepts quickly triggered arguments between economists around interpretation and implementation. Controversies – first about how to evaluate present damages and how to represent through a pricing mechanism welfare damages to future generations caused by climate change – have peaked with the Stern-Nordhaus argument around a steep or ramped hill implementation of carbon prices (Cohen-Setton & Andreicut, 2012; Komanoff, August 2014). This debate eventually focused on the political difficulty to establish an optimal global carbon price and the remaining possibility to implement domestic or regional "Carbon price corridors" (Stiglitz & Stern, 2017). This thesis ambitions to participate in this discussion about implementing carbon pricing policies at the global level by understanding the political-economic challenges faced by jurisdictions facing heterogenous situations to link their respective Emissions Trading policies.

1.1.c A global carbon pricing policy

The last special report from the IPCC underlines the worrying fact that current NDCs to the Paris Agreement are not ambitious enough to reach the 1.5°C targets. Experts recommend enhancing ambitions and adopting Long-term low Emissions development strategies to meet the objectives, including by expanding carbon pricing internationally

(IPCC, 2018). Beyond the fear of the costs associated to fiscal mitigation policy, uncertainties over unfair competition for Emission Intensive Trade Exposed (EITE) sectors, fear of carbon leakage, and apprehensions of a carbon trade war between countries significantly hamper carbon pricing implementation. Provided these significant issues, the Paris Agreement Article 6 encourages a cooperative approach of mitigation policies to accelerate ambition through Internationally Transferred Mitigation Outcomes (ITMO) (UNFCCC, 2015).

The international collaboration of mitigation policies opens new pathways to expand carbon pricing and enable higher ambition consistent with the Paris targets. Economists have advocated for a long time that establishing carbon prices worldwide can decrease the cost and accelerate mitigation ambition at the global level (Neuhoff, 2008; World Bank, 2016). The perspective of instituting a global carbon price has been debated in the climate change governance regime – as developed later in this chapter – but quickly failed to become a real option because of the considerable divergences in opinion, energy mix, and economic development among parties involved (Bodansky, 2016). Thus, establishing a common carbon price between trade partners and compatible economies appears to be a potential solution. The emergence of carbon tax hubs is unlikely due to the difficulty of fixing a consensual common price. Consequently, it remains possible to link domestic or regional Emissions Trading Schemes.

This doctoral dissertation aims to understand how political-economic factors affect the implementation of Emissions Trading Schemes linkage. Economic theory teaches us the benefits of linking ETS in an ideal situation, especially between heterogeneous jurisdictions. However, ETS Linking implementation faces political-economic, legal, public choice, and governance challenges that affect jurisdictions' decisions in the real world. Thus, this thesis ambitions to understand these issues by applying systemic-lens analyses of the policy-process, the sustainability, and political-economic barriers to heterogeneous ETS Linkage through the Northeast-Asian case study.

Chapter 1 concentrates on the Chinese National Carbon market by focusing on the sustainability of the policy design and its Linking readiness. *Chapter 2* compares Chinese, Japanese, and South-Korean carbon pricing policies and analyzes the policy process to ETS Linkage, alignments and harmonization required, and management mechanism for a Northeast-Asian linked system. *Chapter 3* analyses the political-economic barriers to ETS linkage in Northeast Asia with a multi-stakeholders dynamic survey assessing feasibility, confidence, and willingness to link. *Chapter 4* considers the influence of the COVID-19 chock and recovery plans in Northeast Asia on implementing revenue-raising measures in their respective ETS. Before these chore chapters, one must draw the political-economic context behind Northeast-Asia's role in the global climate governance regime and develop the theory and practice of ETS and Linking policies.

1.2 The Climate Change Governance Regime

1.2.a The complexity of global governance

Emissions reductions at the global level necessitate coordinated efforts between jurisdictions. Finding fairways to share the burden has been the critical issue in the fight to tackling climate change. In this context, an international negotiation regime has emerged, whose long and tumultuous history reflects the complexity of finding acceptable and coordinated solutions to tackle climate change. It emphasizes a choc between the documented and expected impacts of the climate crisis and the solutions' anticipated costs.

Following the *first IPCC Assessment Report* (IPCC, 1990), Climate change left the semantic field of pure science to become a political-economic concern for the global community (Bodansky, 1993). This shift led to the *United Nations Framework Convention on Climate Change* (UNFCCC) at the 1992 Earth Summit in Rio de Janeiro. The UNFCCC enshrines from the beginning the burden-sharing complexity by recognizing different categories of Parties that do not bear the same historical responsibility toward GHG emissions (UNGA, 1992; UNFCCC, 1995). It shines a light on the complex ratio of power it creates for burden-sharing (Ritchie, 2019).

The UNFCCC's first era of multilateral climate negotiation targeted a Top-down regulatory approach. This tactic culminated with the *Kyoto Protocol* in 1997, establishing the first binding GHG emissions reduction target but only for industrialized nations with a definite timing (UNFCCC, 1998). Despite its legal bindingness, the Kyoto Protocol's Top-down approach increased political opposition conditions in countries facing the heaviest economic burden. Difficulties in finding a global consensus have culminated at

COP15 in Copenhagen, where parties failed to negotiate a new climate treaty and to agree on internationally defined targets (Bäckstrand & Elgström, 2013; Bäckstrand & Lövbrand, 2016; Falkner, 2016).

The Copenhagen issues triggered a critical change of architecture in the climate negotiation regime by shifting in favor of a polycentric Bottom-up approach. This change affected how to discuss burden-sharing, with the emergence of unified negotiations between Annex-1 and non-Annexed countries (Bäckstrand & Lövbrand, 2016). It eventually resulted in the adoption of the Paris Agreement at COP21 in 2015. The Paris Agreement[2] acknowledges the complexity of adopting binding GHG emission reduction objectives by combining a Bottom-Up national target-setting with a rigorous Top-Down supervision system (Bodansky, 2016). Countries engage in the Paris Agreement with self-determined contributions, the increase of which depends solely on national will (Christoff, 2016). Each nation pledges its commitments in front of the global community by self-assessing its own capacity. While beneficial to circumvent previous issues, it results in fact in current mitigation pledges insufficient to achieve the "well-below 2°C" objectives enshrined in the text (IPCC, 2018).

The Paris Agreement era indeed offers a solid global objective to tackle climate change. However, it does not provide definite burden-sharing mechanisms that are the prerequisite of any climate policy. The Agreement encourages parties to collaborate to reach their self-defined objective, but countries and stakeholders still have to define the cooperation pathways. It is particularly true in the case of Article 6 that outlines a cooperative approach in mitigation policies and international transfer of mitigation outcomes, but faces unresolved challenges in practice. Related to that, and critical for the question of Linking Emissions Trading Schemes, the negotiations of the rulebook of Article 6 display the challenging way of cooperation for the different actors involved. Issues of transparency with Measuring Reporting and Verifying (MRV) systems, sovereignty, and governance-sharing of these policies may be the hardest to resolve. More importantly, adopting accurate Article 6 rules will be determinant for the success of a global and coordinate climate change policy.

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[2] The Paris Agreement reaffirms *the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.*

1.2.b Northeast Asia in the climate governance regime

In this background, the Northeast Asian region has emerged as an essential player. China, Japan, and South Korea are together the biggest absolute emitter globally, emitting around a third – 11.89 $GtCO_2e$ of the 36.44 $GtCO_2e$ – of the global emissions in 2019. Individually, China is the biggest absolute emitter in the world with 10.17 $GtCO_2e$ or 27% of global emissions, Japan emits 1.1 $GtCO_2e$ or 3.3% of the global emissions, and South Korea 0.611 $GtCO_2e$ or 1.7% of the world's emissions (Global Carbon Budget, 2020a)[3]. Historical emissions and per capita emissions tell another story that helps understand the regional political-economic dynamics in the global climate change regime.

Since pre-industrial time, China has emitted around 200 $GtCO_2e$ in the atmosphere or 13.3% of the total human-induced historical emissions, third only to the United States (24.82%) and the European Union (17.36%) (Global Carbon Budget, 2020c). In 2018, Chinese per capita emissions were 6.97 tCO_2e, higher than some developed nations like France (5.33 tCO_2e) or the United Kingdom (5.82 tCO_2e) (Global Carbon Budget, 2020b). The so-called factory of the world, China logically imports emissions and has a consumption-based annual emission in 2018 of 8.96 $GtCO_2e$. It means that China emits around 10% of its total emissions to produce goods exported to other countries. Nevertheless, this net import of emissions enhances Chinese growth and can be considered as a trade surplus. It results in an average adjusted consumption-based emission per capita in 2018 of 6.28 tCO_2e (Global Carbon Budget, 2020d). China disposes of significant coal reserves and is extensively relying on them for energy production. In 2019, coal consumption was about 7.24 $GtCO_2e$, or 71% of the Chinese emissions (Global Carbon Budget, 2020e). In turn, with an energy intensity at 2.09 kWh per unit of GDP and a carbon intensity at 0.27 kg/kWh, China faces a serious energy efficiency hurdle (Our World in Data, 2020a; Our World in Data, 2020b).

Combining its status of economic super-power, first absolute emitter, and of the most populated country on earth, China has substantial leverage on the climate

[3] For the sake of consistency, emissions data mentioned in the introduction of this thesis comes from a single data set collected by the Global Carbon Budget and accessible on the *Our World In Data/University of Oxford* website.

governance regime. China has continuously framed its contribution to tackling Climate change within the limits of its sovereign right to economic growth. This political motto has significantly impeded the achievement of a new international agreement in Copenhagen. China eventually embraced a new role in the Paris Agreement by committing for the first time to domestic mitigation targets but still reflecting the 'right to emit GHG for development' habitus. Chinese NDC has an intensity – not an absolute – target to reduce 60-65% of CO_2 emissions per unit of GDP and a commitment to peak for 2030 (UNFCCC, 2016; Bodansky, 2016; Hilton & Kerr, 2016). Nevertheless, recent pledge to reach carbon neutrality for 2060 seems to announce a new critical shift for the country's commitment to tackle climate change.

Japan was the first Northeast-Asian country to enter industrialization. It results in setting its historical emissions record to 62.34 $GtCO_2e$, the 8th highest in the world (Global Carbon Budget, 2020c). Japanese per capita emissions in 2018 were at 8.93 tCO_2e (Global Carbon Budget, 2020b). Like many developed nations, Japan's consumption-based annual emissions – with 1.31 $GtCO_2e$ emitted in 2018 – are higher than their territorial-based annual emissions. It results in 0.17 $GtCO_2e$ emitted in another country, around 13% of Japan's total annual emissions. In loose terms, the average consumption-based per capita emissions of a Japanese person in 2018 was 10.32 tCO_2e (Global Carbon Budget, 2020d). The great Tohoku disaster[4] has enhanced Japanese reliance on fossil fuel, resulting in a 17% increase in per capita GHG emissions between 2011 and 2016 (Global Carbon Budget, 2020b). In 2019 oil represented 0.420 $GtCO_2e$ – 38% of the total emissions – and coal 0.435 $GtCO_2e$ – 39.5% of the total emissions – in the national energy mix (Global Carbon Budget, 2020e). Having said that, Japan has a comparatively good energy intensity record with 1.13 kWh per unit of GDP, mostly due to high performances in technology innovation (Our World in Data, 2020a). However, carbon intensity has increased since the Fukushima incident up to 0.23 kg/kWh, higher than other developed nations except for Australia (Our World in Data, 2020b).

In the Climate governance regime, Japan is an Annex-1 or long developed country. Despite being the host country of the Kyoto Protocol's Conference, Japan has

[4] The great Tohoku disaster of 2011 and the resulting Fukushima Daiichi nuclear incident forced a decrease in Japanese nuclear energy production due to safety-check measures and growing defiance toward nuclear energy in public opinion (Rudolph & Schneider, 2013).

never been at the edge of climate ambition. However, the country accepted internationally defined emissions-reduction targets in the Kyoto Protocol and pledged a 6% absolute reduction of GHG emissions for 2008-12 (1990 baseline). Nevertheless, the Japanese post-Kyoto climate ambition decreased significantly, and its decision not to support a second commitment to the Kyoto Protocol has been determinant for the future of the Top-down ambition approach. In the post-Kyoto period, the country did not significantly raise its ambition, justifying its absence of energy resources and the considerable cost of mitigating further (Rudolph & Park, 2010; Bodansky, 2011; Sterk et al., 2011). Since the Paris Agreement era, the first Japanese Nationally Determined contribution pledged an absolute reduction of 26% of all GHG emissions by 2030 compared to 2013 (UNFCCC, 2016). Recently, changes of leadership and growing international pressures lead to the first Japanese commitment to carbon neutrality for 2050.

Similarly to its geographic position, the Republic of Korea is somehow at a middle point between China and Japan in terms of economic development. Korean historical emissions record to 15.83 GtCO_2e, the world's top 20th historical emitter (Global Carbon Budget, 2020c). Per capita emissions in 2017 were 12.15 tCO_2e, making South-Korea an intensive per capita emitter (Global Carbon Budget, 2020b). Having reached the newly developed nation's status[5], consumption-based annual emissions in South Korea are higher than their territorial-based annual emissions with 0.688 GtCO_2e emitted in 2018. Related to that, 0.053 GtCO_2e emissions, around 7.7% of the total Korean annual emissions consumed, are emitted abroad, which increases the Korean person's average consumption-based per capita emissions to 13.44 tCO_2e (Global Carbon Budget, 2020d). Concerning energy production, coal is the main factor of GHG emissions, representing 0.315 GtCO_2e in 2019, or half of the total Korean emissions (Global Carbon Budget, 2020e). Energy intensity has been relatively stable in South Korea, with 1.83kWh per unit of GDP in 2016 (Our World in Data, 2020a). The same assumption is valid for carbon intensity at 0.18 kg/kWh (Our World in Data, 2020b). It makes Korea significantly more energy-intensive than Japan, but way less than China. On the other side, Korea happens to be the less carbon-intensive country in the region.

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[5] According to the World Bank standards, South Korea has reached the high-income country status (World Bank, 2020).

Despite being a member of the OECD and considered a high-income country, the Republic of Korea shares with China the paradox of being a not-annexed country under the UNFCCC. Korea ratified the Kyoto protocol, but its UNFCCC status did not bind the nation to any absolute emissions reduction target. However, Korean actions as a middle-sized player in the climate governance regime increased in time. Since 2000, the nation has taken the lead in the "Environmental Integrity Group" at the UNFCCC, supporting a balance between developed and developing countries' interests (Kim, 2014). After doubling its GHG emissions between 1990 and 2005, the Lee Myung-bak administration drafted in 2008 the first genuine national commitment to climate ambition based on intensity targets and "Low carbon green growth" approach (Global Carbon Budget, 2020a; Kim, October 2016). In the Paris Agreement era, the country pledged an absolute reduction of 26% of all GHG emissions by 2030 compared to 2013 (base year target) (UNFCCC, 2016). Finally, in 2020, the South-Korean government pledged carbon neutrality for 2050.

The three countries considered as case-study for this doctoral dissertation have heterogeneous climate policy profiles. Against this background, Northeast Asia is central to any pathways to stay below the 1.5°C objectives of the Paris Agreement. Despite some evident cultural connexions, historical animosity and economic competition are a regional reality that influences potential collaboration in climate policy. However, apparent geographic rationale and the fact that the three countries are major trade partners open the subject of collaboration in carbon pricing policies. The question is to what extent and with which framework will the three Northeast Asian nations cooperate in the Paris Agreement's spirit?

1.3 Emissions Trading in theory

1.3.a The theoretical framework of ETS

In the realm of GHG mitigation policies, Emissions trading is a form of Allowances – or permits – trading mechanism. Allowance trading consists of a market-based fiscal instrument that allocates pollution-right allowances to share the mitigation burden cost-efficiently between polluting entities. Similar to an environmental tax, allowance trading finds its theoretical origins in the principle of *Welfare taxation* developed by Arthur Pigou (1920). Applied to pollution externalities, it aims to incite polluters to reduce their social and environmental impact by internalizing the costs associated with their production. In 1960, Ronald Coase extended the Pigovian principle toward allowance trading by developing the central legal concept of *Transferable Property Right* to pollute (Coase, 1960). Crocker (1966), Dales (1968), and Montgomery (1972) later completed Coase's legal-approach theory by establishing the *polluter-responsibility* that shifts the responsibility to reduce the externality from authorities to polluters. Finally, Baumol and Oates (1988) gave a spatial dimension to this theory by stressing that only the emissions reduction level matter, not the location. On this framework, Allowances trading theoretically enables all possible corporate mitigation strategies to compete on the same level playing field, giving a premium to front runners.

From this theoretical background, three different climate policies involving Allowances trading have emerged as prominent mitigation instruments: two "Credit-based" mechanisms and a genuine "Allowance-based" mechanism. Credit-based mechanisms are project-based instruments depending upon the existence of regulatory standards. In the Kyoto Protocol era, the Clean Development Mechanism (CDM)[6] and the Joint Implementation (JI)[7] Mechanism were both credit instruments (UNFCCC, 2020a; UNFCCC, 2020b). The other category of Market-based mitigation instrument is Emissions Trading – or Cap-and-Trade – which is of interest for this thesis.

1.3.b Design and actors:

An Emission Trading Scheme must convey a price signal reflecting the long-term emission reduction objective to carry investments away from carbon-intensive production and into zero-emission technologies. This price signal on an ETS consists of letting the

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[6] The Clean Development Mechanism finances emissions reduction project in non-annex I countries through Certified Emissions Reductions (CER) credits.

[7] The Joint Implementation is a Mechanism enabling an Annex-B country to receive a permit for helping another with a project of emissions reduction.

market set the monetary cost on GHG emissions through a set of rules and actors' trade. An ETS policy framework implies two types of participants, bearing two types of duty: (i) A regulatory authority in charge of ensuring GHG mitigation (Government agency, ministry…). (ii) The polluting entities' management in charge of taking actions to decrease emissions to meet the reduction target. Both participant categories must set a design agreement harmonizing efforts of the two groups (Tietenberg, 2006)[8]. An ETS design also comprehends four fundamental elements.

The first design element is the Cap, and the generation of a proportional amount of emissions rights to share between covered entities. An ETS cap is the maximum volume of emissions covered sectors are entitled to emit under a defined period (usually annual, but it may differ). Governments usually charter the Cap on the baseline of past emissions levels. The stringency of the Cap is adjusted each period, generating scarcity on the market. This stringency is the main factor determining the market's allowance price and consequently plays a crucial role in environmental sustainability. The Cap purposes to reflect the emissions reduction target, thereby representing the aggregated burden assigned to covered sectors. Relative to the aggregated Cap, the coverage is a set of rules defining each sector and entity included in the ETS. Depending on jurisdictions, the Cap can be predicted several years to the future, which enables covered entities to adjust their emissions reduction strategy to their best marginal abatement cost (Baumol & Oate, 1988; Cropper & Oate, 1992; Newel et al., December 2012, Aldy & Stavins, 2012; Haites, 2018).

The second design element of an ETS is the allocation of emissions permits. The initial allocation aims to transfer the property right to emit a defined amount of GHG to covered entities. It serves as the theoretical limit – or portion of the Cap – each covered entity can emit for the compliance period. The initial allocation can either be through a revenue-raising method like auctioning or a revenue-free method like benchmarking or grandfathering[9]. Both revenue-free allocation methodologies distribute initial allocation to covered entities for free, on sectorial emissions performance baseline for

[8] Readers can find insightful contributions on ETS institutional implementation in OECD reports like Prag et al., (November 2012).

[9] Other initial allocation methods exist in theory but are not standard in GHG ETS like random access (Lottery) or First come, first served (Tietenberg, 2006).

benchmarking, or on historical emissions baseline for grandfathering. Auctioning, on the other hand, requires entities to purchase their estimated need of allowances directly. Jurisdictions can also settle for a mix-system where a part of the allocation is allocated free of charge – usually for Emissions Intensive Trade Exposed (EITE) sector subjected to carbon leakage[10] – and another part is auctioned. As a result, it means letting the market allocate the initial allocation through competition between covered entities (Tietenberg, 2006; Newel et al., December 2012).

The third ETS design element is the allocation trading rules. An ETS requires covered entities to surrender permits equal to their actual emissions at the end of the compliance period. If an entity fails to comply with the limit determined by the initial allocation, a set of trading rules enables the purchase of the difference of permit entailed on the market to entities with remaining permits. ETS trading rules encompass flexibility mechanisms to facilitate compliance. Temporal flexibility mechanisms, like banking or borrowing, enable covered entities to spread emissions reduction over time. It offers a temporal levy to accommodate mitigation strategies to future opportunities and decide when is the most cost-efficient period to reduce emissions. An ETS can also settle for spatial flexibility mechanisms like offsetting that enable firms to purchase emissions reduction credits from mitigation projects outside the ETS and often outside the jurisdiction[11]. With controversial effects on ETS sustainability, offset can include any design-approved methods for reducing or removing emissions uncovered under a particular cap yet[12] (Rubin, 1996; Cronshaw & Kruse, 1996; Kling & Rubin, 1997; Neuhoff, September 2008; Aldy et al., 2010; Newel et al., December 2012).

The fourth fundamental element of an ETS design is the market monitoring and oversight system. This monitoring system has the duty to Measure, Report, and Verify (MRV) compliance and to bring enforcement actions against non-complying entities. It necessitates a set of MRV standards, enforcement rules in case of non-compliance, and an institution to track allowances called Registry. Besides, both the market monitoring mechanism and the Registry play a crucial role in ETS transparency and the scheme's

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[10] Relocation of the emitting facility in less regulated entities to avoid the carbon burden.

[11] In the Kyoto Protocol, CDM and JI projects were eligible offsets in ETS like the EU ETS.

[12] For example, forestry projects, energy efficiency improvement projects, Carbon Capture and Storage projects (CCS).

environmental accountability (Tietenberg, 2006; Neuhoff, September 2008; Newel et al., December 2012).

In sum, the ETS design engages the regulator to set the emission Cap and ensure compliance. Simultaneously, the Cap engages market forces to self-define the least expensive abatement opportunities through permits trading. An ETS's cost-efficiency comes from the fact that covered entities that can reduce emissions more cheaply find interest in enhancing emissions reduction to sell the excess permits generated. On the contrary, Permit buyers can decide to buy permits on the market whenever their marginal abatement cost of GHG emissions reduction is more expensive than buying permits from other sources. Thus, permits trading equalizes marginal abatement cost among covered entities, ensuring an overall abatement outcome at minimum cost.

1.4 Emissions Trading in Practice

Reality considerably alters Emissions Trading Schemes' theoretical assumptions because of imperfect or uncertain access to information, design issues, transaction costs, or political-economic barriers. Regarding ETS in practice, one must first understand its historical foundations before assessing ETS implementation from a public choice and political-economic perspective.

1.4.a ETS in History

The historical literature on ETS still lacks a real comprehensive and balanced contribution from Historical Science. Nevertheless, authors like Schmalensee & Stavins (2017) provided a brief historical compilation of three decades of ETS implementation. Other contributions published in the 2013 winter symposium of the *Journal of Economics Perspective* on "Trading Pollution Permits" also offer some historical angle but still within the economic outlook (Goulder, 2013; Newel et al., 2013; Schmalensee & Stavins 2013). For this doctoral dissertation, *Table 1* provides an up-to-date summary of ETS implemented in 2021.

The first attempt to use Allowance Trading to phase out pollutants happened in the 1980s North-American context, with a US federal policy to rule out lead from Gasoline. Following this effort, in 1990, George H.W Bush signed the first genuine Cap-and-Trade amendment to the Clean Air Act tackling SO_2 emissions responsible for destructive acid rains. However, the fate of Emissions Trading for GHG emissions mitigation faced a total other destiny in the USA because of strong industrial interests' oppositions (Stavins, 2007; Mann, 2021). Henceforward, it is on the other side of the Atlantic Ocean that Emissions Trading gained its first GHG mitigation purpose.

The first tentative to put a price on carbon in the European Union had been through a Carbon Tax. However, industry oppositions and EU treaties unanimity of member-states requirement on taxation impeded the tax option to emerge at the EU level (Ellerman & Buchner, 2007)[13]. Thus, the genesis of the EU ETS embodies the arbitration between the political reality and the necessity to implement carbon pricing. In addition to being the first GHG ETS implemented, the EU ETS is still the world's largest properly working instrument, covering about half of the EU CO_2 emissions and 30 countries in 2021[14]. The EU ETS served as a model at the global stage in terms of ETS development. The implementation in phases, Design, and the EU ETS's institutional structure have significantly shaped GHG ETS architecture worldwide. The EU ETS struggles were also often exported, like using free allocation to avoid competitiveness issues and soften industrial pressures. The decentralized nature of its original allocation system triggered a structural over-allocation issue in the EU ETS that has long blocked the market price to low levels[15]. Gradual implementation of auction-allocation (40% in Phase III), cap tightening, and the Market Stability Reserve mechanism's adoption eventually improved the scheme efficiency. Studies evaluate the impact of the EU ETS as medium, with a noticeable improvement from phase to phase and growing carbon price on the market (Ellerman et al., 2010; Löfgren, 2015; Schmalensee & Stavins, 2017).

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[13] Thirteen countries covered by the EU ETS also implement a national carbon tax for specific non-covered sectors, see Haites (2018).

[14] The EU 27 and Iceland, Norway, and Liechtenstein.

[15] This decentralized allocation system notably led Ellerman (2010) to consider the EU ETS as a "prototype global system".

Since the EU ETS launch in 2005, 24 jurisdictions have adopted Emissions Trading as part of their GHG mitigation arsenal. *Table 1* provides a short chronological description of these instruments, including some fundamentals of their respective design and carbon price. Fifteen of these ETS come from subnational jurisdictions and two different political-economic realities. North-American and Japanese schemes, like the Regional Greenhouse Gas Initiative (RGGI)[16], The Western Climate Initiative (WCI)[17], or the Tokyo and Saitama ETS, originated from the late 2000s' early 2010s' in the Kyoto protocol era. They are Bottom-up induced instruments established in a context of political incapacity of their respective national jurisdiction to pass carbon pricing at the country level. Each national situation being distinct, these ETS resulted from a willingness to act from a subnational authority in the broader international climate policy context after the Copenhagen conference. On the other hand, the so-called Chinese 'pilots' were Top-down incited and indicated to serve as trial-phases before implementing a National scheme in China. Chinese pilots' implementation happened a little after the first category of subnational ETS, and they enter the climate policy discussion to display the Chinese engagement for a future Climate Agreement in Paris. Alternatively, National ETS, except for the fast movers New-Zealand and Switzerland, are an emerging phenomenon, well anchored in the Post-Paris Agreement context.

This historical perspective of ETS development displays distinct domestic political backgrounds of carbon pricing implementation over the last two decades. It also emphasizes the bright dynamic behind ETS policy this last decade. The last ICAP report (2021b) on ETS worldwide stresses that ETS now covers up to 16% of the world's GHG emissions. In this regard, Métivier et al. (2018) provide the most prevalent analysis to date in ETS literature regarding emissions covered, volume, and revenue raised.

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[16] The RGGI includes the US States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Virginia, with Pennsylvania pending membership. For literature on RGGI, see Ramseur (2017).

[17] Collaboration and Linking between the California and Québec ETS, including the management of the new Nova-Scotia ETS, see Bang et al. (2017) for California ETS and Benoit & Côté (2015) for Québec and the WCI.

Table 1 – GHG ETS implemented in 2021[18]

Jurisdiction	Year launched	Average Price in 2020 (US$t/$CO_{2e}$)	Share of jurisdiction's emissions covered (%)	Cap in 2020 ($MtCO_{2e}$)	Linking
European Union	2005	28.28	40	1572	With Switzerland (2020)
New Zealand	2008	19.99	51	41 (2017)	/
Switzerland	2008	28.45	11	4.9[19]	With EU (2020)
RGGI (USA)	2009	7.06	10	67.4	/
Tokyo (JP)	2010	14[20]	20	10 (2017)	With Saitama (2011)
Saitama (JP)	2011	14[21]	20	7 (2017)	With Tokyo (2011)
California (USA)	2013	17.04	75	334.2	With Quebec (2014)
Québec (CAN)	2013	16.97	78	54.7	With California (2014)
Beijing (CN)	2013	12.62	45	50	/
Guangdong (CN)	2013	4.09	70	465 b	/
Shanghai (CN)	2013	5.81	57	158 b	/
Shenzhen (CN)	2013	3.46	40	31.45 a (2017)	/
Tianjin (CN)	2013	3.28	55	100 (2017)	/
Kazakhstan	2013 (real 2018)	1.10	41	159.9 a	/
Chongqing (CN)	2014	3.82	62	97 (2018)	/
Hubei (CN)	2014	3.94	42	270 b	/
South-Korea	2015	27.62	74	589.3 a	/
Fujian (CN)	2016	2.5	60	220 a[22]	/
Massachusetts (USA)	2018	7	11	8.5	/
Nova-Scotia (CAN)	2019	18.16	82	12.7	/
Mexico	2020	/	40	273.1	/
China	2021	/	40	Intensity-based[23]	/
United Kingdom	2021	/	31	155.7	/

a = excluding market reserves b = including market reserves

[18] Information exported from ICAP (2021a) for carbon price and Cap data, Haites (2018) for general information, Métivier et al. (2017) for Cap data.
[19] Excluding airline operators whose cap is 1.3 $MtCO_2$ in 2020 (ICAP, 2021a).
[20] Since there is no trading platform for the Tokyo and Saitama ETS, prices are unknown. Estimates for 2017 gave an average price of 14$ (Haites, 2018).
[21] Same as Tokyo.
[22] No official numbers, estimates only according to ICAP (2021a).
[23] The Chinese national ETS Cap is bottom-up and intensity-based. It will change according to the actual production levels. Estimations set the cap to over 4,000 MtCO2/year for 2021 with ex-post adjustments allowed at the regulatory and at the covered entity level (MEE, 2020a; MEE, 2020b; MEE, 2020c, MEE, 2020d; ICAP, 2021a).

1.4.b ETS in Northeast Asia

Two chapters of this doctoral dissertation consider the Northeast Asian approach to Emissions Trading development. *Chapter 1* comprehensively emphasizes the development of the Chinese National ETS and lessons from the Pilots. *Chapter 2* compares the three Northeast Asian ways to Emissions Trading and provides the context, design, and institutions of these instruments. In extension to these chapters, this introduction delivers a short historical and political-economic assessment summary to contextualize ETS development in the region.

In Asia, the first country to have considered GHG ETS is Japan. In 2008, Japan adopted the first *Action Plan for Achieving a Low Carbon Society* embracing GHG reduction goals for the Copenhagen Climate Summit and including a first mention of interest for carbon pricing. After Copenhagen's failure, and a rare change of political coalition in the Diet, the Japanese government adopted in 2010 the *Basic Act on Global Warming Countermeasures* and decided the implementation of a national Emissions Trading Scheme. The political turmoil of the 2011 Tohoku disaster eventually buried this decision and wiped out any genuine endeavour to implement carbon pricing. Simultaneously, the Tokyo Metropolitan government and the Saitama prefecture decided to launch their own scheme in 2010 and 2011 and directly link the two instruments. The country eventually adopted its first national carbon tax in 2012 (Rudolph & Schneider, 2013; Sopher & Mansell, 2014).

Tokyo and Saitama ETS keep being the only schemes implemented in the country. Both ETS have a very modest scope, and the two systems assume a constant carbon intensity for electricity and a bottom-up allocation. However, the change in the electricity generation mix induced by the nuclear plants' shutdowns in the aftermath of the Fukushima-Daiichi incident has possibly jeopardized the scheme efficiency. Wakabayashi & Kimura (2018) indeed evaluate an increase of up to 0.35% in GHG emissions among ETS-covered entities from 2012 to 2017. Until recently, Japan did not exhibit any serious interest in a national scheme, not even in its NDC to the Paris Agreement. Nevertheless, since the announcement of its intention to reach carbon neutrality for 2050, new carbon pricing measures, including ETS, are under consideration by the Japanese authorities.

Korean ETS History is both fixed in the post-Copenhagen era and the Republic of Korea's political history. After its first official commitment to GHG mitigation in 2009, Korea adopted the *ETS Act* in 2012 under the critical Lee Myung-Back administration. This first legislation on carbon pricing implementation gave birth in 2015 to the second largest ETS instrument working to date. The Korean national ETS had three phases and two reforms, gradually expanding its regulatory scope and introducing a small amount of auctioning in the third phase (From 2021).

The Korean ETS is the first example of successful learning from prior experiences earned in international examples, noticeably from the EU ETS. Park et al. (2014) enlightens that Korean authorities struggled to establish an efficient design. Furthermore, Suk et al. (2017) explain the instrument's liquidity issue because of covered entities' unpreparedness. Korean authorities have developed an original collaboration framework with stakeholders to enhance support for the scheme and solve these issues (Song et al., 2015; Kim, 2016). However, this extensive bottom-up approach did not only trigger positive outcomes because of the over-confidence given to industrial reporting to establish the ETS baseline, leading to a politicized allocation system and low consideration for environmental interests (Kim et al., 2015). Moreover, as the only carbon pricing policy in place in the country, the Korean scheme still falls short of achieving sufficient coverage – 68% – of the domestic emissions-intensive sectors (Narrassimhan et al., 2018).

The first mention of ETS in a Chinese official document was in the 12th Five-Year Plan (2011-2015), committing to use GHG ETS to tackle climate change. Chinese officials received extensive international support to adapt ETS to their domestic reality, especially from the European Union and international institutions like the World Bank through the *Partnership for Market Readiness* (PMR, 2014; Swartz, 2016). As written before, China first developed ETS at the subnational level from 2013. On this topic, Deng et al. (2018) provide a comprehensive description of the pilots' development process. Up to 8 of these subnational schemes – visible in *Table 1* – emerged between 2013 and 2016. These pilots have significant divergences in design, especially for allocation methods and cap setting, enforcing absolute cap, intensity cap, or a mix of both. Some pilots also appear to have been implemented in a rush for political reasons, without assessing cap and emissions trajectory. They all have in common of not covering the essential of emission-intensive sectors (Munings et al., 2016; Xiong et al., 2017).

No extensive empirical studies to date enable us to assess the efficiency of the Chinese pilots' ETS, mainly because none of them disclose emissions data. Nevertheless, political-economic analyses show that Chinese pilots performed relatively poorly (Narrassimhan et al., 2018). Beyond these fundamentals, Chinese authorities triggered the pilots as a sort of ETS trial phase for Chinese stakeholders and regulators to prepare for a national scheme (Duan et al., 2014; Swartz, 2016). Indeed, Chinese engagement to the Paris Agreement passed through the development of a national ETS. The 13th Five-Year plan (2016-2020) mentioned implementing a national ETS as a political objective. Nevertheless, the national ETS elaboration passed through many turbulent phases – including policy change, regulatory modifications, and change of ministry in charge – before the instrument eventually materialized in January 2021, still without any actual trading. Even if the CN ETS is now theoretically the biggest in the world in terms of volume covered, the scheme has an intensity-based cap for the foreseeable future, promising a very symbolic environmental impact.

Japan, South Korea, and China display different approaches to climate change policy. They also show divergent conceptions of economic rationale in their political-economic context. Exploring this history enables contextualizing and explaining each national situation toward Emissions Trading Schemes development. The Emissions Trading practice in the region has historical specificities, but they also embrace constraints and drivers identifiable in the ETS literature.

1.4.c Public choices and Political-economic perspectives of ETS practice

Recent trends in the literature about carbon pricing interrogates the public choice factor and the political-economic dimension of practical implementation. Important researches, like Ellerman (2012), investigates why ETS tends to be politically easier to implement than carbon taxes. Discerning analyses of ETS implementation issues and success can be found in reports like Laing & Mehling (March, 2013) with case-specific examples. Recent studies, like Haites (2018) focus on achievements of carbon Pricing, while pieces like Narrassimhan et al. (2018) explores ETS design implementation processes globally[24]. This broader field of research acknowledges that most remaining challenges in Carbon pricing implementation have a political-economic nature. This doctoral thesis intends to participate in this discussion with a specific focus on ETS Linking implementation and sustainability. Before investigating Linking, one can underline four categories of political-economic questions related to the broader issue of ETS implementation: Design sustainability, MRV & transparency, stakeholders' dynamic, and revenue-raising implementation.

Emissions Trading Schemes sustainability has been a long and tumultuous debate in the literature (Spash, 2009; Rudolph et al., 2012). Two dimensions exist in this discussion: First, there are questions on the environmental impact of instruments implemented. On that topic, the most valuable tool remains the evaluation of ETS achievements – like emissions reductions – with comprehensive studies like Haites (2018) or on specific cases Choi & Lee (2016) for South Korea or Welfens et al. (2017) for a more global perspective. The second dimension of ETS sustainability requires analyzing public choice on regulation and Design. Governance structure and Design elements significantly impact ETS sustainability. Nevertheless, comparing ETS sustainability proceedings remain a challenging exercise because of domestic specifics and diverging rationale, as displayed in Narrassimhan et al. (2018) and Schmalensee & Stavins (2017). Consequently, assessing Design and regulatory choices, like how authorities manage sectoral coverage, allocation methods, cap setting, or offsetting rules, is critical to understand ETS sustainability outcomes. Two chapters of this doctoral dissertation embrace this subject. *Chapter 1* analyses Emissions Trading's development in China, considering sustainability criteria to study Design elements development. *Chapter 2* explores ETS Design development in China, Japan, and South Korea and adopts a comparative approach to assess system robustness to linkage.

Following the sustainability question in the literature, Emissions Trading requires access to information on multiple levels. Market players need access to the accurate carbon price and stable regulations; regulators necessitate appropriate emissions reduction data from an objective Measuring, Reporting, and Verifying system. However,

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[24] The reader may refer to the 2018 *Climate Policy* special thematic section on Carbon Pricing implementation https://www.tandfonline.com/toc/tcpo20/18/8?nav=tocList .

access to information is imperfect, and MRV management complex and sometimes obscure (Newell et al., 2013). Thus, legal enforcement of Transparency in regulations and MRV equally plays a crucial role in ETS sustainability. It is particularly relevant for the Chinese ETS experience, as emphasized by Dean et al. (2017). In addition to the larger sustainability question, the two first chapters of this doctoral dissertation also consider Transparency. *Chapter 1* studies Chinese ETS policies Transparency with a Law and Economics approach. *Chapter 2* addresses the MRV management issue considering practice in Northeast Asia and the challenges ahead for ETS linkage.

Beyond ETS design sustainability and MRV regulation transparency, stakeholder engagement with public choices plays a crucial role in defining ETS outcomes. The climate policy literature underlines many pertinent dimensions influencing carbon pricing implementation like ideological drivers in governments, interest influences, and power relations (Tanner & Allouche, 2011). Influences of stakeholders in ETS policy formation are necessary to establish the appropriate design (Song et al., 2015). However, it also opens the door to over-influence from industrial interest, as seen in ETS experiences worldwide. In contrast, studies display a low impact from environmental-focus interest groups (Markussen & Tinggaard, 2005; Kim et al., 2015; Anger et al., 2016; Gulbransen et al., 2018a; Haites, 2018; Narrassimhan et al., 2018). Thus, assessing these dynamic networks is relevant to understand their impacts on Emissions Trading achievements. It enables comprehending barriers and drivers for design and regulatory elements critical for ETS sustainability. In that regard, *Chapter 3* assesses these networks' dynamic and power-relations in ETS in the Northeast-Asian context and compares influences to explain the political roots of divergences in design. Finally, *Chapter 4* interrogates the political-economic structures impeding revenue-raising allocation implementation in Northeast Asian ETS.

Raising revenue through auctioning allocation and revenue recycling are central questions in the Emissions Trading sustainability discussion. Haites (2018) summarized how Revenue raising measures have been implemented in ETS so far. Carl & Fedor (2016) and Métivier et al. (2018) contributions stress the central role of revenue-use for financing mitigation measures and low-carbon investments. In that backdrop, reducing existing tax through ETS revenue could play a critical part in gaining public support for carbon pricing implementation. However, (full) auctioning implementation and ETS revenues have been predominantly theoretical until recently because governments tended to use free allocation as a levy to facilitate ETS acceptance by reluctantly covered entities (Narrassimhan et al., 2018). This doctoral thesis develops the ETS revenue discussion with an emphasis on Chinese domestic implementation of revenue-raising measures (*Chapter 1*), impacts of linking (*Chapter 2* and *Chapter 3*), and how the COVID-19 external chock represents an opportunity to apply a double-dividend leverage to fund Net-Zero investments from recovery plans (*Chapter 4*).

Political-economic issues in implementing Emissions Trading Schemes pass through the questions addressed in this Chapter. The discussions over Design sustainability, Transparency, Stakeholder dynamic, and Revenue-raising measures implementation influence the linking question and, more broadly, the establishment of carbon prices around the world.

1.5 Linking Emissions Trading Schemes

This doctoral dissertation studies ETS Linking throughout its first three chapters. *Chapter 1* analyzes the Chinese National ETS challenges to a future Linking. *Chapter 2* investigates Linking in practice in Northeast Asia through the design harmonization question and the challenges of managing a linked MRV system. *Chapter 3* explores barriers to Linking ETS in the Northeast-Asian context with a stakeholder network approach. Before moving to these chapters, one must first address ETS Linking theoretical framework and its resulting political-economic challenges.

1.5.a ETS Linking from theory to practice

The discussion about Linking Emissions Trading Schemes emerged at the beginning of the 2000s as a solution for countries to explore flexibility mechanisms provided by the Kyoto Protocol. Kachi et al. (2015) and Mehling (2016) provide the most accomplished historical review on ETS Linking development. Early literature contributed to set the definition and theoretical background of ETS linkage: A formally recognized transfer of emissions permits emanating from a foreign regulatory authority that can be surrendered as valid compliance unit domestically[25]. Mehling et al. (2009) and Jaffe et al. (2009) expanded the theoretical framework of ETS linkage by discussing the architecture and modalities of linkage implementation. The following year, Fankhauser & Hepburn (2010a; 2010b) provided a comprehensive theoretical assessment of designing ETS Linking in Time and Space. Also, specific theoretical literature studying the different options of ETS linkage have arisen with papers like Marchinsky et al. (2012) adopting trade-theory analysis of sectoral linkage.

After abandoning the option to reach a Top-Down solution to price carbon globally, ETS Linking benefitted from the scholarly paradigm shift to a Bottom-up approach in Climate policy. From the early 2010s, ETS is increasingly seen as a credible pathway to spread carbon pricing globally, producing papers on potential linkages with an emphasis on economic conditions and empirical assessment of case studies. Conceptual studies emerged like Tuerk et al. (2009) and Flachsland et al. on linking architecture (2009a) or on Linking benefits and disadvantages (2009b)[26]. In a similar category, Metcalf & Weisbach (2011) provided a critical contribution to this doctoral thesis perspective in studying the theory behind heterogenous ETS Linkage.

The third period of ETS Linking literature adopts a political-economic perspective considering past ETS Linking tentative lessons and experiences. Jevnaker & Wettestad (2016) address critics' though question to linkage and examine its feasibility to date. Additionally, papers like Ranson & Stavin (2016) or Tuerk & Gubina (2016) consider experiences and prospects.

Economists proffer to the linkage of Emissions Trading instruments excellent economic benefits through *cost-sharing* and *effort-sharing* advantages. First, Linking provides an increased economic cost-efficiency compared to autarky[27] by equalizing marginal abatement costs among linked partners. Second, it enhances market liquidity

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[25] Recognition must be reciprocal, and ETS Linkage can be bilateral, multilateral, or unilateral with spatial or temporal flexibility. See: (Quemin, 2017).

[26] The 2009 *Climate Policy* special issue on "Linking GHG Trading Systems" represents the most comprehensive review of this period of the literature with case-specific studies. PMR & ICAP (2016) also provides a noticeable contribution.

[27] Condition of non-linked ETS.

and minimizes risks of both exercises of Market power and price volatility in case of external chock by enlarging the size of the Market. Third, ETS linkage decreases administrative cost through economies of scale and reduces the danger of carbon leakage among trade partners (Burtraw et al., 2013; Flachsland et al., 2009). Furthermore, Bodansky et al. (2015) stress that linkage economic benefits could help tor raise political support for ETS, triggering higher mitigation ambition potential at the market level. Linking theoretical benefits also convey that more partners face heterogeneous realities, like different marginal abatement costs of carbon, more linking is beneficial and should be forecasted (Metcalf & Weisbach, 2011; Green et al., 2014; Mehling et al., 2017).

1.5.b Linking ETS in a heterogeneous world

There is a consensus among experts that the global reduction of Greenhouse Gas emissions requires international cooperation to reach the Paris Agreement objectives (IPCC, 2018). The Paris Agreement engraves this vision with Article 6 charting international cooperation through carbon markets. In this regard, Levin et al. (March, 2019) examine the remaining issues faced to establish the Article 6 rulebook and their importance for the future of International Transfer of Mitigation Outcomes (ITMO)[28]. The most significant challenges for this rulebook occur on settling rules to avoid Double-counting[29], certify Additionality[30], ensure increased ambition and progression[31], and

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[28] A mitigation outcome resulting from cooperative approaches under Article 6.2, which are internationally transferred and authorized for use toward NDCs, or authorized for international mitigation purposes other than NDC achievement see: (Levin et al., 2019).

[29] An instance in which the same mitigation outcome is counted toward the NDC of more than one Party (or another compliance scheme).

[30] The idea that emissions reductions should produce additional abatement compared with a reference scenario of emissions reductions that would have occurred in the absence of the market-based mechanism. See: (Michaelowa et al., 2019).

[31] For example, determining whether subsequent NDCs will be incentivized or disincentivized to increase coverage of GHGs or sectors, and the extent to which Article 6 incentivizes

provide financing options for Article 6 activities and adaptation[32] (EDF, 2018; Michaelowa et al., 2019; Schneider & Warnecke, 2019).

Accordingly, the Paris Agreement Article 6.2[33] and 6.4[34] explicitly refer to decentralized ETS Linking between groups of Jurisdictions. In this decentralized approach to mitigation policies, countries must set their own ambition and design their instrument before choosing to cooperate further through coordination and harmonization. Linkage eventually embodies an opportunity to overcome what Victor (2010) called the "Global Warming Gridlock"[35]. However, as Gulbransen et al. (2018a) underlined, this logic considers that it is easier to coordinate and monitor ITMO between groups of jurisdictions than at the global level.

The political-economic assessment of ETS linkage practice demonstrates that despite noticeable advantages in cost-efficiency, many public perception and opposition issues impede the emergence of ETS linkage (Green et al., 2014; Pollitt, 2016; Ranson & Stavin, 2016). The most prominent obstacle to Linking implementation being that ETS are instruments tailored to suit each domestic situation, generating significant heterogeneities of implementation between jurisdictions. Heterogeneities in Design and practices are inevitable and anchored in the political-economic reality of countries willing to keep the most efficient scheme for their jurisdiction. Notwithstanding the theoretical economic advantages of Linking ETS with heterogeneities, Design divergences, inequivalent results in terms of carbon price level, permits quality, political differences, different ambition level, and the absence of standard accounting rules complicate the

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enhanced ambition over time and results in overall mitigation of global emissions. See: (Levin et al., 2019).

[32] Article 6 rules can either facilitate or hinder the flow of finance available for related activities because investor confidence depends on a credible carbon market. Barriers could introduce market distortion or make participation difficult. The rules can also impact the finance available for adaptation, including through a share of proceeds levied to support the adaptation fund. See: (Levin et al., 2019).

[33] Encourages international linkages that can transfer emission obligations through to trading.

[34] Provision for indirect Linkage.

[35] Impossibility to compel countries to mitigate GHG emissions through an international treaty with binding national targets.

international transfer of mitigation outcomes (Fankhauser & Hepburn, 2010b; Green et al., 2014; Metcalf & Weishbach, 2011; Mehling et al., 2017; Schneider & La Hoz Theuer, 2018). Consequently, Linking ETS from compatible and willing jurisdictions face hurdles to harmonize these heterogeneities, not only in Design but also in practice, activating a complex political challenge. *Chapter 2* and *Chapter 3* especially analyze this central issue of heterogenous ETS linkage and connect theoretical assumptions to Northeast Asia's political-economic reality.

ETS Linking literature insists on the importance for ETS policies to converge in Design and regulations to meet the conditions for a successful linkage (Tuerk et al., 2009; Bodansky et al., 2015). However, political-economic divergences between jurisdictions trigger heterogeneities in ETS design and practice that will be difficult to harmonize. Interactions between conflicting interest groups of varying political power define climate policy formation conditions through negotiations at the domestic level (Fankhauser et al., 2015; Knox-Hayes, 2012; Kroll & Shrogen, 2009). Thus, if interest groups and policy coalitions fail to adopt a similar view on linkage implementation between jurisdictions, they will tend to oppose ETS linking in favor of the status quo. In the words of Gulbransen et al. (2018a), even if ETS architects are well aware of divergences with other schemes, they still adapt Design and regulations to their political and administrative reality before thinking of a potential future Linking, rendering harmonization problematic. In this backdrop, *Chapter 3* interrogates the impacts of the decision-making processes in generating barriers to the emergence of the institutional structure of governance necessary to link Northeast-Asian ETS.

Ensuring environmental integrity is a critical dimension of ETS Linking. Nevertheless, defining the environmental integrity of international carbon markets collaboration has not been an easy task. The minimal consensus requires ITMO to guarantee the same or lower aggregate global emissions. Schneider & La Hoz Theuer (2018) identify four factors mandatory for environmental integrity: (i) Similar accounting rules. (ii) A guarantee of the quality of units generated in partners' schemes. (iii) The ambition and scope of the transferring country's cap. (iiii) The incentive or disincentives for future mitigation action. On this basis, some experts like Green (2017) advocate against ETS Linking because of the risks uncoordinated linkages imply for global mitigation. She underlines the high improbability for the international community to agree on international institutions to manage allowance supply at the global level, like a central carbon bank. *Chapter 3* of this doctoral thesis considers environmental integrity risks of uncoordinated ETS linkage. It shows the impact environmental integrity has on ETS linkage support and feasibility in the heterogenous Northeast-Asian context. The last section of *Chapter 3* also analyzes the risks generated by barriers to convergence for a potential ETS linkage in the region.

In a heterogeneous world, Linking Emissions Trading instruments implies significant challenges mostly unresolved until now. Despite abundant literature, ambitious past prospects, and the Paris Agreement Article 6, linkage of ETS policies fails to transform into a concrete reality. In fact, a genuinely heterogenous ETS linkage is inexistent. Current ETS linkages only concern relatively similar jurisdictions. California and Québec ETSs, or recently the European Union ETS and Switzerland ETS, are Linking examples from the same geographical region between like-minded trade partners. The other linkage example is Tokyo and Saitama linked ETS, representing a domestic ETS linkage case[36]. Diversly, political reasons have already aborded tentative linkages, like the EU & Australia ETS linkage (ICAP, 2018). This thesis reveals that political-economic purposes are also responsible for impeding new tentative ETS linkage to emerge. This dissertation's conclusions emphasize the high political sensitivity of the Linking question, confirming the complexity to establish linkage between countries with heterogeneous policy designs and environmental ambitions. This political-economic reality might well cause a "heterogenous ETS Linkage gridlock" situation. In this case, only like-minded, economically and politically similar partners would succeed in linking their Emissions Trading Schemes, decreasing Linking benefits and significance.

[36] Similarly, the RGGI, if not an ETS linking *per se*, could be considered as a linked system in the same country (The USA) because of its State-based nature.

1.6 Guiding questions and Chapters' description

1.6.a The way of the Dragon: China's new Emissions Trading Scheme and the prospect for Linking

Emissions trading instruments are a growing phenomenon in emerging economies' Climate Policy portfolio. The sustainability of these new ETS is a broad and complex question. Among the developing economies implementing ETS, China is the trickiest example. China has long been hesitant in climate policy and the use of market-based instruments. Now the biggest absolute emitter and facing the environmental challenges of its economic effects, China developed seven regional pilots Emissions Trading Schemes from 2013 and eventually launched in December 2017 the first work plan for its master tool in climate mitigation policy in the form of a national ETS.

Against this background, this chapter examines whether the development phase of the Chinese ETS can be called sustainable, which role transparency plays, and analyze the potential for a future Linking. *Chapter 1's* methodology couples a comprehensive sustainability economics approach to a Law and Economics method. It requires utilizing official Chinese government data, Laws, regulations, and intelligence reports to assess the ETS development process. This paper describes Design evolutions from the pilots to the national scheme and evaluates them based on ambitious sustainability criteria for carbon market design. It then emphasizes the CN ETS's governance structure by assessing the Design sustainability on sector coverage, initial allocation, revenue use, and Offsetting measures. The second section of this chapter compares the CN ETS design with selected domestic ETS in other jurisdictions to evaluate the chances and challenges of linking. Finally, this chapter explores where transparency and sustainability issues happen in the CN ETS development process and catalogs resulting issues for future Linking, referring to the literature on ETS Linking implementation.

This chapter's driving purpose is to understand to what extent the Chinese national ETS, with its cryptic development process and its intensity-based target fastened to GDP growth, remains a regular climate policy or embodies more the characteristic of an international political tool.

1.6. b Linking ETS in Northeast Asia: Process, Alignments, and future Management

The literature does not sufficiently apprehend case-specific challenges related to the process, harmonization, and management of ETS Linking implementation in a heterogeneous context. This Chapter intends to fill this gap for the critical Northeast Asian region by questioning how to practically link ETS of China, Japan, and South Korea.

Northeast Asia is the primary greenhouse gas (GHG) emitter in the world. The region has also become one of the leaders in ETS development in the last decade, with schemes implemented in China, South Korea, and Japan's sub-national level. At the dawn of the Chinese national ETS implementation, Linking carbon pricing policies in Northeast Asia could be a solution to accelerate the path to global GHG mitigation. Nevertheless, significant divergences exist between regional schemes due to differing political-economic situations inducing different public choices. These heterogeneous circumstances between regional trade partners make Northeast Asia an exciting case study.

This Chapter first reviews the literature on ETS Linking implementation process and underlines three phases: A political phase, a technical phase, and a contractual phase. This theoretical backdrop enables analyzing the feasibility of a future regional linkage between China, South Korea, and Japan by assessing these three steps. Henceforth, an efficient future linkage in this heterogeneous context requires handling three main challenges: (1) The process of linking has to overcome local and international political issues. (2) Based on comparative design analysis, the challenges to Design harmonization and regulation reforms necessary to enable linking. (3) How to manage a Northeast Asian linked system concerning e.g., MRV, and information sharing.

In the spirit of a policy paper, this Chapter provides well-justified policy recommendations for a sustainable Linking process and proposes a management mechanism for MRV and Registry of a linked ETS in the region.

1.6.c Understanding barriers to Linking heterogenous ETS

The question of international linkage of Emissions Trading instruments is inherently an economic question. However, barriers to the international linkage of ETS in a heterogenous context surpass the only scope of the traditional cost-benefit approach. On this backdrop, this Chapter intends to understand why it is so politically difficult to establish ETS linkage between heterogeneous partners, taking the case study of Northeast Asia.

Linking Emissions Trading Schemes of countries with heterogeneous climate policies is the Romeo and Juliet story of carbon pricing instruments. Despite being desirable, heterogenous linkage happens to be politically arduous to establish. But, what exactly makes it more challenging for these jurisdictions to agree on ETS linkage? This paper examines this question by gathering original empirical evidence on the Northeast Asian case through a survey of Chinese, Japanese and Korean experts negotiating the Paris Agreement Article 6 Rulebook. Using these data, one can assess two political-economic dimensions of heterogenous Linking: First, it enables interrogating the traditional theoretical background of ETS Linking by assessing why the perception of "cost-sharing" and "effort-sharing" benefits is not enough to convince heterogeneous partners to Link ETS. Second, by evaluating the impact of interests and stakeholder interactions in the policy process to link Emissions Trading instruments.

Methodologically, this paper tests how Feasibility, Confidence, and Willingness affect the specifics of linking in the region. The results display differences in opinion amongst countries and subcategories of stakeholders involved in the policy process. It identifies three different kinds of political barriers to linking in Northeast Asia: An institutional resistance barrier revolving around administrative challenges'; a governance-sharing barrier that embodies the difficulties to solve complex sovereignty questions; and an environmental integrity barrier based on a lack of Confidence between partners in the region.

This research paper has immediate policy implications and can help overcome barriers to linking not only in Northeast Asia but also across the globe. It enables to underlines four main categories of policy insights critical for heterogenous ETS Linking: (i) ETS linkage represents a severe administrative challenge, the intensity of which is inversely proportional to the experience jurisdictions have with ETS at the domestic level.

(ii) In the absence of prior regional integration, interest groups tend to oppose governance-sharing to preserve their influence on domestic carbon pricing. Finding answers to the fear of losing influence will determine the persistence of difficulties in harmonizing many linkage-sensitive design elements essential for linked ETS sustainability. (iii) Questions of Confidence triggers defiance in the environmental integrity of potential partners' policy that could be overcome by resolving the lack of Willingness to harmonize design and set up common institutions. (iii) Beyond domestic institutional resistance resolvable only by strong political leadership, Confidence-building focused on governance-sharing is necessary at cross-sectoral levels.

1.6.d Enforcing Sustainable Auction-Based Emissions Trading Schemes in a Post-COVID-19 world

COVID-19 global chock has tremendous repercussions on the lives of almost every human being on the planet. Consequently, it has a profound impact on many political-economic analyses drawn in this doctoral dissertation. Related to these impacts, COVID-19 primarily embodies an opportunity to change barriers-patterns to sustainability measures implementation in Emissions Trading instruments. Following the characteristic of a policy paper, this Chapter analyzes how to overcome barriers to revenue-raising allocation method in Northeast Asian ETS through the spectrum of the Post-COVID-19 recovery plans.

Initial allocation and revenue use design features in Emissions Trading Schemes such as auctions and proceeds earmarking to energy efficiency projects are often used as leverage to ease policy implementation. In Northeast Asia, GHG ETS implemented (South Korea, China) or considered (Japan) do not deem full auctioning a worthwhile option, even if it would enhance the schemes' sustainability. Anxiety to lose competitiveness and fears of harsh political opposition from industrial and corporate sectors covered by the scheme have prevented GHG ETS from generating significant revenue. However, the COVID-19 crisis raises initial allocation and revenue use with two interdependent issues: (1) how to generate extra public revenues for financing the relaunch of affected economies, and (2) how to accelerate the energy transition.

Against this background, this paper asks whether the COVID-19 global shock represents a new opportunity to overcome national resistance to implement revenue-raising ETS in China, South Korea, and Japan. It analyzes how urgent post-COVID policy concerns – such as industrial re-location, border carbon-adjustment, Green Deal relaunch plans, and the need to find additional public revenue sources – influence existing political barriers to the implementation of sustainable design features in GHG ETS, particularly full auctioning and earmarking of revenues for environmental, economic, and social purposes. The Chapter eventually compares the three Northeast Asian countries' national response to the COVID-19 crisis and the repercussions these responses could have on current domestic barriers in implementing auction-and-earmarking-based GHG ETS. Methodologically this Chapter uses document analysis for national responses to the COVID-19 crisis and semi-structured expert interviews on the domestic barriers to implementing sustainable GHG ETS.

As a significant result, this paper provides policy recommendations on exploiting post-COVID-19 opportunities to enhance Northeast Asian GHG ETS and make them more sustainable. This Chapter's conclusions endorse the use of the COVID-19 chock as a double leverage levy to resolve barriers to revenue-raising measures in Northeast Asian ETS and provide funding for a green recovery compatible regional with net-zero pledges in line with the Paris Agreement objective.

CHAPTER 1

2. THE WAY OF THE DRAGON: CHINA'S NEW EMISSIONS TRADING SCHEME AND THE PROSPECT FOR LINKING

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2.1 An Introduction to the Dragon's New Approach to Climate Policy

In the 1972 Bruce Lee movie, a Chinese Kung Fu martial artist overpowers Karate-trained US and Japanese fighters in a conflict over the dominance of a restaurant. In climate policy, the new national Chinese Emissions Trading System (CN ETS) might also help to overcome persisting US-American and Japanese resistance to carbon markets at national levels, if the program turns out to be well designed, performs well and is open to international linking.

China has long been hesitant of climate policy, particularly in the use of market-based policies. Now the biggest absolute greenhouse gas (GHG) emitter with total emissions surpassing 9.2 billion tonnes of CO_2 and also increasingly faced with the negative environmental consequences of its still booming economy, China approved seven regional ETS pilots in 2011, which started with largely varying designs in late 2013. After years of continuous postponements China then launched its national ETS in December 2017. The CN ETS is supposed to become the country's climate policy master tool in its endeavour to reach its Nationally Determined Contribution (NDC) to the Paris Agreement: to peak emissions in 2030, to reduce carbon intensity by 40-45 percent by 2020 (from 2005 levels) and to decrease energy intensity by 15 percent (from 2015 levels). China also pledged to lower CO_2 emissions by 60-65 percent per unit of Gross Domestic Product (from 2005 levels), to increase the share of clean energy in primary energy consumption to around 20 percent, and to increase its forest stock significantly (UNFCCC, 2014).

Cap-and-trade, on the other hand, is still a prom way of substantiating the Paris Agreement and of contributing to achieving the 2°C target. Economists have almost unanimously supported this instrument due to its economic efficiency and its environmental effectiveness (Endres, 2011), and even a sustainable design is possible, which additionally considers social justice criteria (Rudolph et al., 2012). However, an evaluation of both the design and the effects heavily depends on the transparency of the system in practice. In addition, recently carbon pricing has become more widespread, extending not only across several continents but also across all governance levels (ICAP, 2018b). Against this background, we ask the following questions: Can the CN ETS be called truly sustainable? What role does transparency play? What are the chances for international linking?

In order to answer these questions, this paper first describes the design evolution from the sub-national pilots to the national scheme by emphasizing important aspects in governance structure, sector coverage, initial allowance, revenue use and offsetting features. It allows us to understand current Chinese policy and outlines useful specifics for forthcoming analysis. Secondly, we evaluate the CN ETS scheme based on ambitious sustainability criteria for carbon market design. We also analyze the aspect of transparency and its importance for design and outcome evaluations of GHG ETS using a comparative Law and Economics approach. Finally, we draw some conclusions from the previous analysis on the potential for future linking of the CN ETS with cap-and-trade schemes in other jurisdictions. Methodologically, we use a comprehensive sustainability economics approach and utilize official Chinese government data as well as, where necessary, information obtained from non-governmental organization surveillance.

2.2 From Sub-national Pilots to a National ETS: The Design Evolution in China

China has long been reluctant to apply market-based policies. Instead, the country is an authoritarian state that addresses its environmental issues using command-and-control type standards and bans. Nonetheless, after becoming the biggest GHG emitter in the world and facing growing concerns about its effects on the economy, Chinese authorities approved seven regional pilot ETS in 2011. Starting in late 2013, these pilots significantly varied in design, but they were still the first step for establishing a national ETS (Zhang, 2015). The decentralized pilots system was supposed to run from 2013 to 2015 and be replaced by a comprehensive national system in 2016. Unfortunately, complications, lack of experience and bad decisions have delayed the emergence of a national market. Thus, the pilot system period was extended and continues to be the most established policy in place in China to mitigate GHG emissions today.

In terms of environmental effectiveness and emission reductions, the pilots have not been successful. Moreover, it is difficult to determine the amount of emissions spared by the pilots, as verifiable data by markets regulators are not published. In addition, almost all pilots have faced allowance surpluses that have not allowed the markets to push companies to reduce their emissions (CarbonPulse, March 2018). The same problem of over-allocation, compounded by the lack of knowledge of firms on environmental markets, has led to a structural liquidity issue with significant variations amongst the pilots (especially in Tianjin and Shanghai). Some markets actually see vast trading activities, for better or worse, such as the Hubei system, while others see periods of no activity at all, such as Chongqing. Hence, the uncertainty created by the lack of market data transparency and liquidity issues have put off some external traders from taking part in the markets, weakening their effects.

However, after a few years of prevarications and postponements, in spite of growing scepticism from the international community, the government eventually decided to launch its national ETS in December 2017. While some aspects of the national regulations are still only at drafting stage, even key elements such as the cap size or the transition from existing pilots are completely absent from the draft law. Thus it is already possible to see the overall architecture of the scheme.

2.2.a Governance and Legal Structure

Without any doubt, a “Chinese Way of Emissions Trading” has emerged from the pilot experiences. Early Chinese climate governance has been analysed and criticized for its lack of transparency and efficiency (Deane et al., 2017). Indeed, both the pilots promoted from 2013 onwards by the National Development and Reform Commission (NDRC), and the current national CN ETS Work Plan, are based on legal texts that are nebulous and have been established by different level of power. Most of them are still only ministry regulations and have not passed a proper legislative process. The main text on the design and regulations of the national market, the “National Emissions Trading System Construction Program”, was established by the NDRC in late December 2017 (NDRC, 2017). It found that the Chinese National ETS is the world’s biggest of its kind. The policy is based on the NDC pledged to the Paris Agreement (UNFCCC, 2014) and is engraved in the 13th Five Year Plan (2016-2020) (NDRC, 2015a). The present design has the form of a work plan that indicates directions for an initial program structure and the first three years of operation. Some parts of the forthcoming final regulation have already been released to the public, yet lack the cabinet approval necessary to be enforceable.

The first three years represent three set-up phases: The first phase, the “Development Period” (2018), is to finalize the legislation, launch necessary institutions[37] and prepare the power sector for the transition. In the second phase, the “Simulation Trading” (2019), mock trading between covered entities occurs in order to test institutions and regulations. This phase could be extended in case of unresolved issues. Finally, 2020 will see the real start of the scheme and the first authentic trading between covered entities (NDRC, 2017).

The Chinese government has struggled with the governance structure of some of the pilot systems. Some programs have not been active due to structural problems (Fujian), while others have not received attention from local authorities (Chongqing) (Pang et al., 2015). This has put the establishment of the national system in danger as well as damaging the credibility of regional level governance (CarbonPulse, December 2017). Thus, a real effort for better governance has been made by, for example, elaborating better regulations and changing selected governance features. Cap setting in the national system, such as the NDRC and later the Ecological Environment Ministry, sets an absolute volume general cap, which is currently intended to be around 3,300MtCO_2e, but will possibly be adjusted by a Gross Domestic Product (GDP) factor until 2030. This then makes it an intensity target that will be divided between provinces. Only after 2030 a real absolute volume cap might be implemented. Based on the target cap, the regional DRCs are responsible for issuing emissions allowances within their area. The regional authorities will also be responsible for collecting annual emissions data and for invalidating used allowances held by companies in their jurisdictions. Regarding trading, the central government regulator has to give final approval to every individual transaction (NDRC, 2017). Thus, the regional level will still play an important role in the national ETS, and institutions working for the pilots will still be the ones working for the national scheme. Therefore, the central government wants to secure the solidity of the program structure before moving forward.

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[37] National Registry, Data submission System and National unified trading system.

One of the major threats to the ETS legislation is its legal weakness. Thus far, the majority of the rules are only NDRC department regulations, DRC regulations or technical ministry standards. To date, no ETS specific regulation has been legislated as a proper national law or as a State Council regulation. This legal weakness originates from the pilots, but has not yet been solved for the national draft law. However, this issue is of utmost importance for several reasons. First, the United Nations Framework Convention on Climate Change (UNFCCC) requests a strong and stable legal recognition of mitigation regulations. Second, because the Chinese ETS will be enforced mainly by regional institutions, they should be able to act based on a stable and understandable legal basis in order to be able to check compliance with covered entities and penalize non-compliance from politically powerful enterprises in their territories. Thirdly, studies have shown that the legal strength of the legislation also increases compliance levels (Tang & Guo, 2018). Nevertheless, for now, while only two main texts are the base of the national ETS legislation, in order to correctly follow the law, a plethora of other rules have to be taken into consideration by local regulators, verifiers and market actors. Without a doubt, this significantly limits the transparency of the CN ETS to date.

2.2.b Sectors Coverage

Coverage varies a lot across the pilots; for example, 26 sectors are covered in the rather small Shenzhen city scheme, which is responsible for 83.45 $MtCO_2e$ emissions, whereas only two sectors are covered in the heavily industrialized Hubei province scheme, which is responsible for 463.1 $MtCO_2e$ emissions. In the national scheme, power generators are the first to be covered because they are the main source of GHG in China. Around 1,700 entities emitting roughly 3 to 3.3 billion tonnes of CO_2 will then be participating in the CN ETS. The inclusion threshold limits participation to entities that emit more than 26,000 tCO_2 per year or consume more than 10,000 tonnes of standard coal equivalent (TCE) per year. Hence, according to the present draft policy design, the CN ETS will cover roughly 30 percent of China's total GHG emissions (10,975.50 $MtCO_2e$ in 2012) in its first stage (ICAP, 2018a). Coverage is supposed to be extended to the eight sectors[38] originally targeted in early ETS drafts as soon as possible. In order to prove their commitment to extending the scheme, government officials have already asked all firms – from sectors not yet covered but with emission levels that fall under the inclusion threshold – to submit their emissions data to market regulators (CarbonPulse, December 2017). After the extension, the Chinese ETS will eventually become the biggest carbon market in the world in terms of emissions coverage[39]. It will then cover around 7,000 to 10,000 companies emitting 4 to 5 billion tonnes of CO_2 per year (CarbonPulse, March 2018).

2.2.c Initial Allowance Allocation and Revenue Use

The initial distribution of emissions allowances in the CN ETS will be primarily based on a free-of-charge allocation. Only later, an increasing share is supposed to be auctioned each year, with the revenue going to an "incentive fund for national low carbon development". However, in establishing a free-of-charge initial allocation method, transparency and data relevancy have been serious challenges for the central government. Poor emissions data coming from the provincial level has forced the NDRC to change its plan for the initial allocation methodology. Originally, a mix of grandfathering[40] and benchmarking[41] was supposed to determine the allowances given to each covered entity (NDRC, 2015b). The near impossibility of obtaining real emissions data from thousands of entities entering the national ETS forced market designers to opt for benchmarking only. The NDRC has already developed 11 different benchmarks for the power sector. The initial allocation formula is:

$$\text{Allowance} = \text{Production level} \times \text{Benchmark} \times \text{Provincial Adjustment Factor}$$

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[38]Gradually extended to petrochemicals, chemicals, building materials, iron and steel, non-ferrous metals, paper production, domestic aviation and new energy vehicles (electric and hybrid).

[39]Trade volume will still be bigger in the EU ETS.

[40]Allocation of allowances based on historical emissions of firms.

[41]Ratio between all the emitters, where firms receive a certain proportion of the cap according to a ratio of production/emissions.

But still, ex-post adjustment based on the actual production volumes are to be expected for price management purposes[42]. After the early implementation phase, provincial authorities will also be allowed to apply stricter allocation methods for covered entities in their jurisdiction (NDRC, 2017).

Another crucial issue is how to deal with initial allocations to large power generators in the face of considerable allowance surpluses from the pilots. The national authorities have not solved this question of transition yet. The direction taken by the national regulator seems to recognise regional allowances in order to prevent a price crisis in the pilots on the one hand, but not in a 1:1 ratio in order to avoid initial over-allocation in the national market on the other. (CarbonPulse, March 2016). A recent proposal suggests that pilots' allowances will be given a value depending on the degree of over-allocation and on the price level in their original market. Transparency in the transition must be clearly assured. Therefore, a clear traceability system has to be implemented in order to know how many permits are transferred from the pilots markets to the national one.

2.2.d Offsetting

Originally, the NDRC wanted to introduce a limited number of Chinese Certified Emissions Reductions (CCER) Credits on the national market, just as in the pilots. Officials later announced that these credits will not be allowed until the national CN ETS has matured. Analysts fear that if offset credits are allowed, there will be a risk that they will flood the market with very inexpensive options, and this could put the entire system at risk (CarbonPulse, June 2017). Nonetheless, the Work Plan delegates responsibility for hosting the Offset Registry to the Beijing Environment Exchange, which seems to indicate that offset credits will eventually be accepted in the national market as well. The

[42]Cooperation planned between NDRC and the Ministry of Ecological environment with sector-related ministries to develop adjustment mechanisms for price and risk management. Chinese officials said, on the record, that the regulator would set aside a certain amount of allowances that could be used to manage price volatility.

general CCER regulation for offsets is already established, and some scholars are working on a transparency analysis that already exists for the Pilots (Deane et al., 2017).

2.3 Sustainability, Transparency and Linking: The China Case

2.3.a The Sustainability of the CN ETS

The GHG ETS has been heavily criticized in the literature (Spash, 2009) for representing "the selling of indulgences [and] … a money printing machine for utilities" and for not being "capable of capping the bottle that released the CO_2-Genie … [and] in line with principles of social justice in a globalized world" (Altvater & Brunnengräber, 2008: 9ff; translated by the authors)., or, in short, for their lack of sustainability, GHG ETS are not sustainable.

However, in principle, carbon markets can be made sustainable, so that they not only fulfil ambitious criteria of environmental effectiveness and economic efficiency, but also contribute to social justice (Rudolph et al., 2012). Design recommendations for sustainable domestic carbon markets derived from this normative approach are given in Table 1. Column 2 and Column 3 in Table 1 shows the compliance of the national-level CN ETS with the sustainability criteria.

Table 1: Sustainability criteria for GHG ETS and the CN ETS

	Sustainable Design	CN ETS
Coverage	Mandatory participation	☺
	All GHG (based on CO_2e)	☹
	All polluters	☹
Cap	Target 25-40% reduction by 2020, base 1990)	☹
	Absolute volume cap	☹
	Gradual cap reduction	☹
Allocation	Unit of 1 t of CO_2e/a	☺
	100% auctioning	☹
	Frequent, non-discriminatory auctions	?
	Equally accessible market	?
Revenue Use	100% revenue recycling (earmarked)	☺
	For mitigation, adaptation, cost compensation	😐
Flexibility Mechanisms	Unlimited banking	☺
	No borrowing	☺
	Offsets limited to sustainable projects	☺
Price Management	Price floor (≥ 30 US$/t), inflation adjustment	😐
	Price ceiling (≥ 200 US$/t), inflation adjustment	😐
Compliance	Control periods not longer than 3 years	☺
	Continuous monitoring or verified reporting	☺
	Emission and allowance tracking and registration	😐
	Fines (>p) for non-compliance	☺
	Over-compensation of excess emissions (at least 2x)	☺
Supporting Measures	Border adjustment	?
	Linking	😐

☺ full compliance 😐 partial compliance ☹ non-compliance

This table informs us not only about the merits, but also the deficits of the current CN ETS design. Furthermore, a comparison with other ETS allows for positioning the CN ETS in the current international ETS sustainability continuum (Rudolph and Lerch, 2016, Rudolph and Morotomi, 2016)[43]. The new Chinese scheme already substantially disturbs the global carbon pricing system. Seeing the size of the Chinese economy and its massive interactions with global markets, the volume and the carbon price in the CN ETS will be a factor to take into consideration for every other jurisdiction implementing an Emissions Trading Scheme. Even though the CN ETS is at an early stage of development, China can already count on its pilot ETS as having significantly opened the way for the analysis of the national system. Thus, a comparative approach with other ETS, already in place, is particularly relevant in order to see where the CN ETS currently stands on the spectrum of sustainability. It also helps shape the potential impact that the CN ETS could have on the future of sustainable carbon pricing.

In terms of coverage, the main problem is that the present design only covers CO_2 and not all Kyoto GHG. Additionally, only the power sector is covered (representing around 30 percent of total emissions), which is far from sufficient for substantially lowering China's enormous impact on the global climate. Compared to other ETS, with the exception of the West Coast Initiative (California & Québec) which covers approx. 85 percent of emissions, the Chinese ETS is in line with what is presently done in terms of gas coverage and the proportion of targeted polluters, such as in the EU ETS (below 50 percent) or RGGI and Tokyo ETS (both 25 percent).

One of the biggest problems of the CN ETS policy is its intensity target linked to GDP evolution. In other words, until 2030, the CN ETS is only meant to mitigate the carbon intensity of the economy but not decrease the absolute volume of emissions. In this period, fossil fuel-based energy generation is thus allowed to develop, and with it even absolute emissions, as long as the amount of CO_2 emitted per unit of production complies with the target. While this is in line with China's Paris commitment, it will still lead to a 50 percent increase of absolute emissions until 2030 despite efforts to decrease its intensity emissions intensity[44]. Furthermore, while the draft law indicates a gradual

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[43]We compare the following ETS: West Coast Initiative (WCI – California), RGGI (USA East coast), Tokyo Metropolitan Government (TMG) and the EU ETS.

[44]From around 9.7 Gt CO2/a in 2017 to around 15 Gt CO2/a in 2030.

cap reduction for the covered sector, the concrete reduction path is unknown and will remain linked to GDP development. Chinese authorities justify these intensity targets and the enormous scope of Chinese emissions by demography, GDP per capita and the right to develop as an emerging economy (Zhang, 2015). However, with respect to this design element, and it being the biggest emitter of GHG, the CN ETS is not only unsustainable in its own terms, but lags behind any other carbon market in the world. The CN ETS represents the only carbon market with an intensity-based target instead of an absolute volume cap.

Concerning the allocation method, China has opted for free initial allocations based on benchmarks. While this decision was justified by pointing to data relevancy issues that emerged in the pilots, this argument only excludes grandfathering but not auctioning (as government data requirements are much lower for auctions). However, compared to international markets, China shares its strong reliance on free allocation with many other carbon markets such as the EU ETS, California, Québec and Tokyo. But still, with the exception of Tokyo, all other carbon markets auction off at least a share of allowances. In addition, just as in the pilots, the actual allocation calculation formula to be used in the national scheme is not easy for the informed public to understand. While the formula itself is public, it includes a variable "Provincial Adjustment Factor" that is based on unknown elements. Moreover, as in the pilots, even if the formula would be known, the actual calculus would not be released, neither to the public nor to covered entities. Some studies have actually shown that a "case by case basis" was used for certain factors of the formula in the pilots (Qian, 2014). If the national system follows the pilots' patterns, it could jeopardize the operation of the scheme and negatively impact the provincial adjustment factor, which is used for adjusting the number of allowances received on a regional basis. This puts the transparency of the entire system in jeopardy.

Revenue recycling is among the more sustainable features of the CN ETS, as with many other ETS, as it uses the majority of revenues for mitigation measures and some for compensation of detrimental social impacts. In China, revenues will go to an "incentive fund for national low carbon development". However, this fund is currently not public, raising questions of transparency, and will most likely not be dedicated to social measures.

The flexibility mechanisms of the CN ETS also comply with sustainability criteria, allowing for banking, to a certain extent, and prohibited borrowing. Offsetting will only be allowed when the market is mature and encompasses certified domestic CCER projects, which will have to fulfil sustainability criteria. Additionally, offsetting will only be allowed when the market is matured. The CN ETS shares these features with most other carbon markets across North America and Europe.

Thus far, no price management measures, such as a fixed price floor or ceiling, are planned for the CN ETS. It makes the CN ETS highly vulnerable to price fluctuations, as experienced by the EU ETS in the past. Other large-scale ETS such as California, Québec and RGGI now have price management measures in place, but still do not fulfil sustainability criteria because price limits are too low. In China, in addition, the "Ex-Post Adjustment" clause means that anything is possible in terms of price ceilings and floors, if the regulator deems them necessary. Again, this solution is rather vague, and relies only on the will of the regulator, which is not a sustainable solution, and highlights transparency issues.

With respect to compliance regulations, the NDRC has learned a lot from the pilots. Therefore, the national ETS largely complies with the sustainability criteria, similar to most other carbon markets across the world. It includes real enforcement and penalty rules in case of non-compliance[45] and a monitoring, reporting and verification (MRV) system based on an electronic platform. The major issue lies in the transparency of the MRV system, especially regarding allowance traceability in the registry system. Only market regulators have sufficient access to relevant information, while the informed public will not be granted access.

In terms of supporting measures, no border adjustment regulations have been considered as of yet in order to prevent carbon leakage. However, the scheme does cover direct and indirect emissions. This last aspect can be considered a sustainability measure and a useful tool to avoid carbon leakage. Finally, linking is currently not intended by the Chinese government but might become an option after 2030. In comparison to other ETS,

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[45]The regional authorities are responsible for enforcing penalty regulations):

a) Fine of 3 to 5 times the average permits price and following year allowances deductions (same amount as non-compliance) with an extra 3% fine per day in the case of late payment;

b) Fine of 1 million Yuan for companies that miss the annual deadline for reporting emissions;

c) Non-complying entities will also be included in the National Credibility Information Sharing Platform.

the CN ETS does not stand out so far. However, recent experiences in North America have been promising, and the EU also commands significant knowledge and skills from its negotiations on the Australia and the Switzerland linkages.

2.3.b Transparency and Future Linking

Despite the Chinese government's current lack of interest in international linking, the merits are obvious (World Bank, 2016) and with China being the largest GHG emitter in the world, there is a lot of interest in linking from other jurisdictions such as the EU and other East Asian countries like South Korea and Japan. Furthermore, some government associated think-tanks and academics are currently engaged in initial discussions with Japan and Korea to study potential future regional linking (CarbonPulse, December 2017). It could trigger an increase in collaborations for future carbon mitigation policies. Such a linked market could be more cost-efficient and provide many inexpensive compliance options for big companies like those in Japan. For Chinese companies, it could extend the number of potential buyers and generate new revenues coming from carbon intensity efficiency. However, the environmental effectiveness of this policy would greatly depend on the capacity of the linked jurisdictions to ensure the scarcity of permits and true transparency.

Transparency plays a crucial role, not only in the ex-ante evaluation of program sustainability and the ex-post performance evaluation, but also for potential future linkages. Design structure transparency is paramount. As Table 1 indicates by showing three "?" items, the CN ETS still lacks this transparency to a certain extent. Indeed these "?" items out of twenty-four can be interpreted as "non-transparency" of major parts of the CN ETS. There is a significant danger that some of these features will turn "wrong" in the future and transform the CN ETS to a largely unsustainable policy with no options for international linking.

In fact, many regulatory features are not yet clear enough to be called transparent. First, the GDP Factor in the cap formula allows the regulator to adjust the number of allowances annually, at will, without anyone's approval. Second, an ex-post adjustment is possible, albeit unclear, in cases of severe price fluctuations, which allows for market manipulation. Third, the information channel of the MRV System in the CN ETS is problematic. The NDRC discloses market information only to market actors and to the regulator but does not reveal sensitive information like individual entities' emissions data to the public. Currently, Chinese legislation protects covered entities from the disclosure of "strategic information" like individual fuel consumption. The same is true for allowance ownership or trading activities. Individual entity reporting is not public, so that data verification by third-parties outside of the market is nearly impossible. Moreover, the calculation of the initial allocation remains non-transparent. The calculation method in general is too vague, particularly as it contains a "Provincial Adjustment Factor" and a regulation allowing ex-post adjustments. In this setting, it is impossible for anyone except the market regulator to verify the validity of an allowance. Last but not least, the role of offset credit remains unclear, but it could have extreme impacts on the Chinese domestic market as well as on possible future linkages. Hence, a whole set of transparency issues must be resolved before the system can be judged and reliably discussed for international linking. Compared to other ETS across North America and Europe, with respect to transparency, China is lagging behind.

But despite transparency issues, one major obstacle for international linking is already obvious – the cap. All existing ETS implement absolute volume caps. Thus, it is extremely difficult to imagine linking with the CN ETS before 2030, when the CN ETS might turn into a real cap-and-trade system with an absolute volume cap. Also, the quality of information sharing between linked schemes could become an issue, considering the current lack of transparency in the CN ETS.

In sum, the CN ETS is currently not a sustainable, transparent approach to climate policy and even less so compared to other ETS across North America or Europe. The present-day situation still presents China as being more on the "waiting list" of ambitious climate mitigation than clearly taking decisive actions. However, the regulations on the table might trigger a brighter future and, at least, put a price on carbon in China. Experiences with other ETS across the world raises hopes that once a carbon pricing has become a reality in China, reforms might gradually lead to program improvements and increased compliance with sustainability and transparency criteria. Then a road to sustainable international linkages might also become more accessible.

2.4 Conclusion

Even if some aspects of the CN ETS are encouraging, the Chinese carbon market has a long way to go before it becomes truly sustainable. The actual state of legislation and the present design does not include international links as a short-term possibility. Even so, Chinese government officials have recently described linking as being the next step of development for the Chinese ETS, and the NDRC has declared multiple times its interest in international linkage, especially with Europe even before 2030. The draft design clearly opens the door to such an evolution and long-term collaboration between the EU and China on ETS implementation and promotion.

However, the fact that economic theory promotes linking as a way to increase market efficiency, does not immediately mean that carbon markets have to be linked at any price. As an environmental policy, the purpose of emissions trading is to reduce GHG emissions. Linking cannot be the loincloth of a policy that appears to be tackling climate change efficiently, while actually allowing emissions to rise. Efficiency analyses of potential linkages have produced estimates about the conditions under which ETS efficiency is increased by linking (World Bank, 2016). However it is clear that before considering this, every domestic ETS has to meet sustainability criteria. The Chinese ETS, at its current state of sustainability and transparency, is not yet ready for linking. However, compared to its Pacific neighbours Japan and the US, the Dragon finds itself in a more advanced position in terms of carbon market implementation and might even become a regional leader, if others do not quickly follow its example by implementing domestic carbon pricing.

Chapter 2

3. Linking ETS in Northeast-Asia: Process, Alignments and Future Management

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3.1 Introduction

Northeast Asia (EA) is a major greenhouse gas (GHG) emitter, with China being the number one absolute emitter while Japan and South Korea (Korea) both being heavy per capita emitters (European Commission, 2018). However, the region has also become one of the leaders with respect to testing carbon pricing in the last decade, with carbon markets implemented in China, Korea and on the sub-national level in Japan. At the dawn of the implementation of a fully-fledged national Emissions Trading Scheme (ETS) in

China, linking carbon markets in Northeast Asia could be a promising strategy for accelerating efficient GHG reductions in this area but also, considering that the region could act as a model for other high-polluting jurisdictions, across the world. However, due to local specificities, political will and differing economic situations, significant differences exist not only between Northeast Asian ETS but also with respect to their general climate policy ambitions.

Against this background, the article aims at showing how a sustainable linkage of domestic carbon markets in Northeast Asia could emerge. The concrete purpose is to provide well justified policy recommendations for a sustainable linking process that complies with strong sustainability criteria by strengthening the environmental effectiveness and robustness criteria. We do so by analyzing the practical feasibility of a sustainable regional linkage between China, Korea, and existing the sub-national markets in Japan and stressing three phases necessary to enable linkages between domestic carbon markets (ICAP, 2018b):

(1) First, a political phase, in which the political feasibility of linking between two or more jurisdictions would be assessed. This phase represents a process, in which all potential issues have to be overcome between potential partners.
(2) The second period consist of a technical phase and might require design alignments and regulatory framework reforms. This phase depends a lot on the type of relationship that is implemented between partners.
(3) Finally, the last phase sees partners engaging in a linking contract that has to specify the kind of linkage and how the linked systems will be managed in terms of regulations, but also information sharing and monitoring.

In the first phase, using a political economy approach, we study current general climate policy in the region and establish a first framework for linkage negotiations. In the second phase we provide a comparative analysis of the three respective ETS designs of the Chinese National ETS (CN ETS), the Korean ETS (K ETS), and the Tokyo Metropolitan Government and Saitama ETS (T-S ETS). For this phase we apply an impact analysis based on sustainability criteria in order to justify necessary regulation reforms. The last phase uses the same comparative and impact approach as the second phase and aims at recommendations for a model future Monitoring, Reporting, and

Verification (MRV) system as well as management institutions for an integrated Northeast Asian carbon market.

3.2 Process to Linking

The process leading to a linkage between carbon markets encompasses multiple steps combining high level political implication and stakeholder's cooperation. First, Political leadership is of utmost importance throughout the entire process, following the example of previous successful linkage like the WCI-Québec linkage driven by the Governments of Schwarzenegger and Charest. Second, government officials have to interact with each other at all stages of the process. Usually initial discussions are informal and a working-group with representatives from all potential partners should be started as soon as possible. Representatives should come from the highest level of political power in order to discuss the first key elements (ICAP, 2018b). In the case of Northeast Asia, high-level political talks have already taken place between officials of China, Korea and Japan in order to establish a potential future regional linkage (CarbonPulse, 2017). However, no concrete steps for an actual linkage have so far been taken. Still, analyzing the political divergences might help in predicting the path to a future East-Asian carbon market.

Table 1 – Emissions profiles (European Commission, 2018) and (Climate Watch, 2019)

0	**Total absolute emissions of CO_2 per year (2017)**	**percentage of the total human induced GHG emissions (2017)**	**CO_2 Emissions per capita (2017)**	**CO_2 Emissions per GDP (2017)**
China	10.9 $GtCO_2$	30.18%	7.7 tones CO_2/cap/year	512 tones of CO_2E/million USD of GDP
Korea	0.673 $GtCO_2$	1.7%	13.2 tones CO_2/cap/year	364 tones of CO_2E/million USD of GDP
Japan	1.320 $GtCO_2$	3.6%	10.36 tones CO_2/cap/year	267 tones of CO_2E/million USD of GDP

Northeast-Asia as a region is now the major emitter of greenhouse gases in the world. Nevertheless, the emission profiles of the three countries differ greatly (Table 1). China is by far the biggest absolute emitter in the world. Population and economic growth with a big share of high-polluting industry production are major reasons. Demography as well as a later start of modern economic development also explains China's lower GHG emissions per capita compared to Japan or Korea. Still, already now Chinese per capita GHG emissions are 10% higher than the European average. Carbon dioxide (CO_2) emissions per unit of the Gross Domestic Product (GDP) are very high in China, in fact the highest amongst the world's 30 biggest emitters. This situation is occasioned by China's still strong reliance on fossil fuels, mainly oil and natural gas, the consumption of which has even increased by 3.65% and 14.8% between 2012 and 2017 respectively (European Commission, 2018).

Hence, compared to its neighbors, China is half as efficient as Japan and a third less efficient as Korea. Korea, in turn, represents only a rather small fraction of the absolute global GHG emissions. However, CO_2 emissions per capita are the highest amongst the three Northeast Asian countries, and Korea is still noticeably less energy efficient than Japan. Japan is an already very emission efficient country with the lowest CO_2 emissions per unit of GDP in the region. The country represents a middle point between China and Korea in terms of per capita emissions. These energy efficiency disparities, particularly, create significant opportunities for cheaper energy efficiency progress and thus GHG reductions in China compared to its two neighbors.

*Table 2 – Comparison of the Nationally determined contributions to the Paris Agreemen*t (UNFCCC, 2014)

	China's NDC	Korea's NDC	Japan's NDC
Reduction target	Reduction of 60-65% of CO_2 emissions per unit of GDP (intensity target). Carbon intensity reduction of 40-45% by 2020 (compared to 2005 levels).	Reduction of 37% of all GHG emissions by 2030 compared to business-as-usual (baseline scenario target).	Absolute reduction of 26% of all GHG emissions by 2030 compared to 2013 (base year target).
Peak	To peak in 2030 or earlier if possible. Peak predicted at 15 $GtCO_2$.	Peak year not mentioned but will not exceed 0.85 $GtCO_2$ by 2030.	Reduce emissions to around 1.042 $GtCO_2$ by 2030.
Energy	Energy intensity reduction of 15% per unit of production by 2020 (from 2015 levels).	Raise the share of renewable energy (vague).	Raise to 22-24% the share of renewable energy by 2030.
Sectors concerned	Not specified but mostly energy sector by increasing the share of non-fossil fuels in primary energy consumption to around 20% by 2030.	Energy, industrial processes and product use, agriculture and waste.	Economy-wide: energy, industrial processes and product use, agriculture and waste, land use, transport, land use change and forestry, waste.

Any carbon pricing policy is intimately linked to the international climate policy framework inscribed in the Paris Agreement. International climate protection differs greatly amongst the three Northeast Asian countries. This will significantly shape any future relationship. Japan, Korea and China do not bear the same responsibilities under the Paris Agreement. Japan is listed as an Annex-I (developed) country, while China and Korea are considered as a non-Annex-I (developing) countries. As a consequence, China's absolute GHG emissions will not peak before 2030, and the country only accepted relative reduction targets. Hence, the national ETS launched in China has an annual absolute target but works with an intensity-based national emissions cap that is not planned to be tighten before 2030. Chinese companies will be urged to become more energy efficient, but they will still be allowed to emit more tons of GHG each year until the country peaks its total emissions.

Korea, on the other hand, despite of being a non-Annex-I, has established an absolute 37% emissions reduction target compared to a business-as-usual scenario, and built a real cap-and-trade system based on this target. Korea plans to partially use international markets mechanism to achieve its commitments. Japan, being registered as a developed nation, has an absolute reduction target of 26% compared to base-year emission levels in 2013. However, Japan has so far not engaged in any national-level carbon market policy. Instead it relies on its low-level carbon tax and plans to reduce its emissions mainly by increasing energy efficiency, expanding the use of renewable energy, and using international carbon offsets (UNFCCC, 2014).

Every future linkage discussion implies to take into consideration the existing differences in the respective domestic carbon market policies. Currently, only Korea has a working national ETS in place. China has implemented 8 sub-national pilots since 2013 and is presently establishing a national system, which is supposed to be fully operational and ready for trading by 2021. Japan lacks a national ETS, but Tokyo and Saitama operate a regionally linked scheme. This Japanese linkage will be a precious experience for any future carbon pricing collaboration in the East Asian region.

The question of benefits and risks for each party resulting from linking is another important aspect to assess. In terms of mitigation commitments, future markets actors in the three countries do not face the same obligations. Korean and Japanese emitters will have to reduce absolute emissions and will face a decreasing amount of allowances or credits each year. While in China, covered firms currently only have to increase energy efficiency because the number of allowances they receive will be adjusted each year to the GDP performance of the country. Therefore, allowing access to expectedly cheaper Chinese emissions allowances will be very attractive to market actors in the three countries. Korean and Japanese firms could bargain cheap permits options while Chinese firms could find extra revenues from their mitigation performances. However, as a recommendation, such a linking in East Asia should not be implemented without serious

Design and Regulations reforms such the one addressed in the following chapters. Furthermore, after these reforms, the linked partners still must be able to demonstrate that the linkage does not jeopardize the environmental effectiveness of each scheme. They should also prove that each country would still be able to fulfill its international GHG reduction commitments. In order to do so, modeling the potential linking could be a solution before enforcing the policy to see the impact on the three countries policies (ICAP, 2018b).

The type of linking is another issue to be discussed early in the process. A multilateral two-way linkage is mechanically more difficult to implement than a one-way linking. While a two-way linkage is the ultimate step in creating a genuine global market for carbon emissions, it does not have to be implemented from the start. The intended European Union and Australia tentative linkage provide an example for a step-by-step approach to linking: A one-way linkage was supposed to be established from 2015 onwards. Australian firms would have been able to buy European allowances, while the opposite would not have been possible (European Commission & Commonwealth of Australia, 2013). This arrangement was supposed to stay for a couple of years until a full two-way linkage would have been implemented. In the case of Northeast Asia, an initial one-way linkage could be a real solution to manage the obvious divergences in terms of mitigation ambition until China moves to an absolute emissions reduction target in 2030. It could enable a test phase where Korean and Japanese allowances, generated by absolute target schemes, would be available for firms in the three jurisdictions. This first option, while probably not really interesting in terms of cost-efficiency for Chinese actors, would not endanger the environmental effectiveness integrity of the Korean and Japanese Cap and Trade Systems. Another solution, not entirely secure in terms of environmental ambition, could be to allow directly a restricted double-way linkage while providing each year an adjustment option to the markets regulators that could adapt the amount of Chinese allowances tradable on the Korean and Japanese market to the yearly allowance cap in the CN ETS. If the system happens to be working well in terms of market management, a growing number of permits could therefore be opened for trade in the linked market until a multiple-way linkage is implemented when China turns absolute.

Once the major political decisions about the kind of linkage to implement have been taken, the linking process can move forward. Experts coming from the three countries should separate the work in the different fields affected by linkage and be supervised by high-level representatives of the three governments (ICAP, 2018b). In the case of China, the National Development and Reforms Commission (NDRC) and the Ecological Environment Ministry should be in charge of the talks. For Japan, the Ministry of Environment (MoE) alongside the Ministry of Industry and Trade (METI) should probably resume responsibility. Korea's Ministries of Environment (MoE) and Trade, Industry and Energy (MoTIE) might be the institutions in charge. In the decision-making process, stakeholders have to be involved in order to ensure its political feasibility, but also to address effectiveness as well as social and environmental justice questions, which cannot only be left to government officials. In addition to business groups, this particularly refers to environmental organizations, labor unions, and justice groups. However, given the considerable differences in terms of civil society participation in the three countries, this could lead to major problems.

Design alignments will require particular attention. Furthermore, management issues will soon have to be addressed, especially Monitoring, Reporting and Verification (MRV). The question of the registry linkage is also of utmost importance, because it represents the central institution of communication between the linked markets. Necessary comparisons of the scheme differences have then to be realized in order to prepare solutions and reforms in view of linking.

3.3 Design alignments and Regulation Reforms

As stated above, linking does not necessarily require that each scheme has to be the same (Sterk, 2006). Differences in carbon pricing policies happen to exist to reflect the economic and political situation of each jurisdiction. Linking have been achieved around the world with significant differences in the design of respective domestic schemes, like the stringency of the cap or even the initial allocations methods. California and Québec, for instance, share major design elements, but rely on different caps and initial allocation methods, while using joint auctions. The soon-to-be linked EU and Switzerland schemes also differ with respect to the cap size and the initial allocation. And the same applies the linked Tokyo and Saitama schemes (ICAP 2018b). On the other hand, California and the EU have devised legal conditions for potential linkages that include the same or stricter levels of offsets requirements, the same punishment level for violators, as well as absolute cap requirement (European Commission, 2003) (California Senate, 2011). Based on the available literature on linking carbon markets, the following conclusions can be drawn for prospective Northeast-Asian linkages.

As a first step, we compare design elements of the Chinese national ETS (CN ETS), the Korean ETS (SK ETS), and the Tokyo Saitama linked ETS (T-S ETS) and identify which design features, that are relevant for linking, should be aligned or reformed in case of a future linkage in Northeast-Asia. Given the current situation of carbon pricing in Japan, this framework can also be used by Japanese authorities to build a future linking-friendly national scheme that would immediately enable an integrated Northeast Asian carbon market to emerge. This comparative analysis of ETS designs elements in the respective jurisdictions is done based on three criteria (Rudolph et al., 2012; ICAP, 2018b): The economic efficiency is mainly influenced by the initial allocation, the temporal flexibility, and possible price management. The environmental effectiveness is mainly determined by elements such as the cap size, coverage, and offsets. Finally, the system robustness basically concerns all design elements. One purpose of this comparative approach is to study potential side effects of linking with respect to these three criteria and to draw a sketch of necessary reforms.

Table 3 – CAP (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
CAP	~ 3300 $MtCO_2e$/Year (projection only)	*Tokyo:* ~ 66 $MtCO_2e$/Year aims at a reduction of 25% below 2000 levels by 2020. *Saitama* ~ 37 $MtCO_2e$/Year intends to lower emissions by 21% below 2005 levels. *Total*: 103 $MtCO_2e$/Year. Compliance factors (compared to base-year emissions): 2010-14 8/6%; 2015-19 17/15%; 2020-24 27/25%.	~ 562 $MtCO_2e$/Year (2016) including 89 $MtCO_2e$ for market stabilization measures. Total amount of emissions currently on the market is around 1777 $MtCO_2e$ (2018-2020: 548 $MtCO_2e$/Year) .

Linking ETS schemes with different cap features is definitely one of the biggest challenges. In the case of Northeast Asia, it is immediately obvious that the three jurisdictions have not pledged the same environmental ambition at the Nationally Determined Commitment (NDC) level. This has consequences for the respective ETS designs. The CN ETS cap is huge given the size of Chinese emissions and will not be tighten on a regular basis. Instead the cap will be only adjusted by the market regulator depending on the GDP growth of the Chinese economy. The cap of the T-S ETS and the SK ETS are, in turn, absolute and will be tighten on a regular basis.

In general, differences in the cap size do not affect any of the three criteria. However, divergences in the trajectory of the cap potentially affect environmental ambitions of the linking partners. The most obvious issue is that China's cap trajectory cannot be anticipated, since the government will adjust the cap to economic growth until at least 2030. If a non-restricted linkage is implemented, it represents a threat to the environmental effectiveness of the other two absolute cap ETS. Indeed, if the cap trajectory of the CN ETS is unknown due to its intensity-based nature, in a linked system this implies that the SK and the T-S ETS cap trajectories will also be unknown.

The most obvious adjustment would be to convert the CN ETS cap to an absolute one. However, this is politically not probable in the foreseeable future, so a solution can only be found in pre-fixed exchange rate that reflects the real value of the allowances coming from the intensity-based CN ETS. Thus, Korean and Japanese regulators would be able to calculate the value of a Chinese allowance on their own market to reflect the real environmental value of the permit and avoid risks, like liquidity chock that could happen when China adjust its cap (Marschinski, 2008).

The cap setting could also be a political setback between the respective jurisdictions. Transparency issues with respect to data coming from Chinese regulators (Dellatte, Rudolph, 2019) make it difficult for the partners to be confident that the cap setting in China is accurate and based on validated emission data. This could affect the robustness of the linked market by generating a flow of allowances from China, where control is less demanding, into other systems. Therefore, the regulation should be aligned in a way that enables all partners to establish common rules for cap setting, which in turn allows the three parties to have full access to the same level of quality of verified emission data.

Table 4 – Coverage (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Coverage & proportion	10975,50 $MtCO_2e$ (2012) (45%) (Current state of planning)	21% of Tokyo's total CO_2 emissions. 70% of Saitama prefecture total emissions.	A share of 68% of Korea's total GHG emissions.
Gas coverage	CO_2 only.	CO_2 only.	6 Kyoto protocol gases: CO_2, CH_4, N_2O, PFCs, HFCs, SF_6.
Sector coverage	First power generators only. Later: petrochemicals, chemicals, building materials, iron and steel, non-ferrous metals, paper production, domestic aviation, and new energy vehicles (electric and hybrids). Both Direct and Indirect emissions are covered. (Current state of planning)	Tokyo took a unique approach and focused its ETS on the end-use of energy in large office buildings, plus a few industrial emitters (20% of covered facilities). Same approach for Saitama scheme but around 70% of emitters come from the manufacturing sector.	Current Korea ETS covers six sectors: heat and power, industry, building, transportation, waste sector, and public sector. Both Direct and Indirect emissions are covered.

Entities and gases targeted in the three jurisdictions vary. The quantity of firms or the type of gases covered do not matter at first, except for the fact that broader firms' coverage increases the cost-efficiency of the system. A significant divergence in terms of sector coverage could potentially affect the economic efficiency of the scheme. Specifically, it could be a threat to fair competition between entities (especially trade-exposed actors) of the same sector but from different jurisdictions of the linked market. In the current situation in Northeast Asia, it should not generate significant problems. But industry sectors will have to be covered soon in China, and competitive distortions between entities in the three jurisdictions could occur if export-oriented sectors are covered in one scheme but not in the other. But this unfair competition will even happen if the domestic ETS are not linked (Sterk, 2006). Still, in order to establish a level playing field, it would be reasonable to align sectoral coverage, at least for emission-intensive trade-exposed (EITE) sectors.

The point of regulation of covered entities differs amongst the three jurisdictions, and it could theoretically be a threat to the robustness of the system, as it might create a risk of double- or not-counting (ICAP, 2018b). However, given that there is currently no electricity export or import amongst the three countries, this theoretical threat does not apply to the current Northeast Asian case.

Table 5 – Compliance (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Liable entities	Beginning: ~ 1,700 entities. Later at least 7,000 to 1,0000.	Tokyo: ~ 1,200 facilities; Saitama: ~ 600 facilities.	~ 610 entities.
Compliance	Mandatory for entities that fall within the Inclusion threshold: Entities with annual emissions of ~26,000 t/CO_2 (in any year between period 2013–2015)	Mandatory for entities that fall within the Inclusion threshold: Facilities with energy consumption ≥ 1,500kL crude oil per year (~3,000t/CO_2/Year).	Mandatory for entities that fall within the Inclusion threshold: Entities >125,000 tCO_2/year or Facility >25,000 tCO_2/year.

Currently, despite of major differences in economy size, the number of covered entities is comparable in the three jurisdictions. Covered entities are obliged to participate in all three jurisdictions, which secures partaking in the scheme and respective emission reduction efforts. However, in the foreseeable future, China will have the by far dominating number of covered entities as soon as Chinese authorities extend their scheme to other sectors than electricity generation. But still, this should not create a problem, but even offer more options to Korean and Japanese market actors.

Concerning the inclusion threshold China and Korea both cover major direct emitters in power generation and manufacturing, but do not share the same standards. Korea has a smaller threshold for facilities but a very high at the entity level. Chine on the other hand consider only the entity level. Their Japanese sub-national counterparts have a significantly lower inclusion threshold, because the current T-S ETS mainly targets urban buildings' emissions. This reflects the present differences of size between covered companies in China, Korea, and Japan. This difference could, potentially, generate a risk of emission leakage to the jurisdiction with the largest inclusion threshold in order to avoid coverage. Thus it is a threat to the environmental effectiveness of the linked markets. However, here again this could happen with or without linkage. Overall, on that aspect and for the general linkage process, the most obvious requirement is that Japan creates a national scheme that covers its entire emitting sectors. Once it is done, a certain level of convergences of emissions threshold per sectors could be discussed between the three partners.

Table 6 – Allocation (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Allocation	Free allocation (Benchmarking[46]), later a part will be auctioned.	Free allocation (Grandfathering[47]). Instead of distributing allowances for all emissions under the cap, both jurisdictions only issue excess reduction credits (ERC) for reductions beyond the reduction obligations.	2018-2020: 97% freely allocated and 3% auctioned. From 2021: Less than 90% freely allocated and more than 10% auctioned. EITE sectors received 100% free allocation.

While China and the Japanese sub-national jurisdictions currently allocate emissions allowances free-of-charge, thus not generating extra-costs to covered entities, in Korea a significant number of permits will soon be auctioned, which, in turn, will increase costs for Korean firms. This could result in competitive advantages for firms in the CN and T-S ETS, which feature free allocation, if linking happens without any reform. Moreover, the fact that the CN ETS allocation is based on benchmarks that can be updated annually, while the Japanese sub-national systems rely on historical data-based grandfathering. This means that Chinese companies could receive extra allowances adjusted to their economic performances, which would create a competitive advantage even over firms in Tokyo and Saitama, which benefit from free allocation. Hence, for competitiveness reasons, design alignment with respect to the initial allocation method is recommended.

[46] Allocation for free based on emissions performances of each sector.

[47] Allocation for free based on historical emissions.

As China plans to experiment with auctioning, which anyway is the most efficient initial allocation method, and the Japanese sub-national jurisdictions are well advised to also consider this approach, the first-best alignment option for the initial allocation in the event of linking is certainly to organize joint auctions via common platforms. Indeed, this option makes market organization simpler, is safer with respect to avoiding market manipulations, and is more probable to secure a common market price signal (ICAP, 2018b). However, given the size and the regulation differences in the existing Northeast Asian markets, this option is for the time being unfeasible. As a second-best option, separate domestic platforms could be established, but they could use similar methods for the initial allocations. If still different methods are used, the third=best option would be that each domestic regulator takes into consideration the difference in the initial allocation method and adjusts the real value of the allowances to the domestic market reality in order to avoid serious risks to the sustainability of the linked system.

Table 7 – Flexibility mechanisms (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Temporal flexibility	Banking allowed Borrowing not allowed.	Banking is currently only allowed between consecutive compliance period, Borrowing is prohibited.	Banking allowed with limitations between phases. Borrowing is allowed only within a single trading phase.
Trading phase and compliance period	Trading period: Annual Compliance deadline: No information available yet.	Compliance periods: 5 years (2010-14, 2015-19, 2020-2024) with annual reporting Bilateral trading of Emissions Reduction Credits (ERC) and offset credits has been allowed since 2011. No use is made of stock exchanges but supply-demand-matching fairs are organized frequently to facilitate trading.	Trading period: Three years, Five years from 2021.

In a linked system, any flexibility mechanism enforced in one system, like banking or borrowing, affects all linked systems by propagation (ICAP, 2018b). Major banking issues are avoided in the Northeast-Asian case given that all three designs currently allow banking anyway. However, there are differing limits to banking, and the best option for design alignment would be to limit banking in China, and have the same limitation in Korea and Japan. The risk to avoid is a linkage with a dominating CN ETS, which so far allows unlimited banking. Indeed, this situation could have a serious impact on market price and on the system robustness, when big number of banked Chinese allowances are released on the linked market.

Borrowing is not allowed in China and Japan but is allowed with restriction in Korea. A linked Northeast Asian market that allows borrowing in even only one domestic ETS could be a real threat to the environmental effectiveness and the system robustness of the entire system, because as a consequence. All covered entities in the linked market will be allowed to borrow by propagation. Borrowing weakens the environmental effectiveness of an ETS by enabling covered firms to postpone mitigation efforts. If then emission reductions are not undertaken in the future, overall emissions increase. Or the future cap is artificially tightened, and due to political pressure authorities could be tempted to weaken future mitigation ambition in order to lower the burden on covered entities and give an advantage to domestic firms (ICAP, 2018b). Therefore, even if the SK ETS currently allows borrowing only within a single trading phase, this feature should be removed when linking.

The trading and compliance periods vary significantly between the CN, SK and T-S ETS. The Compliance period is annual in China, currently three years in Korea but planned to be 5 years from 2021, and 5 years in Tokyo-Saitama. These differences induce some risks that are moderated by other flexibility mechanisms like banking or offsets. Indeed, cross-system trading in order to take advantage of allowance price variations caused by different compliance periods could occur, but this would not adversely affect any of our criteria. These divergences of compliance period could even have positive effects on market liquidity (Sterk, 2006). At present, Japan does not use a stock exchange for trading while China and Korea have their own centralized trading platform. Hence, while in the case of Northeast Asia design alignment with respect to compliance periods is unnecessary, a common trading platform would enable more transparency in allowance trading.

Table 8 – Price management (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Provision for price management	The NDRC and the Ministry of Ecological environment in cooperation with sectors' related ministries have to develop adjustment mechanism to prevent abnormal price fluctuations, risk prevention & control mechanism to prevent market manipulations. The regulator would set aside a certain amount of allowances that could be used to manage price volatility.	The regulator offers offset credits for trade in case of excessive price management. However, the regulator does not control carbon prices since covered entities trade over-the-counter.	Allocation Committee is in charge to implement a set of market stabilization measures when it is needed. Auction Reserve Price =[Average price over the previous three months + Average price of last month + Average price over the previous three days] / 3.
Transaction ceiling and price floor	No information available yet.	No price controls.	Taken in consideration.

Price and quantity management mechanisms are of utmost importance when linking. Currently, each of the three ETS reflects respective solutions that are adjusted to domestic circumstances. Ex-post adjustment will be used in China to keep strong control over the allowance price as opposed to the T-S ETS, which does not have a price control mechanism in place. Korea has established an Allocation Committee that is entitled to take price stabilization measures[48] if required. The Korean authorities have clearly defined when price stability is considered to be in danger and when the Committee has to

[48](1) Additional allocation from the reserve (up to 25%);

(2) Establishment of an allowance retention limit: minimum (70%) or maximum (150%) of the allowance of the compliance year;

(3) An increase or decrease of the borrowing limit;

(4) An increase or decrease of the offsets limit; and

(5) Temporary set-up of a price ceiling or price floor.

take measure[49]. Linking does not specifically call for having an aligned price and quantity management system. Each system can actually restrict its policy to its own market. For example, the EU ETS Market Stability Reserve does not apply to Switzerland, even though both markets will be linked (European Commission, 2017) and California and Québec have slightly price management mechanisms. However, in a linked system rules of one jurisdiction usually have consequences on the functioning of the entire system, so these impacts have to be taken into consideration, particularly as they could possibly compromise the robustness and the environmental effectiveness of the scheme. In the Northeast Asian case, price and quantity management mechanisms differ significantly, so that, while not indispensable, design alignments would substantially improve the reliability of a linked market.

To be more concrete, China wants to keep control over allowance prices in its national market, and without any design alignment prior to linking, due to its sheer size, soon China would de facto rule the price management of all linked ETS. Currently both price floor and ceiling as well as a special quantity mechanism are available for use in the SK ETS, which in general provides a broad variety of price stabilization measures. With a converging allowance price, it would be easier to establish common rules to the three schemes compared to letting each system being ruled individually, while anyway affecting the other schemes by propagation. Therefore, technically the easiest alignment would be to extend the original Korean Allocation Committee solution to a linked system, with committee members then coming from all participating jurisdictions. For a future linkage, the three jurisdictions will not necessarily have to adopt the same price stability mechanisms, but establishing a common framework e.g. implemented by a joint

[49] (1) The market allowance price of six consecutive months is at least three times higher than the average price of the two previous years.

(2) The market allowance price of the last month is at least twice the average price of two previous years and the average trading volume of the last month is at least twice the volume of the same month of the two previous years.

(3) The average market allowance price of a given month is smaller than 40% of the average price of the two previous years. In 2015 and 2016, the price threshold is KRW 10,000 (USD 9.09).

(4) When it is difficult to trade allowances due to the imbalance of supply or demand.

Allocation Committee would significantly benefit a linked system. Such a solution would preserve the environmental effectiveness, which could be adversely affected if an excessively low price-floor would be implemented in one of the three jurisdictions, and would also increase the system robustness by enforcing a strong common institution. However, given the will of the Chinese government to rule its own price, the political hurdles to overcome are high.

Table 9 – Penalties (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Punishment for non - Compliance	1) Fine for non-compliance = 3 to 5 X average market price in the 12 months prior + same number of allowances deducted from the firm's allocation for the following year. If the penalty is not paid before deadline: + 3% per day fine added to the previous fine. The regional authorities are responsible to issue the fine. 2) Fine of 1 million Yuan for firms that miss the annual emissions reporting deadline. 3) Non-complying entities will also be included in the National Credibility Information Sharing Platform.	Tokyo fines up to 500,000 ¥ + 1.3 times ex-post surrender of excess emissions in case of non-compliance. No penalties for Saitama facilities if a firm fail to comply. Both jurisdictions publish companies' names, which in Japan has traditionally been an effective enough means for deterring facilities from non-compliance with regulations. Both programs realized an almost 100% compliance rate in their 1st compliance periods	Penalty that does not exceed 3 X the average market price of the given compliance year or KRW 100,000 (USD 90.85) / Tone.

With respect to penalties for non-compliance the three Northeast Asian jurisdictions have again established very different rules (Table 9). Nevertheless, significant punishment for non-compliance is of utmost importance for the sustainability of a carbon market. Except for Saitama, the Northeast Asian markets in question here already provide regulations to ensure that the penalty is more expensive than the market price, which secures environmental effectiveness. In a prospective linked market, in order to preserve system robustness, none of the partner should have a considerably weaker punishment mechanism in place than the others in order to avoid unfair treatment inside the linked market. Thus, for this design aspect, first, Saitama has to implement stringent penalties similar to the other jurisdictions and the three partners need to ensure that all failures to comply are pursued. A public disclosure of non-complying entities as it is done in the Japanese sub-national schemes would be attractive for securing transparency in the linkage and confidence between the three jurisdictions.

Table 10 – Offsets (Tokyo Metropolitan Government, 2015), (Ministry of Strategy and Finance of the Republic of Korea, 2012), (NDRC, 2017), (ICAP, 2019)

Aspects	CN ETS	T-S ETS	SK ETS
Offsets	Domestic only: *Chinese Certified Emission Reduction Credits* (Expected from the third phase)	Offsets are accepted from non-covered small-and-midsize facilities, renewable energy projects, and installations outside of the two jurisdictions but inside Japan; Saitama additionally allows Forest Absorption Credits.	Offsets are accepted with limits: Qualitative limit: CERs generated after 1st of June 2016 from international CDM projects developed by domestic companies are allowed. CDM projects operated by Korean companies are allowed with restrictions. Quantitative limit: Up to 10% of each entity's compliance obligation (of which up to 5% for international offset credit).

Offsetting is a key challenge for the environmental effectiveness, the system robustness and the economic efficiency of a carbon market. Offset regulation and restriction influences market price by disclosing extra mitigation options on the market. Thus, in case of linkage, it is of highest importance for regulators to cooperate in terms of offset standards. In our three Northeast Asian schemes, The CN ETS will allow offsets but is still vague about the potential concrete regulation that will rule acceptance. In the Japanese schemes, offsets are only allowed for projects implemented outside of the two jurisdictions of Tokyo and Saitama but inside Japan. Korea has enforced both quantitative and qualitative restriction to offsetting and allows projects developed by Korean companies to be recognized as offset. Bad quality offset credits coming from environmentally doubtful Certified Emission Reductions (CER) projects are a serious threat to the environmental effectiveness of an ETS. If the quality of offsets in one of the Northeast Asian systems is not guaranteed, it can imperil the two other systems by propagation. The two Japanese sub-national jurisdictions as well as China use domestic approaches only in order to guarantee credit quality, while Korea, for the same purpose, insists that the operator of the project is of Korean origin. Existing linkages have often used aligned offset regulations, e.g. same the EU and Switzerland or the still remaining Western Climate Initiative (WCI) partners.

In the Northeast Asian case complete alignment will probably be difficult. Thus, a common guidance framework that ensures MRV of the offset projects is probably the best choice. This alignment would be comparable to the one implemented in the WCI. All information on the projects should be disclosed in order to allow for transparency. The framework should also guarantee that all offset projects indeed reduce GHG emissions, that reduction are permanent, additional and verifiable by independent entities (ICAP, 2018b). For the purpose of environmental effectiveness, it should also be made sure that the same project is not counted multiple times in the linked market.

Korean rules are an interesting model for a common Northeast Asian framework, because they establish a double quantity and quality limitation to offsetting. While the three Northeast Asian jurisdictions can accept different project types, but should implement the same level of project and thus emission reduction credit quality. A jointly used MRV would be a big step in this direction. The quality of third-party certification bodies should be guaranteed by all three jurisdictions before those agents are allowed to verify projects. In general, for a Northeast Asian linked carbon market to be implemented, it means that the joint framework establishes common rules for verification and reporting as well as the certification of third-party verifiers.

Also, a similar quantity restriction has to be established, which could be the 10% rule currently enforced in the SK ETS. If different quantity restrictions are implemented, it would affect the entire linked market, the number of allowances available as well as the common carbon price (Zetterberg, 2012). Given the potential size of the Chinese offset system, a common quantity restriction seems reasonable. Whether offsetting projects implemented outside of the three countries can be recognized or not do not matter if the same quality of regulation is applied in those projects. Anyway, mutual confidence between the partners with respect to good implementation of the common guidelines is of utmost importance.

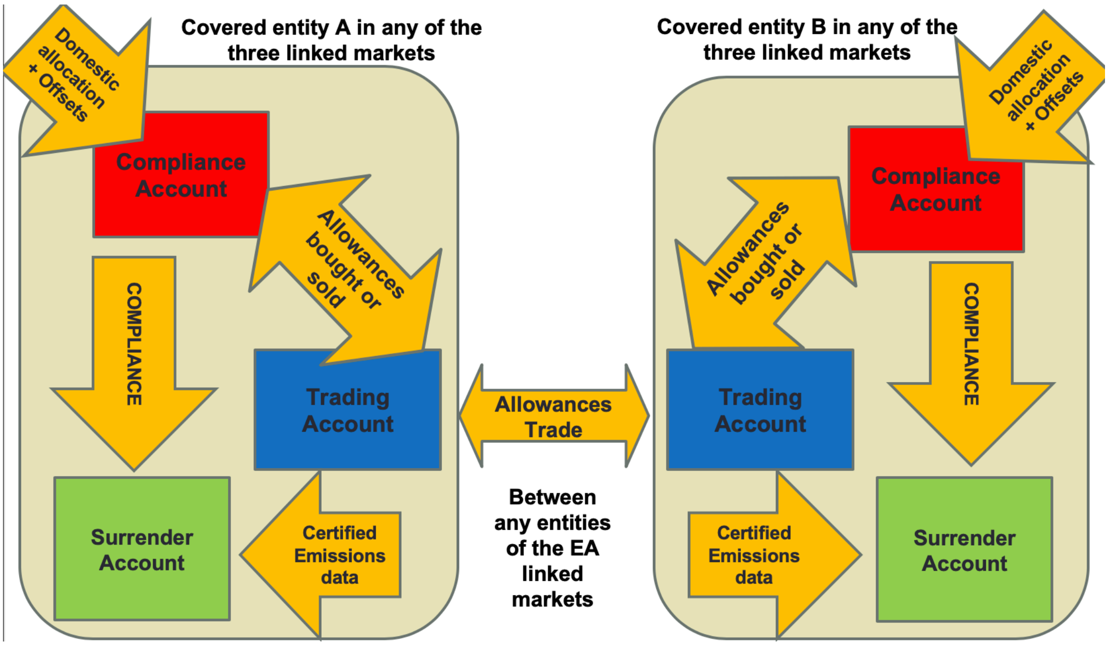
3.4 Management of a Linked System

Design features and respective regulations are not the only aspects to reform or adjust in the prospect of Northeast Asian linking. Once the two first steps are done, a legally binding linking agreement between the parties has to be approved in order to give the policy a strong and reliable legal basis. Finally, questions about the management of the linked system has to be answered. New management institutions have to be established or existing one have to be reformed so that they to fit the new linked Northeast Asian ETS (registry, etc.). As soon as this is done, allowance trading can be allowed between market actors in the linked markets. Still, and most importantly, transactions have to be recorded and emissions monitored (ICAP, 2018b). Hence, for the purpose of this paper, we will focus on the MRV and registry institutions of a prospective Northeast Asian ETS.

The registry system is the central management institution of an ETS. It basically is a database containing information on markets actors, market transactions, and emissions. In Northeast Asia registries differ but still have a common basis. All three registries in China, South Korea and the sub-national jurisdictions in Japan are electronic and opening and maintaining an account is mandatory for all market actors. The Tokyo-Saitama ETS registry separately records initial allocations of Excess Reduction Credits, assigned offset credits, credit transactions, credits surrendered for compliance, and credit transfers between the two linked systems. Each market actor holds a Compliance Account, a Surrender Account, and a Trading Account, which in sum allow traceability of all credits (Tokyo Metropolitan Government, 2015). South Korea also manages initial allocations, trading, and surrendering of emission allowances via its own registry. It contains information about the total number of emission allowances per commitment period and compliance year, about verified GHG emissions of each entity covered, about the number of emission allowances held by each market actor, and about the number of emission allowances in reserve (Ministry of Strategy and Finance of the Republic of Korea, 2012). The Chinese registry is centralized and has links to every provincial trading platform. It collects identity information on who is trading what in the Chinese carbon markets and is supposed to enable the tracking of allowances back to the original owner. However, so far, the Chinese registry rules framework guarantees information from the registry to be accessible only by developers and traders. But there are plans to open it to all participating entities after 2020. The current state of the legal framework for the national ETS, however, does not allow the registry to be publicly accessible or to establish a traceable allowance identity number to enable the tracking of allowance movement (NDRC, 2017).

Given these differences, a Northeast Asian linkage calls for reforms of the current domestic registries, however, with some common basis already in place, which could notably ease the process. Simply connecting three different domestic registries would be an option but would still require alignments e.g. in terms of information provided. But any domestic flaws, hacking, or mismanagement, or even only bad cooperation would certainly endanger the robustness of the entire linked system. A second alternative would be the implementation of a common registry in order to meaningfully facilitate the management of a linked system and strengthen information sharing and verification between market operators. It could build stronger confidence between partners and make fraud or any violation of the rules more difficult. Whether or not the three countries decide to implement a joint registry or to link their domestic registries, the same standards of information disclosure as already currently used in the Korean and the Japanese schemes would be required from all three ETS. More concretely, this refers at least to information on emissions, allowance allocations, and compliance and allowances reserves. A possible common electronic platform could build on the Tokyo ETS registry, which already takes into consideration the linkage with the Saitama ETS. The Tokyo ETS registry requires three accounts to be held by each market actor. Following this design, in a linked Northeast Asian ETS each market actor would have to open a compliance account, which is used for tracking emissions, a surrender account for recording allowances submitted for compliance, and a trading account, which records allowances sold and bought on the linked market. Such a scheme would secure the linked system's robustness by allowing allowance traceability for every regulator and the same level of market information available for MRV.

Figure 1 – Proposal of Registry system and account for a linked East Asia ETS system based on the current T-S ETS Registry (Tokyo Metropolitan Government, 2015)



Data reliability depends on the pertinency of an MRV structure, which should embrace the entire information channel of a (linked) carbon market. MRV is based on the interaction between third-party verifiers on the one side and market actors such as Covered entities, traders, and market regulators on the other side. It is an essential institution for the global transparency of any GHG mitigation policy. A Northeast Asian ETS hence requires the enforcement of solid and reliable MRV regulations in the three respective jurisdictions. It is indispensable for the confidence between the linked partners, but also for environmental effectiveness and the system robustness of the three systems. Any weakness in any of the MRV schemes could lead to violation and endanger the outcome of any of the three ETS by propagation. Data provided on emissions, emission reductions, allowances transfers, and prices must be comparable between the linked partners. While the structure of the MRV system, third-party verificators, and verification protocols do not necessarily have to be the same, the MRV reports produced need to be similar in order to fill the different accounts of the Registry proposed in Figure 1.

In the respective Northeast Asian region current domestic MRV standards do not differ fundamentally. South Korea and the two Japanese ETS already base their MRV on current international MRV standard guidelines, which have been established by the Intergovernmental Panel on Climate Change (IPCC) and the International

Standardization Organization (ISO) (Ministry of Strategy and Finance of the Republic of Korea, 2012; Tokyo Metropolitan Government, 2015). And even China is implementing an MRV system on the same basis using the EU ETS' MRV system as a model (PMR, 2014). In addition, a prospective linkage could even motivate the country to adopt stricter and better MRV regulations (Swatrz, 2018).

But even if common standards are preferable for the sake of reliability and confidence between the three partners, in fact, differences still exist. These differences should be acknowledged amongst the partners when reform discussions will be scheduled. First, alignments with respect to data monitored and information provided in the registry should be made e.g. regarding type of gases, measurement units and other emissions factors… Then the protocol of verification, that instructs how firms should be monitored, should be modulated. If, in contrary, the three systems follow significantly different protocols, emission reports will differ and comparisons of data and information between the systems will not be easy. Of course, the easiest way is of course complete alignment of the three protocols. This would then even benefit certification bodies, which then could be easily recognized across the linked market and possibly even intervene in all the three jurisdictions. If this solution cannot be applied for political reasons, at least an alignment of information monitored by these protocols should be done in order to ensure the same level of quality.

3.5 Conclusions

Linking existing carbon markets in Northeast Asia is a promising project for making climate policy, in one of the most polluting regions, more efficient and even effective. However, while complete design alignment is not necessary, some questions have to be tackled:

The biggest challenged to address in the prospect of a sustainable linkage is confidence. If the three respective jurisdictions China, South Korea, and Japan cannot obtain a sufficient level of mutual trust, they will not be able to pass through the three phases emphasized in this paper as necessary for successful linking.

In the process leading to linkage, diverging climate policies targets are a serious problem to solve. China, by far the biggest absolute emitter, is eager to increase energy efficiency as a win-win-strategy, but only proposed relative targets for both its national climate policy and national-level CN ETS. Japan and South Korea, on the other hand, both have absolute mitigation targets. Due to still existing huge differences in marginal abatement costs across the respective jurisdictions, linking domestic ETS would be reasonable in order to minimize overall abatement costs. However, as a first step, the prospective partners have to overcome their political differences.

In terms of policy implementation, the three countries stand at different stages of the process. There is a mature national ETS in place in South Korea, China is currently developing its first national scheme, and Japan still lacks a national-level ETS but has a linked sub-national system successful running in Tokyo and Saitama

The comparison of the three domestic ETS designs and the respective impact analysis with respect to the criteria of environmental effectiveness, economics efficiency, and robustness provides direction in which the three systems could be reformed in order to facilitate linking. The general technical risk in linking is the propagation of low-ambition features and their effects to other, previously more ambitious schemes. Indeed, many domestic regulations that are not shared when linking unwillingly propagate to partner schemes and have detrimental impacts on the three criteria.

To be concrete, the major issue for Northeast Asian linkages are cap differences. Particularly linking absolute with relative cap schemes – K-ETS and T-S ETS with CN ETS to be concrete – could endanger the environmental effectiveness of the entire region. Allocation and offsetting regulation also have to be carefully considered before linking. There is no doubt that the free allocation in China and Japan could be a danger to the robustness of the linked market if nothing is done and create unfair competitions while risking the environmental effectiveness of the system. Moreover, different qualities of offset standards would also be a threat to the systems by creating a way to easily avoid carbon responsibility if it is not wisely managed. Finally, the question of information sharing and the MRV and registry management must be discussed between the partners in order to guarantee the robustness of the emission and allowance accounting framework. Common or at least similar verification methods and report standards will be necessary, in order to build confidence and guarantee the sustainability of mitigation outcomes reported in a common or linked registry. As a goal, each of the Northeast Asian partners should be able to have trust in the capacity of the two others to monitor and enforce their ETS policy. This confidence will be built on collaboration, information sharing, and the good will of all three jurisdictions to work together for an integrated Northeast Asian carbon market throughout all three phases of the process.

CHAPTER 3

4. UNDERSTANDING BARRIERS TO LINKING HETEROGENOUS EMISSIONS TRADING SCHEMES: EVIDENCE FROM AND LESSONS FOR NORTHEAST ASIA

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4.1 Introduction

Despite two decades of respective research, proven merits and immediate policy relevance e.g. under Paris Agreement Article 6, linking emission trading schemes (ETS), to a large extent, remains a theoretical idea.

Usually, cost- and effort-sharing benefits are considered main motivations for potential partners to link (Burtraw et al., 2013; Doda et al., 2019). The more heterogeneous prospective linking partners' marginal abatement costs are, the more linking is beneficial (Mehling et al., 2017). The literature also conveys linking as a "bottom-up" solution to international collaboration in line with the Paris Agreement, adding political and institutional benefits to the economic dimension (Bodansky et al., 2016; Mehling et al., 2019).

However, except for the Tokyo-Saitama link in Japan, the California-Québec link in North America, and the EU-Switzerland link, linkages are rare and exclusively apply to similar jurisdictions. In other cases, tentative linkage eventually politically failed such as in the EU-Australia and the Australia-New Zealand cases, or it only operated briefly like the California-Quebec link with Ontario (Narassimhan et al., 2018; ICAP, 2021a). Ambitious past visions have faced the same fate, like Tuerk et al. (2009) expecting an OECD-wide carbon market in 2015 or "linkage-ready" ETS in major emerging economies by 2020.

The literature discusses these setbacks, highlighting the political sensitivity of linking, especially between countries with diverging policy designs and environmental ambitions (Metcalf & Weishbach, 2011; Jevnaker & Wettestad, 2016; Tuerk & Gubina, 2016). In this regard, Weitzman (2019) notes that free-rider- incentives in international cap-and-trade go beyond allocation issues, noticeably in negotiating cap-and-trade improvements. Gulbransen et al. (2018a) challenge the Article 6 logic, which considers International Transfers of Mitigation Outcomes (ITMO) easier between groups of jurisdictions than at the global level because of well-anchored design divergences.

Analyzing barriers to ETS linkage requires to go beyond economic rationale and assess the complexity behind linking implementation politics. Fankhauser et al. (2015) and Kroll & Shrogen (2009) argue that contextual time-series interactions between conflicting interest groups of varying political power define the conditions of climate policy formation through negotiations. It is therefore necessary to understand how interests and interactions affect the implementation of linkage.

Against this background, this paper examines the assumption that linking's theoretical benefits suffice to overcome political barriers, particularly in a heterogeneous climate policy context. The existing literature falls short in assessing this political dimension of linking barriers, especially using evidence-based approaches. This paper provides an original international comparison of stakeholders' dynamics in influencing barriers to ETS linkage. We employ a case study design focusing on Northeast Asia as a high-emitting region critical for the success of global climate policy. We use a qualitative survey methodology novel to this question and inspired by proven methods from climate policy studies e.g. Knox-Hayes (2012); Jevnaker & Wettestad (2016); Gulbransen et al. (2018b).

As a guiding hypothesis, we consider the policy-making process itself to generate barriers to institutional governance structures necessary for trading greenhouse gas (GHG) allowances across borders. We analyze the impacts of politico-economic factors on implementing ETS linkages in a heterogeneous country context.

In this regard, Northeast Asia is particularly suited for this case study for several reasons. The People's Republic of China, Japan, and the Republic of Korea have been considering regional linkages for years without entering into effective negotiations (CarbonPulse, December 2017). They represent the biggest emitting region worldwide in absolute emission terms, have heterogeneous ETS, divergent climate ambitions[50], different energy and emission profiles[51], and distinct political regimes. The region

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[50] Japan is an Annex-I country with a 26% GHG emissions reduction target compared to 2013, it recently pledged carbon neutrality for 2050. Korea and China are both Annex-II countries. Korea plans to reduce its GHG emissions by 37% compared to a Business-as-Usual scenario level by 2030 and recently promised carbon neutrality for 2050. China plans to reduce CO2 emissions per unit of GDP by 60 to 65% in 2030 from 2005 level, plans to peak its GHG emissions around 2030 and recently committed carbon neutrality for 2060 (UNFCCC, 2020).

[51] China has an energy intensity of 2.09 kWh/GDP and a carbon intensity of 0.27 kg/kWh; Japan has an energy intensity of 1.13 kWh/GDP and a carbon intensity of 0.23 kg/kWh;

features a working national ETS in Korea since 2015, a recently launched national ETS in China[52], and a linked sub-national ETS in the Japanese prefectures of Tokyo and Saitama since 2011. In the recent literature, Ewing (2018) considers a Northeast Asian linkage and Doda (2018) underlines the necessity to further assess linking barriers' political dimensions.

By doing so, we identify three different kinds of political barriers to ETS linking in Northeast Asia: an Institutional Resistance barrier, a Governance-sharing Barrier, and an Environmental Integrity Barrier, and we evaluate the chances to overcome them.[53]

4.2 Method

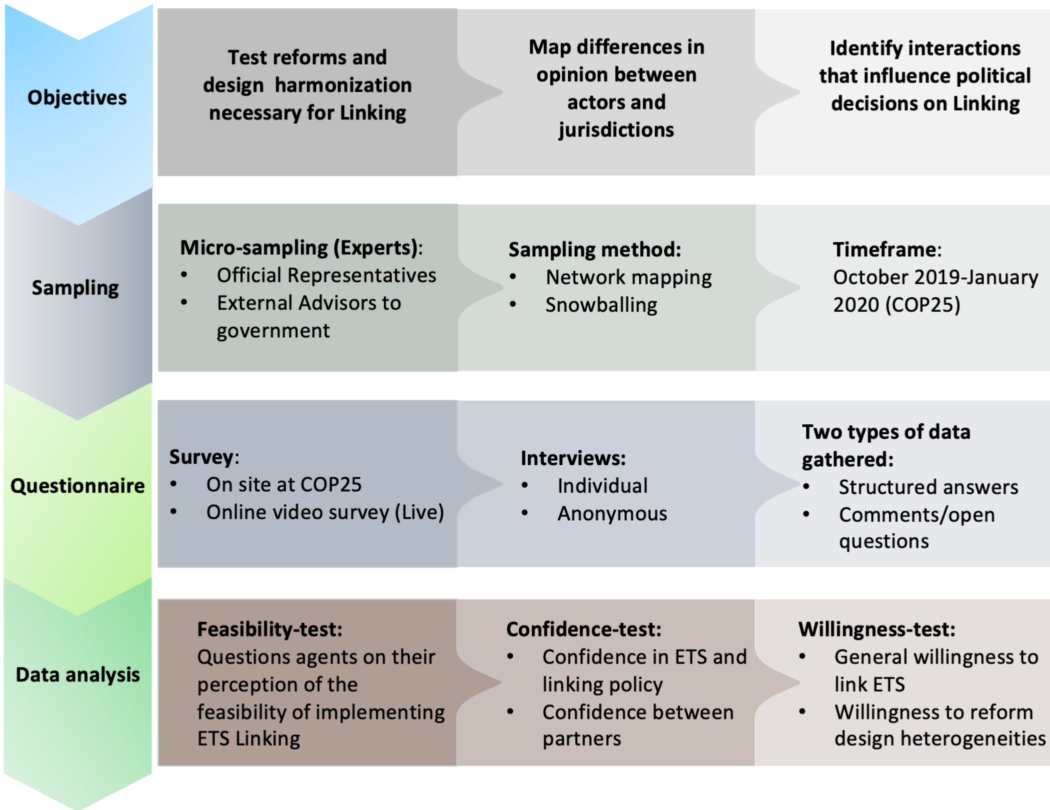
We adopt a methodology that is capable of both acknowledging and depicting the complexity of interactions impacting linkage implementation by mapping differences in opinions between countries and agent subcategories. *Diagram 1* describes the methodological process step-by-step in detail.

South Korea has as energy intensity of 1.83kWh/GDP and a carbon intensity of 0.18 kg/kWh (Our World in Data, 2020a; Our World in Data, 2020b).

[52] CN ETS phase 1 began in 2021. China already has eight functioning regional pilot ETS since 2013 in Shanghai, Beijing, Hubei, Tianjin, Fujian, Shenzhen, Guangdong and Chongqing.

[53] The authors would like to thank the reviewers for all the valuable remarks and suggestions, which helped to improve this paper's quality.

Diagram 1 – *Method description*[54]:



For empirical data collection, we surveyed opinions about linking and necessary reforms with respect to existing policy heterogeneities in the region[55]. We show design heterogeneities and harmonization proposals in *Table 1*. For sample selection, we concentrated on representatives in the negotiation teams or advisors to national delegation negotiating the Paris Agreement Article 6 Rulebook. In the interviews, we target agents' opinions on who important actors in the process are, actors' influence on decision making, and actors' opinions on Northeast Asia linking. A detailed sample description is available in *Table 2*. The survey was mainly conducted before and during COP25 in Madrid, i.e. from October 2019 to January 2020[56].

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[54] For more on this methodological approach the reader may refer to Young et al., (2018) and Tanner & Allouche (2011).

[55] Heterogeneities in design and policy analyzed by Dellatte & Rudolph. (2021).

[56] Except for two agents, all interviews were conducted before the end of COP25, thus decreasing potential conference-outcome impacts on the answers.

Table 1 – Harmonization framework and current Design heterogeneities

Regulation	Design Heterogeneities [57]	Alignments or Reforms tested[58]
CAP	**CN**: Intensity-based (2021 estimated: 4000 $MtCO_2$) **JP**: Bottom-up facility level Baseline (2018 estimated Tokyo + Saitama (TS): 103 $MtCO_2$) **SK**: Annual absolute cap (2021: 589.3 $MtCO_2$)	Absolute target ETS cap Common / similar rules for cap setting
Coverage	**CN**: Power sector (2021) – 40% total **JP**: (TS) Buildings – 20% total **SK**: Heat and power, industry, buildings, transportation, waste sector, and the public sector (2021) – 75% total	Sectorial coverage alignment
Compliance	**CN**: Mandatory for entities that fall within the Inclusion threshold: Entities with annual emissions of ~26,000 t/CO2 **JP**: (TS) Mandatory for entities that fall within the Inclusion threshold: Facilities with energy consumption ≥ 1,500kL crude oil per year (~3,000t/CO2/Year). **SK**: Mandatory for entities that fall within the Inclusion threshold: Entities >125,000 tCO2/year or Facility >25,000 tCO2/year.	National scheme Convergence of inclusion threshold/sector
Allocation	**CN**: Free allocation (Benchmarking[59]), later a part will be auctioned. **JP**: Free allocation (Grandfathering[60]), instead of distributing allowances for all emissions under the cap, regulator issues excess reduction credits (ERC) for reductions beyond the reduction obligations. **SK**: From 2021: Less than 90% freely allocated and more than 10% auctioned. EITE sectors received 100% free allocation.	Align allocation methodologies Similar method for initial allocation
	CN: No auctioning, later a part of the allocation is planned to be auctioned. **JP**: (TS) No auctioning **SK**: Auctioning gradually implemented	Auction-based allocation Organize joint auctions Common trading platforms
Price management	**CN**: Regulator ex-post adjustment allowed. Banking allowed; Borrowing not allowed. **JP**: (TS) Regulator does not control carbon prices but provide offsets. Banking is currently only allowed between consecutive compliance period; Borrowing is not allowed. **SK**: Allocation Committee is in charge to implement a set of market stabilization measures. Banking allowed with limitations between phases. Borrowing is allowed only within a single trading phase.	Common framework for price management Limit banking to same proportion
MRV	**CN**: Annual reporting (Only CO_2); Provincial verification process (Governmental) document-based. **JP**: Annual reporting (7 Kyoto GHG); Third party verifier. **SK**: Annual reporting (7 Kyoto GHG); Third party verifier and Certification Committee.	Align MRV rules for offset projects Align data monitored and gathered in the Registry

[57] Heterogeneities in design and policy are analyzed by Dellatte & Rudolph (2021) with main sources on design: TMG (2015); NDRC (2017); MSFRK (2020); MOEK (2020); MEE (2020a); MEE (2020b); MEE (2020c); MEE (2020d); ICAP (2021a).

[58] Case-specific framework and questionnaire elaborated based on studies on how to harmonize ETS with heterogeneous design can be found in ICAP (2018); Bodansky et al. (2016); Tuerk et al. (2009), Metcalf. & Weishbach (2012); Mehling et al.(2017).

[59] Allocation for free based on emissions performances of each sector.

[60] Allocation for free based on historical emissions.

Table 2 – *Sample*[61]:

Category of actors	China	Republic of Korea	Japan
Officials	*14 agents including*: • National Development and Reform Commission (NDRC) • State Council • Ministry of the Ecological Environment • National center for climate change strategies under the Ministry of the Environment • Energy Research Institute (ERI) • Research Institute on Climate change and Energy transition • Nanjing Information Engineering University (Advisor to the NDRC)	*6 agents including*: • Ministry of Foreign affairs • Ministry of the Economy and Industry • Ministry of the Environment • Korea Research Center on Climate Change	*8 agents including*: • Ministry of the Environment (MoEJ) • Ministry of the Economy, Trade and Industry (METI) • OECC institution under the MOEJ • Ministry of foreign affairs
Energy actors	*7 agents including*: • 中国恩菲工程技术有限公司 (Enfi) • 上海电气集团股份有限公司 (Shanghai Electric) • 国家电网冀北电力公司 (State Grid Jibei Electric Power Company)	*2 agents including*: • Kepco (Korea)	*2 agents including*: • Tepco • Kansai denryoqu (Kepco)
Corporate actors	*7 agents including*: • 全联新能源商会 (All Union New Energy Chamber of Commerce) • 中新城镇化（北京）科技有限责任公司 (China-Singapore Urbanization (Beijing) Technology Co., Ltd.)	*4 agents including*: • Korea Exchange • EcoEye (SK ETS major trading company advisor) • Korea industry federation	*5 agents including*: • Mitsui Institute for the Industry sector • MUFG advisors to the MOEJ and METI
Size of the sample	28	12	15

As a working hypothesis, we consider agents' perceptions of three factors influential in generating barriers to Northeast Asia ETS linking: feasibility, confidence and willingness. Differentiating agent categories' and their perceptions of the three factors then allows for understanding patterns that affect the policy process and the locus of blockages. More concretely, the empirical interview-based Feasibility-test assesses agents' perception of the practicability of linking implementation. It thus allows for identifying the impact of policy complexity on barrier generation. The Confidence-test explores both agents' awareness of linking benefits and their perception of linking partners' reliability. It thus enables to understand the barriers originating from a lack of policy understanding and distrust towards potential partners. Finally, the Willingness-test examines the politics behind the barriers and asks for agents' acceptance of ETS design

[61] Agents were interviewed anonymously and only employers' names that were allowed to be disclosed are listed in *Table 1*.

harmonization. This test identifies the willingness to harmonize ETS design heterogeneities between the three jurisdictions and the underlying influence networks.

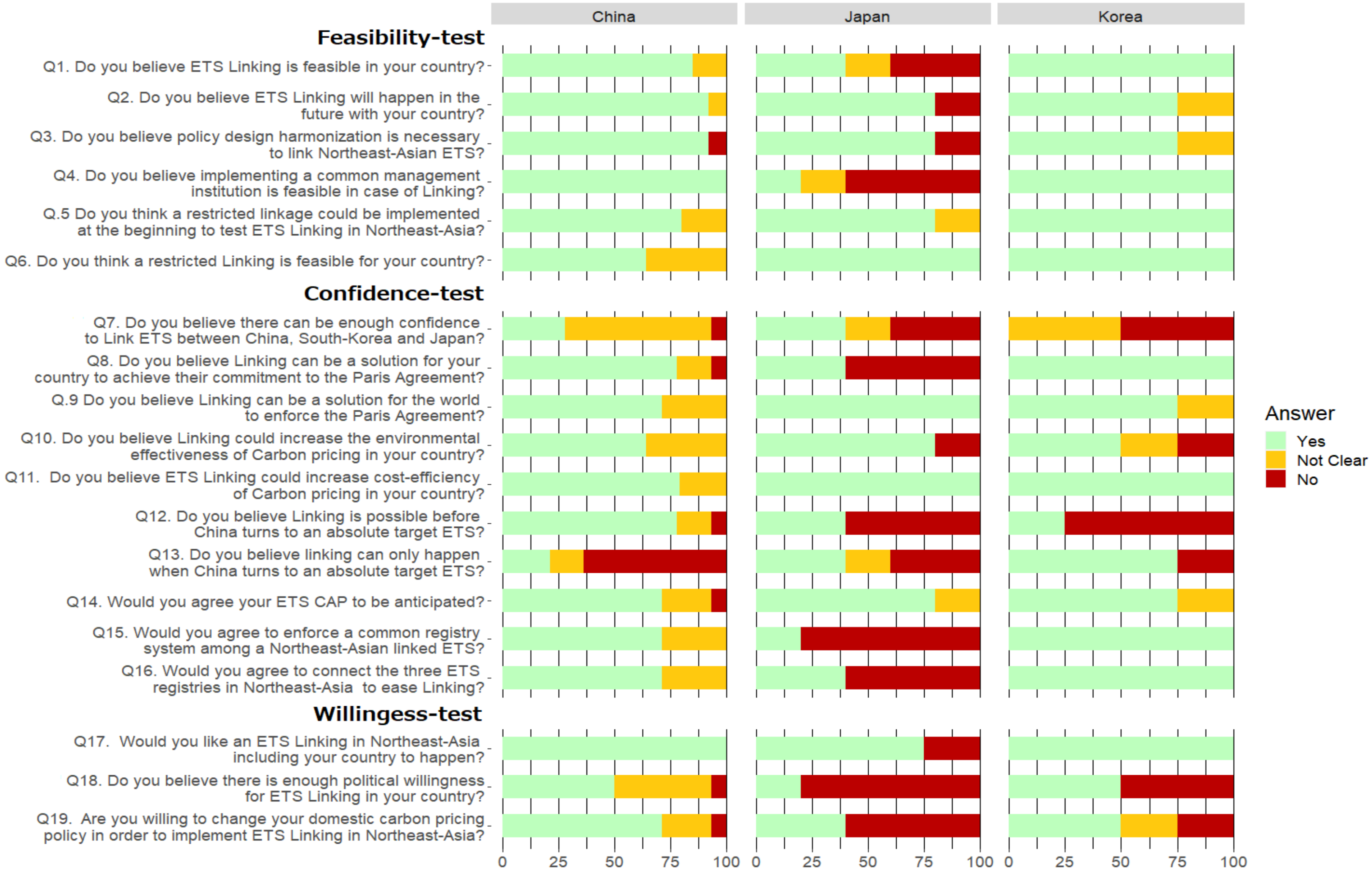
The questionnaire, available in the Appendix, is based on a double and semi-structured qualitative survey approach similar to those employed in conservation science case studies (Young et al., 2018). Agents are required to answer 30 questions and respond to 13 statements on climate policy and ETS design[62]. For each question and statement, a comment section allows further elaboration. Additional open questions render a deeper analysis of the reasoning behind each agent's positions possible. The following section presents the survey results, while the discussion section develops the analysis.

4.3 Results

The survey results are organized in two figures. *Figure 1* aggregates the results of the Feasibility-, Confidence- and Willingness-tests and displays the percentage of positive and negative answers per jurisdiction, allowing for easy international comparison. *Figure 2* is a Likert-type scale depicting sub-categories of agents' and their opinions on ETS harmonization proposals. It provides a more detailed analysis of power-relations and constrains in the policy process. This visualization tool allows for identifying patterns and mechanisms, which generate ETS linking barriers, in the discussion section. Direct quotes from the comment sections are included whenever they are particularly expressive and useful for the analysis.

[62] If they "Fully Agree", "Partially Agree", "Partially Disagree" or "Fully Disagree".

Figure 1. Feasibility-, Confidence- and Willingness-Tests



4.3.a. Feasibility-test

The Feasibility-test aims at assessing how the perceived linking feasibility affects actual ETS linking implementation in China, Japan, and Korea. Measuring feasibility of linking implementation requires the analysis of multiple institutional settings dependent on political interactions and each agent's perception of aspects connected to the feasibility of policy implementation.

According to survey results, the perceived feasibility might have a relatively small influence in the Korean and Chinese samples. In fact, while a vast majority of agents in all three countries believe regional ETS linkage will be established in the future [Q2] and that harmonization is necessary [Q3], the Japanese samples' negative feasibility perception [Q1] appears to generate barriers to linkage. More precisely, results might indicate a Japanese fear of establishing and utilizing common institutions [Q4]. However, restricted linking could facilitate linking perception [Q5/ Q6]. Notably, despite a relative optimism towards policy harmonization in Japan, the Feasibility-test shows that the perception of feasibility declines with the level of integration necessary to implement linking.

4.3.b. Confidence-test

The Confidence-test surveys the level of confidence in the samples and questions the adhesion to specific items connected to the confidence factor. In addition, it tests two confidence dimensions that can trigger barriers to linking: confidence in the policy itself and in prospective linking partners.

Our survey results show a confidence that is weaker than the feasibility perception among all three samples. Also, the confidence in prospective partners [Q7] seems to be lower than the average confidence in the instrument design. In addition, the majority of the three samples has confidence in ETS linking benefitting both the Paris Agreement target achievement [Q9] and economic efficiency [Q11], and, to a lesser extent, domestic environmental effectiveness [Q10]. Samples are particularly split on cap specifics [Q12/13][63] and institution pooling, which is critical for transparency [Q14/15/16]. Even more than for feasibility, the Japanese sample exhibits the lowest confidence.

4.3.c Willingness-test

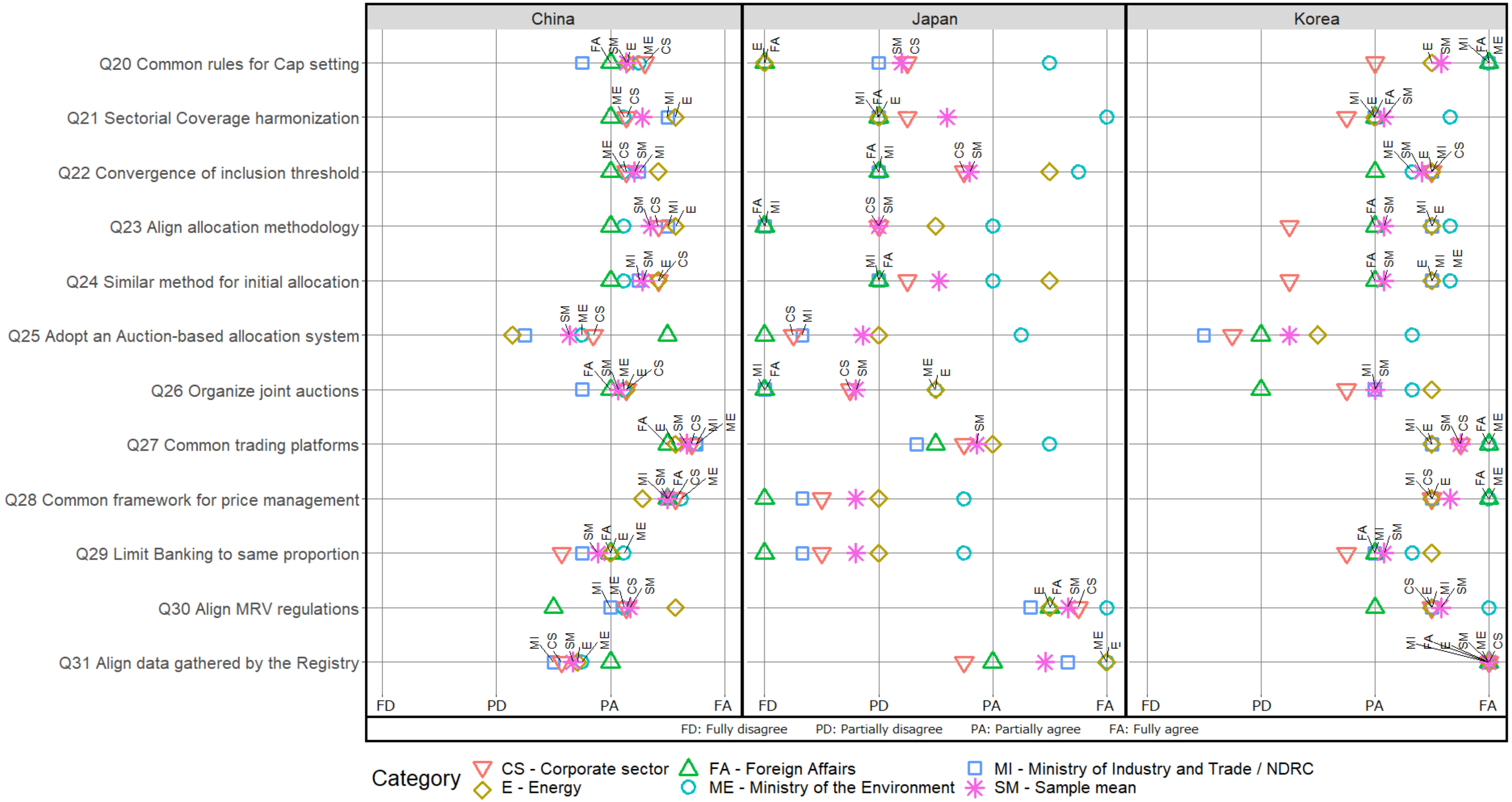
According to the above results, a substantial part of the samples still believes linking will eventually be implemented. Agents stress the future impacts of the emission reduction urgency and respective cost-efficiency properties of ETS [Q2 comments]. Thus, beyond feasibility and confidence, political willingness appears fundamental.

Notably, in *Figure 1* the perception of domestic political willingness to link is weak or uncertain in all three countries [Q18]. Despite individual support of linking by a majority of agents [Q17], the willingness to link and to change policy design [Q19] is still perceived as problematic.

Figure 2 shows that half of the harmonization items potentially represent an issue and can thus contribute to creating implementation barriers.

[63] ETS regulators set an annual declining cap of emissions reduction, except for China, which adjusts its ETS cap to annual GDP.

Figure 2. Willingness to harmonize



In sum, Japan is the only country in which all three factors are significant. Japan has internal feasibility issues and also lacks confidence in potential partners. The Japanese sample judges political willingness to be weak on almost all the criteria tested, which suggests serious difficulties in carrying out any kind of carbon pricing collaboration. The survey also reveals a deep division between the environment-oriented part of the sample (MoEJ[64] and advisors) and the economy-oriented part (METI[65], corporate sector).

This result also partially applies to Korea. The Feasibility-test indicates that a high level of cooperation and ETS linkage is considered worthwhile [Q4]. In contrast, the Confidence-test raises issues on environmental integrity [Q10] and the cap [Q12]. Korean agents judge political willingness as mixed [Q18/19], and economy-oriented agents seem to treat the allocation harmonization [Q23/24] and auctions [Q25/26] with skepticism.

The Chinese sample differs from the other two with answers being predominantly positive across questions. The Confidence-test suggests a fear that the two potential partners might lack confidence in Chinese policy [Q7 comments]. Also, despite positive harmonization perception [Q3], the Chinese willingness to cooperate with other jurisdictions is ambiguous [Q17/18], but most agents indicate their determination to achieve ETS linkage in the future.

4.4 Discussions

The above outlined results support three fundamental barriers to ETS linking in heterogeneous Northeast Asia.

4.4.a The institutional resistance barrier

[64] Ministry of the Environment of Japan.

[65] Ministry of Economy, Trade, and Industry of Japan.

The Institutional Resistance Barrier conveys that the domestic institutional process typically complicates ETS linking. It echoes the administrative challenges that linkage enforcement represents, especially among jurisdictions with heterogeneous climate policy, as already outlined by Bodansky at al. (2016). It additionally emphasizes what Ranson & Stavins (2015) described as the influence of instable domestic political opinion on the issue.

Particularly in Japan, the survey indicates a perceived lack of administrative workability of linking justified mainly by feasibility apprehensions. In *Figure 1*, while the feasibility perception in Korea and China is positive, this is not the case in Japan [Q1]. Besides, there is an obvious contradiction in the Japanese samples' response to the Feasibility-test: A majority believes linkage will happen in the future [Q2], while only a minority deems it feasible [Q1]. This contradiction suggests political reluctance concerning linkage implementation in Japan. Japanese agents characterize the difficulties as legal and administrative feasibility issues of changing legislation for linkage in Japan. Agents explain this anxiety by a *skepticism in the capacity of the political decision-making process … to implement international cooperation in such a sensitive political subject both at the legislative and the executive level* (JP-METI agent, 4/12/2019). Fear of institutional change thus constitutes an important obstacle to Northeast Asia ETS linking.

Bernstein & Cashore (2012) state that climate policy's complex global governance nature implies a difficult multidimensional administrative challenge for stakeholders at the domestic level. Similarly, in *Figure 1*, most of the Japanese agents judge the willingness to change very weak [Q18] because of Japan's institutional rigidity towards changes, which reinforces the previous contradiction. Meanwhile, despite a tendency to believe in the necessity of policy harmonization [Q3], Korean agents show some anxiety about the idea of renegotiating hard-fought-for elements of the Korean ETS with private sectors. This anxiety resonates in *Figure 2* with the lack of willingness of corporate agents to revise sensitive design elements such as the initial allocation [Q23/24]. These contradictions convey a resistance to change policy on the basis of authorities' apprehensions of their own capacity to implement changes despite a perceived inevitability of ETS linking. We call this the Institutional Inertia Paradox.

Japan's institutional inertia significantly reduces the regional integration potential. Korean agents express that their main concerns about regional linkage feasibility is Japan's slow institutional process of adopting a national ETS: (The) *More the Japanese scheme takes* *time to be developed,* (the) *more it will slow down linkage implementation in Northeast Asia* (MoEK[66] agent, 10/12/2019).

Knox-Hayes (2012) and Fankhauser et al. (2015) explain the importance of prior policy efforts for enhancing the implementation of new climate policy, which can be confirmed in our surveys. In *Figure 1*, all three samples conform to the necessity to have policy design harmonization in order to link [Q3]. Regardless, *Figure 2* reveals that only Japanese agents associated with the MoEJ hold to a common management system, while there is resistance from business and energy sectors and JP-METI and MoFAJ[67]. In contrast, Korea and China show strong approval of the establishment of a common management system for centralizing market information [Q28]. Prior policy experiences partially explain this difference. From their own domestic ETS experience, Korean stakeholders are familiar with a strong centralized domestic institution[68]. Chinese agents acknowledge being accustomed to centralized systems in Chinese ETS. Economy-oriented agents in Japan, in contrast, have not experienced such a system yet and thus are suspicious. Hence, significant ETS experience seems to be crucial for mitigating Institutional Resistance.

4.4.b The governance-sharing barrier

4.4.b.1 The difficulties in sharing governance

While challenging, Bodansky at al. (2016) underline that, in the absence of default international rules, harmonization is the only credible option for ETS linking. According to our results, amongst linkage-sensitive design elements, common institutions face the biggest obstacles. In *Figure 1*, Japanese agents reject any kind of common management institution [Q4], while a majority supports privately organized common trading platforms [Q27]. This position is, however, not shared by China and Korea. Still, there is weak general confidence between potential partners, which hints to similar anxieties concerning institutional integration

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[66] Ministry of the Environment of Korea.

[67] Ministry of Foreign Affairs of Japan.

[68] *The Korean Allocation Committee* see: MSFRK (2012)

[Q7 and comments]. Altogether, the three countries appear to see design harmonization particularly regarding common institutions differently, revealing a Governance-sharing Barrier.

Bernstein and Cashore (2012) emphasize that, in global climate policy, complex governance systems interact with complex sovereignty. And ETS linkage even complicates authorities' influence on domestic policy governance. Mehling et al. (2017) argue that linking translates into a loss of sovereignty and a reduction of autonomy, but they claim that this is supposedly outweighed by linkage benefits. However, in our survey, as depicted in *Figure 2*, in Japan, the willingness to harmonize price management [Q28], allocation methods [Q23/22], banking [Q29] or cap setting [Q20] is controversial among agents sub-categories . Rejection is particularly acute in the economy-oriented parts of the sample, which interpret these measures as *losing sovereignty on important economic features* (JP-METI agent, 4/12/2019). In Korea, in contrast, harmonization is considered necessary for good linking governance, despite experienced difficulties of negotiating crucial design elements with covered sectors. Korea will be ready to share some sovereignty, if it provides a safeguard for data quality and strengthens confidence between partners. Chinese agents follow a similar pattern and believe some common institution *is necessary to control the flow and the quality of permits exchanged and ensure rules to be respected* (NDRC[69] agent, 15/11/2019). This difference in perception between samples exhibits diverging conceptions of sovereignty, which, in turn, shapes attitude differences on governance-sharing.

Green et al. (2014) state that linking means shifting mitigation and capital outflow from one jurisdiction to another and implies serious political risk for authorities. It also leads to sacrificing some control over domestic carbon market prices, which, according to Ranson & Stavins (2015), may not be critical in countries' decisions to adopt ETS linkage. And indeed, in our study, Korea is not particularly worried about the loss of sovereignty, as confirmed in *Figure 2* by Korean agents' perception of the implementation of a common framework for price management [Q28]. Instead, Korean agents express the presence of *industry pressures* (MoEK agent, 10/10/2019) demanding to increase liquidity and to lower the cost burden. In contrast, however, in Japan, skeptical agents such as MoFAJ and JP-METI express their uneasiness with governance sharing by putting a higher priority on *keeping command on the*

[69] National Development and Reform Commission (China).

national economic and energy policy (JP-METI agent, 10/12/2019) than on potentially higher carbon prices in the future. While some carbon pricing sensitivity has long been underlined for Japan by Tuerk et al. (2009) or Rudolph & Schneider (2013), our results show that it is dominated by the sensitivity to maintain domestic control over economic and energy policy. China does not seem to suffer a lot from this anxiety, however. Instead, the Chinese sample believes linking advantages to be big enough to compensate for some loss of control over carbon prices.

Finally, the all three countries' solid support for first establishing restrictions (exchange rate, border adjustment, or quantitative restriction) in a trial-phase before moving to unrestricted linkages [Q5/ Q6] indicates the influence of the fear of losing control in the Governance-sharing Barrier. It also exemplifies the importance that restrictions or carbon trade agreements could play in the future to facilitate ETS linking, as also stressed in Quemin et al. (2019) and Schneider et al. (2017).

4.4.b.2 Governance-sharing and power-relations

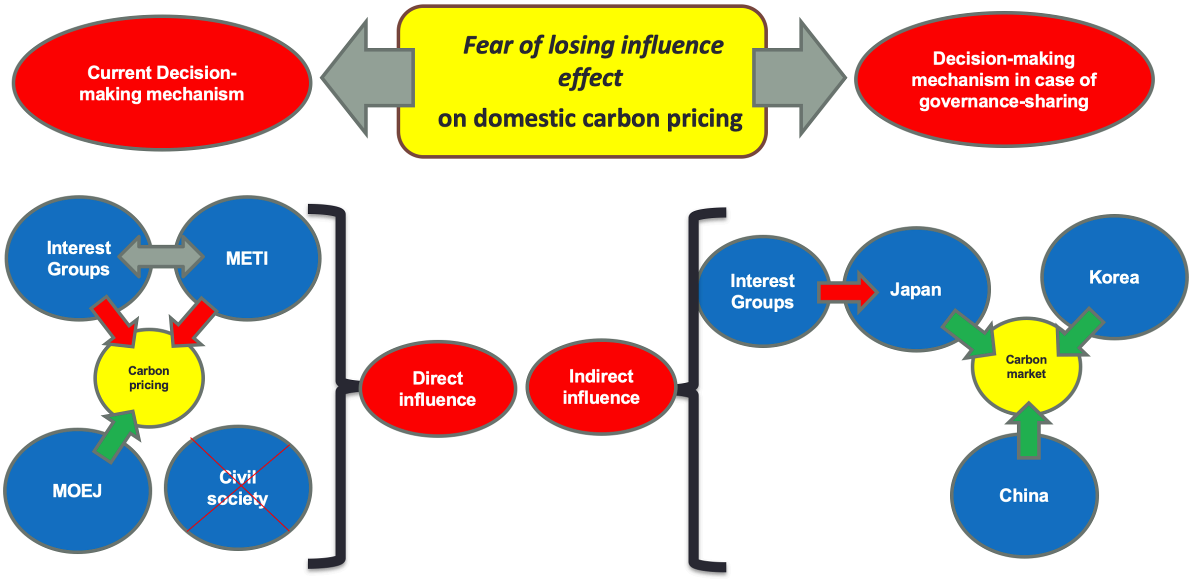
On the reasons for these differences in national approaches to ETS linkage governance-sharing, Metcalf and Weishbach (2011) mention that linking creates new winners and losers amongst domestic businesses, which has an immediate impact on policy interests. Thus, linkages disturb the traditional power (im)balance between actors in domestic carbon pricing policy. Furthermore, Gulbransen et al. (2018a) underline that ETS architects adjust design and regulations to their political and administrative reality before thinking of potential future linking, rendering harmonization problematic. On this issue, a clear divide between China and the two other jurisdictions is visible in the outcomes of our survey.

The literature on economic impacts of ETS linking is broad, especially on Chinese rents, central to understand Northeast Asian linkage (Masseti & Tavoni, 2012; Alexeeva et al., 2016; Qi & Weng, 2016; Li et al., 2019). However, our survey results in *Figure 1* show only a moderate interest of the Chinese sample in receiving a linkage-rent [Q11, comments] and the confidence indicator shows a great appetite in the Chinese sample to underpin their own domestic ETS through international linkage [Q7/8 and comments]. Priority, in fact, is given to the international legitimacy of the national ETS over a not yet clearly established distribution of carbon price burdens at the national level. This pattern also partly explains the converging willingness to harmonize design elements expressed by different Chinese agents in *Figure 2*, however, with the notable exception of sensitive questions like auction [Q25] and cap setting [Q12/13/20], revealing contradictions in the Chinese sample. The two democratic countries Japan and Korea, in contrast, follow different mechanisms.

Bodansky at al. (2016) and Gulbransen et al. (2018a) state that each domestic ETS design element represents a compromise between diverging stakeholder interests within a country, and any change could create additional political barriers. Thus, governance-sharing poses a structural threat to domestic interest groups' capacity to influence national ETS design. For the early EU ETS, Markussen & Tinggaard (2005) emphasized that organized interests intuitively invested their influence into maximizing rents. In our case, power-relations trigger differences in positions on linking between Korea and Japan. In Korea, fears of governance-sharing are overlaid with the cross-sector willingness to lower the KETS price burden. In Japan, in contrast, the fear of a high carbon price is currently superimposed by stakeholders' anxiety of losing their influence network on national carbon pricing. This phenomenon, which we call the Fear-of-losing-influence Effect*,* jeopardizes potential adherence to governance-sharing in Japan, while it does not in Korea.

In line with this effect in Japan, industry pressure goes beyond the current skirting of carbon pricing; it further aims at avoiding the loss of influence on future domestic carbon pricing policy. The reason for that can be found in Japan's specific decision-making architecture, as hinted in Arimura et al. (2018). The Japanese sample justifies reluctance to ETS linking by the relationships between the government and industry federations such as Keidanren, the latter of which has long since opposed any ambitious carbon price (Keidanren, 2019). The influence of this relationship on Japanese government representatives is well-visible throughout the survey, e.g. in the position on general feasibility [Q1] and institutional integration [Q4/Q15/Q16] in *Figure 1*. In *Figure 2*, the unwillingness of corporate agents to harmonize elements that would reduce direct influence on policy design and outcome (common price management [Q28], initial allocation [Q24/25], sectorial coverage [Q21] or banking [Q29]) also supports this notion.

Figure 3 – Fear of losing influence effect



In order to further assess this Fear-of-losing-influence Effect, opinions toward allocation harmonization and auctioning in Korea and Japan are worth considering. In *Figure 2*, the weakest support for allocation harmonization in Japan comes from the corporate sectors, METI and MoFAJ, with METI being even more reluctant than corporate representatives [Q23/24]. *Figure 2* also shows uniformity amongst countries in the fear of auction-based allocation [Q25] and common auctions [Q26], but again most pronounced in Japan. Additionally, these allocation elements see significantly lower willingness from the economic side than from environmental agents in Japan and Korea. Reasons provided in the interviews confirm that this positioning is purely self-interest driven. Corporate agents believe harmonizing allocation methodologies would create *unfair competition rules due to cost-divergences* (Japanese corporate agent, 3/12/2019), and they display great skepticism regarding the chances of negotiating a fair allocation in Northeast Asia. Korean authorities, in turn, emphasize that *free allocation was used by authorities to convince covered sectors' representatives to take part to the scheme* (Korean METI agent, 5/12/2019), thus showing the importance of allocation design as a lever to overcome domestic industry opposition to ETS implementation as mentioned in Song et al. (2015) and Kim (2016).

One could conclude that power-relationships between industry and authorities have a stronger impact in Japan than in Korea, which would be in line with Fankhauser et al. (2015) argument that the executive branch's strong willingness to challenge interest groups when passing climate legislation is of utmost importance. But even in Korea industry pressure is the reason for Koreans' weaker governance-sharing anxiety, because corporate sector interests have shifted from preserving influence to lowering the carbon price burden.

A partial explanation of the Japanese situation can be found in the absence of political party changeover since the failed attempt to establish a national ETS in 2010 and the 3/11 triple catastrophe in northern Japan (Rudolph & Schneider, 2013). Arimura et al. (2019) provide another cause in the Japanese appetite for light-handed environmental regulation, using voluntary stakeholder cooperation. Either way, our results indicate a lack of balance between economic and environmental interests in political decision-making in Japan. Two factors collude to sustain this mechanism: foremost, a government architecture that heavily prioritizes short-term private sector interests; subsequent, a lower adherence to the concept of effort and risk sharing in ETS from the economic sectors representatives. The latter is particularly significant for explaining the rejection of governance-sharing in Japan, because any governance-sharing would de facto disturb a well-established power-relationship that is perceived as being more beneficial than any cost-efficiency gains from ETS linking.

4.4.c The environmental integrity barrier

Environmental consequences of a Northeast Asian linkage also generate concerns. Schneider & La Hoz Theuer (2018) argue that the minimal consensus on environmental integrity requires ITMO to guarantee the same or lower aggregate global emissions. In this regard, *Figure 1* shows a majority of the three samples seeing linking as a useful instrument to boost domestic environmental ambition [Q10] and cost-efficiency [Q11]. Some Chinese agents express that *sharing governance could even trigger higher environmental ambition at the domestic level* (Chinese MoEE[70] agent, 6/12/2019). Overall, the results reaffirm the adherence to the notion that ETS linking reduces emission reductions in countries with higher marginal abatement costs, while increasing them in low-cost countries, but would provide extra mitigation outcomes at the linked market level (Green et al., 2014).

[70] Ministry of Ecological Environment.

Still, it does not appear to be a sufficient argument to convince stakeholders in the three jurisdictions to trustfully collaborate. Weak confidence [Q7] explains this gap between the perceived theoretical environmental benefits of linking and the lack of application in Northeast Asia. In *Figure 1*, it even seems that the more ETS experience a country has, the more it is pessimistic about environmental benefits of linking [Q10]. One explanation for this is the anticipated divergence of environmental ambitions amongst potential partners. This triggers a particular barrier connected to the perceived environmental integrity of potential partners' policy.

Ranson and Stavins (2015) argue that ETS linking structurally connects the environmental effectiveness of the joined system to the environmental integrity of each partners' own domestic scheme. And as emphasized by Bodansky et al. (2016), any flaw in the measuring, reporting, and verifying (MRV) system threatens the integrity of the entire linked scheme. Fears of poor-quality data coming from partners are thus a common concern in the Confidence-test [Q7 and comments]. This fear is directly related to the capacity of the three partners to establish reliable (MRV) institutions, which enable all partners to verify mitigation performance at the regional level (Schneider & La Hoz Theuer, 2018) . However, this capacity, crucial for transparency, is jeopardized by the two previous institutional barriers [Q15/16].

In *Figure 2*, Korea's and Japan's willingness to align MRV regulations [Q30] and data gathering in the registry [Q31] by far exceeds China's. The Chinese notion can be partially explained by the relatively low sensitivity of data disclosure currently anticipated in the CN ETS draft design (NDRC, 2017). In this situation, doubts in potential partners' integrity can flourish, representing a lack of confidence not so much in partner's intentions but in the reliability of partners' policy. In addition to that, Ranson & Stavins (2015) also underline that linkage can imply tolerating a certain level of uncertainty about the quality of allowances coming from a foreign scheme. But under structural absence of confidence, this dimension appears to be particularly difficult to accept amongst Northeast Asian agents, giving rise to a double defiance phenomenon.

The first defiance, shared in Japan and in Korea, finds its roots in China's intensity target-based ETS, yearly adjusted to GDP, intended to apply until at least 2030 (Chemnick & Storrow, September 2020). As *Figure* 1 indicates, Japanese and Korean agents worry about this structural divergence in environmental ambition [Q12/13]. For Japan, these results are echoed in Takeda & Arimura (2017). This perception is supported by Flachsland et al. (2009), underlining that the risk of selling "hot air"-allowances in case of asymmetrical environmental ambition is real and that endorsing linking without assessing this risk could jeopardize each partner's domestic climate policy goal. Mirroring this risk, Korea and Japan expect a full linkage to transfer the power to determine the environmental ambition of the linked market and thus a key political decision to Chinese authorities. This lack of confidence is mainly based on the expectation that one partner adopts strategic behavior and sets a loose cap (Bodansky et al., 2016). The Japanese rejection of common cap setting mechanism [Q20] makes it difficult to overcome. Overall, it reinforces the linkage benefits paradox mentioned by Ranson & Stavins (2015): Despite the advantages of linking heterogeneous ETS, environmental ambition divergences represent a significant political barrier to linking.

The second confidence-based defiance entails a general lack of trust in China's current environmental intentions. In Figure 1, most Japanese agents remain sceptical even if China turns to an absolute ETS cap [Q13]. Korea currently does not have an absolute cap either, but it does not suffer the same suspicion from the Japanese sample [Q13 comments]. MoEK agents, in turn, share Japan's concerns about Chinas environmental ambitions [Q12comments], which demonstrates the sensitivity of the question. In China, it echoes the felt need to legitimize the CN ETS internationally through linkage. Similar concerns about ITMO in the absence of international MRV institutions have been raised in the literature (Mehling et al., 2017; Schneider & La Hoz Theuer, 2018). This distrust in China's general environmental strategy is particularly difficult to overcome.

4.4.d Risks for a future Northeast Asian ETS Linking

In this context, can linkage ever be made sustainable? The three previous barriers impede the current political mood toward a regional ETS linking in North-East Asia and make it difficult to institute. However, they also have broader impacts on the three countries' capacity to establish a sustainable linkage in the future. If political willingness evolves to a nicer horizon towards regional collaboration in ETS, this political-economic pattern draws some potential caveats for its sustainability. Indeed, only partial resolution of these barriers could ease linkage implementation but still significantly darken the linkage's sustainability. Three main problematics enable us to discuss this issue further: The Cap question, the harmonization of linkage-sensitive design items, and sustainability measures.

The cap feature is a significant advantage of Emissions Trading Schemes because it gives jurisdictions power to set the amount of emissions removed annually directly. However, this ETS advantage also triggers uncertain sustainability when combined with a lack of trust and Governance-sharing issues. In the survey, the three countries consider cap as a significant sovereignty item that complicates linkage achievement. This paper has already discussed the Korean and Japanese rejection of linking if the three countries do not have an absolute cap as an environmental integrity issue. Nevertheless, in the NDC world, where each country freely sets its ambition, the sustainability outcomes of linking ETS with different caps are not necessarily connected to the absolute or intensity target question but to predictability. If partners can agree on a governance mechanism to discuss cap trajectory, each jurisdiction can then ideally guarantee the linked scheme ensures a global cap stringent enough to achieve each national environmental goal (Burtraw et al., 2013). Except that in the North-East Asian case, even discussions on cap-setting rules seem challenging to achieve. The governance-sharing issue directly inhibits countries' ability to agree on any cap-setting policy with their potential partners. Without resolving the Japanese rejection of common rules, a sustainable linkage is impossible. The absence of some agreement on cap automatically risks the schemes' sustainability if one jurisdiction decides to implement a loose cap and adopt strategic behaviors to maximize rent (Marschinski R., 2008; Sterck et al., 2006). Hence, settling the absolute cap question does not guarantee that linkage discussion will be eased nor sustainable. Discussions will still face a lack of trust in the environmental integrity and governance-sharing reluctance. If confidence can arise, the solution to the cap question's sustainability lies in resolving the governance-sharing reluctance question. Ideally, the harmonization level should represent the equilibrium that provides sufficient confidence in the partners' environmental integrity while allowing each country to keep enough control on the political decision to set at which level it wants to reduce its emissions.

Beyond cap, the mechanism behind the governance-sharing barrier in Japan heavily obstructs harmonization in some linkage-sensitive design features like allocation methodology or, to a lower extent, coverage. The consequences of this obstruction, if persisting, could be severe for the sustainability of a future Linking in the region with risks of generating "Hot Air" ITMOs and allowances leakage (Sterck et al., 2006; Mehling et al., 2017). Harmonization of sectorial coverage, compliance, and allocation features does not create but erases potential unfair competition and generates beneficial distributional effects (Burtraw et al., 2013). Indeed, the emergence of un-linked individual cap-and-trade in the region where sectors are covered and allocated very differently like today[71]produces potential competitive distortion between trading partners. Notwithstanding, the samples understand this reality, and the mechanism behind the governance-sharing barrier does not block every kind of design harmonization. More potential harmonization disturbs the domestic effort-sharing equilibrium; more it tends to be rejected. In Figure 2, harmonizing inclusion threshold looks accessible but still sensitive for METI in the Japanese sample. It reveals an acknowledgment of the necessity to create fair competition rules between covered entities. Meanwhile, MRV settings seem easier to achieve, which demonstrates a theoretical attachment to structural transparency. However, if some of these blockages persist, it could seriously endanger the sustainability of linkage. A convergence of design is an essential part of ETS linkage, especially in EITE sectors, to avoid carbon leakage to the jurisdiction with a higher inclusion threshold or a roomier allocation methodology. In addition to that, harmonization is a powerful instrument to raise environmental ambition among partners. Japanese and Korean representatives are worried about the Chinese scheme's environmental integrity, and these features are precisely the design harmonization that has to be negotiated to enhance environmental ambition.

Emissions Trading Schemes can be made sustainable by the implementation of sustainability measures like auction or banking limitation. Reforms for ETS linkage could represent an exciting period to implement such measures and enhance sustainability in the connected schemes. Auctioning finds its interest for ETS sustainability because it can guarantee revenue to concerned jurisdictions and give the market the responsibility of initial allocation. At the moment, Korean authorities plan to implement a 10% auction allocation from 2021 (MoEK, 2018) and China considers partial-auction implementation for the future, according to Chinese agents interviewed. Even if all ministries actors of the three samples acknowledge the potential interest of raising revenues, *Figure 1 & 2* show a uniformity among the three countries in fear of the economic consequences of an extra carbon cost derived from an entirely auction-based allocation. In addition to that dimension, auction rejection also

[71] South-Korea plans to move to a 10% auctioning system for non-EITE sectors while 90% will remain freely allocated. In China, the CN ETS initial allocation will be benchmarked, owing to a lack of data reliability. The subnational Japanese ETSs use Grandfathering to compute the individual baseline. Noticeably different from the other EA systems, Japanese covered entities trade Excess Reduction Credits (ERC) received for reductions beyond their reduction obligations and do not receive any initial allocation.

encompasses the fear of losing influence effect of the governance-sharing Issue by structurally reducing interest-groups capacity to influence initial allocation. That being said, if auction-allocation represents a real competition issue for EITE sectors in the absence of a carbon border adjustment mechanism, the implementation of a common regional auction-system would equalize competition between trade partners (Burtraw et al., 2013). However, current oppositions to Auction at the domestic level also jeopardize auctioning in case of linkage. This rejection of sustainability measures enlightens the mechanism behind the fear of governance-sharing: According to the Korean survey, *authorities used free allocation to convince covered sector representatives to participate in the scheme*. This depletion of Auction as a levy to facilitate ETS implementation embodies the compromise that has been necessary to resolve the reluctance to carbon pricing. Thus, risks are that the same pattern would infer potentially strong oppositions to ETS linkage implementation.

The Chinese case seems to imply less apprehension from the economic representatives to lose their influence on the decision-making process in a case of linking. However, similarly to the two other countries, NDRC agents reject auction-based allocation encompassing the very low probability to see Auctions becoming mainstream in the country. Additionally, the weak Chinese adherence to banking limitation also demonstrates a comparable habitus in the rejection of further sustainability measures. Corporate sector representatives express that the CN ETS's intensity target nature would allow covered entities to bank more permits for the future when the scheme turns absolute. They fear common banking limits would endanger their position when tighter cap conditions would apply. This unwillingness does not directly come out of the governance-sharing issue. Nevertheless, anxieties of the potential consequences of linkage still block the sustainability of the linked market.

Table 3 – Summary risks for a future Northeast-Asian linking:

Design element	Sample	Barrier	Kind of risk triggered by the barrier	Literature
Cap	Japan	Governance-sharing	System Robustness + Environmental Ambition	Burtraw et al., 2013; Marschinski R., 2008; Sterck et al., 2006
Sector coverage	Japan	Governance-sharing	Economic Efficiency + Environmental Ambition (Carbon leakage)	Burtraw et al., 2013
Compliance	Japan	Governance-sharing	Environmental Ambition (Carbon leakage)	Burtraw et al., 2013
Allocation	Japan	Governance-sharing	Economic Efficiency + Environmental Ambition	Sterck et al., 2006; Mehling et al., 2017
Auction	Japan + Korea + China	Environmental integrity	Environmental effectiveness	Burtraw et al., 2013
Temporal flexibility	Japan + China	Governance-sharing Environmental integrity	System Robustness + Environmental Ambition	Sterck et al., 2006; Mehling et al., 2017
Price management	Japan	Governance-sharing	System Robustness + Environmental Ambition + Economic Efficiency	Sterck et al., 2006; Mehling et al., 2017

There are strong connections between governance sharing and barriers to sustainability. Fears of losing influence threaten many of the environmental and competitive advantages of linkage. Thus, resolving governance-sharing rejection and its mechanisms will determine the persistence of difficulties to settle Cap questions, allocation methods, and sustainability measures. It is especially true in Japan, the country with weaker political willingness to ETS implementation and where these barriers are the most acute. Without encompassing these issues, the probability of a sustainable linkage in North-East Asia is low and unprobeable.

4.5 Conclusions

Based on extensive stakeholder interviews with Chinese, Japanese, and Korean UNFCCC negotiation teams at COP25, this paper supports the notion that, despite economic advantages, heterogeneous domestic climate policies create effective barriers to international ETS linking. Even outranking the expected political risk of instituting a structural economic rent, fears of losing control over domestic policy design and resulting effects appear to be the number one barrier-generating concern.

Our results suggest that in China and Korea, the perceived feasibility has a relatively small influence on linking implementation. In Japan, however, the perceived low feasibility indicates a specific fear regarding expected domestic implementation difficulties. The results also show a connection between the perception of feasibility and the level of integration necessary to implement linkage. Questions of confidence dominate the results, with concerns about environmental integrity and institutional integration. The willingness to link appears to vary considerably across the three countries. Fear of losing control over important aspects of economic policy triggers resistance to linkage, particularly in Japan, jeopardizing harmonization of linkage-sensitive design elements.

Based on these results, we identify three main politico-economic barriers to Northeast Asian ETS linking, all of them particularly persistent in Japan. First, an Institutional Resistance Barrier revolving around the perceived political capacity to implement institutional changes. It describes linkage as a significant administrative challenge, the intensity of which is inversely proportional to the experience jurisdictions have with domestic ETS.

Second, a Governance-sharing Barrier connected to the level of institutional integration necessary to link ETS across jurisdictions and to fears of losing control over domestic economic and energy policy. It causes difficulties for authorities to settle complex sovereignty issues and entailed political risks. The mechanism leading to this issue bears that, without prior integration, business interest groups tend to oppose governance-sharing in order to preserve their influence on domestic carbon pricing.

Third, an Environmental Integrity Barrier describing the impact that the lack of confidence has on environmental concerns. The first dimension of this barrier arises from the understanding of the partner’s ETS policy. The second-dimension centers around a mistrust in the general environmental ambition, particularly in China.

In order to overcome such barriers, finding answers to the fear of losing influence will determine the persistence of difficulties in harmonizing many linkage-sensitive design elements required for sustainable ETS linking. Further research focusing on partner-choice effects and specific agent categories' behavior regarding the fear of losing influence on domestic carbon pricing policy could provide essential insights for overcoming this issue. Furthermore, confidence-building focused on governance-sharing is necessary at cross-sectorial levels. Nevertheless, mistrust in environmental policy integrity between potential ETS linking partners could well remain the most complex barrier to overcome, notably in the absence of similar ambition levels or cap-setting approaches. An international framework for linking and MRV, however, could be a promising first remedy.

In sum, facilitating carbon pricing policy cooperation in heterogeneous contexts such as Northeast Asia is crucial for bringing climate change to a halt. However, this paper emphasizes the high political sensitivity of establishing ETS linking between jurisdictions with diverging policy designs and environmental ambitions. These politico-economic issues require increased attention and research. Otherwise, only like-minded, economically and politically similar partners would succeed in ETS linking, which would significantly limit linking benefits and thus the instrument's potential to help in achieving the Paris Agreement targets.

4.6 Funding

This work was supported by the Kyoto University Asian Studies Unit under the 2019 KUASU Challenge + Research activities Grant.

4.7 Appendices

Guidelines to answer the questionnaire:

- There are three tables in the questionnaire.
- Table.1 and Table.3 are open questions or “Yes or No” questions. To answer the “Yes or No” questions, please write an “X” in the case of the answer of your choice.
- For Table.4 & 6, you are asked to evaluate the confidence of your answer using a scale from 1 (weak confidence = I am really not sure of what I am saying) to 4 (strong confidence = I am pretty sure of what I say).
- Table.5 is based on statements. You are asked to choose if you agree or disagree with each specific statement. To answer the statements questions, please write an “X” in the case of the answer of your choice.
- For comprehension, you can always comment on your answers.
- You are asked to answer the questions and statements using your opinion about “what is the position of your country / of the authority you represent”.
- The questionnaire targets your opinion as representative of your institution.
- If you believe the authority you represent does not have a position yet on a specific question/statement topic, please write down your own opinion about what is most probably going to be the position of the authority you represent and notify it in the comment section.
- If you don’t know how to answer a question or a statement, please choose no option and explain why in the comment section.
- The questionnaires are anonymous but you are asked to identify the country you are from and the institution you represent (e.g.: The Ministry of Environment, the Ministry of Foreign affairs, Research Institute, etc…). Please identify specifically your institution with its official name.
- Your answers will not be disclosed individually but will be aggregated per country and randomized.
- **For Chinese representatives:** ETS means the National Chinese ETS. However, you can use the example of the Pilots ETSs to explain your answer in the comment section.
- **For South-Korean representatives:** ETS means the national SK ETS.
- **For Japanese representatives:** You are asked to give your opinion about a potential future National ETS. However, you can use the example of the Tokyo and Saitama ETSs to explain your answers in the comment section.

Table 4. Feasibility-, Confidence-, and Willingness-test: Confidence scale: 1 = Weak / 2 = Medium / 3 = Good / 4 = Strong

	Question in Figure 1 & 2	Question	Yes	No	Not clear yet	Confidence in your answer?	Comments
1		What is your general opinion about ETS Linkage?					
2	Q17	Would you like an ETS linkage in North-East Asia including your country to happen?					
3	Q2	Do you believe ETS linking will happen in the future with your country?					
4		If yes, in your opinion, around when will Linkage happen?					
5		Do you believe ETS Linkage can be a good option for your country?					
6		What would be the most direct benefit of Linkage for your country?					
7		What would be the most direct disadvantage of Linkage for your country?					
8	Q11	Do you believe Linkage could increase cost-efficiency of Carbon pricing in your country?					
9	Q10[72]	Do you believe Linkage could increase the environmental effectiveness of Carbon pricing in your country?					
10		Do you believe Linkage could affect the environmental effectiveness of Carbon pricing in your country?					
11	Q18	Do you believe there is enough political willingness for linking in your country?					
12	Q8	Do you believe linking can be a solution for your country to achieve their commitment to the Paris Agreement?					
13	Q9	Do you believe linking can be a solution for the world to enforce the Paris Agreement and stay below the 2*C of warming?					
14		Do you believe your country has enough technological advance to make linking feasible?					
15		What would be the institutional environment necessary for linking?					
16	Q7	Do you believe there can be enough confidence to Link ETS between China, South-Korea and Japan?					
17	Q1	Do you believe linkage is feasible in your country?					
18	Q3	Do you believe policy design harmonization is necessary to link EA ETSs?					
19	Q19	Are you willing to change your domestic carbon pricing policy in order to implement linkage in EA?					
20	Q4	Do you believe implementing a common management institution is feasible in case of an EA Linkage?					
21	Q12[73]	Do you think linking is possible between China (Intensity-based ETS) and absolute systems (Korea and Japan) while being environmentally effective to reduce GHG?					
22	Q13	Do you believe linking can only happen when China turns to an absolute target ETS?					
23	Q5	Do you think a restricted linkage could be implemented at the beginning to test linking in Northeast-Asia?					
24	Q6	Do you think a restricted linkage is feasible for your country?					

[72] Item 9 and 10 are similar questions intended to test both confidence on linking theoretical benefits and agents' general knowledge of the policy. Due to almost identical results, we have decided to use only one result in Figure 1.

[73] Q12 and Q13 are questioning the confidence dimension.

Table 5. Willingness to harmonize: Evaluate the strength of your opinion according to the statements

	Question in Figure 1 & 2	Statement	Fully agree	Partly agree	Partly disagree	Fully disagree	Comments
25	Q19	We agree to implement common rules for cap setting in the three linked markets (e.g. enhance data reporting quality to the same level in the three jurisdictions).					
26	Q20	We agree to harmonize sectoral coverage in the three jurisdictions (China, Japan, South-Korea).					
27	Q21	We agree to implement a certain level of convergence of emissions inclusion thresholds per sector between the three linked partners?					
28	Q22	We agree to align the allocation methodologies between the three countries.					
29	Q23	We agree to have similar method of initial allocation in the three EA countries.					
30	Q24	We agree to adopt an auction-based allocation system for linking.					
31	Q25	We agree to organize joint auctions in case of linking in East-Asia.					
32		We agree to the creation of common auction platform(s) between the three countries.					
33	Q28	We agree to limit banking to similar proportion in the three countries.					
34	Q26	We agree to create common trading platform(s) for the linked market.					
35	Q27	We agree to establish a common framework for price management in ETS in East Asia.					
36	Q29	We agree to align MRV rules for offsetting projects.					
37	Q30	We agree to align data monitored by the MRV system and gathered in the registry.					

Table 6: Transparency[74]: Confidence scale: 1 = Weak / 2 = Medium / 3 = Good / 4 = Very strong

	Question in Figure 1 & 2	Question	Yes	No	Not clear yet	Confidence in your answer?	Comments
38		What is your opinion about transparency in Carbon market linkage?					
39	Q14	Would you agree your ETS CAP to be anticipated in order to allow Linking to happen in confidence with partners?					
40		Would you agree to publicly disclose the list of non-complying entities from your domestic scheme?					
41		Would you agree to publicly disclose all MRV information about offsetting projects allowed in your domestic ETS?					
42	Q16	Would you agree to connect the three ETS registries in EA to ease linking?					
43	Q15	Would you agree to enforce a common registry system among EA Linked ETS?					

[74] The questionnaire encompassed a transparency section that we do not reference in this paper as an independent Transparency-test. However, we present the original questionnaire used for this study in the Appendix for reasons of scientific rigor. This paper considers the data gathered from table 5 under the Confidence-test when relevant and connected to the confidence factor.

CHAPTER 4

5. ENFORCING SUSTAINABLE AUCTION-BASED EMISSIONS TRADING SCHEMES IN A POST-COVID-19 WORLD

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This chapter is co-authored with Dr. Sven Rudolph, Assoc. Prof. at the Graduate School of Global Environmental Studies, Kyoto University, Japan. It is an adaptation of: Dellatte, J., Rudolph, S. (2021). Enforcing sustainable auction-based ETS in a Post-COVID-19 world: Evidence from and Lessons for Northeast Asia. *Critical Issues in Environmental Taxation*, Vol. (23), 243-255

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5.1 Introduction

Initial allocation and revenue use design features are often used as a leverage to ease policy implementation of greenhouse gas emissions emission trading schemes (GHG ETS). While GHG ETS have already been implemented in South Korea and China and are under consideration in Japan, full auctioning has so far not been deemed a worthwhile option, even though it would enhance the sustainability of the schemes. (Rudolph et al., 2012). Anxiety to lose competitiveness and fears of harsh political opposition from industrial and corporate sectors covered by the schemes have thus prevented GHG ETS from generating significant revenue in the region. However, the COVID-19 crisis raises the question on initial allocation and revenue use anew with two interdependent issues: (1) how to generate extra public revenues for financing the re-launch of affected economies, and (2) how to accelerate the energy transition.

Against this background, here we raise the question whether the COVID-19 global shock represents a new window-of-opportunity for overcoming national resistance to implementing revenue-raising GHG ETS in China, South Korea and Japan. We analyze how urgent post-COVID-19 policy concerns such as industrial re-location, Green Deal relaunch plans, and the need to find additional public revenue sources influence existing political barriers to the implementation of sustainable design features in GHG ETS, particularly full revenue-neutral auctioning and earmarking of revenues for environmental, economic, and social purposes in sustainable COVID-19-recovery programs.

We compare the three Northeast Asian countries' national response to the COVID-19 crisis and assess the impact these responses will probably have on current domestic barriers to the implementation of auction-and-earmarking-based GHG ETS. Methodologically we use document analysis with respect to national responses to the COVID-19 crisis and semi-structured expert interviews on the domestic barriers to implementing sustainable GHG ETS. Being part of a broader study, in this paper we focus on the perception of the adoption of auction-based allocation among the three expert samples.

Based on the empirical evidence we identify a common rejection-pattern toward auction-implementation in GHG ETS in the sample. We show how this pattern is impacted by the COVID-19 crisis. And, we provide policy recommendation on how to exploit post-COVID-19 opportunities for enhancing Northeast Asian GHG ETS by lowering the barriers to revenue-raising design features.

5.2 Pre-COVID-19 climate policy in Northeast Asia

Northeast Asia is the biggest absolute GHG emitting region in the world, China (10.9 GtCO_2e), Japan (1.3 Gt CO_2e), and South Korea (0.673 GtCO_2e) are cumulatively responsible for 12.9 Gt CO_2e per year, which was more than one third of global emissions in 2017 (European Union, 2018) (Rudolph et al., 2012). With respect to climate policy, Northeast Asia at this very moment stands at a critical crossroads with respect to climate target development and carbon pricing policy implementation (Table 1).

The three Northeast Asian countries' policy response to climate change differ in many aspects while they also share some similarities in their historical development. Japan is an Annex-I country with an absolute 26% GHG emissions reduction target compared to 2013 by 2030. Korea and China are both Annex-II countries. Korea intends to reduce its GHG emissions by 37% compared to a Business-as-usual scenario by 2030. China plans to reduce CO_2 emissions per unit of Gross Domestic Product (GDP) by 60-65% in 2030 from 2005 levels and intends to peak its GHG emissions around 2030 (UNFCCC, 2020). China and the Republic of Korea both recently pledged carbon neutrality, respectively for 2060 and 2050 (Chemnick et al., 2020). In addition, the three countries are quite heterogenous with respect to the constitutional and political situation. China is a one-party autocracy, while Japan and Korea are multi-party democracies.

With respect to GHG ETS, the region has seen a working national scheme in place in South Korea since 2015 and a linked sub-national ETS in Japan (Tokyo-Saitama-ETS) since 2010/11 (Rudolph et al., 2020). China has been developing a national GHG ETS since 2017, which is currently still in the set-up-phase (Dellatte et al., 2019).

The Tokyo and Saitama ETS with just above 100 million tons of total GHG emissions in 2016 focus their linked ETS on the end-use of energy in large office buildings, while also including industrial emitters, thus covering around 1,800 facilities and a share of 21 percent of total CO_2 emissions. Emission under the cap are supposed to be reduced by an average of 15% by 2020 and 35% by 2030 from average 2002-2007 emissions. Initial allocation is fully free of charge, so no revenues are raised.

The Chinese national scheme was supposed to begin trading in 2020, but the Covid-19 outbreak has postponed the implementation of the first real trading phase. However, China already has implemented eight operating regional pilot GHG ETS in

Shanghai, Beijing, Hubei, Tianjin, Fujian, Shenzhen, Guangdong and Chongqing since 2013. Still, the pre-COVID-19 political situation with respect to carbon pricing had already seen many barriers to sustainable GHG ETS design in the region. And even successful GHG ETS implementation resulted in programs that mostly excluded auctioning and government revenue raising in particular.

Table 1: NDC and GHG ETS in Northeast Asia[75]

	China	Japan	Korea
NDC targets	Reduction of 60-65% of CO2 emissions per unit of GDP (Intensity target).	Absolute reduction of 26% of all GHG emissions by 2030 compared to 2013	Reduction of 37% of all GHG emissions by 2030 compared to Business as Usual.
New objective announced	Peak before 2030 and Carbon neutrality in 2060 (not official NDC yet)[76].	Same objective[77].	Carbon neutrality for 2050 (not official NDC yet)[78].
ETS	8 Regional pilot ETSs (Since 2013). National ETS scheduled for 2020 but delayed because of COVID-19 crisis.	Tokyo and Saitama ETS (Linked since 2011). Decision to implement a national ETS deferred after the Tohoku disaster in 2011. First Carbon (fuel tax) in 2012.	Korean ETS (since 2014)
Allocation method	National ETS: Free allocation (Benchmarking)[79], a portion is forecasted to be auctioned later.	Free allocation (Grandfathering)[80].	2018-2020: 97% freely allocated and 3% auctioned. From 2021: Less than 90% freely allocated and more than 10% auctioned. EITE sectors received 100% free allocation.

[75] (UNFCCC, 2020) (TMG, 2015) (Ministry of Strategy and Finance of the Republic of Korea, 2012) (Ministry of the Environment of the Republic of Korea, 2018) (NDRC, 2017)

[76] Announce made by Xi Jinping at the 2020 Virtual UNGA see: Chemnick (2020, September).

[77] (Doyle et al., March 2020)

[78] (Ha, September 2020)

[79] Allocation for free based on emissions performances of each sector.

[80] Allocation for free based on historical emissions. Instead of distributing allowances for all emissions under the cap, both jurisdictions only issue excess reduction credits (ERC) for reductions beyond the reduction obligations.

Globally, GHG ETS raised approximatively 21.61 bn US$ of public revenue, while carbon taxes yielded a slightly higher 23.67 bn US$ in 2019 (WorldBank, 2020), However, this represents only a very small portion of the approximatively 856 bn US$ revenues from environmental taxes or charges worldwide in 2018 (OECD, 2020).

In Northeast Asia, China, Japan and Korea collected 0.7%, 1.35% and 2.66% of GDP in environmental taxes in 2018, respectively (OECD, 2020). Japan, the only country in the region with an explicit carbon tax in place, raised 2.43 bn US$ in carbon tax revenues in 2019 (World Bank, 2020). With respect to GHG ETS, the Chinese and Japanese sub-national jurisdictions still allocate emissions allowances free-of-charge without generating extra costs to covered entities. The Korean ETS raised 179.27 million US$ in 2019 (World Bank, 2020), but Korea intends to increase its still small share of allowances auctioned in the near future, which will higher costs for Korean firms (Table 2). Given the small absolute volume and public revenue share from carbon pricing in Northeast Asian countries, increasing GHG ETS revenues from the implemented or planned schemes represent a promising public income opportunity, particularly in times that require extra funds for sustainable economic recovery.

5.3 Barriers to auction-based GHG ETS in Northeast Asia

With respect to research methodology, insights into barriers to auction-based GHG ETS in China, Japan, and South Korea have been gained from a survey at COP25 in Madrid. The survey consisted of three expert samples from China, Japan, and South-Korean (Table 3). All interviewees were country representatives in the negotiation teams of the Paris Agreement Article 6 Rulebook or advisors to the respective national delegations. The samples contained experts and negotiators from relevant government agencies and from the energy and corporate sectors. Semi-structured interviews were conducted before, during and after COP25 between October 2019 and January 2020.

Table 3: Interview Sample[81]

Category of actors	China	Republic of Korea	Japan
Officials	*14 agents including*: • National Development and Reform Commission (NDRC) • State Council • Ministry of the Ecological Environment • National center for climate change strategies under the Ministry of the Environment • Energy Research Institute (ERI) • Research Institute on Climate change and Energy transition • Nanjing Information Engineering University (Advisor to the NDRC)	*6 agents including*: • Ministry of Foreign affairs • Ministry of the Economy and Industry • Ministry of the Environment • Korea Research Center on Climate Change	*8 agents including*: • Ministry of the Environment (MoEJ) • Ministry of the Economy, Trade and Industry (METI) • OECC institution under the MOEJ • Ministry of foreign affairs
Energy actors	*7 agents including*: • 中国恩菲工程技术有限公司 (Enfi) • 上海电气集团股份有限公司 (Shanghai Electric) • 国家电网冀北电力公司 (State Grid Jibei Electric Power Company)	*2 agents including*: • Kepco (Korea)	*2 agents including*: • Tepco • Kansai denryoqu (Kepco)
Corporate actors	*7 agents including*: • 全联新能源商会 (All Union New Energy Chamber of Commerce) • 中新城镇化（北京）科技有限责任公司 (China-Singapore Urbanization (Beijing) Technology Co., Ltd.)	*4 agents including*: • Korea Exchange • EcoEye (SK ETS major trading company advisor) • Korea industry federation	*5 agents including*: • Mitsui Institute for the Industry sector • MUFG advisors to the MOEJ and METI
Size of the sample	28	12	15

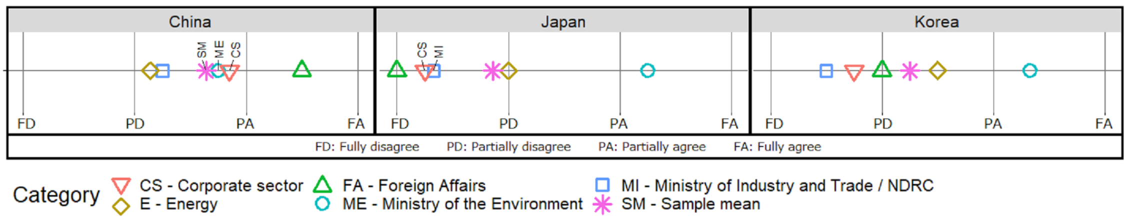
Testing the possibility of implementing auction-based allocation involves analyzing the effects of auctioning on stakeholders and their interests towards these effects. Auction increases the cost of carbon for covered firms but makes the initial allocation more efficient and fairer. Private costs increase because emission costs are fully charged to polluters thus following the strong Polluter pays Principle (PPP). Cost-efficiency increases compared to free-of-charge allocation as there is no time lag between the allocation and the generation of the scarcity price, and because both transaction costs and administrative costs can be reduced. Also, the immediate scarcity price signal provides polluters with price certainty and sets immediate innovation incentives. Fairness

[81] Agents were interviewed anonymously and only employer's name that were allowed to be disclosed are listed in *Table 2*. Some corporate and energy agents are representative of more than one company and some are not disclosed in this paper because agents required full anonymity.

increases as competitive distortions due to complex free-of-charge allocation are prevented. In turn, auctioning raises revenues for government bodies and considerably reduces the risk of over-allocation (Burtraw et al., 2013).

With respect to the opinion of interviewees about the implementation of in their respective domestic GHG ETS, the interview results show that design features implying revenues such as auction-based initial allocation are often rejected both by polluters and economic government agencies. Especially in Korea and Japan, agents argued that these features are politically too difficult to settle with covered sectors. In the Korean case, auction-based allocation policy was even explicitly ruled out in the early-stage policy implementation process in order to obtain adherence from covered sectors (especially emission intensive trade exposed facilities, EITE) to the GHG ETS policy itself.

Figure 1: Do you agree to move to an auction-based allocation?[82]



As indicated in *Figure 1*, none of the three samples consequently agrees to auction-based allocation. More precisely, only Chinese representatives show an average opinion slightly in favor of auctioning. However, despite this slightly positive average opinion in China, a majority of policy-maker' agents interrogated – like NDRC agents – rejects auctions. Even agents from the Chinese Ministry of the Environment only display partial support for the idea. Meanwhile, on average, the two other samples from Japan and Korea, both democracies, disagree with the idea of a full auctioning. Here, a clear divide happens to exist in both samples between agents of the ministries of environment, slightly in favor of some sort of auction-allocation system, and the economic agents from industry, the corporate sector, the economic ministries and even from the foreign affairs agencies, which mostly reject auctions. It illustrates the strong constrains faced by

82 The results are organized in a Likert-type scale table depicting sub-categories of actors' opinions on auction-based allocation. The samples mean are given as an indication.

authorities to increase the carbon burden on covered sectors and the influence of interest-groups on these issues. In country comparison, Japan seems to face the strongest opposition on average.

In spite of these observations, in open questions part of the survey, a majority of government authorities' interviewees recognizes that the revenues generated by auctions would be a most welcomed addition to the budget and could be used for financing innovation. However, given the data presented in *Figure 1,* this agency appetite for additional revenues and budget seems to have a lower incidence than the dominant fear of negative economic consequences and political pressure from covered entities due to the extra cost burden originating from full auctioning. In their comments, corporate sector interviewees justify their skeptical position based on expected competitive disadvantages, while economic ministries' representatives – METI in Japan and Korea – describe this extra-cost as politically explosive with respect to generating strong political resistance from covered sectors to GHG ETS in its entirety. In addition, in *Figure 1*, the sections of representatives of the three countries that still believe auction could happen in the future happen to be less prevalent. In fact, explanations of their answers reveal interviewees' support to only some sort of partial auction that would explicitly not represent the majority of the initial allocation scheme.

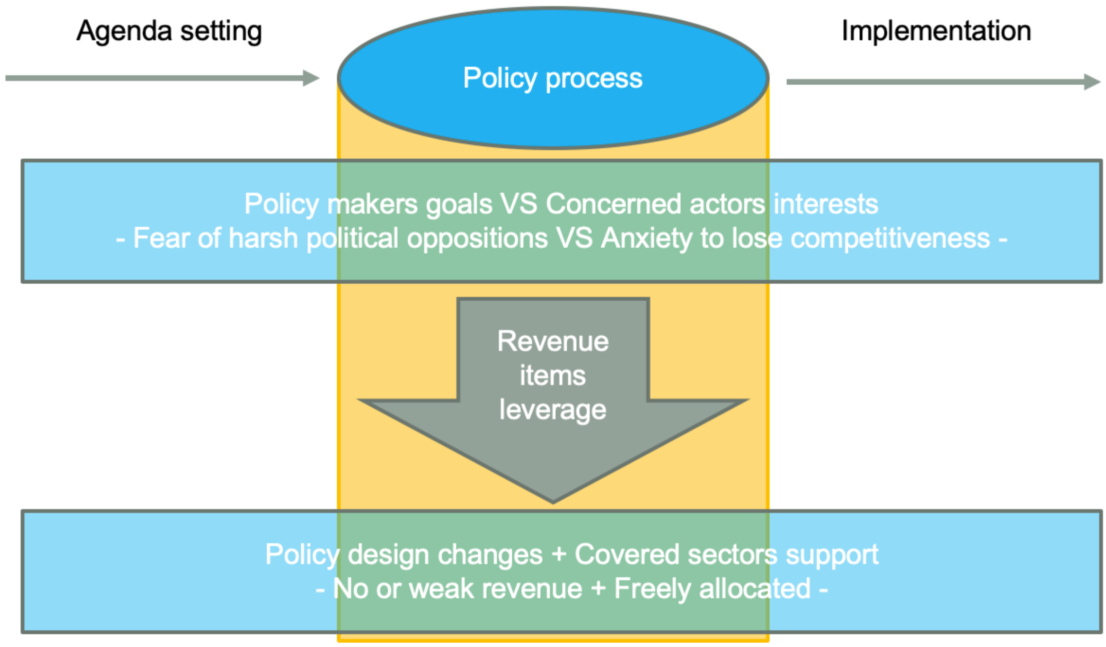
Thus, similar response pattern to auctioning proposals can be identified among the three samples: If auctioning is implemented, government representatives expect strong opposition to this idea. They also expect the stronger opponents to from the EITE sectors, but in fact opposition comes from a large part of the industry sector. Korean representatives specifically recognize that it would be challenging to change the current allocation rules in the their GHG ETS and move from the current auctioning share towards full auction. They argue that it would affect the repartition of the effort between economic sectors and would hence re-awaken opposition that had been hard to pacify during the initial implementation of the South Korean ETS (ICTDS, January 2015). Japanese governmental representatives confirm Korean experiences by stating that full auctioning would be very difficult to enforce in the current Japanese political context and thus could jeopardize any steps forward with respect to a national GHG ETS.

This argument also sheds light on a particular political strategy visible both in the Japanese and the Korean cases: According to the Korean interviewees, free allocation was used by government authorities to convince covered sectors to accept the scheme.

This exploitation of auctioning as a political leverage to facilitate GHG ETS implementation embodies the compromise necessary to overcome resistance to carbon pricing by the covered sectors. In the Chinese case, resistance from covered sectors is less prevalent, but NDRC representatives still reject auction-based allocation, which might hint to a similar but less visible mechanism in place.

These results display a distinct barrier-pattern, echoing the general political barriers to GHG ETS (Figure 2).

Figure 2: Schematic of the barrier-pattern to the implementation of revenue-based measures



During the GHG ETS policy process, policy-makers hold stakeholder consultations in order to negotiate special-interest wants and tailor the program design to the domestic needs. Government representatives' fears of harsh political oppositions from industry representatives meet and are reinforced by the factual anxiety of covered sectors' special interest groups to face a genuine carbon cost that could endanger international competitiveness and reduce profits. This, in turn, encourages policy-makers to swap the design element of auctioning for political support for the policy itself, but by doing so jeopardizing a sustainable GHG ETS design including revenue-raising mechanisms features.

5.4 Northeast Asia and the COVID-19 crisis

As it has been the case across the world, the COVID-19 crisis has severely affected people's lives also in Northeast Asia. Despite relatively well-handled outbreaks, regional economies have been hit hard by lockdowns, travel restrictions and quarantines. For response, governments were forced to take unusual and costly actions to save their economies. These measures have been funded by national debt increases and money printing, are of the extensive type (fiscal measures, stimuli for small and medium-sized enterprises (SME), furlough, direct subsidies etc.) and targeted citizens as well as all economic sectors.

However, obviously, the concrete direction of these relaunch plans has been politically motivated and varied across countries due to country-specific economic structures (Table 4). China has adopted a relatively small relaunch plan compared to the size of its economy. The Chinese Premier Li Keqian even made no mention of climate change in his last speech in front of the National People's Congress in May. Though, he announced the continuity of a massive "New Infrastructure" spending plan to target economic recovery and a green economic transition (Fialka, August 2020). In Korea, the relaunch measures contain a so-called "Green New Deal" of around 10% of the relaunch plan that directly targets the green transition of the economy. In Japan, though, the gigantic relaunch plan is at the moment dedicated to the preservation of the current economic structure with little resources directed to a green transition.

Table 4: COVID-19 measures and the environment in Northeast Asia (UNESCAP, 2020)

	Total stimulus (in Billion US $)	**Percentage of GDP**	**Allocation for green transition**
China	594	4.1%	Not specified, but distinct "New Infrastructure" investment plan of $1.4 trillion including green transportation
Japan	2,100	40%	$102.8 million
Rep of Korea	246.6	12.1%	$25 billion

Nevertheless, green transition investments are not mentioned in the 594bn US$ Chinese relaunch plan and it is not clear how the central government will fund these new spending. Still, China counts on its gigantic 1.4 trillion US $ "New Infrastructure" investment plan to spark the economy if though it is not an explicit part of the Chinese post-COVID relaunch plan. The New Infrastructure plan claims targeting a green transition, mainly through new technologies, high-speed train development and electric vehicle subsidies. It also wants to give funding to local green initiatives at the provincial level (Liu et al., June 2020).

In Japan, the 2.43 bn US$ revenues of the carbon tax do not compare in size to the 102.8 million US$ invested for green recovery in the Japanese post-COVID relaunch plan. Only 74 million US$ of this are going to energy-efficient ventilation systems in public space and the construction of renewable energy facilities for companies, with the intention to bring back manufacturing to Japan; an additional 28 million US$ will be given to national parks (Regalado, June 2020).

In regional comparison, Korea is positioned as a pioneer with its genuine "Korea Green New Deal" of 25 bn US$. The Deal heading through 2022 includes green remodeling of public facilities, building, housing and manufacturing facilities as well as direct stimulus to SME involved in the green economy (UNESCAP, 2020). Furthermore, the very small-yield auction in the SK ETS – approximatively 180 million US$ – gives Korean authorities plenty of room to generate more carbon pricing revenues to fund and expend their present green new deal.

Table 4 displays how the three countries have developed very different answers to the crisis and have adopted divergent political approach to "green relaunch".

Nevertheless, these three responses still follow usual national pattern with respect to promoting the green transition. In addition to its relaunch plan targeting affected sectors, China has a comprehensive plan of around 10% of its national GDP to foster the economy also after COVID-19, which is supposed to at least partially target the green transition. In Korea, 1.2% of GDP equivalent is going to be spent on green stimulus. However, in Japan, only a very restricted amount of spending is going to be made on green features.

It shows that the country with the greatest reluctance to auctioning (Japan) spends proportionally the most for the economic relaunch but dedicates the least to the green transition. These results illustrate that relaunch plans tend to confirm existing patterns in climate policy. It further demonstrates that making the decision to invest in green measures, in time of big spending as in normal time, is a very political decision. That being said, not only could revenues from full auctioning in domestic GHG ETS partially finance the entire stimulus programs in the Northeast Asian countries, but it could also strengthen the political argument for using a bigger share for a green transition.

5.5 COVID-19 influence on pre-existing barriers to auctioning-based GHG ETS

The COVID-19 crisis represents an unprecedented opportunity to change the predominant barrier-pattern toward auctioning-based GHG ETS and to build legitimacy for revenue-raising design elements. Indeed, as depicted in *Figure 1*, the traditional pattern generating blockage in the policy process is based on anxiety of government representatives to lose political support due to rather harsh resistance to auctioning from covered sectors. COVID-19, however, can change this opposition-equilibrium. It creates a situation in which major parts of COVID-19 recovery spending in Northeast Asia are safety measures to protect domestic companies affected by the pandemic. Thus, it creates the opportunity to apply a "double dividend" type leverage by conditioning financial support on the acceptance of revenue raising by auction-based domestic GHG ETS. Major parts of green relaunch plans could then be financed by GHG ETS revenues. This approach allows to both raise revenues for financing green relaunch plans and the green transition on a longer term by structurally expanding government incomes and make domestic GHG ETS more sustainable. It also allows to create a support-coalition for building legitimacy for auction-based GHG ETS by linking the funding of green relaunch plan via implementing the strong polluter pay principle.

The use of carbon revenues for funding green public policies is not new. Approximatively 70% of revenues generated from GHG ETS already tend to be allocated to "green spending" (Carl et al., 2016). Thus, revenues from GHG ETS auctions genuinely fit the post-COVID-19 finance needs of affected countries implementing relaunch plans, and they can also provide an additional incentive to include green measures. With respect to the political process, several studies have shown that clearly explaining to the public how carbon pricing revenues are used can increase the political support of carbon pricing policies (Carattini et al., 2018). Moreover, the more a jurisdiction exhibits weak support to carbon pricing, the more allocating revenues to environmental expenditures is beneficial to enhance social adherence to the measure. Hence, in the current situation, linking the funding of post-COVID green relaunch plans to GHG ETS revenues could trigger a better understanding for carbon pricing in the region. More importantly, connecting GHG ETS auction-based allocation and revenue raising to COVID-19-relaunch plans would include carbon pricing in a wider policy context that is broadly perceived as necessary, which, in turn, is an important step for support-coalition building (Leigh, 2019).

More concretely, the adoption of an "Auction and Invest Approach", where public spending for green transition is directly linked to carbon pricing revenue, appears promising (Leigh, 2019). For Northeast Asia, we propose to adopt GHG ETS' auction-based allocation to the sectors targeted by COVID-19 stimulus. A look at *Table 4* directly gives a glimpse of where this Auction and Invest approach could be applied in the Northeast Asian case. In China, it signifies to pair auction-allocation experimentation to sectors concerned by the relaunch plan and providing fund for the "New Infrastructure" package. In Japan, connecting auction-allocation rules to the stimulus received by industrial sectors would trigger significant revenues that could be used to source a genuine national green new deal. It also offers a new opportunity to negotiate the establishment of a national ETS that has recurrently been rejected by industrial sectors representatives for many years (Keidanren, March 2019). In that aspect, it represents a powerful advocacy window that gives leverage to policy-makers to implement a more ambitious carbon pricing policy in the country. In the Republic of Korea, this auction and invest approach embodies an opportunity to structurally fund and increase the already existing "Green New Deal" package.

This approach has the double advantages to find a sustainable source of finance for green stimulus in a transformative and disruptive period while at the same time reducing the political vulnerability of policy-makers with respect to opposition from covered sectors. In addition, the legitimacy of covered sectors' opposition to revenue-raising GHG ETS features can be weakened, if revenues are used for funding green stimulus packages.

5.6 Conclusion

In this paper we asked whether the COVID-19 crisis opens a new window-of-opportunity for overcoming national resistance to auction-based GHG ETS in the three Northeast Asian countries of China, South Korea and Japan.

The empirical data analyzed in this paper shows that the strong rejection of auction-based allocations by covered sectors interest-groups, particularly in Korea and Japan, and often supported by economic ministries prevents the implementation of revenue-raising features in GHG ETS.

The COVID-19 crisis, however, provides an unprecedented opportunity to resolve this barrier-pattern, because additional government revenues are desperately needed to finance economic recovery programs, which will also benefit sectors usually in opposition to auction-and-revenue-earmarking design elements in GHG ETS.

Thus, we propose to couple post-COVID-19 crisis economic relaunch plans with the adoption of revenue-neutral auction-based allocation in Northeast Asian GHG ETS. Financial support from relaunch plans to sectors covered by the respective GHG ETS should be conditioned on support for auction-based allocation. In addition, we propose to apply an "Auction and Invest Approach" to finance sustainable relaunch schemes by GHG ETS revenues, which would foster not only economic recovery but also effective and fair climate mitigation and adaptation.

In sum, the COVID-19 crisis offers an unmissable window-of-opportunity to overcome covered sector's and linked government agencies' resistance to the strong polluter-pays-principle and to implement revenue-neutral full auctioning and sustainably earmarked revenue recycling in Northeast Asian GHG ETS. This unique chance should not be missed!

6. GENERAL CONCLUSION

The question of linking Emissions Trading Schemes is crucial for the emergence of a cooperative global climate policy facilitating the technical revolutions and lifestyle shift needed to reach the Paris Agreement targets. The significant advantages of ETS linking are the effort-sharing and cost-sharing effects, equalizing Marginal Abatement Costs of mitigating GHG emissions across linked instruments and, thus, helping the emergence of a global carbon pricing system. However, considering the very diverse international situation regarding climate policy implemented, energy generation, economic development, institutional architecture, and political opinion, ETS linking faces many currently unresolved implementation challenges. This doctoral dissertation analyses these challenges, taking a multidisciplinary political-economic perspective to study the Northeast Asian (China, Japan, and South Korea) case. The outcomes of this comprehensive research reveal the notable political limitations facing ETS linking because of well-established barrier mechanisms and sustainability issues in ETS design and regulations that must be addressed before implementation.

In a context of extreme difficulty to concretely implement ETS linking as a feasible solution and to establish standard rules to International Transfer of Mitigation Outcomes, this doctoral thesis makes two main contributions to the scientific debate. First, in defining the sustainability challenges of ETS in Northeast Asia: (i) for the new Chinese National ETS, (ii) and for the process to implement ETS linkage in the region. Second, by assessing the missing political dimensions and stakeholders' influences dynamic generating barriers to ETS Linking in a heterogeneous climate policy context; and barrier mechanism to auction-based allocation implementation in ETS.

In addition to studying the Northeast Asian case, the originality of this doctoral dissertation is to adopt multidisciplinary methods to expand the traditional economic literature's insights on ETS sustainability and linking implementation. The first two chapters have a regulatory, institutional, and governance lens. *Chapter 1* assesses the CN ETS design and regulations with a high-standard sustainability model to determine sustainability issues and policy recommendations. *Chapter 2* analyzes Northeast Asian ETS designs and regulations with the economic literature on sustainability and system robustness, and provides institutional, management, and harmonization recommendations for linking. Finally, the last two chapters of this dissertation interrogate the economic literature's assumptions on ETS linking anticipated benefits (*Chapter 3*) and sustainability measures implementation (*Chapter 4*) through an extensive survey of Chinese, Japanese, and Korean stakeholders. These last two chapters map stakeholders' and interests' influence in generating barriers by applying original visualization instruments that enable novel analysis on overcoming them.

Chapter 1 yields that even if some aspects of the CN ETS design are encouraging, the Chinese National Emissions Trading Scheme, as launched in 2021, has a long way to go before becoming genuinely sustainable. Transparency issues in allocation and MRV, the strength of the legal structure of the design and the regulatory corpus, governance Issues, over-allocation, and the Intensity-based target are the main factors impeding sustainability. Compared to other international instruments, the CN ETS is currently the less sustainable ETS implemented worldwide. The actual state of legislation and the current design does not include international links as a short-term possibility. However, the CN ETS represents the most prominent instrument currently implemented that has the capacity to decrease international mitigation cost significantly. Regardless of this attractive asset, without severe reforms and learnings from domestic and international practices, the current state of the CN ETS makes it an irrelevant candidate to a sustainable international ETS linkage.

Chapter 2 addresses the critical question of ETS design and regulations divergences in the case of linking. The economic literature underlines that policy harmonization is necessary to link ETS of different jurisdictions to guarantee system robustness, sustainability, and transparency. This chapter makes a comparative analysis of the design and regulations governing Northeast Asian ETS based on three criteria: environmental effectiveness, economic efficiency, and system robustness. The results draw a diverging and asymmetric regional situation toward ETS, and the analysis underlines the risks and impacts of linking Northeast Asian ETS without harmonization. Accordingly, problematic sustainability issues require harmonization for linking: Cap divergences, different Allocation system, and no common standard for Offset. This chapter eventually provides policy harmonization proposals for a transparent and sustainable linking in Northeast Asia and sets a management MRV system proposal to guarantee a transparent information-sharing mechanism.

Chapter 3 centers on a comprehensive stakeholders' survey of the Chinese, Japanese, and Korean UNFCCC negotiation teams of the Article 6 rulebook at COP 25. This chapter identifies and defines three main politico-economic barriers to Northeast Asian ETS linking, particularly tenacious in Japan. (i) An Institutional Resistance Barrier revolving around the perceived political capacity to implement institutional changes. (ii) A Governance-sharing Barrier connected to the level of institutional integration necessary to link ETS across jurisdictions and to fears of losing control over domestic economic and energy policy. (iii) An Environmental Integrity Barrier entailing the impact that the lack of confidence has on environmental concerns. These findings support the notion that, despite economic advantages, heterogeneous domestic climate policies create potent barriers to international ETS linking. Even exceeding the expected political risk of instituting a structural economic rent, fears of losing control over domestic policy design and resulting effects appear to be the number one barrier-generating concern for heterogeneous ETS linking to emerge.

The COVID-19 crisis has opened a new global policy era: High-spending, monetary easing, and massive relaunch plans supposedly targeting a green transition. Following the insights learned from the three first chapters on sustainability issues in ETS design, harmonization for linking, and barrier mechanism anchored in stakeholders' influence dynamic, *chapter 4* argues that this unprecedented crisis enables overcoming classic barrier mechanism to carbon pricing and sustainability measures in particular. For this purpose, it requires coupling post-COVID-19 crisis economic relaunch plans with the adoption of revenue-neutral auction-based allocation in Northeast Asian GHG ETS. In order to do that, support for auction-based allocation should condition financial assistance from relaunch plans to sectors covered by the respective GHG ETS. Finally, adopting an "Auction and Invest Approach" to finance sustainable relaunch schemes by GHG ETS revenues would foster economic recovery and effective and fair climate mitigation and adaptation, triggering higher support for sustainable carbon pricing.

This doctoral dissertation yields the high political sensitivity and difficulties entailed in establishing sustainable ETS linking between jurisdictions with diverging policy designs and environmental ambitions. This thesis explicitly underlines the sustainability concerns in established design, the risks of linking without harmonization, and the barrier mechanism impeding sustainability and harmonization in the case of Northeast Asia. It also provides policy proposals and emphasizes policy strategies to overcome resulting issues. In a context of the growing importance of implementing International Transfer of Mitigation Outcomes, the political-economic problematics developed in this dissertation demand increased attention and research from the academic community. Otherwise, only like-minded, economically and politically similar partners would succeed in trustfully collaborate in carbon pricing like ETS linking. In that case, it would considerably narrow the emergence of a cooperative global carbon pricing system and significantly limit the benefits of linking Emissions Trading Schemes, decreasing its potential to help to reach the 1.5°C limits of the Paris Agreement.

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