Evolving Carbon Market Systems: The Role of Policy Diffusion in Shaping Design Properties

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Abstract:

This paper examines the extent to which and how the spread and design of carbon trading systems worldwide have been shaped by international policy diffusion. We highlight eight central design characteristics and identify nine cases for further scrutiny. Focusing on similarities and differences across the cases, we find that international diffusion can explain both converging and diverging designs. While the former observation is in line with the traditional understanding of diffusion leading to convergence as actors adopt a policy initiated by others, it is more striking that policy diffusion stands forth as important for understanding design divergence. Evidence presented in this paper demonstrates that diffusion mechanisms interact with and contribute to the evolution in the policy as it diffuses over time. Hence, we argue that policy convergence is not necessarily a great measure of diffusion because the policy is not the same over time. The policy divergences, partly rooted in different domestic conditions and political constraints, mean that no linked global system is likely in the near future, although the spread of the policy model can be seen as promising for a future emissions trading regime from below.

1. Introduction

In 2008, after having successfully overhauled the frontrunner EU emissions trading system (EU ETS), Environment Commissioner at the time Stavros Dimas triumphantly stated that "the [EU] ETS is going to be the prototype for the world to imitate" (ENDS Europe 2008). But for proponents of carbon pricing, the post-2008 era has been somewhat mixed (see Mehling 2012; Calel 2013; IETA 2014: World Bank 2015; ICAP 2016). The EU experienced increasing problems, with a growing surplus of allowances and a low carbon price, caused not least by recessionary pressures. The growth of renewables further lowered demand for allowances, highlighting problematic interactions with other policy instruments. But due to a fascinating change of momentum, with Germany taking on a leading role, the EU managed to adopt an important "market thermostat" in spring 2015 (the Market Stability Reserve), to come into force in 2019 (Wettestad and Jevnaker 2016).

Around the globe, other significant systems have started operating, like that in California, which covers the world's ninth biggest economy. Of particular interest and importance is the turn to emissions trading (ET) in China, the world's biggest greenhouse gas (GHG) emitter (some 10 billion tons CO_2 per year), where seven sub-national pilot systems have been established. There are also interesting developments elsewhere – as with smaller systems established in countries as diverse as Kazakhstan and Switzerland; the South Korean ETS established in 2015; and countries such as Brazil and Mexico considering the introduction of emissions trading (see e.g. ICAP 2016). The climate summit in Paris in December 2015 showed and offered further support to the increasing interest in developing carbon pricing worldwide.

Not least the problems experienced by the EU ETS have put the spotlight on the question of *design*: how to design systems that produce a stable and reasonably high carbon price and interact well with other policy instruments in fulfilling the overriding goal of achieving emissions reductions in a cost-effective way (see Klinsky et al. 2012). Most research has focused on the diffusion of systems for emissions trading as such, and not on specific design characteristics (e.g. Betsill and Hoffman 2011; Meckling 2011; Paterson et al. 2014). Further, studies dealing with the spread of particular design features have focused on similarities across systems, not differences (Paterson et al. 2014).

As systems develop at different speeds, with frontrunners and more recent adopters, the question of interaction among systems becomes increasingly pertinent. Such a focus on inter-system communication and learning creates natural links to rich and lengthy debates in political science on how to conceptualize and understand policy diffusion (e.g. Finnemore and Sikkink 1998; Elkins and Simmons 2005; Simmons et al. 2006; Börzel and Risse 2012; Shipan and Volden 2012). Hence, the main question addressed in this paper is: to what extent and how have the spread and specific design features of carbon trading systems worldwide been shaped by policy diffusion?

After having elaborated the analytical framework and presented main concepts (section two), we present a brief chronological overview of the emergence of main carbon trading systems around the world, highlighting some particularly notable design characteristics of the emerging systems and identifying nine main cases for further scrutiny (section three). On this basis we then tentatively examine some main design similarities and differences across these cases (section four), and discuss to what extent and how policy diffusion stands forth as a reasonable explanation for the similarities and differences (section five). Section six then presents some concluding reflections.

2. Analytical framework

Our principal research question concerns the causal role of international diffusion in shaping the *properties of emissions-trading systems*. We pose this question because we think that those properties, in turn, influence whether an emissions-trading system is *effective* (resulting in significant reductions in GHG emissions) and *efficient* (achieving such reductions at minimal costs). Such systems can be classified according to various criteria – for overviews, see e.g. Weishaar (2014),Van Asselt (2016), and World Bank (2016). As further elaborated in Underdal et al. (2015), at least eight main design features can be distinguished:

- **type of system**, including the distinction between baseline-and-credit and cap-and-trade systems, the existence of intra-temporal safety valves (such as banking, i.e. saving allowances from one phase/period to another), and the governance level (e.g. national vs sub-national or supra-national systems);
- **ambition level**, concerning the level of the cap and emission cuts aimed for within a given period, and the possible specific role assigned to the ETS in achieving the target(s);
- **sectors, gases and emissions covered**, with a basic distinction between energy-producing and energy-consuming/energy-intensive sectors/industries; if only CO_2 is covered or also other greenhouse gases; and if only “direct emissions” (from production) are covered – or also “indirect emissions” (from consumption of goods)?

- **allocation mechanism(s)**, with a basic distinction between allocation by market (auctioning) and allocation for free (based on grandfathering or some type of benchmarking);
- **external offsetting and linking**, including the rules for allowing external offsets/credits (whether national or international, such as CDM credits), and provisions for linking up to other systems;
- **MRV (monitoring, reporting and verification) and enforcement**, pertaining to the rules for carrying out these tasks and reacting to cases of non-compliance;
- **price or quantity-focused management mechanisms**, pertaining to the rules and possible institutions established to stabilize the carbon price (such as price floors/ceilings or quantity-focused measures);
- **revenue earmarking**, concerning possible rules for earmarking auctioning revenues for specific activities or sectors.

In seeking to explain similarities and differences in the design of systems, we pay particular attention to the role of policy diffusion, linking up to the rich literature and discussion in political science. Policy *diffusion* can be seen as a particular type of "interdependent, but uncoordinated decision making" in which a party *unilaterally* adopts a policy or practice initiated and pursued by others (Elkins and Simmons 2005: 35).

Drawing on this literature, we distinguish between two main triggers, operating through different causal mechanisms (cf. Finnemore and Sikkink 1998; Elkins and Simmons 2005; Shipan and Volden 2008, 2012; Simmons et al. 2006). The first main trigger has to do with *cognitive* or *normative* influence – *ideas* – that can be understood in constitutive terms (notably, internalization or socialization). Diffusion may take the form of more or less sophisticated *learning* that may involve correcting design flaws in response to the perceived failures of another system. Relevant lessons can be communicated through bilateral channels (like the collaboration agreement between California and China) or multilateral channels (e.g. discussions in the International Carbon Action Partnership, ICAP), and communicated by governmental and non-governmental actors alike (as for instance the International Emissions Trading Association, IETA). Diffusion may also take the form of simple *emulation,* which usually involves copying policies or practices pursued by prestigious peers.

The second main trigger involves *material consequences* and operates through the mechanism of *adaptation* to altered conditions. This mechanism directs attention to "competition" and "coercion" stemming from growing political and economic interdependencies between economies and the related impact of these on the payoff structures associated with the pursuit of different policies. This highlights the need for analysing economic interdependency relationships and the extent to which decision-makers and industries perceive policy differences as an impediment to effective low-carbon policymaking. This includes efforts by governments or international organizations (like the World Bank) to induce greater international policy harmonization through financial incentives – which may be seen as a sort of coercion.

We assume that international diffusion impulses may be *mediated* by domestic institutions and political processes in different jurisdictions. Given that the outcome of such mediating processes may be both policy convergence and divergence, this assumption raises the question: Should diffusion be reserved *exclusively* for cases of policy convergence? Diffusion is most often seen as leading to convergence as actors adopt a policy or practice initiated by others (e.g. Elkins and Simmons 2005: 35) and as "policies and institutions spread across time and space" (Börzel and Risse 2012: 5). Other definitions, however, are broadly framed, allowing for both *divergence* and *convergence* to occur as a result of policy diffusion (Underdal et al. 2015: 7). According to Simmons et al. (2006: 787), for example, international policy diffusion occurs "when government decisions in a given country are systematically conditioned by prior policy choices made in other countries (sometimes mediated by the behaviour of international organizations or even private actors or organizations)".

Shipan and Volden (2012: 788) have observed that while much of the literature on policy diffusion focuses on the adoption stage, we have limited knowledge about how the policy instruments that diffuse globally change over time. Hence, they argue, "Extending the policy diffusion literature beyond initial policy adoptions is warranted and long overdue" (Shipan and Volden 2012:793). This implies that both convergence and divergence may occur as policy instruments evolve over time. Indeed, recent scholarship has argued that full convergence is not a necessary or even a likely outcome of diffusion because norms, ideas and practices often change in form and content as they diffuse (Klingler-Vidra and Schleifer 2014: 264).

In this paper, our primary focus is on the contribution of international or transnational diffusion to the design of ETS in different jurisdictions. For this purpose we mainly scrutinize available evidence from ETS tracking systems (such as the EDF/IETA reports), news services (such as *ENDS Report*) and various secondary sources. We also draw on interviews and correspondence with policy experts as well as well as case studies of several jurisdictions, including the EU, California, China Australia and New Zealand, conducted as part of a larger research project on ETS diffusion.[1]

3. Carbon markets: a brief overview of their emergence and design

The idea of using markets in the context of environmental policy started in the US in the late 1960s and 1970s, with the "Project 88" network of US economists and policy-makers as an important milestone in the more specific climate change context (see Calel 2013 for a nice overview of this early history; in addition Voss 2007, Mehling 2012 and Paterson et al. 2013). In Europe a similar idea was presented by Michael Grubb in the late 1980s (report on "Negotiating Targets" 1989) (Grubb 1989). The 1992 UN Framework Convention on Climate Change said little about this. The US launched the first major ETS in 1995, however on air pollutants (SO2 and NOx). The idea of carbon markets and flexible mechanisms was also pushed by the US in the process leading up to the 1997 Kyoto Protocol, which ended up with three flexible mechanisms (CDM, JI; international ET). Spurred by the Kyoto Protocol and a failure to adopt an internal carbon tax, the EU made a turn-about in 1998 and started to design an EU ETS.

The EU ETS Directive was then adopted in 2003, with a pilot phase 2005-7 followed by the; Kyoto commitment phase 2008-12. As the EU then was an international frontrunner and uncertainty was high among stakeholders, the design was a decentralized one, with much power to member states and permits ("allowances") handed out for free. To provide additional flexibility, a linking directive adopted in 2004 opened up for using CDM credits in the pilot phase and also JI credits from 2008. A more complete design overview for the EU ETS and other systems briefly described in this overview is presented in table 3 (see pp. 8-9). The EU ETS started operating in 2005. Norway launched a national ETS, aiming to link up to the EU ETS.

At this point in time, a voluntary ETS was launched in Japan. There was also regional action in the US, with the East Coast Regional Greenhouse Gas Initiative (RGGI) launched. RGGI focused only the power sector but its design included a price floor and some revenue earmarking. On the West Coast, a 2006 Global Warming Act required California Air Resources Board to develop a Scoping Plan and explore the possibility of an ETS. This was followed in 2007 by the launch of the Western Climate Initiative (WCI) (including British Columbia, Manitoba, Ontario, Quebec and California). Californian Governor

[1] These case studies are work in progress; we only cite case studies that have been published as papers at international conferences and workshops.

Schwartzenegger was also central in launching the International Carbon Action Partnerhsip (ICAP) in 2007, together with the EU and others.

In the Asia/Pacific region, a Tokyo Strategy/Plan was launched in 2007, including an ETS. In Australia a climate policy assessment process was started (i.e. the Garnaut process) which included an ETS discussion. In neighboring New Zealand an ETS was launched in 2008, with a rather unique "trading without cap" design, and a broad coverage. Back in Europe, Switzerland launched a voluntary ETS in 2008. More important, the EU adopted significantly altered ETS rules for 2013-20 phase in 2008, with more centralization and auctioning as main pillars. In 2009 the EU also launched a goal of an OECD-wide carbon market by 2015 and "even broader" in 2020. A formal link was made between the EU ETS and Norway and the two other European Economic Area members Lichtenstein and Iceland.

The EU had a vision of a transatlantic carbon market, related to the work ongoing in the US on a national carbon market. However this bill (Waxman-Markey) was stopped in 2010 and the EU had to look for linking partners elsewhere. A Carbon Pricing Mechanism (ACPM) was launched in Australia and the EU started to look in this direction. In Japan the Tokyo ETS was launched, As a potentially very important development, China's National Development and Reform Commission (NDRC) designated 13 low-carbon zones and referred to emissions trading. A dialogue on emissions trading was started with the EU. In 2011 the China NDRC and State Council announced ETS pilots in five cities and two provinces.

Regional action continued in the US, with the California ETS launched in 2012. A notable design feature was a complex price floor system. 2013 was a mixed year for carbon markets: Tony Abbott became PM in Australia and halted the ETS process there. The EU ETS carbon price was sagging and a crisis came to a head when the European Parliament voted down backloading in the spring of 2013. On the other hand, an ETS was launched in Kazaksthan. And not least, the Chinese ETS pilots started operating, with both similarities and differences in their designs.

More positive events happened for carbon markets in 2014, with the European Commission launch of the Market Stability Reserve (MSR) proposal. In the autumn a Carbon Pricing Leadership Coalition was established at New York UN Climate Summit. 2015 saw the launching of a South Korean ETS in January. The turning of the tide in the EU ETS was confirmed in May, with the MSR proposal adopted in May. China announced a national ETS to be launched in 2016. The end of 2015 saw the Paris UN summit adopting a bottom-up, pledge and review framework from 2020 on, with several elements interpreted as positive for carbon markets.

As to major processes and systems in operation, we distinguish nine main cases for scrutiny, covering the bulk of systems actually in operation so far: the EU ETS, Tokyo, RGGI, California, New Zealand, Australia, China, South-Korea and Kazakhstan.[2] Table 3 provides a rough overview of the design of these systems:

	EU ETS	**TOKYO**	**RGGI**	**CALIFORNIA**	**NEW ZEALAND**	**AUSTRALIA**	**CHINA**	**SOUTH KOREA**	**KAZAKSTH**
TYPE OF SYSTEM	Cap and trade Phase I: 2005-7 Phase II: 2008-12 Phase III: 2013-20 Phase IV: 2021-30 Banking allowed	Cap and trade Phase I: 2010-14 Phase II: 2015-19 Phase III: 2020-22 Banking allowed	Cap and trade Phase I: 2009-11 Phase II: 2012-14 Phase III: 2015-20	Cap and trade Phase I: 2013-14 Phase II: 2015-17 Phase III: 2018-20	Trading, but no cap Banking and borrowing	Planned transition to cap and trade from 2015	Cap and trade pilot systems 2013-15 Eight pilot systems, with differing designs Combination of absolute caps and relative targets	Cap and trade Phase I: 2015-17; Phase II: 2018-20; Phase III: 2021-26	Cap and trade Phase I: 2013 Phase II: 2014-
AMBITION LEVEL	Initially no common cap 2013-20: 21% reduction by 2020 (2005)	25% reduction by 2020 (2000)	Caps through emission budgets for each phase	Help meet ambition to reduce emissions by 2020 to 1990 level	5% reduction by 2020 (1990)	Contribute to achieve 5% reductions by 2020	Intensity targets coverge around a 17-21% band	29% reduction by 2020 (BAU)	Contribute overall reduction 2020 (1990)
COVERAGE	Power producers and a number of energy-intensive industries -airlines from 2012 Upstream focus ('Direct' emissions) CO_2 . also nitruois oxide and perfluoricarbons (phase III) Around 11 000 installations	Direct and indirect emissions from the use of energy Only CO_2 Around 1230 facilities	Electricity generators in nine states Only CO_2	Broad coverage of energy suppliers and industries -also imported electrical cars from 2015 *Seven GHGs* Around 450 entities	Power producers and energy-intensive industries -But also forestry *Six GHGs* Totally around 2500 participants -2160 voluntary opt-ins	Power production and energy-intensive industries -But also fuel-related transport emissions CO_2 and three other GHGs Around 500 entities	Mainly power producers and energy-intensive industries –but also transport (Shanghai) Both direct and indirect emissions Most pilots only CO_2 – but Chonquing six GHGs Close to 2000 entities	Power producers, industries *Six GHGs* 490 large emitters	Oil, coal and production, industries -Agriculture a transport deba Only CO_2 166 companie
ALLOCATION MECHANISMS	Initially mainly free allocation From 2013 on, ca 40% auctioning, to increase	Free allocation	*More than 50% auctioning*	Initially 90% free allocation	Free allocation	Combination of free allocation and auctioning	Mainly free allocation Some experiments with auctioning	Initially 100% free allocation Gradually a limited auctioning	Free allocatio
OFFSETTING	Initially 10% CDM/JI Limit Certain credits projects banned from 2013	Certain domestic offsets allowed	Max 3.3% domestic offsets for each installation	Max 8% for each company Various offsets in US, Canada and Mexico	Domestic (forestry) and international credits (until 2015)	Liberal domestic and international offsets rules	Chinese 'repurposed' CDM credits (CCERs)	Max 10% domestic offsets No international credits	Domestic offs Possible
MRV	Annual reports from installations,	Annual reports from installations,	Yearly reports	Annual reports to CARB	Annual reports to NZ EPA	Oversight by an Independent	Non-harmonized MRV	Annual reports, verified by a	Annual, veri reports

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[2] ICAP (2016) counts 17 systems in operation. But this includes seven Chinese pilots which we count as one case.

	verified by third part Initially 40 euro penalty for non-compliance; then 100 SJEKK	verified by third part Penalty: shortfall multiplied by 1.3	through EPA system Penalty provisions in two stages:			Clean Energy Regulator	protocols Differing penalty systems	third part Governmental register	No penal initially
PRICE AND QUANTITY MANAGEMENT	Initially nothing. Then rule about two years of high price in 2009 Market Stability Reserve adopted in 2015, to work from 2019	None	*Price floor*	*Price floor system*	No mechanisms	Three phases: fixed, flexible and floating	Some have price floor, others 'symmetric safety valve'	Government can increase quantity if 'too high' price and generally adjust system	No mechanism
REVENUE EARMARKING	From 2013, recommendation to use 50% of revenues for climate purposes	None	Revenues to support energy efficiency and renewable energy	Revenues go into Greenhouse Gas Reduction Fund	No specific earmarking	Unclear, but some revenues expected for low-carbon technologies	Guangdong plans to use revenues to support low-carbon/energy-saving	Revenues to contribute to Low Carbon Green Fund (being established)	None

Sources: In addition to the referenced works in section 3, mainly EDF/IETA reports and ICAP 2016.

4. Main similarities and differences across systems and their design properties

The social and political systems examined here vary considerably and along several dimensions – from US state California and Tokyo city, to centrally planned giant China, to multi-level and institutionally complex EU. The general picture to emerge is that there are basic similarities for most of the design properties that we have singled out, but important differences in their more specific elaborations. Here are some key observations: as to the *type of system*, with the main exception of New Zealand, all the systems examined are cap-and-trade systems. But they differ in other basic system features such as possibilities for banking or borrowing and the length of the trading periods.

With *ambition level*, the cases exhibit significant variation concerning the level of the cap and emissions cuts aimed for within a given period. It is difficult to rank the cases according to ambition level owing to differences in reference year and future deadline and the specific role assigned to ETS in achieving the targets.

Regarding ET *coverage*, almost all trading systems cover the large and relatively easily monitored emissions from the power sector. The core sectors and activities now included in the EU ETS – power producers and energy-intensive industries such as steel, cement and pulp and paper – are covered by most other systems examined here, including the Chinese pilot systems. A particularly notable aspect of the Chinese pilot systems is that they also seek to cover electricity consumption and indirect emissions. RGGI stands out as a system with particularly narrow coverage: the system only applies to CO2 emissions from utilities.

As to other sectors, aviation is covered in the EU, South Korea and Shanghai (but still in different ways), while other transport emissions are covered in systems such as Beijing and South Korea (and to some extent California and New Zealand). The NZ system is unique in its inclusion of forestry. With regard to gases, CO2 is covered by all. Four systems stand out with a very wide coverage (i.e. five or more GHGs): California, Chanquing, New Zealand and South Korea.

Moreover, most systems examined have included a first pilot phase, reflecting the acknowledgement that it is necessary to adjust the systems based on lessons learned from experience. Moving from the pilot phase to subsequent phases, most systems have gradually expanded their coverage of sectors and industries.

With *allowance allocation* it is striking (but not surprising) to see that all systems start out with a mix dominated by free allocation, with auctioning becoming stronger over time. Among the systems examined here, only RGGI introduced full auctioning from the very beginning – but that system covers only power producers. It is likely that the possibility of beginning an ETS by distributing allowances for free and gradually introduce auctioning is one of the flexibility features that make emissions trading an especially attractive option for policymakers.

Regarding *offsets and linking rules*, all the systems examined here provide for access to some types of credits to cover obligations, although quantitative and qualitative restrictions on their use vary. For example, different quantitative restrictions prevail across trading systems, with the Californian system having relatively strict quantitative restrictions for the use of credits to cover obligations. Different qualitative restrictions also apply across the systems examined here. For example, whereas the EU ETS allows for only a very limited use of credits from land use, land-use change and forestry, California and Australia (and New Zealand) allow for the use of credits generated by forest and land-use projects. Hence, we see that although different restrictions apply, almost all systems provide for access to at least some types of offsets.

All systems examined have established procedures for *MRV (monitoring, reporting and verification) and enforcement*. Most trading schemes have established emissions-trading registries to enable monitoring of trade in allowances, and have introduced third-party verification and enforcement mechanisms. Indeed, only one ETS to date, that in Kazakhstan, was introduced without any systems in place for MRV and enforcement (van Asselt 2016; expert interview 2016).

As to *price and quantity management*, a widely used mechanism is to introduce a price floor or ceiling. California has a quite complex price floor system based upon the implementation of an auction reserve price, as does RGGI on the US East Coast. Also some of the Chinese pilots include price floor mechanisms, as well as other price management mechanisms. The first phase of Australia's Carbon Pricing Mechanism was based on a fixed price. The intention was to replace the fixed price with a price ceiling in the second phase, which would have been removed in the third phase. Hence, the Australian ETS would have gradually allowed greater volatility in the carbon price through the removal of price management mechanisms. Similarly, New Zealand also introduced a price ceiling in its first, pilot phase.

Finally, with *revenue earmarking* there is significant variation across the systems examined. Some systems have earmarked proceeds from allowance auctions to greenhouse gas reduction funds (as in California), whereas other systems, such as the EU ETS phase 3, have recommended to use a certain proportion of auctioning revenues for climate change mitigation and adaptation measures. In the first two phases of the EU ETS, allowances were mostly handed out for free and hence the issue of revenue earmarking from auctions became irrelevant.

5. Zooming in on the role of international policy diffusion

Not surprisingly, given the frontrunner and comparatively long history of the EU ETS, more is known about emissions trading in the EU than in the other jurisdictions we address. Particularly the initiation of the EU ETS is well documented, which also facilitates specifying the role of diffusion in shaping the initiation and development of the system.

Let us first sum up main insights on the role of policy diffusion in the establishment of the EU ETS. Starting with the mechanism of learning, the fundamental choice of going for a cap-and-trade system was inspired by US experiences. As further elaborated in Skjærseth and Wettestad (2008), key figures in DG Environment were economists that had studied emissions trading in the USA. Damro and Luaces Mendez (2003) mention the negotiations in 1997 leading up to the Kyoto Protocol as a venue for transferring lessons from the USA to EU policymakers. Zapfel and Vainio (2002: 7) state that in the immediate post-Kyoto phase, US actors such as EPA staff, ENGO Environmental Defense, and the think-tank Center for Clean Air Policy (CCAP) "invested a lot of time and pressure in participating in the European [ETS] debate." However, given the different institutional, cultural, legal and administrative nature of the EU, "the value of the contributions by US experts declined steadily" (ibid.: 9). This was also due to the lack of development of a national US ETS. Paterson et al. (2013) further support this view of very limited US influence on the evolving design of the ETS, noting the important underlying division between US and European trading communities, with limited cross-community personal contacts.

An important document in discussions on the possible design of an EU ETS was the Green Paper put forward in 2000. This document contained no explicit references whatsoever to US experiences in this policy field; neither did the consultant reports co-authored by CCAP and FIELD in 1998 and 1999. Still, Damro and Luaces Mendez (2003: 89) claim that key aspects of the design of the monitoring and verification system, not least the registry part but also the penalties regime, were borrowed from the US SO_2 system.

As to the adaptation mechanism, we should note that at the stage in global climate politics when the EU made a turn-about and started to develop emissions trading (from 1998 on), the EU saw itself as a frontrunner – as it indeed was, comparatively speaking (see Grubb et al. 1999; Christiansen and Wettestad 2003). ETS design choices did not emanate from any fundamental need to adapt to the actions of others, in the sense of ratcheting up.

However, the pioneering position made EU industries, primarily the energy-intensive industries competing in the global marketplace, worried about an uneven global economic and regulatory playing field. These concerns were voiced in the Commission's various stakeholder consultations, channelled also through member-state inputs. This element clearly contributed to the decision to establish an ETS where initially almost all allowances were handed out for free, although also other concerns played a role. These worries also contributed to the decision to link up the ETS to the Kyoto flexibility mechanisms, as such a link was seen as a safety valve against a too high carbon price. With regard to the EU's Kyoto Protocol commitment to an 8% reduction, this functioned only as a loose yardstick for the ambition level of the system. However, with no common cap established for the ETS, this link to the Kyoto Protocol had little practical significance.

The EU ETS has been reformed in two subsequent processes; one in 2007/2008, adopting a significantly more centralized and auctioning-based system for the 2013-20 phase (Skjærseth and Wettestad 2010); and one in the 2012-16 period, tightening the rules with particular relevance for the 2020-30 phase (Wettestad and Jevnaker 2016). As to the process in 2007/8, learning from others did seemingly not play a significant role, as there still were few other systems to learn from. The adaptation mechanism continued to be relevant, however, as the decision to continue to give energy-intensive industries a large number of free allowances post-2012 was clearly rooted in competitive concerns and fears about carbon leakage. With regard to the 2012-16 process, lessons from others figured in the discussion on price/quantity management mechanisms and Commission entrepreneurs were aware of a somewhat similar Market Stability Reserve (MSR) concept which had figured in the US discussions on the Waxman-Markey bill in 2008-9. That said, the focus on and attention to the specific design of the EU MSR measure had primarily EU internal roots. Adaptation and competitive concerns continued to play an important role and were reflected in the decision to continue to hand out a significant number of free allowances post-2020, to counter carbon leakage concerns.

What do we know about the role of policy diffusion in shaping the design of other systems? An important issue here is learning from the EU ETS, given its frontrunner role. Cap-and-trade has been intensely debated in Europe and North America (Betsill and Hoffmann 2011: 89), but Paterson et al. (2014) argue that lesson-drawing across the Atlantic was limited. They maintain that the idea of emissions trading in the EU and the United States emerged at the same time but independent of developments on the other side of the Atlantic: "our analysis reveals that this policy idea [emissions trading] developed almost simultaneously in the United States and Europe, with very tenuous links between them and prior to actors in either jurisdiction adopting ET as an actual policy tool" (Paterson et al. 2014: 423). Research conducted as part of our research project on ETS diffusion corroborates the finding that the general idea of ET emerged almost at the same time in the United States and Europe (Bang et al. 2016). That said, we must look beyond the adoption stage to examine whether and how specific design properties diffuse globally and change over time. And we do find evidence of some policy diffusion regarding the more specific design properties of ETS in the United States and Europe – and also China.

Beginning with California, evidence indicates that EU experience did not play a prominent role in the political discourse about emissions trading, but it seems to have influenced more technical discussions on certain design properties (Betsill and Hoffmann 2011; Biedenkopf 2012; Paterson et al. 2014). The EU ETS is cited both as a positive example from which to draw lessons, and as a negative case that enabled lessons-drawing from the mistakes made by the EU, particularly in the first phase of the ETS EU policy experts promoted the ETS through various direct contacts with North American actors, which enabled communication and learning (Biedenkopf 2012: 19).

Possibly learning from EU ETS experience, California opted for some auctioning of allowances from the first compliance period, not free allocation of all permits. In this regard, California may have learned from EU experience about avoiding likely problems with low permit prices and windfall profits (Bang et al. 2016). In the first phase of EU ETS, free allocation had brought windfall profits to power companies that received allowances without cost and nevertheless charged their customers. Although most venues that are or have been operational began with free allocation of permits, there is a trend toward convergence around auctioning, at least that some permits be auctioned. Like the EU ETS, the Californian system includes not only the power sector but also energy-intensive industries (e.g. cement, iron and steel, pulp and paper). By contrast, the Regional Greenhouse Gas Initiative (RGGI) has a narrower scope, regulating only emissions from the power sector. This may indicate that policymakers in California looked to Europe rather than to RGGI on the East Coast for lessons learned concerning the appropriate coverage of an ETS, given that exchanges of knowledge with both the EU ETS and RGGI shaped key design mechanisms in the early phase of developing the cap-and-trade (Bang et al. 2016).

The Californian system provides for access to some types of offsets, subject to quantitative and qualitative restrictions. However, while the 2009 EU ETS Directive indicates that the use of credits in the 2008–2020 period could be up to half of the EU-wide reductions below 2005 levels, California allows their use only up to 8% of a covered entity's obligation for each compliance period. The more stringent restrictions in place in California may be a result of learning that using international offsets in an ETS reduces the incentives for domestic or regional mitigation. According to Bang et al. (2016: 14), the main focus for policymakers in California "was to avoid making the same mistakes as others had experienced, especially related to allocation of permits, compliance rules, offset practices and price-setting." Regarding qualitative restrictions on the *types* of credits that will be accepted, the EU ETS has limited the use of credits from land use, land-use change and forestry since its inception, whereas California allows credits from US forest projects and is considering allowing credits from REDD+ (Reducing Emissions from Deforestation and Forest Degradation) and other sector-based initiatives.

At a more technical level, US emissions trading schemes appear to have learnt from the EU ETS that having solid baseline data is important in order to avoid over-allocation and windfall profits, as experienced in the first phase of the ETS. Regarding the Western Climate Initiative (WCI), Biedenkopf (2012) highlights the security breaches in the EU with regard to the ETS registry as one technical aspect that WCI designers noted, and how "these lessons from an EU mistake contributed to awareness of data security aspects in the WCI rules" (ibid.: 20).

ET initiatives and designs in other countries and regions also seem to have learnt from experiences with ET in Europe. In Australia, evidence indicates learning from the history of the EU ETS, sustained interaction with other governments like that of New Zealand, and potential linking to the EU ETS (e.g. Bailey et al. 2012; Calel 2013; Crowley 2013a, 2013b). However, we also note considerable – and progressively increasing – influence from internal dynamics as well as "negative" learning from other jurisdictions aimed at avoiding design mistakes made by frontrunners, and at adapting emissions trading to the specificities of the Australian economy and political and popular debate on climate policy.

One example of learning from the EU ETS is the Australian decision to have an initial phase in which permits are traded at a fixed price, to help the regulator establish the appropriate level of the cap for the second trading phase (Calel 2013). Van Asselt (2016) maintains that the Australian scheme shows policy learning from the EU's experience of free allocation (and windfall profits) in the decision to provide a higher proportion of auctioning from the start. Some analysts argue that the Australian scheme also learned from the EU ETS the importance of establishing the legal status of allowances from the outset, to avoid fraudulent activity and lack of market oversight (Patay and Sartor 2012; Peel 2014).

Turning to China, several studies point out that an important stimulus for turning China towards emissions trading has been experience with flexibility mechanisms through the implementation of numerous CDM projects in China (see Shen 2014). As to the subsequent shaping of design, evidence indicates that Chinese pilots' MRV systems in particular have been shaped by international experience – primarily that of the EU ETS. MRV guidance documents refer explicitly to EU documents (as also to ISO standards and IPCC inventory), and the registry systems have seemingly been copied from the EU ETS (Li 2013; Zhang et al. 2014: 5, 13). Meetings and discussions between EU and Chinese officials are well documented, and funding both from the EU centrally and governments like those of Germany and the UK have been pointed out as mechanisms for such learning from 2010 on (Sandbag 2012: 22; Biedenkopf and Torney 2013; Gippner 2014 Torney 2015).

More generally, we can note some striking similarities between the initial EU ETS design and the Chinese pilots, with regard to the common core of industries covered, the initial dominance of free allocation, and the penalty systems in pilots like the Guangdong and Hubei systems (three times the average market price).

What about the mechanism of competition? Previous studies have emphasized the weight that the Chinese authorities attach to independence and their explicit unwillingness to adapt to any sort of international pressure in this issue area. However, the prominence of energy-intensive and trade-exposed industries like steel, cement, and aluminium, with the related need to protect the interests of these industries, has been noted as a factor likely to influence the design of Chinese emissions trading (Munnings et al. 2014: 10).

To summarize, we have observed both similarities and differences in key design properties across the systems examined here. Dominant diffusion theory, emphasizing design convergence as evidence for of diffusion, would lead us expect a significant causal role for diffusion for all the basic *similarities* we have identified. Evidence examined in this paper gives some support to this. For instance in both the Australian case and the Chinese pilot systems, there have been meetings and cooperation programmes that have functioned as likely venues for learning and policy diffusion. We have also noted how policymakers in California interacted with EU ETS experts and learnt from the EU's experiences with emissions trading.

Corroborating the argument made by Klingler-Vidra and Schleifer (2014), we have also found evidence indicating diffusion and learning as a cause of design *differences*. The prime case here is California, with both MRV and price management properties apparently designed so as to avoid perceived weaknesses in the EU ETS (Bang et al. 2016). This dynamic also seems relevant for understanding some choices made with China's pilot systems and in Australia (Bailey et al. 2012) and New Zealand (Inderberg and Bailey 2016). Hence, we see evidence of outright rejection, rather than refinement, of particular ETS design features through learning how to avoid the mistakes made by others, but we argue that as long as a particular policy model *is* adopted, such learning can be treated as evidence of policy diffusion. Indeed, learning how to avoid the weaknesses of a policy model appears to be an important form of sophisticated learning, leading to incomplete rather than complete policy convergence.

6. Concluding reflections

Our analysis lends support to the observation made by Paterson et al. (2014) that more is known about why authorities around the world have turned to, and are still turning to, emissions trading as such, than why they choose more specific designs. However, the evidence examined in this paper provides some evidence of the role of international diffusion in the adoption and spread of certain design properties.

A systematic comparison of core design properties of nine central carbon trading systems and processes reveals both striking similarities and differences. Key similarities include type of system (cap and trade), allocation mechanisms (much initial free allocation) and MRV procedures. But there is important divergence in coverage, price management mechanisms, offsetting rules and revenue earmarking. And of course ambition levels, with different types and ambitiousness of targets, challenging to compare easily.

There is substantial evidence available to support the assumption that international policy diffusion plays an important role for some of the ETS design similarities observed. Obvious examples are the initial dominance of free allocation and MRV procedures. This observation is in line with the traditional understanding of diffusion leading to convergence as actors adopt a policy or practice initiated by others. It is more striking and notable that policy diffusion stands forth as important for understanding design *divergence* too. As carbon trading has spread across jurisdictions, actors have deliberately sought to avoid making the mistakes experienced by others, resulting in policy divergence rather than convergence. Those subscribing to the notion of diffusion as leading to policy convergence might argue that such avoidance learning cannot be seen as evidence for policy diffusion. However, treating policy convergence as movement towards a standard, with divergence being the opposite – movement away, can be problematic. Evidence presented in this paper demonstrates that diffusion mechanisms interact with and contribute to the evolution in the ET policy model as it diffuses over time. Policy convergence, then, is not necessarily a great measure of diffusion because the policy is not the same over time.

While a number of jurisdictions have adopted ETS in recent years, they evolve in very different political contexts – from the US state of California and Tokyo city, to centrally planned giant China, to multi-level and institutionally complex EU. It is not surprising, then, that substantial design divergences can be noted, partly rooted in different domestic conditions and political constraints. This means that linking the systems will be challenging and we should not expect a globally linked system with cross-border trading in the near future. Still, we see that actors learn from each other and conclude that improving knowledge about the role of policy diffusion mechanisms can be of both theoretical and practical value in following up the ambitious goals adopted in Paris 2015.

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