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International Experience with Emissions Trading

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About Climate Strategies

Climate Strategies is a leading international research organisation based in the UK, with a network of global experts. We assist governments and industrial stakeholders around the world in setting climate change and energy policy. We are a not-for-profit organisation with all our activities funded through a broad spectrum of governments, businesses and foundations.

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1. Introduction

Drawing on the experiences with emissions trading in Europe, North America and the Asia Pacific region, this chapter identifies international practices that have emerged from the design and implementation of emissions trading systems to date. Important design features are highlighted, such as the coverage and scope of the system, the distribution of allowances to covered entities, and the management of allowance prices in the market. The chapter then proceeds to highlight lessons from the operation of emissions trading systems in practice, focusing on the insights garnered under the European Union Emissions Trading System (EU ETS). Both widely discussed experiences – such as excess allocation and the effects of mostly free allowance distribution in the early phases – as well as more recent challenges, including the debate about carbon price levels and means to address excess supply, are covered, with a focus on empirical observations as opposed to theoretical assumptions. Finally, the chapter concludes with a survey of efforts to assess the performance and impacts of the EU ETS, and attempts to define a set of methodologies for the assessment of emissions trading systems more generally.

2. Designing an Emissions Trading System: An Overview of International Practices

Emissions trading systems of one form of another have been designed for almost 20 years, ever since the United States (US) introduced the pioneering Sulphur Trading programme in 1995.[1] Subsequently, programmes have been established for greenhouse gas emissions trading in a number of jurisdictions, including the European Union (EU) and New Zealand, and – at the subnational level – the US, Canada, Australia, as well as Japan. Despite a wealth of experience emerging from this diversity of emissions trading systems, there is no single accepted methodology for their design. What exists, however, are valuable lessons on key features and resulting implications for system design. This section focuses on some of the most salient design features, identifying the lessons that emerge from the various jurisdictions. Key issues and lessons emerging in this section are:

- **The importance of coverage and scope for an ETS:** Understanding what key sectors should be included is vital to the early success of emissions trading schemes – focusing on the most important sectors first, and then scaling up to wider coverage has helped schemes overcome political barriers.
- **Distributing allowances under an ETS:** The choice between freely allocating and auctioning permits has implications, not just for revenue but also for incentives. Different methods of freely allocating permits offer stronger or weaker incentives to abate, whilst free allocation brings with it the spectre of windfall profits.
- **Price management and flexibility options under an ETS:** To what extent markets should be free to adjust, or should be steered is a crucial design question. Price floors and ceilings are options to buttress price expectations, and reduce fears about high costs. Floors, through auction reserve prices, are more common than ceilings. Other forms of flexibility through offset provision offer interesting options that give more room for markets to determine prices.
- **Managing the new market created through the ETS:** Emissions trading schemes create new, potentially large markets in a good that is solely the creation of regulation. This makes them incredibly susceptible to policy and regulatory uncertainty. They have also been the victim of fraud, theft and illegality, due to their complex nature. Building regulatory capacity and the right institutional tools from day 1 is an important lesson for all emerging schemes.

The following trading systems will serve to analyse these issues:

- **the European Union Emissions Trading System (EU ETS):** the largest and most mature of the carbon markets. Trading under the EU ETS started on January 1, 2005, and following the first (2005-2007) and second (2008-2012) trading phases, the system is now entering its third trading phase, which runs from 2013 to 2020. Section 3 focuses in more details on specific lessons from the system;
- **the Regional Greenhouse Gas Initiative (RGGI):** a state-level emissions trading system that started trading on January 1, 2009, covering CO2 from power generation

[1] For a full discussion of the US Acid Rain Program see Ellerman et al. (2000).

in nine states in the Northeast and Mid-Atlantic of the US;
- **the Western Climate Initiative (WCI):** an initiative of US states and Canadian provinces to develop emissions trading systems. Currently only California and Quebec have implemented systems, and trading formally started on January 1, 2013;
- **the New Zealand Emissions Trading System (NZ ETS):** a system established in 2008, covering a wider range of sectors than either the EU ETS or RGGI, with specific design lessons in terms of land use, allocation, and price caps;
- **the Tokyo Metropolitan Government Emissions Trading System (TMG ETS):** established in 2010, this trading system targets energy-related CO2 in industrial facilities as well as public and commercial buildings;
- **Australian Carbon Pricing Mechanism (CPM):** although not a fully emissions trading system yet, Australia's experience provides important lessons for the design and implementation of trading mechanisms.

2.1. Coverage and Scope

An important initial design question for any system regards its coverage and scope. As the various trading systems already in existence affirm, a range of options is available, but there does seem to be some evidence of a trade-off between coverage and ease of implementation. In theory, an emissions trading system should cover the full range of emissions sources – allowing the market to find the cheapest abatement option, regardless of which sector or activity it lies in. However, the costs of such comprehensive coverage are often prohibitively high due to the large number of point-source emitters that would need to be included. Covering upstream fuel importers or refiners, as has been done under the WCI, does allow heating and transportation to be included, but including point-source emitters in agriculture has proved extremely difficult even in New Zealand, where agriculture is a significant source of emissions. WCI provides an interesting example, as it is the only system so far to aim for ample coverage within a short-time frame, reaching an expected 85-90% of Californian emissions by 2015 (Tuerk et al., 2013). This experience is at odds with the other systems currently in existence.

The evolution of the EU ETS, which emerged as a result of political difficulties in introducing a carbon tax across the EU, is a useful starting point to illustrate the role of scope and coverage. A focus on key sectors initially (namely industry and electricity in the EU), prior to including other sectors such as aviation in 2012, has the advantage of being both politically more viable and administratively easier to implement. This staged approach has also been adopted in New Zealand, so far the only system to include land-use emissions. The NZ ETS started with emissions from the forestry sector, and is introducing other sectors in an incremental process. Even the WCI, whilst aiming for large-scale coverage, has started with the power-generation and industrial sectors only. The political difficulties faced by Australia, and in some senses the failure of the federal US emissions trading system legislation introduced in 2009, lend support to the expedience of starting small, helping to procure political buy-in and build administrative and regulatory capacity, before scaling up the scope and coverage of an emissions trading system.

The TMG ETS shows that emissions trading does not have to focus on the traditional areas of large industry and electricity generation. It can also be used to address abatement in small and medium enterprises across commercial and institutional buildings (Chiba 2011). By targeting perhaps the most crucial sector in the relevant jurisdiction, the metropolitan area of Tokyo, the TMG ETS is aiming for 25% in greenhouse gas reductions between 2000 and 2020. It is the only system so far to have covered the building sector, and provides an interesting option for cities and regional jurisdictions looking to develop emissions trading mechanisms.

Finding the correct balance between coverage, scope, administrative costs and political feasibility is not an easy task, but the experience with existing emissions trading systems is that these should initially focus on the most important emission sources in a jurisdiction, and then expand the system in a structured and transparent manner, bringing in additional sectors as it becomes feasible politically and administratively, and is required to address emissions.

2.2. Distributing Allowances

A key design question that arises in the context of emissions trading systems is how to distribute allowances. There are two main approaches, auctioning – where covered entities must purchase their allowances from the system administrator, be it directly through an exchange or at auction[2] – or through free allocation, where permits are given out to those entities based on historical emissions (grandfathering) or through benchmarking, such as uniform and fuel-specific benchmarks.

Basic Coasian economic theory tells us that how property rights are allocated has no effect on the outcome when permits are traded in order to manage environmental externalities. However, the experience of the emissions trading systems around the world tells a different story.

The EU ETS was launched in 2005, and during its initial phase, free allocation was mandated for a vast majority of allowances. Allocation was determined at the level of the EU Member States, who used National Allocation Plans (NAPs) to apply different approaches to free allocation: some Member States made use of benchmarking, but more commonly they applied grandfathering based on self-reported historical data. The motivation for this was partly administrative, to create a simple system of allocating permits to all initial participants, and partly to protect against politically relevant concerns of carbon leakage and competitiveness. Free allocation maintains the carbon price signal as covered entities face the cost of abating a tonne of CO2 versus the opportunity cost of selling the allowance on the open market. However, it also means that the full cost of accounting for every unit of emissions already produced is not faced by the firm, implying less need to re-locate, or change where inputs are sourced. In non-competitive markets, carbon costs are passed through to consumers, implying windfall profits for the firms involved.

Free allocation is not, however, a homogenous process. It can be achieved by giving allowances equivalent to previous historical levels (grandfathering), the approach chosen by most Member States as they developed their NAPs for Phase I of the EU ETS, or through the use of benchmarks, most often based on production and assigning an amount of allowances per unit of production. There are two basic benchmarking approaches that can be contrasted with grandfathering:

- uniform-based benchmarking: this involves the application of industry-wide benchmarks based on industry best practice. Although this approach can mean that consumption choice is affected as fewer costs are passed through to consumers, fuel choice options are preserved, as are the incentives to improve production efficiency;
- fuel-based benchmarking: this approach involves applying fuel-specific benchmarks, e.g. coal based power stations receive free allocation equivalent to a coal-based benchmark. This approach was widely used by Member States in determining free allocation to the power sector in Phase I and II of the EU ETS. The downside of this approach is that it removes the incentive for firms to fuel-switch to reduce emissions, e.g. moving from coal to gas production;
- grandfathering: this approach involves allocating allowances in proportion to the historical emissions of covered entities. This approach, especially if self-reported, raises a number of concerns. If continued over time it erodes the incentives for firms to reduce emissions, and if self-reported can create incentives to over-estimate emissions. It was the main allocation method used during Phases I and II of the EU ETS.

Free allocation has traditionally been used in the EU ETS to stem carbon leakage and reduce competitiveness concerns (Droege and Cooper 2010). The extent to which this concern has been justified or not is discussed more in Section 3 However the general trend under the EU ETS has been away from free allocation toward auctioning. After a vast majority of permits were freely allocated in Phase I, there was a move towards limited auctioning in Phase II[3]. The UK, Germany, the

[2] In the EU ETS, anybody with an EU ETS registry account can purchase allowances. Any party that meets the qualification requirements, including demonstrating financial security, can take part in RGGI auctions.

[3] EU Member states were permitted to auction or sell up to 5% of allowances in Phase I and 10% in Phase II. In Phase I

Netherlands and Austria sold a percentage of allowances at auction and through other means, both to test different methods and to raise revenue. The UK was the first member state to initiate auctions, eventually auctioning 10% of the allowances it distributed, compared to an EU average of 3%. The UK operated direct auctions, with participation open to registered participants. Germany, however, followed a different model, offering allowances for sale via exchanges.

From Phase III onwards, the EU has moved towards full auctioning for the ETS in order to create stronger price signals, remove the spectre of windfall profits (discussed in Section 3), and to generate important revenue. Free allocation has been retained for energy-intensive industries that have to meet specific criteria, and for some power generators in the new Member States of Eastern Europe (European Commission 2009). Full auctioning across Europe is scheduled for 2027. The free allocation that remains is based on industry-specific benchmarks, rather than grandfathering, and thus represents an improvement on the free allocation in earlier phases[4].

The use of free allocation in the early phases of systems has also been seen in the nascent Californian and Quebec systems. Under the WCI, there is a requirement that auctioning must be put in place for at least 10% of allowances distributed, with jurisdictions able to choose higher levels[5]. In practice however, in a similar manner to the EU ETS, the majority of allowances have been distributed for free (Tuerk at el 2013). An interesting design option seen in the WCI is the free allocation to electricity providers in California, who are then required to use the allowance value "for the benefit of electricity ratepayers" (Burtraw et al., 2012), attempting to pre-empt hardship cases for low-income households while also addressing the spectre of windfall profits in the electricity sector as seen in the EU ETS (see Section 3). The exact nature of this "benefit" is still unclear, however.

Auctioning may offer a significant advantage over free allocation in that it can be a generator of revenue. This is most clearly seen in RGGI. Under the RGGI Model Rule, 25% of allowances must be assigned for either consumer benefit or for strategic energy purposes[6]. In practice, however, the majority of allowances are auctioned, and even despite the low prices, by 2011, the system had generated nearly US$1 billion in revenue (Hibbard et al., 2011).

New Zealand provides an interesting mix of freely allocating and selling emission allowances. It distributes allowances for free based on output-based benchmarks[7], but as highlighted below in Section 2.3, it provides an unlimited supply of permits at NZ$25 per tonne. This mix provides an interesting combination of free allocation, but can provide a source of revenue if prices reach a certain level.

The experience from the EU ETS and other trading systems is that free allocation, although potentially useful as a politically more viable transition mechanism and to reduce fears relating to carbon leakage, can reduce the intended mitigation incentive. Further, if free allocation is used, some forms of allocating (grandfathering) can be significantly less effective than others (uniform benchmarking) in providing relevant incentives for industries.

2.3. Price Management and Flexibility Options

A key issue that has arisen in the design of emissions trading systems is how much flexibility should be allowed in the market. Should prices be allowed to rise and fall without bound, purely subject to the dynamics of supply and demand? Or is there a need for intervention in order to secure achievement of certain policy objectives?

On this question, the EU ETS has perhaps adopted the most laissez-faire approach so far. Specifically, the EU Commission has been reticent to interject in the price formation of the EU ETS – taking the line that the role of the Commission is to establish the market, and let supply and demand decide the price. Recently, however, the financial crisis and ensuing collapse in economic activity, followed by a strong decline in both emissions and allowance prices, has re-opened the debate about market intervention. This has led to proposals to withdraw a percentage of allowances during Phase III to "restore the price mechanism to levels envisaged in the initial impact assessment."[8] These proposals have met with

Hungary, Ireland and Lithuania conducted some limited auctions (Chlistalla and Zahres, 2010).

[4] For a deeper analysis of the effects of changes in allocation, see Lecourt et al. (2013)

[5] Details on auctioning in the WCI are available at: http://www.westernclimateinitiative.org/the-wci-cap-and-trade-program/faq.

[6] For more details on the investment of RGGI revenues, see RGGI (2011).

[7] For full details of the use of benchmarks in New Zealand, see http://www.mfe.govt.nz/publications/climate/emissions-trading-bulletin-12/index.html.

[8] ICIS (2011).

political resistance, and at present, the proposal for "back-loading"[9] 900 $MtCO_2$ of allowances is working its way through the EU institutional architecture. [10]

In contrast to the EU approach to price management, other systems have built in more explicit intervention mechanisms. From the outset, RGGI has had a defined price floor on its auctions – this operates as a reserve price, meaning that if in an auction the bids for the allowances are less than the price floor, the allowances are withdrawn. The price floor is currently US$1.93 per short ton[11] of CO_2, and the most recent auctions have all cleared at this price, with almost half of allowances offered in December 2012 withdrawn rather than sold. [12] The reserve price increases annually with inflation, rising from US$1.86 in 2008 to its current level. As part of a recent review there were proposals for the movement towards a current market reserve price model, where the reserve price would be calculated by a mix of futures market and auction prices.[13] However, this proposal has been recently removed and the annual increment fixed at 2.5% - allowing greater certainty and simplicity for investors.

The Californian system also has greater use of price controls, implementing price floors for its auctions at the relatively high level of US$10 per tonne of CO_2[14]. This level will increase by 5% plus the annual rate of inflation, implying strong regulatory certainty for investors that a stable level of prices will be maintained.[15]

Price floors are used to help create certainty for companies making long-term investment decisions in long-lived assets. Another form of price management, price ceilings, is used to help abate concern over runaway price increases in the market, and thereby increases political buy-in for the trading system. New Zealand provides the most salient example of an existing price ceiling. As a system, it is effectively uncapped – as many allowances as are required can be obtained at a price determined by the government, currently NZ$25 per tonne. [16] This means that, in effect, there is no absolute cap on emissions. If the allowances are available below this price, then an incentive akin to a cap is created. The price ceiling in New Zealand was introduced as part of a transition phase that was originally to end on December 2012. The ceiling was introduced, along with other measures, in order to obtain support for the scheme, reduce fears about high prices, especially given New Zealand's relatively unique emissions profile of predominantly forestry and agricultural emissions. However, due to uncertainty in future international carbon markets particularly after 2015, to which New Zealand is linked, the ceiling price has been extended indefinitely.[17] Price ceilings can also be introduced through other means, however, such as the use of allowance reserves. California and Quebec have set aside 4% of allowances that can be introduced into the market if prices rise too high.[18] When that occurs, the newly added supply in the market will have a dampening effect on allowance prices, operating very similar to a price ceiling in practice.

RGGI uses an interesting alternative to price ceilings to help dampen price increases (although this mechanism has never been triggered so far). If prices consistently exceed certain thresholds, a greater number of offset credits is allowed into the system in order to meet excess demand. The use of offsets is a viable model to apply some limitations on prices without the explicit need for a price ceiling. The EU ETS allowed Member States to determine the extent to which units from the Kyoto Protocol project mechanisms could be used towards compliance in Phase II of the system. This use of offsets helped sustain the market for Certified Emission Reductions (CERs) from Clean Development Mechanism (CDM) projects, while also providing an escape valve if prices within the EU ETS had risen too high. Offset credits equalling 1.7 billion tonnes of CO_2 reductions through CDM or Joint Implementation (JI) projects are allowed into the system between 2008 and 2020 [19] . This represents half the reduction in emissions expected from the EU ETS in the same period, and includes the credits that have already entered the system. There are also restrictions on the types of offsets allowed, with no credits allowed for projects relating to nuclear energy projects,

[9] This term describes delaying the auctioning of a portion of allowances to a later date, effectively narrowing supply in the short term.
[10] Business Green (2013).
[11] Short ton is an imperial unit of mass equal to 2,000 pounds, equivalent to 0.91 metric tonnes.
[12] Auction reports are available at http://www.rggi.org/market/co2_auctions/results/Auction-18.
[13] See Shobe (2010) for a full outline of the current market reserve price model.
[14] Tuerk et al (2013).
[15] Quebec (2011).
[16] In addition in the transition phase firms only require one unit of credits for every two tonnes of CO_2.
[17] New Zealand has also extended the ban of exports of credits from its scheme from non-forestry sectors for the duration of the fixed price regime. More information on the amendments to the scheme is available at: http://www.climatechange.govt.nz/emissions-trading-scheme/ets-amendments/ets-2012-amendments-key-changes-for-participants.pdf
[18] California (2011).
[19] See http://ec.europa.eu/clima/policies/ets/linking/index_en.htm.

afforestation or reforestation, or, from 2013, destruction of industrial gases – the category that represented the greatest share of early CDM credits[20]. Restrictions are also placed on the origin of credits, which may only be generated from projects in least developing countries from 2013 onwards, and the amount each individual operator may use[21]. The overall lack of demand in the EU ETS – as shown by its low prices – can help to explain the extremely low level of prices for CDM credits.

A further option for introducing flexibility is linking with other markets. It has been a goal of the EU ETS to link with other markets, envisioning "bottom-up" linking of domestic emissions trading systems as a potential pathway to an international carbon market. The EU is negotiating with Switzerland and has negotiated a link to the Australian CPM: an interim link from 2015 means that Australian entities can use EU allowances for compliance purposes, with a full two-way link planned for 2018 (European Commission 2012). The linking of systems can help to both sustain prices upwards – if prices are low in one system, demand from the other system can boost demand – and also to constrain prices: if prices are too high, allowances can be sought from elsewhere. Linking provides a possible avenue for flexibility, and efficiency, without explicit intervention from policy makers.

Banking and borrowing can also provide flexibility in emissions trading systems, allowing covered entities to arbitrage between periods and thereby smoothen prices over time. Most systems allow some form of banking, whereas borrowing has proved less popular. Banking is attractive as it can incentivise covered entities to take early action, and hold back surplus allowances for future use; borrowing, however, brings with it the risk that entities will borrow heavily in the early phases of trading, and then be unable to cover the borrowed allowances in the future. The EU ETS, with its annual compliance periods but multi-year phases, allows implicit borrowing within phases, but not between them, while banking has been possible within phases and between Phases II and III. RGGI has followed a similar model, allowing unlimited banking, but prohibiting borrowing. The use of banking and borrowing provides temporal flexibility in systems but can threaten long-term emission reductions if there is path-dependence in emissions pathways. If borrowing allows firms to avoid early emissions reductions, potential gains from learning-by-doing and innovation in new technologies may be lost, meaning that the costs of long-term mitigation options are increased. Also, while less problematic than borrowing, banking can give rise to concerns if there is a glut of allowances early in a trading system, and banking allows entities to carry over the allowance surplus into future trading phases; depressed allowance prices in the current trading phase are thus extended into subsequent trading phases, prolonging the underlying problem.

Flexibility and price management instruments provide a method to help cope with changes in economic circumstances, deal with uncertainties involved in setting caps, and constrain or buttress costs if abatement proves more difficult, or easier, than anticipated. Their use has varied across mechanisms, and any potential system must keep its overall objective in mind (an issue returned to in Section 3) when introducing such options.

2.4. Managing the New Market

Emissions trading creates large new markets for a unique product. The product is neither a commodity, as it has no physical basis, nor a currency, as it does not possess all the features attributed to money. It does, however, share important features of both, and can create substantial new financial markets, give rise to new institutions and a dedicated services sector, but also – as a consequence – result in significant problems.

Emission allowances are a tradable unit that is inherently linked to regulation, the decisions of policy makers, and thus politics. The EU experience shows that prices can be extremely volatile in the light of regulatory statements, emissions forecasts, and political trends. Phase I of the EU highlights that many actors in the market had little basis to form price expectations. Prices climbed strongly before the shocks of over-allocation hit the market, leading to a series of price crashes. A similar pattern was seen in the evolution of Phase II prices, where regulatory activity and the release of emission data again affected prices dramatically. This experience shows the importance of reliable policy environments in creating long-term price signals from emissions trading.

The scale of trading amongst different operators in Phase I of the EU ETS also raises another important design issue: how to create liquidity in the market. A

[20] See Grubb et al. (2011) for a greater discussion of the evolution of the CDM. There are further restrictions on large hydroelectric projects exceeding 20MW of installed capacity.
[21] These restrictions focus on limiting operators to the amount allowed to them for the period 2008 to 2012, or a minimum of 11% of their allocation for the period 2008 to 2012, whichever is the highest. The full details are outlined in the Revised EU ETS Directive Article 11a (8).

component of the initial allocation decision was to over-allocate to industry and under-allocate to power generation in order to help motivate trading. However, as many power generators were still large, state-owned energy companies, with little experience of trading in financial products, a large amount of allowances were simply held for compliance purposes, leading to low trading volumes (Ibikunle et al. 2011). This reduced the liquidity in the market and also the ability of other firms to trade, hampering the capacity of the market to seek out the true lowest cost abatement options. Building up the experience, and culture, of trading is an important step in building a fully-fledged market.

Strengthening the experience and capacity of regulators is also crucial. As any emissions trading system is inherently artificial and based on policy decisions, it can be susceptible to criminal activities and manipulation. Although the incidence of fraud is by no means limited to emissions trading (as demonstrated by the financial crisis), the experience of the EU ETS has shown that emission trading markets are particularly vulnerable. Various scandals have hit the market, especially through Phase II. A VAT fraud, made possible due to the decentralised nature of the EU ETS, where allowances were rapidly moved between different tax regimes, was the first large scandal to hit the system, highlighting the importance of a centralised mechanism to govern the system (CDC Climat Research 2011). A further scandal emerged in 2010 with phishing attempts on the German national registry leading to thefts of millions of euros worth of allowances (CDC Climat Research 2011). These experiences have led to a review of the EU registry system, and to a tightening of security systems and tax regulations (Tuerk et al. 2013). They highlight the importance of building a robust governance framework and security safeguards from the outset of any system.

The relative lack of regulatory capacity has been an important feature of the EU ETS. Other systems are starting to incorporate the lessons learnt in this regard. The WCI has moved towards an integrated trading platform, rather than the decentralised national registries originally used in the EU (Tuerk et al. 2013). Trading is also subject to the oversight of the US Commodity Futures Trading Commission (CFTC)[22]. In Australia, an independent authority – the Climate Change Authority – has been created to oversee Australia's mitigation policies in general, and carbon pricing in particular[23].

Understanding that an emissions trading system creates new markets, with properties similar to, but not the same as, both commodity and currency markets, is crucial to building a suitable regulatory system that can provide sufficient oversight. Learning the lessons from the EU regarding centralisation and strong regulation is crucial to new emerging systems. Understanding that regulatory shocks can have huge effects on the markets is vital for regulators and policy-makers alike. The experience of the EU ETS as the largest and most mature emissions trading system is invaluable in this regard, and we now turn to more detailed lessons and insights from its more than eight years of experience.

3. Lessons from the EU ETS

The world's largest emission trading system, aside from the notional international trading mechanism established under the Kyoto Protocol, [24] is the European Union's Emissions Trading System (EU ETS). Now entering its third Phase, it has been operating for over eight years and offers a series of significant lessons to any jurisdiction embarking on the introduction of an emissions trading system. In addition, given the time scale under which the EU ETS has been operating, early empirical evidence as to some of its actual effects is emerging. The key issues and lessons discussed here are:

- **Defining the cap:** The EU ETS has faced a number of challenges in how to set its overall cap, with over-allocation arising in each of its two completed phases. Lack of data, decentralised decision making and strong, effective industry lobbying contributed to this over-allocation, however the move toward a singularly defined, declining cap should help resolve some of these issues.
- **Effects of trading:** The EU ETS's eight years of operation offers evidence on its impact on abatement, investment and competitiveness issues. The key lessons

[22] The Californian system has created a derivatives market that falls under the jurisdiction of the CFTC. The Californian Environmental Protection Agency's Air Resources Board has worked with the CFTC to set up a market surveillance program, monitoring the daily activities of large traders, price movements, and supply and demand factors. See http://www.arb.ca.gov/cc/capandtrade/market_oversight.pdf.

[23] For full details of the scope of the Authority see: http://climatechangeauthority.gov.au/about.

[24] In theory, International Emissions Trading covers a greater absolute volume of emissions, but trading activity has been significantly lower.

are that over-allocation does not mean no abatement; price signals at whatever level can be crucial in moving decisions into board-rooms; and competitiveness issues, although valid in isolated sectors, have not been as widespread as predicted by industry and measures to reduce these concerns should be used carefully.

- **Defining the priority objective:** strong price signal versus quantity rationing at least cost: A key lesson from the EU ETS is to define the key objective, whether to have a high stable carbon price for long-term investors or whether to have a firm emissions trajectory, meeting that trajectory at lowest cost. Although inter-related which of these is the priority objective will define lots of other design issues, such as the use of price management options, the use of offsets, and how flexible the scheme is designed to be.

3.1. Defining the Cap

The EU ETS was first formally proposed by the European Commission in October 2001, and was approved by a Directive just two years later. The EU was then faced with the prospect of establishing a system covering 10,000 installations, across 25 countries, in just two years (Butzengeiger and Michaelowa 2004).

A decision was reached, partly for pragmatic and partly for jurisdictional reasons, to let Member States decide their own level of emission reductions, their own level of expected growth trajectories, and their own level of allowance allocation (Rogge 2006). The EU's role was solely to determine adherence to a country's Kyoto commitments. A number of issues arose with this approach, however. Data availability in many Member States was limited, and the existing sector definitions created significant noise in the data (Betz et al 2006). Member States also tended to have overly optimistic views on future emission trajectories, based on future scenarios of strong economic growth – a common issue with emissions projections (Grubb and Ferrario 2006). These factors combined to mean that Phase I was significantly over-allocated with the volume of allowances exceeding real emissions by around 100 million tonnes of CO2 (Kettner et al 2007). The cap set for in Phase I was thus achieved at significantly lower cost than projected – a common trend in emissions trading systems and environmental regulations more generally (Harrington et al 2000).

What Phase I did allow, however, was the development of capacities in Member States to collect, store and analyse emissions data, and to set suitable allocations. The insulation of Phase I from subsequent phases was an important design feature that allowed this learning to occur without impacting significantly on later phases.

Phase II operated with a similar methodology as Phase I, with Member States again proposing their own NAPs. This time, there was stronger coordination with the EU taking a more aggressive role against states they felt had over-allocated, relative to their Kyoto target compliance pathways. In fact, in November 2006, the majority of NAPS were rejected as being inconsistent with Member States' international obligations (Grubb and Sato 2009). The cuts that resulted lowered the total cap by 10% as compared to the initial documents. And yet, the overall experience in Phase II was again over-allocation, partly due to the financial crisis, although some evidence of a likely excess of allowances was already emerging even before the worst of the crisis hit (Grubb et al. 2011).

Starting with Phase III, the EU has moved away from the system of NAPs to a centralised (declining) cap set by the Commission. This removes some of the risk of over-allocation by Member States, often in the context of extreme lobbying pressure. The majority of NAPs were compiled by ministries responsible for industry and commerce, and Phase II NAPs were negotiated before the worst of the surpluses of Phase I had become apparent (Grubb and Sato 2009). The existing linkages between industry and the ministries responsible for industry and the economy allowed for effective lobbying by industry trade groups for excessive allocations, on the grounds of competitiveness and carbon leakage. The transition to a centralised cap has helped lessen some of this observed tendency, and the establishment of centralised allocation rules is an important lesson to learn for all multi-jurisdictional emissions trading systems.

3.2. Effects of Emissions Trading

Following eight years of operation, an increasingly important question regarding experiences with the EU ETS relates to its effects on abatement, investment and innovation. Essentially, the pressure is growing for the EU ETS to demonstrate that it is able to achieve the objectives it was established for, namely mitigation of greenhouse gases at reduced economic cost. With allowance prices lower than anticipated in both Phase I and Phase II (and currently the early stage of Phase III), doubts have been voiced about the scale of abatement and investment the system has driven. Still, it is important to note that the EU ETS has been successful at capping emissions within its covered sectors and has established a carbon price, both of which are significant achievements.

An important lesson emerging from the EU ETS is that over-allocation can be consistent with abatement. Despite the excess of allowances in Phase I, a number of studies have estimated positive abatement activity in Phase I, with estimates in the realm of 200 $MtCO_2$ for the system as a whole (Ellerman and Buchner 2008; Anderson and Di Maria 2011) and 150$MtCO_2$ in the power sector (Delarue et al. 2008). This abatement was incentivised by the initial high carbon prices, and the expectation of carbon prices going forward, helping to identify the low-hanging fruit in the sector. Of course, these studies use counter-factual scenarios that are difficult to estimate, and are subject to error, but they show that abatement activity was continuing despite over-allocation. Further evidence can be seen in bottom-up studies looking at firm behaviour, with evidence emerging of abatement in unusual places, such as the development of lower-clinker intensity cement helping to reduce process emissions in the product (Ellerman et al. 2010).

In terms of investment, there is evidence emerging that despite the low prices the mere existence of an incentive to reduce carbon is helping to change decision-making in some corporate entities. In early empirical surveys, covered entities acknowledged that the existence of a carbon price influenced investment decisions and affected strategic decision making, was reflected in corporate accounting, reporting, and risk disclosure, and even resulted in the establishment of new management structures and departments, such as the trading desks many large companies in the energy sector and across covered industries have set up (Point Carbon 2006; Point Carbon 2007). Evidence from the German power sector (Rogge et al. 2010; Hoffman 2007) shows that CO_2 appraisal is now an important part of the investment decision in power plant construction and that the EU ETS is the main driver for small-scale investment decisions with short amortisation times. The importance of the EU ETS in helping to move the climate decision into the boardroom has been highlighted by Kenber et al. (2009). A key lesson, however, emerges with regard to expectations of the stringency of the cap. A wide survey of manufacturing companies covered by the EU ETS found that there was a strong positive association between firms' expectations regarding future tightness and overall innovation in emissions saving processes or products (Martin et al. 2011).

The important lesson from the EU ETS is that emissions trading can have an effect on abatement and investment, even with over-allocation and lower than anticipated prices. Firm and sector level abatement can occur, and emissions trading is important in seeking out unanticipated mitigation options. It can play a crucial role in helping to move the issue of CO_2 into the realm of managers, financial officers and directors.

3.3. Competitiveness, Carbon Leakage and Profits

The establishment of carbon pricing generally, and emissions trading in particular, has brought with it the related fears of eroding competitiveness and carbon leakage. These fears were (and are) apparent in the EU ETS, and mechanisms such as free allocation have been built into the system to deal with them. Looking back on eight years of operation with the EU ETS, however, one may ask: how valid were these fears? And what can the EU ETS tell us about the justification for mechanisms used to address concerns about leakage and competitiveness?

A number of studies have highlighted that the overall macro-economic cost of the EU ETS is small, less than 1% of GDP (European Commission 2008), and could be even lower if auction revenue is used as a "double dividend" to reduce distorting taxes elsewhere or solve market failure problems in areas such as research and development. Despite the low overall costs, however, the impact on individual firms and sectors could still be significant.

The EU ETS has now provided some evidence on the extent to which carbon costs have to be absorbed by companies, leading to competitiveness and carbon leakage concerns, and the amount that can be passed through to consumers. It is important to note that this cost pass through does not depend necessarily on whether the firms receive allowances for free or via auctions – firms make decisions on opportunity costs, not accounting costs, and the opportunity cost of an allowance is the price on the market, whether the firm paid for it or not. Further, the cost pass through may not be an intention of the firm in question. In competitive markets, firms are price takers, and thus – if product markets respond to higher opportunity costs with higher prices – this will affect all firms involved[25]. The extent that cost pass through occurs depends on the elasticity of demand and supply in the market (Sijm et al. 2009).

The first evidence of cost pass through as a result of the EU ETS emerged from modelling of various countries' power sectors (Kara et al. 2008 for Nordic markets, IPA 2005 for the UK, and Lise et al. 2010 for multiple countries). These studies reached a general consensus that the majority of carbon costs have been passed through in the surveyed power sectors. This cost pass-through, along with the free allocation received by these sectors in Phases I and II of the system, led to significant windfall profits in these sectors. These profits have been estimated at as much as £800 million per annum in the UK power sector (IPA 2005).

Electricity generation is immobile, however, and as such there are limited fears regarding carbon leakage, and the loss of jobs, from its relocation abroad. Greater concern has generally been expressed in industrial sectors such as iron and steel, cement, and aluminium, all of which face relatively high carbon costs and exposure to international trade. The EU has established two criteria to determine sectors at risk eligible for free allocation in Phase III of the system, the mechanism chosen to address competitiveness concerns: the cost impact in relation to gross value added and trade intensity.[26]

The question arises as to how much the sectors in question can pass through costs to consumers, and therefore how exposed they are to the risk of carbon leakage. Evidence of cost pass through in industrial sectors is slowly emerging. In the UK, evidence of more than 100% of carbon costs being passed through to consumers has been found in the ceramic goods industry, although much lower rates are found in relation to ceramic bricks (30-40%) (Obendorfer et al. 2010). In a wide ranging study, CE Delft (2010) found pass-through rates of over 100% across Europe for hot and cold rolled metal products, but much lower rates for chemicals such as polystyrene (33%). Evidence has also emerged of significant holdings of allowances by large industrial firms, including iron and steel and cement firms such as Arcelor-Mittal, Lafarge, Tata Steel, ThyssenKrupp and Riva Group (Sandbag 2011). In total, the study found that 240MtCO2 of allowances were being held by the top ten benefiting companies. These findings raise the possibility of windfall profits in at least some of the industrial sectors that have received, and will continue to receive, free allowances from the system.

Overall, the experience under the EU ETS has been that significant competitiveness and carbon leakage concerns have consistently been raised by industry, but as of present there is little evidence that these concerns are fully justified. There are some individual sectors in some countries that may be at risk and justify specific measures, but the blanket use of free allocation raises the danger of windfall profits, an equally unattractive scenario, and one which has given rise to public criticism and political and social pressures, potentially threatening the continued acceptance of emissions trading as a policy instrument in sections of the population, especially given the current nature of the economic crisis.

3.4. Defining the Objective of Emissions Trading: Prices versus Quantities

A fundamental question that arises in the design of emissions trading systems is how best to achieve the central objective. Unfortunately, in many cases – including the EU ETS – the central objective is not always clear. Is it more important to sustain high carbon prices, helping to drive investment and innovation, or is it more important to achieve the targeted level of carbon emissions at the lowest possible cost? Although these are inter-related issues, the potential incongruence between them is highlighted when we examine the success of the system, and any modifications that may be required if the system is deemed to need improvement. This issue has been touched upon above when discussing options for flexibility and price management, and it has emerged in the context of the EU ETS and the way it has been impacted by the economic and financial crisis.

As in other regions, the financial crisis had the effect of reducing business-as-usual emissions in the EU, meaning that far less abatement was required in order to meet the previously defined cap. This led to an excess of allowances, a drop in prices, and a reduction in the expectations of future prices, potentially impacting on investment and innovation. Yet the original goal of meeting the cap at the lowest possible cost has so far been met. The impact of the financial crisis raises the question: are low carbon prices good or bad? This question directly connects to the aforementioned question about the primary objective of emissions trading. On the one hand, low

[25] For a more detailed description of the economic theory behind cost-pass through and windfall profits, see de Bruyn et al. (2010)

[26] Sectors are deemed to be at risk if their cost impact as a proportion of Gross Value Added (GVA) is at least 5% and their non-EU trade intensity is above 10%, or if their cost impact is greater than 30% or their non-EU trade intensity is above 30%.

carbon prices are considered undesirable, because an important part of meeting the climate change will be to address the underlying market failures and internalize the social and environmental costs of carbon emissions, creating price signals to incentivise firms to invest in long-term low-carbon technologies and processes. For this to occur, high, stable and consistent carbon prices are required. On the other hand, emissions trading systems set out to provide an emissions trajectory toward a low-carbon future, and meeting this trajectory at lowest cost is part of their appeal. In times of economic hardship, in particular, the automatic drop in demand for allowances and falling allowance prices could even be considered beneficial, as this reduces the cost burden faced by compliance entities already struggling with difficult economic conditions. From this perspective, low prices would be a sign that trading systems are working.

In the EU ETS, the debate over the nature of the key objective has been brought up a number of times in the context of the price weakness faced in the two completed trading phases. A broad consensus has emerged from the political discussion that the EU ETS is meant to both cap emissions at lowest cost and drive long-term investment through a sufficiently robust price signal. While these two objectives may not always be easy to reconcile, an understanding of the balance between short-term emissions reductions and long-term investment is therefore crucial when designing and implementing emissions trading systems in any jurisdiction.

4. Assessing Emissions Trading Systems: A Toolkit

After having created and implemented an emission trading system, policymakers soon come under pressure from the media, analysts and other authorities to assess the system's performance and effects. This will likely be particularly true for pilot emission trading systems in China, whose results may inform decisions about creation of a Chinese national ETS in the future. Key aspects of ETS performance which an assessment would seek to evaluate are:

- **Environmental effectiveness:** does the ETS cause emissions to decrease and if so, by how much?
- **Static efficiency or cost effectiveness:** does the ETS maximize net benefits or reduce the costs of mitigation or target achievement relative to a benchmark or other policy instruments?
- **Dynamic efficiency or innovation effects:** does the ETS incentivise innovation and technical research and development?
- **Economic impacts:** does the ETS cause "carbon leakage," lower profit margins for covered entities relative to those not covered, or have effects on employment?
- **Additional categories:** these can include, e.g., the political or administrative feasibility of an ETS, the administrative costs, organizational changes, and other relevant aspects of an ETS.

Evaluating these consequences tends to be challenging, however, because entities covered by an ETS operate in a dynamic context influenced by a number of factors other than carbon price alone; it can therefore prove very challenging to find suitable methodologies to deal both with the numerous and complex variables relevant for the performance of an ETS, and to establish causality between the ETS and a projected or observed outcome in the real world. The EU ETS and RGGI offer powerful examples of this fundamental epistemic challenge: in both systems, total emissions declined well below the cap during the respectively foreseen trading periods; but in both cases, factors not directly related to carbon prices were largely responsible for the falling emissions trajectory. The European economy (and, as a direct consequence, its emissions) declined significantly in the wake of the financial crisis starting in 2008. In the Northeast and Mid-Atlantic region of the US covered by RGGI, a major switch from petroleum liquids to natural gas in the electricity sector (largely as a result of falling gas prices) accounted for much of the greenhouse gas reductions. In both cases, the environmental objective of the programme was reached: emissions remained below the cap. Given low allowance prices, moreover, compliance costs also remained low, satisfying the criterion of static efficiency. But while it may thus be possible to conclude that these systems have been environmentally effective and cost-effective, that assessment does not necessarily serve a useful purpose in terms of informing future ETS design.

With that limitation in mind, different approaches to the assessment of an ETS are available. An important distinction lies in the temporal perspective, namely whether the assessment occurs ex ante, that is, prior to the assessed performance or effect, or ex post, that is, based on a retrospective evaluation. Epistemologically speaking, an ex ante assessment only allows for an analytical approach, typically based on simulation studies juxtaposing e.g. the status quo with different counterfactual scenarios based on specified assumptions, while an ex post assessment can be based on actual empirical observation. Ex ante assessments offer an opportunity to garner valuable information prior to the adoption of an ETS, for instance estimates of potential cost savings relative to alternative policy instruments. A vulnerability of ex ante simulations lies in their reliance on idealized assumptions, which typically prove at odds with political reality[27], as has been the case with assumptions about economic growth and emissions in many ex ante models of the EU ETS and projected carbon prices in the European carbon market. Ex post assessments based on factual evidence are not as vulnerable in their underlying premise; but they have the drawback of being limited to observable situations and developments, which precludes assessing e.g. the cost of different constraints on individual transactions, as these are not generally subject to observation unless they form part of a controlled experiment (Tietenberg 2006). An additional distinction relates to whether the assessment yields quantitative or qualitative results; largely self-explanatory, each approach answers a different kind of question, with quantitative assessments looking to quantify effects ("how much?"), and qualitative assessments limited to identifying the effects ("what?").

There has been no shortage of scholarly publications, research papers and policy documents assessing the performance or effects of past, current and proposed future ETS, focusing on different aspects and applying different methodologies. Within the scope of this chapter, it would be impossible to provide a comprehensive survey of this broad range of approaches; instead, the following paragraphs will highlight a limited sample of assessments illustrating some of the main types of assessment, their guiding questions and chosen methods. Among the most common interests in the assessment of ETS has been the aim of providing quantitative data on ETS effectiveness in addressing the environmental challenge that prompted their adoption in the first place. In Chapter 6 of their book Pricing Carbon: The European Union Emissions Trading Scheme, the scholars Ellerman, Convery and de Perthuis create a counterfactual emission trajectory for the EU in the years 1990-2007 based on Europe's GDP growth trends and countries' historic emissions. They compare this to actual emissions from the sectors covered by the EU ETS and conclude that the programme did induce abatement (Ellerman et al. 2010). Such an evaluation – comparing actual emissions under an ETS to a plausible counterfactual scenario – can be a useful exercise several years into a programme to trace results. These will be more useful if the data on emissions and other economic indicators is well-defined and consistent at the start of ETS implementation, as it renders ex-post comparisons to scenarios without an ETS more accurate.

Assessment Objective: Quantitative assessment of mitigation effectiveness of an ETS

Recommended Assessment Tool: Collect current and historical data on factors likely to be evaluated a few years into the programme, to facilitate quantitative comparisons to a counterfactual scenario (economic conditions without an ETS). Examples of such annual data and trends include emissions from covered entities, GDP share of covered sectors, imports/exports of products from covered sectors, and employment figures in covered sectors. The more robust the data on these factors, and the more clearly it is declared as intended to be used in later comparative assessments, the more useful its quantitative results will be. When conducting the assessment, important steps include defining an appropriate benchmark and setting the scope and timing of the evaluation.

Aside from this quantitative approach, attempts to assess ETS effects use qualitative or indirectly quantitative approaches, with a particular emphasis on surveys. The annual report of

[27] An example provided by Tietenberg (2006) ist he fact that many model simulations will base their caluclation of the maximum cost savings from an ETS on the unrealistic assumption that past capital investment in abatement technology can be disassembled and reassembled at no cost where abatement is the cheapest, when in reality the abatement technologies are fixed capital allocations which cannot be relocated at will in line with market forces.

Thomson Reuters Point Carbon[28] summarises the results of a survey conducted every year since 2006 asking over 3000 carbon market stakeholders about their views on issues ranging from likely outcomes of international negotiations to future allowance prices. Questions directly related to environmental effectiveness of market design, such as "to what extent has the EU ETS caused your company to reduce its own emissions", are reserved for the (less than 20% of) respondents who are actual covered entities. These survey results have indicated that the EU ETS has in fact caused companies to undertake emission reduction efforts even though the degree of market over-allocation would not seem to warrant such action, showing that the instrument has been somewhat effective in achieving its environmental objective.

The results have also provided indicative answers to questions of cost effectiveness and competitiveness, with between 42 and 50 percent of respondents each year agreeing with the statement that "the EU ETS is the most cost-efficient way to reduce emissions in the EU" (Point Carbon 2012, page 2) and more than 80 percent of covered entities surveyed saying they have not even considered moving production outside Europe because of carbon costs under the EU ETS (Point Carbon 2012, page 4). A result relevant to the innovation question is that over 90 percent of EU ETS respondents each year confirmed the long-term carbon price (e.g. in 2020) at least somewhat influences new investment decisions in their industry (Point Carbon 2012, page 3). Another survey of German EU ETS participant companies, conducted jointly by a German bank and research group, indicates that 57 percent of ETS companies in Germany planned to invest in CO_2-abatement measures in 2010, up from 40 percent in 2009. Nineteen percent of the companies stated CO_2 emissions as the main reason for their investment decisions, up from 5% in 2005-09 (KfW and ZEW 2010, pages 13-16)[29].

Assessment Objective: Qualitative assessment of effects on covered entities in terms of operating cost, investment decisions and organizational changes

Recommended Assessment Tool: Conduct surveys among carbon market stakeholders, especially covered entities. Start as early as possible (even before the programme enters into force) in order to gather a historical backlog of respondent data – this allows for comparison of trends over time. Ideally, the respondent pool is the same each time but individual respondents (companies) remain anonymous to ensure unbiased results. The survey method may be particularly useful in capturing ETS effects on competitiveness (are facilities impacted by the carbon price?) and innovation (is the carbon price influencing their investment decisions?), as those factors are rarely reflected in companies' production, revenue or other data for which quantitative methods can otherwise be used.

Another measure of economic effects assesses how resources generated by the programme are recycled into the local economy, for instance via use of proceeds from emission allowance auctions. A 2011 report by a consulting firm[30] evaluating RGGI dissected the use of that programme's auction proceeds, finding that states used them to promote further expansion of local renewable energy and energy efficiency measures as well as education and job training programmes. These can lead to emission reduction beyond the programme's unambitious caps, rendering it more "successful" in economic and environmental terms than the emission trajectory alone would indicate. The study traced which programmes benefitted most from the proceeds of states' allowance auctions, and (in cases of re-investment in energy efficiency and renewables) how much further emission reduction those programmes could cause over the next decade.

[28] Latest issue available online at http://www.pointcarbon.com/polopoly_fs/1.1814671!Carbon%202012_FINAL.pdf

[29] Kfw/ZEW report available online at ftp:/onducted among /ftp.zew.de/pub/zew-docs/co2panel/CO2Barometer2010.pdf.

[30] Hibbard et al. (2011).

Assessment Objective: Quantitative assessment of distribution and innovation effects from auctioning revenue use

Recommended Assessment Tool: Require reporting of how funds are used within the programme – proceeds from allowance auctions, if applicable, can be traced and their effect on the local economy and/or tallied to measure the net impact of the ETS on the covered region. These contribute to effects (such as additional emission reduction or new employment in the "clean tech" sector) not captured by looking at mere achievement of the programme's target or cap.

5. Conclusions

As jurisdictions around the world look to emissions trading as a tool for greenhouse gas control, they will be guided by the expectation of a number of benefits this policy instrument purportedly offers: certainty of environmental outcome at limited economic cost, a price signal to spur behavioural responses and innovation, and possibly also revenue to finance expenditures for adaptation and mitigation, or to offset other fiscal burdens. While decision makers proceed with the design and implementation of an emissions trading system, however, they will also be faced with a very different perception of this instrument and its possible consequences: stakeholders in industry and other potentially affected sectors will raise concerns about the likely economic impacts they stand to suffer, potentially forcing them to relocate or threatening their very survival; environmental groups may point to the fact that emissions trading allows polluters to avoid real structural change by paying a symbolic fee, and that, anyhow, the cap and environmental ambition of the system are too weak; and the public, perhaps influenced by political opponents using media and other channels to undermine the acceptance of carbon markets through simplified messaging and a populist campaign, will be split about the merits of this instrument, with a large share seeing it as a mere tax on energy use and hence another arbitrary burden.

Realizing the beneficial promise of emissions trading will require getting every aspect of its design and implementation right; whereas only one mistake can already be enough to undermine public support and threaten the political viability of this policy[31]. Fortunately, the aforementioned decision makers can refer to a substantial and rapidly growing body of empirical knowledge garnered from existing emissions trading systems to provide guidance, both in terms of established practices and lessons on the success or failure of different design choices. In a very concise manner, this chapter has sought to survey major emissions trading systems in Europe, North America and the Asia-Pacific region to identify best international practices in system design and implementation, and proceeded to highlight key lessons from the largest and most mature emissions trading system currently in operation, the EU ETS. While various design options and implementation challenges were raised in the course of this exercise, a recurrent theme has been the need to balance short term cost and feasibility with long term sustainability in several areas of system design. A central lesson in itself is that easy choices at the outset, such as free allocation or a weak cap, have a literal price and can return to create potentially more difficulties than they initially avoided. Hard choices at the outset can meet with substantial resistance, but pre-empt the need for subsequent intervention and foster greater acceptance over time. Another lesson arguably has been that every emissions trading system has tended to be rather too weak than too ambitious, partly due to the inevitable rent seeking and also due to underestimated innovation and early action incentives.

Once the decision to proceed with emissions trading has been reached, however, and first steps have been taken towards its implementation, the attention will shift from the broad debate about merits and shortcomings of the policy instrument and other alternatives, to scrutiny of its environmental effects and economic impacts. For policy makers, having workable assessment tools at their disposal will be vital to provide arguments both to explain and also justify the introduction of emissions trading for climate change mitigation. Sooner or later, every policy initiative will be measured against its ability to meet the objectives for which it was adopted in the first place.

[31] The recent failure of federal climate legislation in the US – which would have established the largest single carbon market in existence – serves as a vivid reminder of the complexities faced in introducing an emissions trading system, and the importance of active outreach and communication in fostering political support.

Hopefully, such an assessment will reveal that the emissions trading system has been designed and implemented in a way that will ensure all objectives are achieved; but if not, the assessment can yield vital information on how to address shortcomings of the trading system, and thereby contribute to its improvement over time and, ultimately, to effective and efficient mitigation of climate change.

Table. A comparison of the ETS

ETS	Target	Coverage	Allowance Distribution	Flexibility Provisions Compliance and temporal flexibility	Price Management	Market Oversight
EU ETS (European Union Emissions Trading System)	CO_2 emissions reduced 21% from 2005 levels by 2020. Post-2020 default cap currently set to decrease at - 1.74% /year	Downstream coverage of energy and industry sectors for CO_2 emissions only in Phase I and II; Phase III will include CO_2, N_2O and PFCs, and aviation	Free allocation dominant in Phases I and II. In Phase III, starting 2013, at least 40% of allowances will be auctioned, rising to 100% by 2027	CERs and ERUs permitted. Offset usage limited to 50% EU-wide cumulative abatement between 2008-2020, relative to 2005 levels. 1 year compliance periods. Banking allowed; borrowing within trading periods possible but being phased out	Auctions can be moved forward to address excessive price volatility. No price regulation intervention mechanisms currently introduced	A market monitoring function within Agency for the Cooperation of Energy Regulators (ACER) will detect market abuse; Revisions will bring spot trading of EUAs fully within scope of MiFID by classifying units as financial instruments
RGGI (Regional Greenhouse Gas Initiative)	CO_2 emissions from the power sector reduced 10% from 2014 levels by 2018	Downstream coverage of fossil fuel-fired power generation for CO_2 emissions only	Around 90% of allowances are auctioned	Up to 3.3% of total emissions reductions can be offset. Domestic but not KP offsets approved. 1 year compliance periods. Unlimited banking possible, but borrowing is prohibited	Access to national and international offsets increased if price exceeds certain levels	Whilst regulation & enforcement authority lies with compliant states, RGGI, Inc. supports data reporting systems, auction platforms and market monitoring for auction and trading
WCI (Western Climate Initiative)	GHG reduced 15% from 2005 levels by 2020	Downstream electricity generation and industry; upstream residential, commercial and industrial fuel, and transportation. Seven GHGs covered	At least 10% of allowances will be auctioned; others freely distributed	Offsets limited to 50% of total emission reductions; 8% for an individual installation; and are mostly domestic. 3-year compliance periods. Banking possible; de facto borrowing within trading periods is limited but possible	Use of intervention mechanisms is limited. Auction floor prices used but no hard caps	Western Climate Initiative Inc. provides administrative and technical support such as market monitoring and administration for allowance auctions
NZ ETS (New Zealand Emissions Trading System)	GHG emissions reduced 10-20% below 1990 by 2020; 50% below 1990 levels by 2050	Stepwise inclusion of all sectors of the economy. All six GHGs mentioned in Kyoto covered	Allowances issued freely, according to output. For all sectors excluding forestry, one tonne allowance must be surrendered for every two tonnes emitted	Unlimited use of CERs and ERUs allowed; domestic forestry can generate and sell allowance units. Banking and borrowing are permitted	Initial price cap period extended beyond the planned end period of end-2012	Ministry of Economic Development manages NZ ETS operations, responsible for verification, compliance and enforcement, and the Registry. To ensure compliance and strengthen market integrity, participants subject to audit
AUS CPM (Australian Carbon Pricing Mechanism)	GHG emissions reduced to 5% below 2000 levels by 2020	Electricity and industry sectors; also fugitive emissions and waste, and some transport fuels. Four of six Kyoto GHG emissions covered (CO_2; CH_4; NO; PFCs from Al smelting)	Auctions for most allowances; Emissions-intensive, trade-exposed (EITE) industries receive free allowances	Offsets created by the Carbon Farming Initiative are limited to 5% to July 2015, unlimited thereafter. International offsets with some project restrictions permitted after July 2015. Borrowing limited to 5% of compliance requirement; unlimited banking of permits permitted	July 2012-June 2015: fixed and increasing carbon price. From July 2015: flexible ETS price subject to price floor and ceiling for first three years	A Clean Energy Regulator will regulate the system with a Climate Change Authority acting as independent body. Minister for Climate Change and Energy Efficiency will determine the policies, procedures and rules for auctioning carbon units
TMG ETS (Tokyo Metro-politan Govern-ment Emissions Trading System)	CO2 emissions reduced 25% below 2000 levels by 2020; 50% below 2000 levels by 2050	Commercial and institutional buildings and industrial facilities covered - around 40% of emissions. Only energy-related CO_2 subject to reduction	Free distribution of allowances in Phase I. Allocation determined by past emissions	Unlimited offsets from small-medium uncapped enterprises within Tokyo permitted, and from nationwide renewable energy certificates. Banking but not borrowing allowed	Possibility to increase use of credits for small and medium entities and for use outside Tokyo, and to allow Kyoto credits	Authority shared between regional and national governments. Verification of GHG emission reductions by registered agency is required. The Accounting Standards Board of Japan (ASBJ) issued basic policy on accounting for TMG ETS

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