1 An Introduction to Carbon Markets

1.1 Relevance of Carbon Markets

How to address climate change is one of the greatest global governance problems of our time. At the international, national, and subnational levels, over 50 different carbon markets have been implemented as a key policy to incentivize the reduction of greenhouse gas (GHG) emissions in a cost-effective and flexible way, and several more are being planned or considered (World Bank, 2021). In addition, 89 Nationally Determined Contributions (NDCs) submitted by Parties to the 2015 Paris Agreement mention the use of carbon markets as a condition for achieving their mitigation targets (Pauw et al., 2016). Article 6 of the Paris Agreement envisages the implementation of carbon markets or similar international cooperative arrangements as a policy instrument to facilitate the achievement of its goals.

Carbon markets are markets where a certain amount of GHG (e.g., a tonne CO_2 equivalent) is commodified as a tradable unit either as an emission allowance issued under a cap-and-trade system or as a verified emission reduction/removal credit issued under a baseline-and-credit system.

In "cap-and-trade" or emissions trading systems (ETS), a regulator defines an allowed maximum level of GHG emissions (the "cap") for a certain group of entities (e.g., countries, companies, or facilities). The cap is then subdivided into distinct emission allowances, which are distributed to the regulated entities. The covered entities need to submit one allowance for each tonne of carbon dioxide equivalent (CO_2e) emitted during a compliance period, usually a year. The initial allocation of allowances to covered entities can be free of charge, e.g., based on historical emissions levels ("grandparenting"), partially free (with free allocation limited by a politically determined technology performance benchmark), and/or sold at auction by the regulator.

In a "baseline-and-credit" system a regulator[1] defines how emission (reduction or removal) credits can be generated by activities that reduce GHG emissions or remove GHGs from the atmosphere compared to a reference scenario (baseline) that reflects the counterfactual situation without these activities. The difference between the baseline emissions and the emissions of the activity determines how many credits can be issued. To generate emission credits, ex post verification of the reduction/removal by an officially recognized institution – a verifier – is necessary. The emission credits can then be used as offsets against mandatory or voluntary GHG emission targets or other

[1] In the context of voluntary carbon markets, private standard organizations can take up regulatory functions.

policy instruments aiming at GHG mitigation. Table 1 shows the key differences between a baseline-and-credit and a cap-and-trade system.

Both types of units form the supply in the market. There can be different types of demand for allowances or credits at different levels. Governments can use units to comply with emissions targets under an international treaty such as the Kyoto Protocol or the Paris Agreement. Companies can use allowances to comply with their targets under emissions trading schemes. In some jurisdictions, they can use credits in emissions trading systems, dedicated baseline-and-credit systems for specific sectors, or instead of having to pay carbon taxes (e.g., as allowed in Colombia or South Africa). Finally, private companies and individuals can use credits for offsetting emissions in the context of their voluntary GHG mitigation targets; such demand has increased significantly in the past years.

The carbon price is discovered in both compliance and voluntary markets through the buying and selling of units, whereas the scarcity of units and the marginal costs of reducing greenhouse gases influence the price. The initial allocation or issuance of allowances and credits by the regulatory authority represents the primary carbon market. Allowances and credits can then be traded in the secondary carbon markets (spot market), either directly between parties, usually facilitated by brokers (over-the-counter transactions, OTC), or traded on an exchange. While the latter requires prior standardization of contracts, for OTC transactions, the transacting parties can freely shape the contract in terms of, for example, price and volume of units being traded. Since the details of these contracts are generally not published, OTC transactions can be quite opaque for other market players and regulators (Kachi and Frerk, 2013). A further component of carbon markets is the derivative market. It is composed of financial instruments, such as options and futures contracts, to hedge the risks associated with emission allowances and credits.

We would like to note that, in practice, the terminology is not always used consistently. While the IPCC Assessment Reports (Gupta et al., 2007; Stavins et al., 2014) and all relevant carbon market research literature (e.g., Michaelowa et al., 2019b) apply the terms as defined in this volume, a few practitioners[2] further differentiate baseline-and-credit systems into those that use emission credits for offsetting and those (national or subnational) systems in which baseline emission levels are defined for individual regulated entities (e.g., based on historical levels or on an industry standard) and units are issued to entities that have reduced their emissions below this level. Under such a system, units can be sold only to other entities exceeding their baseline emission levels.

[2] See, e.g., the definitions by the World Bank under https://carbonpricingdashboard.worldbank.org/what-carbon-pricing.

Table 1 Differences between baseline-and-credit and cap-and-trade systems

Baseline-and-credit	**Cap-and-trade**
Emission reductions/removals compared to baseline or target are tradable	Allocated allowances, which allow holders to emit a certain quantity of emissions, are tradable
Units are credits and are generated *ex post* after verification (and certification)	Units are allowances and allocated/ auctioned *ex ante* to regulated entities
Wide participation in unit generation	Tradable surplus of units can only be created by regulated entities
System needs to be integrated and linked to other types of policies such as a cap-and-trade system or carbon tax, or to corporate or individual voluntary mitigation targets	System needs own implementation
Examples: Clean Development Mechanism Joint Implementation The Article 6.4 Mechanism under the Paris Agreement Carbon Offsetting and Reduction Scheme for International Aviation Voluntary carbon standards (e.g., Gold Standard, Verra)	Examples: Subnational, national, and supra-national emissions trading systems (such as the Californian, the Swiss, or the South Korean systems, or the EU ETS) International emissions trading under Article 17 of the Kyoto Protocol

Source: Authors.

Following the research literature, in our volume we use the term "baseline-and-credit-system" in a broad sense, covering all types of markets in which emission credits are issued compared to a baseline. We also note that occasionally the literature uses the term "emissions trading" as an umbrella for all systems described above.

1.2 Carbon Markets Around the World

Currently, at least 29 ETS and 27 baseline-and-credit systems[3] are in place around the world, covering international, supranational, national, and subnational jurisdictions (World Bank, 2021).

[3] This excludes the voluntary market, where there are a few large, internationally relevant standards (Verra, Gold Standard) but a plethora of smaller standards, both internationally and domestically.

At the global level, the 1997 Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC) introduced three market-based flexibility mechanisms: the Clean Development Mechanism (CDM), Joint Implementation (JI), and International Emissions Trading (IET). The CDM is a baseline-and-credit system that finances emission reduction projects in countries without emission reduction targets under the Kyoto Protocol (so-called non-Annex I countries). The Certified Emission Reductions (CERs) generated by these projects can be used by countries with targets under the Kyoto Protocol (Annex B countries) toward their own compliance. JI is a similar baseline-and-credit mechanism, which operates in Annex B countries. The units it generates are called Emission Reduction Units (ERUs). There are two forms of JI: Track 2, which is subject to international oversight, and Track 1, which is not. IET allows Annex B countries to trade the Kyoto Protocol's unused Assigned Allowance Units (AAUs) with each other.

Under its Article 6, the 2015 Paris Agreement specifies the implementation of similar market-based mechanisms, with detailed rules agreed by COP26 in 2021. Direct bilateral cooperation under Article 6.2 allows, for example, the linking of national, subnational, and supranational ETS and the trading of so-called Internationally Transferred Mitigation Outcomes (ITMOs) in a way comparable to IET and to JI Track 1 projects. A multilaterally overseen Article 6.4 Mechanism will be a baseline-and-credit system similar to CDM and JI Track 2 (Michaelowa et al., 2019c). In addition, in 2016, the International Civil Aviation Organization (ICAO) established a pilot baseline-and-credit mechanism known as CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation). CORSIA, which started operating in 2021, aims to incentivize carbon-neutral growth of the international aviation sector.

At the supranational level, the EU ETS is the largest ETS currently in place. It covers installations in the power and heat generation, energy-intensive industry, and commercial aviation sectors in all 27 EU member states as well as Iceland, Liechtenstein, and Norway. It has set emissions limits for more than 11,000 installations and airlines, covering about 40 percent of the EU's GHG emissions.[4]

So far, eight national-level ETS are operating, and more are being planned. Subnationally, several Canadian, Chinese, Japanese, and US jurisdictions have implemented or are planning ETS. In addition, several of these jurisdictions have implemented baseline-and-credit systems to supply offsets to their ETS (ICAP, 2021; World Bank, 2021).

Figure 1 presents a simplified overview of the main international carbon markets, their linkages, and traded units.

[4] https://ec.europa.eu/clima/policies/ets_en.

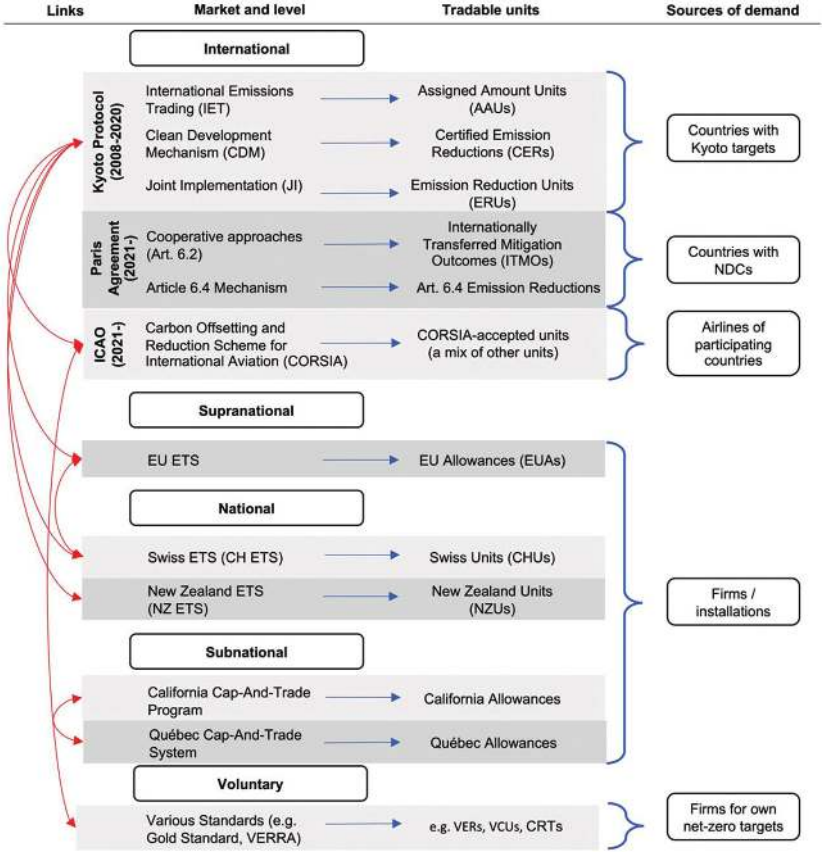

Figure 1 Examples of trading systems, linkages and traded units

Source: Own graphic. The red arrows depict direct links between the different systems which allow them to trade with each other. In addition to this, some markets may be linked indirectly – e.g., the EU ETS and the NZ ETS are connected through their link to the Kyoto Protocol mechanisms.

This volume does not aim to be comprehensive and cover all carbon markets but rather focuses on major compliance markets. For a comparison of national-level baseline-and-credit schemes see Michaelowa and colleagues (2019b), while an excellent overview of national emissions trading schemes has been done by Haites (2018). It also does not provide a comprehensive description of the political processes that led to the evolution (and improvement) of carbon markets over time (for this, see, e.g., Wettestad and Jevnaker, 2016, 2019; Michaelowa et al., 2019c). Rather, its goal is to focus on the risks that surround the design of carbon markets and the solutions that have been devised to address those risks. Instead of offering full case studies of individual carbon markets,

then, we use them to derive lessons across the various design aspects of carbon markets.

1.3 Carbon Markets as Polycentric Governance Arrangements

Carbon markets are complex governance arrangements (see Ahonen et al., 2022). They entail artificially created markets for goods – emission allowances or credits – that are created by policy. As described above, they have emerged at all levels of governance, and engage public and private actors in regulatory and governance functions. They comprise various, mostly independent governance systems that are interlinked – in a few cases through formal market links, but in most cases loosely through flows of information and expertise, capacity building, and through the overarching goal of helping to achieve international climate mitigation commitments (Burtraw et al., 2013; Paterson et al., 2014; Biedenkopf et al., 2017). For these reasons, carbon markets are inherently polycentric in nature, involving multiple and often overlapping sources of authority (Jordan et al., 2018).

When the sources of authority cross the boundaries between different levels of public and private governance, the literature speaks of transnational governance. As early as in 2008, the CDM was portrayed by Pattberg and Stripple (2008) as a prototype of this form of governance; the Article 6.4 mechanism under the Paris Agreement is comparable. At the UNFCCC level, the parties adopt political guidance, whereas the Supervisory Body takes care of day-to-day decision-making. At the national level, state-appointed Designated National Authorities approve potential Article 6.4 activities in the host country. Private entities – so-called Designated Operational Entities (DOEs) – validate and verify the activities and their baseline methodologies (see Figure 2). Further private actors are involved in identifying, proposing, and investing in activities. Some of them also help to shape the rules and regulations that govern this market. Finally, multilateral organizations, including through public–private partnerships, provide technical advisory, capacity building, and project finance. Under the CDM this was done by the World Bank's Prototype Carbon Fund; more recently, the World Bank Partnership for Market Readiness took up a similar role.

The EU ETS involves much authority at the supranational level, along with the national level, with a deep intertwining of decision-makers at both levels, and an additional involvement of private actors (Bailey and Maresh, 2009). The balance of authority exercised by the supranational and the national levels – for instance, in terms of allocation of allowances – has important implications for the environmental effectiveness of the system (Clò, 2009).

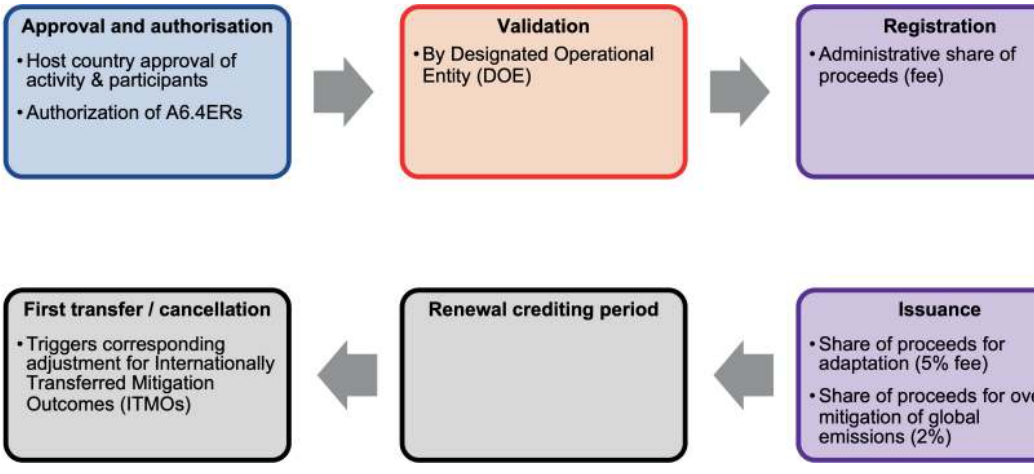

Figure 2 Activity cycle under the Article 6.4 mechanism

Source: Own graphic.

Note: A6.4ERs = Article 6.4 Emission Reductions (tradeable units under Art. 6.4); SOP = Share of administration). Colors denote the actors involved in the process.

In addition, the voluntary carbon market represents an extreme case of involvement of private actors as sources of governance. In words still fully adequate today, Pattberg and Stripple (2008: 378) described the voluntary carbon market as "a site of climate governance beyond the state," in which various, mostly private, actors compete in developing validation and verification standards and providing offsets of varying qualities. Over the last years some large voluntary carbon market standards such as Gold Standard and partially Verra have become more stringent than international compliance markets like the CDM, while small niche standards have offered low-quality credits (Ahonen et al., 2022).

Governance arrangements for carbon markets, therefore, exemplify a much broader trend in global environmental governance, away from traditional state-centered multilateral regimes, and toward a co-existence with private and hybrid forms of governance in which new types of actors exhibit authority, experiment with novel arrangements and policy instruments, and interact at various jurisdictional levels (Pattberg and Stripple, 2008; Biermann, 2010). In the past decade, these complex multilevel, and polycentric, arrangements have been extensively researched in terms of their implications for effectiveness, institutional interaction, policy learning, diffusion, and convergence, as well as the role of local cultures, ideology, and political economic factors in shaping them (for the case of carbon markets see, e.g., Clò, 2009; Wettestad, 2009; Knox-Hayes, 2016; Biedenkopf et al., 2017; Wettestad and Gulbrandsen, 2018).

These novel arrangements entail opportunities but also risks for climate governance and its effectiveness. In terms of opportunities, carbon markets are characterized by a strong degree of policy experimentation and learning (Biedenkopf et al., 2017), which can lead to solutions that will, over time, be better for the climate. At the same time, given the increasingly decentralized (or "fragmented," see Biermann et al., 2009; Biedenkopf et al., 2017) authority, it is likely that these arrangements will lead to insufficient, patchy, and uncoordinated regulation that may result in regulatory loopholes and abuses. Misaligned interests and resources between the different sides involved in policymaking may further increase these risks (see, e.g., Bailey and Maresh, 2009).

It is, therefore, crucial to take a closer look at how these governance arrangements perform in terms of regulatory quality, and what risks they entail for ensuring environmental integrity and improving economic efficiency.

Contrary to what policy diffusion theory would predict, there has been a high degree of divergence in market design as policymakers have learned from the mistakes of previous experiences, and as they have adapted existing designs to the structural and political particularities of their own jurisdictions (Biedenkopf

et al., 2017; Wettestad and Gulbrandsen, 2018). This has led to great variation in the regulatory and design aspects of carbon markets (Gulbrandsen et al., 2019).

In a context in which we now have substantial experience with various carbon markets at different levels, but where many new markets are being planned, there is a need to survey these various market design characteristics, identify where there are risks for environmental integrity and economic efficiency, and propose lessons for future policy design, with a particular emphasis on sound regulatory oversight. That is what this volume seeks to achieve.

2 Toward a Principle-Based Assessment of Regulatory Frameworks for Carbon Markets

How can we evaluate carbon market design options in a systematic and objective way? Carbon markets are created through political processes to achieve climate policy goals. For this reason, they must comply with legal, economic, and environmental principles generally associated with policy instruments, or more specifically related to the creation and functioning of a market. In the following sections, we rely on such principles to assess the potential abuses and broader risks to environmental integrity and economic efficiency that may emerge in the design and implementation of baseline-and-credit and cap-and-trade systems and the related trading activities, to discuss the performance of regulatory frameworks used in existing markets, and to collect lessons for mitigating those risks and preventing abuses.

We consider market abuses to consist of any action by an individual, group, or company to exploit the market to their own advantage in a way that can affect environmental integrity or economic efficiency. With risks we denote the likelihood that such abuses may take place, including lobbying efforts which lead to rules reducing environmental integrity or efficiency. Abuses may be the unintended consequence of regulatory loopholes – something likely to happen in international and multilevel markets where several, not necessarily consistent, bodies of law may apply. But they can also include illegal and even criminal practices.

Examples include traditional market abuses such as price manipulation, money laundering, collusion, cyber-attacks, and other predatory behavior, and carbon-market-specific abuses such as misreporting of performance data to increase the number of credits issued. Risks include design risks related to lax cap-setting or other crucial design elements such as sanctions or monitoring, reporting, and verification rules. For each risk or abuse, we offer a description, assess its relevance, offer real-life examples, and suggest tools for its prevention, detection, and enforcement.

2.1 Legal Principles for Carbon Markets

Generally, principles are variously understood as a "fundamental truth or doctrine," "a proposition so clear that it cannot be proved or contradicted unless by a proposition which is still clearer," "that which constitutes the essence of a body or its constituent parts," and "that which pertains to the theoretical part of a science" (Black, 1990: 1193). Their scope, therefore, is vague and abstract. In a legal context, however, principles acquire a narrower, more formal role and can take on specific legal effects.

Principles are an integral part of most legal systems and considered necessary for their functioning, without necessarily being set out in written law (Kohen and Schramm, 2013). Their normativity may derive from long-standing practice and legal custom or from accepted requirements of fairness and justice (Dworkin, 1978). Sometimes, however, legal principles are also expressly set out in treaty instruments, statutory law, or even constitutions.

Although the existence of legally relevant principles is hardly disputed, their exact role and definition remain a matter of continued jurisprudential debate. Their legal scope is generally acknowledged to be general and abstract. They apply to a broad and unspecified set of actors and situations which can include future and as yet unknown circumstances or transactions.

They are thus distinct from rules, which are more binary in nature and call for an automatic outcome whenever specified conditions are met (Dworkin, 1978). Principles do not involve such an automatism. Rather, their role is often seen as subsidiary. They guide administrative discretion or judicial decisions where legal rules allow for different outcomes, due to textual ambiguity, the existence of substantive gaps, or conflicts between different applicable rules (Kohen and Schramm, 2013). As a result, legal principles rarely have the normative force to decide a dispute or determine a legal question on their own. They tend to require further elaboration through legislation, case law, or scholarly writing to take effect.

Several legal principles may be relevant for the regulation of carbon trading. It would be difficult – if not impossible – to enumerate all of them, however. Across legal systems and jurisdictions, and even across different areas of law, countless principles of varying weight and degrees of conceptual clarity exist, with sometimes subtle differences in terminology and material substance. We consider selected key principles of public law, private law, and the cross-cutting substantive area of environmental law to potentially be the most relevant ones.

2.1.1 Principles of Public Law

With regard to public law, a vast majority of legal systems based on the rule of law recognize certain general principles that govern the exercise of public